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Exposure to economic inequality at the age of 8 enhances prosocial behaviour in adult life

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Abstract

Children as young as 3-4 years old are already concerned about inequality and declare that equality is a norm that should be followed.[1] At the age of 3 to 8, they develop a strong preference for equality, which is typically reflected in both "envy" and "compassion",[2,3] that is, aversion to disadvantageous and advantageous inequality, respectively.[4] Further studies suggest that inequality aversion does not continue increasing after that age, but rather exhibits an inverse-U shape relation with age in childhood and adolescence, with a peak at 8 years old.[3,5] Since children are particularly sensitive to inequality at the age of 8, it is an open question how exposure to real economic inequality at this age modulates prosocial behaviour in adult life. Here, we link generosity in dictator game experiments conducted among Spanish university students (n > 400) with existing macro-level data on income inequality within the region they lived as children. The data show that individuals who were exposed to higher levels of inequality at the age of 8 are more generous in adult life. Interestingly, exposure at older ages has no impact on generosity. Our results extend previous findings on the development of egalitarianism by showing long-lasting effects of childhood inequality experiences in adult life. If prosocial behaviour is (partly) developed as a reaction to an unequal environment, then inequality might be counteracted in the future.

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Children as young as 3-4 years of age are already concerned about inequality. Indeed, at the age of 3 they explicitly declare that equality is a norm that should be followed (although they often do not).[1,6] Even from the time they are 2 years old, children are also surprised when witnessing the unequal distribution of resources.[7-9] At these ages, however, they are happy to receive more than others but upset at receiving less[10] and, in fact, are willing to pay a cost to prevent others from getting more.

Recent studies using economic experiments to measure equality preferences among children have shown that inequality aversion reaches a maximum at the age of 8, but also highlight the existence of asymmetric developmental patterns depending on whether inequality is advantageous or disadvantageous.[11,12]

In “envy” games, children are asked to choose between an allocation where both the decision maker and the partner get a $1 reward and another allocation where the decision maker gets $1 and the partner receives $2: choosing 1/1 (vs. 1/2) reflects envy since it prevents the partner from earning more. About 40% of 3- to 4-year-olds select the equal distribution; while at the age of 8 nearly 80% do so. This implies that envy increases with age from 3 to 8 years old. A related study[3] expanded the analysis to 8- to 15-year-old kids. At the age of 8, 80% preferred the equal distribution – they are envious – while this fraction decreased to 40% at the age of 15.

In “sharing” games designed to measure “compassion” or aversion to advantageous inequality, the choice is between the fair division (1/1) and the unequal division (2/0). At the age of 3 almost no kids choose to share, while at 8 the fraction amounts to about 50%. After the age of 8, the second study[3] again showed very low values below 10%. Hence, compassion also displays an inverted-U shape with age until adolescence. Similar results have been found in another study[5] which showed that the share of egalitarian children decreases from the age of 9 (63%) to 17 (22%).

All these studies and further advances suggest that preferences for strict equality are particularly relevant at the age of 8, after which children begin to develop more complex patterns such as meritocratic, ingroup-biased and altruistic preferences,[3,11] thus leading to cross-cultural differences.[13,14]

It has been demonstrated that the local socioecological (environmental) conditions people are exposed to during childhood shape many facets of adult life,[15-17] including social behaviour.[18-22] Indeed, recent research indicates that by 8 years old, and even earlier, children understand local economic inequality and perceive it as unfair.[23,24]

Following the existing evidence, we hypothesised that, given that children are particularly concerned about equality at the age of 8, they must also be sensitive to the surrounding (real) inequality at that age.

Therefore, we test whether exposure to economic inequality at a young age modulates social behaviour in adult life. In particular, we argue that the level of inequality observed during childhood, and more specifically at age 8, impacts on children's social cognition and perception,[25] and that this shapes their adult social behaviour.

Yet there are reasons to expect either a negative or a positive impact of early inequality exposure on prosocial behaviour. To the extent that local inequality serves as a cue for the harshness and unpredictability of the socioecological environment, a prominent strand of the literature suggests that individuals should adaptatively respond to inequality experiences by reducing their cooperativeness and increasing their aggressive behaviour, partly due to a higher preference for short-term outcomes and risk-taking.[20,26,27] Since one's ability to gather the future gains from prosociality (e.g. from others' reciprocity) is reduced in harsh and unpredictable environments, individuals exposed to inequality should be less willing to cultivate long-term social relationships, thus developing uncooperative and aggressive behavioural patterns.[29,30] These arguments suggest a negative effect of childhood inequality experiences on adult prosocial behaviour.

A more recent account,[21] however, posits that individuals raised in uncertain environments develop/internalise strategies for uncertainty management which, in the arena of social behaviour, translate into risk-pooling through cooperation with other individuals to protect themselves from future shocks.[31] To a large extent this account is related to the classical notion of "choice behind the veil of ignorance" in distributive justice theory.[32,33] If one does not know which position she will occupy in the social ranking in the future, then she should take actions that reduce the variance in outcomes between low- and high-rank individuals and distribute resources as equally as possible. The prediction of this framework is, therefore, that childhood inequality exposure yields a positive effect on adult prosociality.

In sum, our main research question is, do children raised in unequal environments become less or more prosocial adults than those raised in equal environments? And, furthermore, is it at age 8 when childhood inequality exposure displays the strongest effect on adult prosocial behaviour?

To answer these questions, we link behavioural data from economic experiments conducted among Spanish university students (N = 448; mean age = 19.01 ± 2.26 (SD), range 18–44; 49.29% females) with existing macro-level data on economic

inequality (S80/S20 index) in the geographic region where the participants lived during their childhood. See Supplementary Information (SI) for more details.

The Eurostat S80/S20 index reflects the ratio between the average income in the top and bottom quintiles of the income distribution in a particular region for a particular year and is the most robust measure of inequality available for the regions and periods of interest. Thus, the higher the index, the higher the income inequality.

We use the oldest available wave of the S80/S20 index (from 2004 to 2012; see SI). The majority of the participants (65%) in this experiment were 5 years old in the starting year of 2004 and 13 years old in the final year of 2012 (see the age distribution in SI, Table S2). This implies that reverse causality is not possible since, while our participants were exposed to different levels of inequality during that period, they could not affect the local income distribution themselves due to their young age. Importantly, even if our participants display a limited range of ages, there is enough variability to disentangle the effect of exposure to inequality at a particular age (our variable of interest) from the effect of the inequality observed in a particular year.

Prosocial behaviour was measured through an economic experiment conducted in December 2017 and January 2018. The participants were 1st-year university students from 37 different universities of Spain in the 17 regions of the country. The entire experimental setup was implemented online using real monetary incentives.

An important feature of our study is that all the participants belonged to the same country. This implies that the macro-level data solely reflect within- and between-region differences in income and income inequality, respectively, but not differences in other variables like access to education, health care, etc. This is rarely achieved in cross-country comparisons. Moreover, our data also allow us to control for the participants' socioeconomic status.

Our key output variable, which reflects the participants' prosocial behaviour, is giving in a dictator game (DG).[34] In the DG, player 1 (the dictator) is endowed with a certain amount of money and asked to split it with a second, passive player (the recipient). Since there are no strategic reasons to share, any positive donation is interpreted as a signal of altruism or generosity.[35] In our experiments, the dictator's endowment was €100. It has been systematically reported[35-37] that only a fraction of dictators keep the entire pie and many of them give half to the recipient (i.e. the equal division is a modal response). Our data provide figures comparable to

previous experiments: 6.67% share nothing and 50.22% split the pie equally, with an average giving of 40.37 ± 18.59 (SD) of the endowment (see SI, Table S1).

RESULTS

Given the period considered due to data availability (2004–2012), the distribution of ages among participants (all were born in 1999 or before) and that we focus on the age of 8, we restrict our main analyses to inequality exposure at ages 6–10. Figure 1 shows, from left to right, the estimated impact of the inequality observed within the participants' region at the age of 6, 7, 8, 9 and 10 on DG giving. In each case, the dependent variable is DG giving in an ordinary least squares (OLS) regression and the explanatory variable is the standardised S20/S80 index for that age (see SI, Table S3). All regressions control for gender, household income and experimental session. Sampling weights are enabled in all regressions.

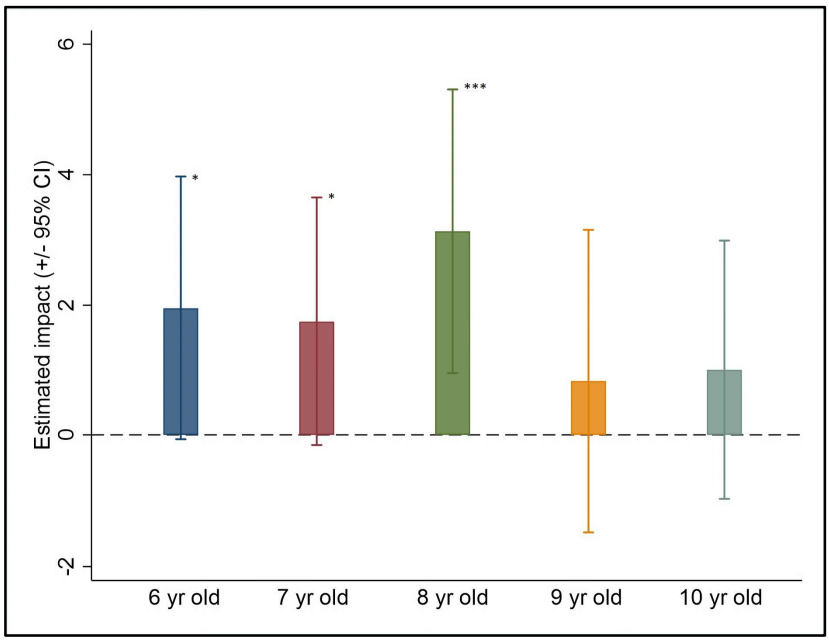

Figure 1| Estimated impact of childhood inequality exposure at different ages on DG giving. The figure depicts the estimated coefficients (and 95% confidence intervals) for the impact of local economic inequality during childhood on prosocial behaviour. From left to right, we show the estimated effect of the standardised regional S80/S20 index at the age of 6 ($\widehat{\beta_6}$ = 1.953, p = 0.058, n = 353), 7 ($\widehat{\beta_7}$ = 1.748, p = 0.072, n = 391), 8 ($\widehat{\beta_8}$ = 3.133, p = 0.005, n = 413), 9 ($\widehat{\beta_9}$ = 0.837, p = 0.478, n = 422) and 10 ($\widehat{\beta_{10}}$ = 1.010, p = 0.317, n = 430) on DG giving. See SI, Table S3 for full regression results. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

While the estimated impacts of inequality exposure at 6 and 7 years old on DG giving are positive and marginally significant ($p = 0.058$ and 0.072, respectively), those for 9 and 10 years are smaller and not significant ($p > 0.31$). In sharp contrast, the estimated effect of local inequality at the age of 8 is the largest and yields significance at standard levels ($p = 0.005$). Therefore, participants who were exposed to higher inequality at the age of 8 were more generous.

This effect is displayed in Figure 2. Specifically, an increase of 0.51 units in the inequality index (one standard deviation) at the age of 8 translates into an increase of 3.13 euros in DG giving (over €100). This estimated value, 3.13, represents 16.68% of the SD at the individual level and 62.47% of the SD at the regional level, that is, when we consider the variance in donations across regions.

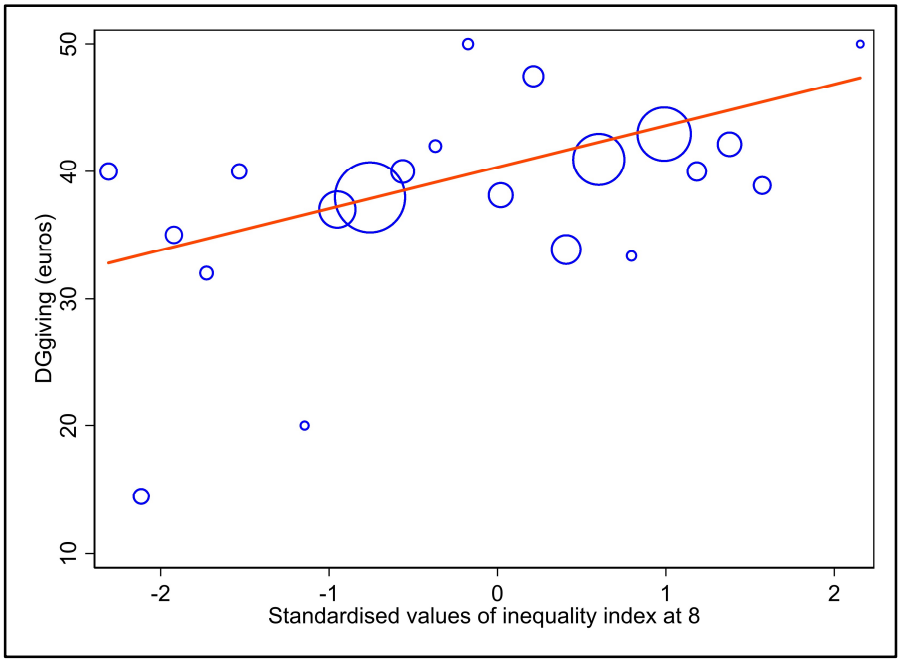

Figure 2| Scatterplot (and linear fit) of mean giving for each value of the inequality index at the age of 8 (given by region + year). The size of the bubbles reflects the number of observations. $\widehat{\beta_8} = 3.13$, $p = 0.005$, $n = 413$. For the full regression results, see model 3 in SI, Table S3.

To account for potential problems arising from multiple testing, we corrected our estimations using the Bonferroni and Romano-Wolf[38] procedures. With the Bonferroni correction, which is arguably too conservative when the tests are not independent (as in our case), the estimated effect of local inequality at the age of 8 remains significant ($p = 0.025$). However, the effects for inequality exposure at

either 6 or 7 years old become non-significant (p = 0.29 and p = 0.36, respectively). The Romano-Wolf correction yields more power than Bonferroni to detect false null hypotheses since it incorporates the dependence structure of the test statistics. Using the Romano-Wolf correction, the adjusted p-values for the estimated effect of local inequality at the ages of 6, 7 and 8 years old become 0.08, 0.08 and 0.007, respectively. In short, after both corrections, the estimated effect of local inequality at the age of 8 remains largely significant, while the effects at age 6 and 7 are either non-significant or only marginally significant depending on the correction used.

To alleviate concerns about potential confounds, we ran several robustness checks. First, we used a different measurement of economic inequality based on an estimation of the Gini index for Spanish regions (see SI). Note that there are no official statistics for the regional-level Gini index, so we had to stick to the available calculations of individual researchers.[39] Given that the regional Gini index is not available before 2006, these data can be used for ages 7 to 10 but not 6 (which also implies that the sample is reduced for all the ages considered). The effect of the standardised regional Gini index at age 8 on DG giving is positive and marginally significant ($\widehat{\beta_8}$ = 1.567, p = 0.091). Exposure at the ages of 7, 9 and 10 never yield significant estimates (p > 0.13; see SI, Table S4).

Second, and in order to disentangle whether the impact of inequality is due to the age of the children or instead to the particular year considered (note that participants aged 18 at the time of the experiment were 8 in 2007), we ran a new analysis (see SI, Table S5). The regressions shown in Figure 1 were first repeated for students aged 18 (65% of the sample) or 19 years old (14%) and then for students older than 18 (35%). The results are qualitatively similar. Exposure to inequality at the age of 8 has a positive and significant, or marginally significant, effect on giving in both groups ($\widehat{\beta_8^1}$ = 3.311, p = 0.003; $\widehat{\beta_8^2}$ = 2.995, p = 0.089). Inequality at the remaining ages does not yield significant estimates in any case (p > 0.12), except for a marginally significant positive effect found at age 6 for the group of 18- to 19-year-olds ($\widehat{\beta_6^1}$ = 1.953, p = 0.058). Therefore, we can conclude that the observed effect is driven by the age of inequality exposure and not by the inequality existing in a particular year.

Third, we performed a “variable selection” method[40] on a regression model with the same specification as above, where the S80/S20 inequality index was included for all ages from 6 to 10. The model reporting the best fit, as reflected by the Bayesian information criterion, is the one that only includes the inequality index at age 8.

For the sake of completeness, we also tested the effect of the inequality index for ages 11–15 on giving and found that none of them is significant (p > 0.19) when

the inequality index for 8 years is accounted for (which remains significant in all cases; *p*-values between 0.004 and 0.041). Finally, we tested the effect of the inequality index for the year of the experiment (i.e. 2017), but it did not yield significance ($p > 0.64$).

DISCUSSION

Our findings support the hypothesis that exposure to economic inequality at the age of 8 has a long-lasting effect on social behaviour in adult life. Individuals exposed to higher inequality are more generous in adult life. Given that the effect is positive, these results favour the uncertainty management interpretation of the impact of childhood experiences on adult social behaviour.[21]

This study has two important implications. First, our results extend upon previous findings regarding the development of egalitarian behaviour.[1-3,5-14] These papers show that inequality aversion exhibits an inverse-U shape relation with age in childhood and adolescence, with a peak at the age of 8. We find that exposure to inequality at a young age, particularly at 8 years old, has an impact on social preferences in adult life.

Second, the observation that inequality exposure at a young age promotes prosocial behaviour in adult life is a particularly relevant result in the current world context of increasing within-country inequality.[41,42] If social preferences (partially) emerge as a reaction to the existing unequal environment, as our results suggest, then individuals who are raised in unequal environments will be more prosocial in the future and will therefore promote more equal societies in the future, thus counteracting existing inequality.

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Ethics. This study was approved by the Ethics Committee of Middlesex University Business School. All participants signed an informed consent prior to participating.

Author Contributions. P.B.G., A.M.E., T.G. and A.H. developed the research ideas and designed the study; P.C. and A.M.E. conducted the experiment and T.G. analysed the data. P.B.G., P.C., A.M.E., T.G. and A.H. wrote the manuscript.

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SUPPLEMENTARY INFORMATION

This document contains the following sections:

Materials and Methods

- Experimental Setting
- S80/S20 Index
- Gini Index

Supplementary Tables S1-S5

References

MATERIALS AND METHODS

Experimental Setting

The experiment was conducted online using Behave4 Diagnosis (https://diagnosis.behave4.com), a platform designed to run online behavioural experiments. Online economic experiments are being increasingly used, and recent evidence suggests that the results obtained are valid and comparable to those obtained in physical lab settings (Anderhub et al. 2001, Horton et al. 2011 and Arechar et al. 2018). The details of the experiment have been reported elsewhere (Amador et al. 2019). We summarize here the main protocols related to the current study.

Sampling: We collected a nationally-by-regions representative sample of $N = 556$ (the sample represents a population of 11,780 students; 52.5% females) comprising first-year, Spanish students enrolled in Business Economics (BusEc hereafter). We computed the participation or weight of every university in the national-by-regions representative population using the BusEc enrollment in September 2017 by universities provided by the Spanish Ministry of Education. For this study we excluded those participants ($n = 108$) who were not born in Spain in order to obtain comparable data for childhood region-level inequality.

Recruitment: To find students from every region of Spain, we first contacted university professors by email to ask them to collaborate. We only contacted the professors in charge of courses taught in year one (freshmen) according to the official webpage. All the lecturers were asked to announce the recruitment in class 48 hours before the experimental online platform was open. Apart from other practical information, a specific login/password was provided for each institution in the announcement.

Participants: Self-selected participants logged in at home on Behave4 Diagnosis and completed the tasks. The participants were given one hour and informed that after 30 min of inactivity the system would automatically switch off. Once the number of required participants for a given university was achieved, no more students for this institution were allowed to participate.

Earnings: One out of every 10 participants was randomly selected for real payment (i.e., each participant had a 10% chance of getting paid for real). At the end of the experiment, a random mechanism determined whether the participant was one of the winners or not. If selected, participants were asked for their email to contact them. Payments were made by bank transfer. One decision (from the entire set of games and tasks) was randomly selected for each winning subject to compute his/her payment. This has been proven as a valid payment method in economic experiments (Charness et al. 2016). The 56 participants who were selected to be paid earned on average €41.37. The payments ranged from €0 (12 individuals) to €120 (2 individuals). The average length of the experiment was 50 min.

S80/S20 Index

As a measure of economic inequality within Spanish regions, we use the S80/S20 ratio (or income quintile share ratio). This ratio is a measure of the inequality of income distribution and is calculated as the ratio of total income received by 20% of the population with the highest income (the top quintile) to that received by 20% of the population with the lowest income (the bottom quintile). All incomes are compiled as equivalised disposable incomes, that is, the total income of a household after tax and other deductions that is available for spending or saving, divided by the number of

household members converted into equalised adults. Household members are equalised or made equivalent by weighting each according to their age using the so-called modified OECD equivalence scale. The first adult in the household is assigned a weight of 1, the other adults a weight of 0.5 and children under 14 years of age a weight of 0.3. Our data comes from the Living Conditions Survey conducted by the Spanish National Statistics Institute.

Gini Index

The Gini index is the most widely used index of income inequality. It is a gauge of economic inequality that measures income distribution among a population**.** This index comes from the Lorenz curve, which relates the accumulated percentages of population (x-axis) to the accumulated percentages of income (y-axis). The diagonal line represents perfect income equality (10% of the population receives 10% of income, etc.). From a geometric point of view, the value of the Gini Index associated with a given income distribution is equal to twice the area between the Lorenz curve of the distribution and the diagonal. In the situation of maximum equality or distributive equity, the Gini Coefficient is equal to zero and as inequality increases, its value approaches 1. The data on the Gini index have been obtained from Herrero Blanco et al. (2013) since there are no official statistics available for regional-level Gini Index.

SUPPLEMENTARY TABLES

Table S1. Distribution of DG giving

DG giving (€)	Frequency	Percent	Percent (weighted)
0	36	8.04	6.67
10	32	7.14	7.62
20	32	7.14	6.39
30	27	6.03	5.62
40	75	16.74	16.86
50	214	47.77	50.22
60	20	4.46	3.95
70	4	0.89	0.50
80	3	0.67	0.51
90	0	0	0
100	5	1.12	1.66
Total	448	100	100

Table S2. Distribution of participants' age in year 2017 (since the experiments were run in the last days of 2017 and first days of 2018, the age reported by the participants is assumed to reflect their age in 2017)

Age in 2017	Frequency	Percent	Percent (weighted)
18	291	64.96	65.30
19	62	13.84	12.22
20	38	8.48	8.82
21	22	4.91	6.77
22	9	2.01	1.72
23	8	1.79	1.19
24	4	0.89	0.88
25	2	0.45	0.28
26	4	0.89	0.99
27	2	0.45	0.39
29	3	0.67	0.85
32	1	0.22	0.10
35	1	0.22	0.39
44	1	0.22	0.10
Total	448	100	100

Table S3. OLS regression models. Impact of childhood inequality exposure on DG giving (S80/S20 index)

Inequality index when:	Model 1	Model 2	Model 3	Model 4	Model 6
6 years old	1.9531*				
	(1.0266)				
7 years old		1.7485*			
		(0.9677)			
8 years old			3.1333***		
			(1.1056)		
9 years old				0.8374	
				(1.1973)	
10 years old					1.0098
					(1.0077)
Female	-0.5358	-0.6323	-0.1969	-0.3437	-0.2969
	(1.2555)	(1.1989)	(1.1643)	(1.1538)	(1.1292)
HHS-Income	-1.1809	-0.8326	-0.3977	-0.5682	-0.6613
	(1.1442)	(1.0820)	(0.9951)	(1.1011)	(1.0401)
Sample size	353	391	413	422	430

Notes: Robust standard errors in parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively. All regressions control for experimental session (either 9 AM or 8 PM session). Sampling weights are enabled in all regressions. HHS-Income refers to household income.

Table S4. OLS regression models. Impact of childhood inequality exposure on DG giving (Gini index)

Inequality index when:	Model 1	Model 2	Model 3	Model 4
7 years old	1.6967			
	(1.1251)			
8 years old		1.5672*		
		(0.9254)		
9 years old			0.2167	
			(1.0009)	
10 years old				-0.3850
				(1.2660)
Female	-0.8331	-0.4640	-0.6248	-0.5697
	(1.3792)	(1.2667)	(1.2233)	(1.1899)
HHS-Income	-0.9887	-1.0551	-1.1803	-0.7798
	(1.2277)	(1.1819)	(1.1317)	(1.1249)
Sample size	291	353	391	413

Notes: Robust standard errors in parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively. All regressions control for experimental session (either 9 AM or 8 PM session). Sampling weights are enabled in all regressions

Table S5. OLS regression models. S80/S20 index. For participants aged 18–19 years old and older than 18

Inequality index when:	Model 1a (18-19)	Model 1b (>18)	Model 2a (18-19)	Model 2b (>18)	Model 3a (18-19)	Model 3b (>18)	Model 4a (18-19)	Model 4b (>18)	Model 5a (18-19)	Model 5b (>18)
6 years old	1.9531*	-0.0487								
	(1.0266)	(2.0533)								
7 years old			1.5862	-0.0894						
			(1.0341)	(2.1472)						
8 years old					3.3107***	2.9952*				
					(1.1439)	(1.7490)				
9 years old							0.4588	3.8087		
							(1.2554)	(2.4996)		
10 years old									0.8233	2.9256
									(1.1041)	(2.1695)
Female	-0.5358	1.8534	-0.4756	0.0163	-0.3248	1.4716	-0.5019	1.2829	-0.5224	1.4157
	(1.2544)	(2.8466)	(1.2591)	(2.1119)	(1.2598)	(1.9856)	(1.2795)	(1.8463)	(1.2704)	(1.8051)
HHS-Income	-1.1809	-1.0212	-0.8883	-1.2018	-0.8359	0.9988	-1.1181	1.0135	-1.0800	0.3478
	(1.1442)	(3.3672)	(1.1584)	(2.4038)	(1.1063)	(1.9169)	(1.2340)	(1.8824)	(1.1041)	(1.8567)
Sample size	353	62	353	100	353	122	353	131	353	139

Notes: Robust standard errors in parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively. Sampling weights are enabled in all regressions. All regressions control for experimental session (either 9 AM or 8 PM session).

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