Spillover Effects of Girls' Empowerment on Brothers' Competitiveness: Evidence from a Lab-in-the-Field Experiment in Uganda*

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Abstract

We use data from a lab-in-the-field experiment in Uganda to examine the effect of empowering girls on their brothers' competition preferences. Our identification strategy exploits random assignment of a girls' empowerment intervention across communities and natural variation in sibling sex composition. We find that empowering girls significantly increases their brothers' competitiveness. These results suggest that competition preferences are malleable, and that programs targeting girls can have spillovers to their brothers. *JEL Classification: C91, C93, D03, J16.*

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1. Introduction

Recent evidence documents that those who like to compete have better education and labor market outcomes [e.g. Zhang 2012, Buser et al. 2014, Berge et al. 2015, Flory et al. 2015, Reuben et al. 2015, Buser et al 2018]. A question of interest for public policy is then whether competition preferences are mainly acquired through genetic inheritance or whether they can also be learnt. Evidence that social experiences matter suggests that competition preferences are malleable and potentially changed by policy interventions. In this paper, we study the role of siblings in shaping competition preferences during adolescence. Specifically, we examine the effect of having sisters, as compared to having brothers, on boys' competitiveness, and how this effect is explained by the socioeconomic status of girls.

The degree of girls' socioeconomic status or empowerment can affect their brothers' competitiveness through different channels.[1] First, siblings can directly influence one another because they spend a large amount of time together. For example, empowered sisters can act as positive role models to their brothers and, to emulate their success, brothers may change their attitudes towards competition. Second, siblings can also indirectly influence one another through parental responses, because siblings compete for limited family resources [Becker and Lewis 1973]. An increase in sisters' empowerment may intensify this sibling rivalry, as parents may allocate more time and financial resources to daughters based on their economic potential [Garg and Morduch 1998]. This may trigger brothers to react and to update their willingness to

[1] The literature on "sibling spillovers" distinguishes between direct effects, where siblings have a direct effect on one another, and indirect effects, where siblings affect each other through change in parental allocation of resources [e.g. Black et al. 2017, Alsan 2017, Qureshi 2018a, Qureshi 2018b].

compete. Parents may also try to directly cultivate a greater taste for competition in their sons to help them catch up with their empowered sisters.

While the exact mechanisms at play are difficult to pinpoint, they all demonstrate that changes in the socioeconomic status of sisters can lead to changes in their brothers' competitiveness, and as a result, policy interventions aimed at empowering adolescent girls can have important spillover impacts onto their brothers. Our core contribution is to provide a formal test of this hypothesis with a lab-in-the-field experiment that we conducted in Uganda. We recruited adolescent boys and girls from the sampling frame of the Bandiera et al. [2020] long-term randomized evaluation of a large-scale adolescent girls' empowerment intervention. They show that the program led to large gains in girls' labor market outcomes, control and autonomy over their bodies, and improved aspirations. Our analysis leverages random assignment of the intervention across communities, natural variation in sibling sex composition within communities, and a measure of taste for competition collected from an economic experiment conducted four years after the Bandiera et al. [2020] intervention was initiated.

Our results show that having sisters rather than brothers in control communities, where girls have a relatively lower socioeconomic status, suppresses boys' competitiveness. This result is reversed in treated communities, where the program raised the economic and social empowerment of girls. There we find that having sisters rather than brothers raises boys' willingness to compete. Interestingly, these patterns do not emerge among girls. We also find that, in contrast with existing research conducted in more developed contexts, boys and girls are equally competitive in control communities, and that despite the impacts of the empowerment program on a range of other dimensions, we find no impact on girls' competitiveness.

We view our results as providing important insights into the role of the (family) environment in shaping competition preferences. Our work adds to a growing literature examining the endogeneity of competition preferences [e.g. Gneezy et al. 2009, Booth and Nolen 2012, Andersen et al. 2013]. Two related studies are Cameron et al. [2013], who show that being a single child is associated with reduced competitiveness; and Almås et al. [2016], who show that adolescent boys' competitiveness is increasing with the socioeconomic status of their fathers.[2] A few other studies have also examined the role of parents in shaping competition preferences [Cassar et al. 2016, Khadjavi and Nicklisch 2018, Tungodden 2019]. Our results also contribute to a growing body of evidence documenting that in less developed countries women appear to be as competitive as men on average [e.g. Cardenas et al. 2012, Zhang 2012, Khachatryan et al. 2015, Bjorvatn et al. 2016] – in contrast with a large body of evidence from more developed countries showing that men are more eager to compete [see Niederle and Versterlund 2011, for a review]. Finally, our analysis directly complements the work of Bandiera et al. [2020], by showing that their empowerment intervention targeting girls had spillovers onto their brothers' competition preferences. In doing so, we add to a recent evidence base examining sibling spillover effects from improvements in the human capital of children [Barrera-Osorio et al. 2011, Das et al. 2013, Alsan 2017, Qureshi 2018a, Qureshi 2018b, Ashraf et al. 2019].

[2] Okudaira et al. [2015] report suggestive evidence from a sample of Japanese high school students that having (older) sisters is associated with reduced competitiveness for boys. But their sample is relatively small, raising concerns about the generalizability of their findings.

The remainder of this paper is organized as follows. Section 2 describes the lab-in-the-field experiment. Section 3 presents the results. Section 4 concludes.

2. Experimental Design

2.1. Program and Evaluation Background

The Empowerment and Livelihood for Adolescents (ELA) program in Uganda is a multifaceted program – designed and implemented by BRAC – that aims to jump-start adolescent girls' empowerment. It provides girls with vocational and life skills training, as well as a safe space to meet and socialize with other young women. The vocational training focuses on skills to improve girls' labor market trajectories, with a special focus on the ability to establish small-scale enterprises. The life skills training is mostly focused on topics related to sexual and reproductive health, but also covers topics such as negotiation and leadership skills to improve girls' bargaining power in their relations with men. The program operates through development clubs led by trained local mentors, which provide a safe meeting place for girls during weekday afternoons (outside of school hours). Club participation is voluntary, and all girls between the ages of 14 and 20 in the community are eligible to participate.

To evaluate the impact of the program, Bandiera et al. [2020] randomly assigned 150 communities from ten BRAC branch offices in Uganda to either treatment and control groups. Within each community, they drew a random sample of approximately 40 adolescent girls to survey. Girls were first surveyed in 2008 before the start of the intervention, and then at follow-ups in 2010 (two years post-intervention) and 2012 (four years post-intervention). Bandiera et al. [2020] document that at baseline, girls exhibited very low levels of economic and social empowerment. On the economic front, only around 10% of the girls were engaged in any kind of income-generating activity, and the majority were concerned with finding jobs in adulthood. On the social front, 17% reported having had sex against their will in the previous year. Adolescent girls also held strong views about gender-roles in labor markets, education, and household chores. Despite these low baseline levels of empowerment, about 20% of the girls in treated communities participated in the ELA program.

The (intent-to-treat) impacts were striking. Four years post-intervention, girls in treated communities were 4.9 percentage points (pp) more likely to be engaged in income-generating activities (a 48% increase over baseline levels) relative to girls in control communities – an impact mostly driven by greater engagement in self-employment. Girls in treated communities were also 3.8pp less likely to have a child (a 34% decrease), 8pp less likely to be married or cohabiting (a 62% decrease), 5.3pp less likely to report having had sex unwillingly in the past year (a 31% decrease), and their aspired ages at which to marry and start childbearing increased.[3] Bandiera et al. [2020] suggest that these impressive results were in part driven by strong spillover impacts from participant girls to non-participant girls in treated communities. In this paper, we focus on spillovers onto their brothers.

[3] There are evaluations of the ELA program with a very similar research designs in Tanzania, Sierra Leone, and South Sudan. In Tanzania, the program was largely unsuccessful in impacting any of the core markers of (economic) empowerment [Buehren et al. 2017]. In Sierra Leone, the evaluation period coincided with the Ebola outbreak of 2014, which caused major social and economic disruptions. The program reversed most of the adverse effects by reallocating young girls' time away from men, preventing out-of-wedlock pregnancies and enabling them to re-enroll in school after the crisis [Bandiera et al. 2019].

2.2. Subject Pool

Our lab experiment took place four years after the rollout of the ELA program. We recruited adolescent boys and girls from the sampling frame of the Bandiera et al. [2020] household panel survey. Eight out of the ten BRAC branch areas included in their impact evaluation were selected for the experiment.[4] We chose a random subsample of households in both control and treatment communities. In each household, we selected a girl between the age of 12 and 21, who was the female panel respondent from one of the first two survey waves in Bandiera et al. [2020], or one of her siblings – boy or girl. We followed the same age restriction used by Bandiera et al. [2020] four years earlier during their baseline survey. This implies that we primarily selected the younger siblings among the girls surveyed by Bandiera et al. [2020]. At the time of the lab experiment, the average girl in their sample was about 20-21.

In total, 172 boys and 237 girls in treated communities, and 129 boys and 151 girls in control communities, participated.[5] Table 1 shows that the average boy and average girl are both about 17 years old, and, thus, as expected about 3-4 years younger than the average girl in the Bandiera et al. [2020] sample at the time of the experiment. Consistent with what they found at baseline four years earlier, about 70% of the girls are currently enrolled in school – compared to 80% of

[4] The remaining two branch areas were the most remote and rural ones, and they were dropped for logistical reasons. Bandiera et al. [2020] show that the program impacts were homogenous across rural and urban or semi-urban communities.

[5] The recruitment team for the experiments was able to rely on more detailed identifying information for girls compared to boys. First, given that the girls were the targeted respondent for the survey from which we sampled experiment invitees, personal information that could be used to track them was recorded more accurately and thoroughly. Second, the experiments were conducted right after girls had been tracked and contacted for the second follow-up survey round for the impact evaluation. These circumstances are likely to be contributing factors to the differential participation rate between boys and girls in the experiments.

the boys. In line with Uganda having one of the highest fertility rates in the world [World Bank 2014], the average boy has about 5.1 siblings (2.5 of which sisters), and the average girl has 5.8 siblings (3.1 of which sisters).[6] Importantly, treatment and control groups within gender are balanced across these characteristics, in line with the program having been randomly assigned.[7]

While our sample may not be perfectly representative of the Bandiera et al. [2020] sample, it is important to emphasize that Bandiera et al. [2020] document that the impacts of the ELA program were largely homogenous across a large number of dimensions, such as rural versus urban or semi-urban households, rich versus poor households, younger versus older girls, as well as across parental beliefs over the ideal age of marriage for a woman and related gender norms. They also provide evidence that the impacts that they estimate are a result of a combination of direct exposure to the program and considerable within-community spillover effects onto other girls. Moreover, all experiment participants were recruited from the households in the impact evaluation sample and, therefore, all female experiment participants were eligible for membership in ELA clubs which were still in operation at the time of the experiments. We are thus confident that adolescents in our treatment subsample received considerable exposure (directly or indirectly) to the empowerment impacts of the ELA program.

2.3. Experimental Procedure

[6] There are no directly comparable variables to the number of siblings and number of sisters in the survey data from the impact evaluation.

[7] The p-values on the tests of equality are obtained from an OLS regression of each characteristic on a dummy for whether the boy (girl) comes from a treatment or control community, with standard errors clustered at the community level.

We follow the experimental protocol developed by Niederle and Vesterlund [2007], which elicits a measure of the willingness to compete. Participants (both boys and girls) perform a certain task three times: once when they are paid according to individual performance, once when they are paid based on their performance compared to three other individuals, and once when they are given the choice of whether to perform the task in a competitive (tournament) or individual (piece-rate) environment. In the final round, they are also offered to submit past performance to a competitive setting. Our methodology differs from that of Niederle and Vesterlund [2007] in two ways. First, their subjects are US college students, while the subjects in our study are adolescents in Uganda. Second, their task is solving a math problem, while ours – due to concerns over education levels – is sorting images of shapes from smallest to largest.[8]

Each experimental session had three to four randomly assigned groups of four participants each, and participants were neither informed about the identity of the other members in their group, nor were they sitting next to their group members. Each participant received 400 UGX as a show-up fee, as well as 400 UGX for completing the experiment. At the beginning of each experimental session, participants were informed that there would be four rounds of play, with one round randomly chosen for payment at the end of the experiment. Participants were not provided feedback about their performance relative to the other participants in their group until the end

[8] In our setting, participants were asked to successfully order six eight-sided building blocks with various geometric shapes on each side from smallest to largest. Each side of a given block has one of six shapes. The relative location of the shapes on each of the six blocks is different. The task is to arrange all six blocks such that a given shape (e.g., star) appears facing up, and to align the six versions of that shape (e.g., all six stars) in order from smallest to largest. Upon completing one shape, the participant moves to the next shape. The blocks are designed so that the order of the blocks for one shape does not confer any advantage to arranging the blocks for the next shape.

of the experiment (see Online Appendix, for the experimental protocol, including the instructions).

In round 1, participants were paid 400 UGX for each correctly completed task (piece rate), irrespective of how other group members performed.[9] In round 2, the participant with the highest score in his or her group received four times the piece-rate, while the others received nothing (tournament rate). The first two rounds served to familiarize participants with the experimental task and to provide a means to control for differences in ability across participants in later rounds when participants had a choice over the payment scheme.

In round 3, before performing the task, participants were asked to choose which payment scheme, piece rate or tournament, he or she would like to be paid with. If the choice was piece rate, the participant was paid 400 UGX for every task correctly completed. If the choice was tournament, the participant's performance was compared to the second-round performance of members in his or her group. If the participant's score was the highest in his or her group, he or she was paid four times the piece rate for each correctly completed task; otherwise, he or she received nothing.

As Niederle and Vesterlund [2007] emphasize, the decision to compete in round three could still be driven not only by the "pure" taste for competition, but also by general factors such as confidence, risk preferences, and preferences over receiving feedback on their performance. To

[9] At the time our experiment took place, a 1 USD was worth approximately 2,500 UGX. Over the course of the first three rounds, the average participant successfully completed about 30 tasks, thus worth about 12,000 UGX. This amount is equal to the amount spent on monthly consumption expenditures on personal goods by the median girl, as reported by Bandiera et al. [2020].

control for these confounding factors, in round four participants were given the choice of submitting past round 1 performance to either tournament or piece rate. If they chose piece rate, they were paid piece rate for their round one performance. If they chose tournament, their performance was compared against their group members' previous round one performance. Thus, the choice to compete in rounds three and four is affected by risk preferences, relative feedback aversion, and self-confidence, but only in round three is the participant actively competing. In this way, the choice to compete in round four can be used to control for these general factors in round three's choice to compete, the main outcome of interest.

Following the four experimental rounds, we elicited participants' beliefs regarding their relative performances in the first two rounds, to further control for differences in confidence. To elicit truthful answers, participants were paid 100 UGX for each correct response. Participants then completed a short exit questionnaire, in which we recorded information about the size and sex composition of their siblings.

3. Results

3.1. Boys' and Girls' Competitiveness by Treatment Status

The literature documents a systematic gender difference in competitiveness among adolescents, with boys more eager to compete than girls on average (see Sutter et al. [2019] for a review). A number of studies have, in turn, focused on identifying policy interventions that mitigate gender differences in competitiveness among young individuals. Most of these studies use laboratory experiments (e.g. Balafoutas and Sutter [2012], Niederle, Segal, and Vesterlund [2013], Sutter et al. [2016]). Closest to our study is Alan and Ertac [2019], who also use a randomized field experiment to evaluate an educational intervention on the willingness to compete of boys and girls in elementary schools. They find that the intervention (which focused on fostering grit) was able to eliminate an underlying gender gap in competitiveness. This is an important line of research because gender differences in competitiveness are thought to drive gender differences in labor market outcomes in adulthood. A natural first step in our analysis is thus to check whether boys are more competitive than girls in control communities, and if so, whether the ELA program was able to mitigate that gap by raising girls' competitiveness.

To answer these questions, Table 2 presents summary statistics on the experimental results by gender and treatment status (Columns 1-4), as well as p-values on the tests of equality across the four groups (Column 5).[10] The first row focuses on our measure of competitiveness: the choice of tournament over piece-rate in round 3. The remaining rows focus on the experimental controls designed to capture possible drivers of tournament entry other than the pure taste to compete, as discussed in Section 2.3.

We find that, in control communities, boys enter the tournament as often as girls do. About 32-37% of the boys and girls in our sample chose tournament over piece rate. This is despite boys appearing to be more confident than girls regarding their performance relative to others. As a benchmark, we note that in their seminal study with US college students, Niederle and Vesterlund [2007] found that only 35% of the women chose to compete compared to 73% of men (a statistically significant difference). We also find no impact of the empowerment program on

[10] The p-values on the tests of equality are obtained from an OLS regression of the outcome of interest on a gender dummy, a treatment dummy, and their interaction, with standard errors clustered at the community level.

girls' tournament entry, despite its impacts on other dimensions of the girls' lives. In treated communities, boys and girls also compete at similar rates. This is perhaps unsurprising given that in the absence of the program, there were no gender differences in competitiveness.[11]

3.2. The Sisters Effect on Boys' Competitiveness by Treatment Status

3.2.1. Descriptive Evidence

To illustrate our main results on the impact of the program on the effect of having sisters rather than brothers on boys' competitiveness, Figure 1 shows the proportion of female siblings among boys across the choice of compensation scheme and treatment status. We see that in control communities, boys who choose tournament have a lower share of sisters than boys who choose piece-rate ($p = .038$). Strikingly, the pattern is reversed in treated communities, where boys who choose tournament have a higher share of sisters than boys who choose piece-rate ($p = .012$).[12] The next section quantifies these effects and examines the extent to which they are driven by changes in the "pure" taste to compete.

3.2.2. Empirical Method

We estimate the following OLS linear probability model using the subsample of boys:

[11] Bjorvatn et al. [2016] also show in a subsample of Ugandan adolescents that boys and girls compete at similar rates in urban areas: about 35-40%. This evidence is consistent with ours since the participants in this experiment come from mostly urban and peri-urban areas.

[12] The difference between these two differences is statistically significant at conventional levels ($p = .002$).

$$y_{ijs} = \alpha_0 + \beta_1 sis_{ijs} + \beta_2 \left(sis_{ijs} \times treat_{ij}\right) + \sum_s \alpha_{1s} S_s + \sum_s \alpha_{2s} (S_s \times treat_i)$$
$$+ \boldsymbol{\delta}'_{\mathbf{1}} \boldsymbol{X}_{ijs} + \boldsymbol{\delta}'_{\mathbf{2}} \left(\boldsymbol{X}_{ijs} \times treat_i\right) + \sum_j \gamma_j C_j + u_{ijs} \tag{1}$$

where y_{ijs} is a dummy equal to one if boy i in community j and sibling size s selects a tournament over a piece rate in round 3, sis_{ijs} is the number of sisters that the boy has, $treat_{ijs}$ is a dummy equal to one if the boy comes from a community randomly assigned to receive the ELA program, S_s are dummies for the total number of siblings, and C_j are dummies for the community. $\boldsymbol{X}_{ijs}$ is a vector of experimental controls, including: the number of successfully completed tasks in rounds 1 and 2, controlling for ability; a dummy for believing to have been the highest performer in their group of four during round 1, controlling for confidence; and a dummy for choosing tournament over piece rate for past round 1 performance, controlling for general factors such as risk and feedback aversion. u_{ij} is a disturbance term that we cluster at the community level, the unit of randomization of the program.

Equation (1) thus exploits within-community variation in boys' tournament entry decisions, induced by variation in the sex composition of their siblings – across treatment and control communities – holding constant sibship size and several possible mechanisms driving tournament entry other than the "pure" taste to compete, such as ability, overconfidence, risk and feedback aversion. These patterns are captured by our parameters of interest: β_1, $\beta_1 + \beta_2$, and β_2.

β_1 and $\beta_1 + \beta_2$ identify the effect of having a sister instead of a brother on boys' tournament entry – in control and treatment communities, respectively – under the assumption that conditional on the number of siblings, the gender of the siblings is exogenous [as in e.g. Wang and Zhou 2018]. The difference-in-difference parameter, β_2, measures the causal impact of the ELA program on the effect of having a sister instead of a brother on boys' tournament entry. This is identified solely by exploiting the randomized assignment of the program across communities.

The underlying assumption for the identification of β_1 and $\beta_1 + \beta_2$ is that the gender of the siblings is randomly assigned by nature. This assumption would be violated in the presence of any gender-based fertility stopping behavior among parents. We find this unlikely based on the demography literature that shows no evidence of such behavior for most of sub-Saharan Africa, including Uganda [Basu and De Jong 2010]. Further, if parents in our setting continue to have children until they reach some desired number of (say) boys then there should be a correlation between the share of sisters and the total number of siblings. We, however, find no evidence of such a pattern.[13] We also note that the share of sisters in our sample is close to the natural sex ratio estimated in the literature [Jacobsen et al. 1999], which mitigates concern regarding differential mortality across genders.[14] Taken together the evidence lends support to the assumption that sibling sex composition is exogenous.

[13] The correlation between the share of sisters and total number of siblings is 0.06 (p-value = .484) among boys in control communities, and 0.08 (p-value = .241) among boys in treatment communities.

[14] The 95% confidence interval for the share of sisters is [44.8%, 50.1%] among boys in control communities and [44.9%, 49.7%] among boys in treated communities, which include the proportion caused by the natural sex ratio estimated in the literature of 48.5% [Jacobsen et al. 1999].

3.2.3 Estimation Results

Table 3 presents the results from estimating equation (1). Column 1 only controls for the number of sisters and fixed effects for the total number of siblings, and community fixed effects. This parsimonious specification estimates treatment-control differences in the within-community impacts on boys' tournament entry of having an additional sister (as compared to an additional brother). Columns 2 to 4 sequentially condition on the following experimental controls (also fully interacted with the treatment dummy): (i) performance in the first two rounds of the experiment, controlling for ability (Column 2); (ii) beliefs regarding round one performance, controlling for confidence (Column 3); and (iii) retroactive choice of compensation scheme for round one performance, controlling for general factors that may drive tournament entry such as risk and feedback aversion (Column 4).

Throughout, we find that having sisters rather than brothers has a systematic impact on boys' tournament entry. The sign of this impact is *negative* in control communities ($\hat{\beta}_1 < 0$) and *positive* in treated communities $(\widehat{\beta_1 + \beta_2}) > 0$. Our preferred specification is in Column 4 with the full set of controls. This shows that having an additional sister instead of an additional brother in treated (control) communities leads to an 8.6 (9.3) percentage points increase (decrease) in tournament entry for boys, equivalent change of about 23% increase (25% decrease) in the propensity to compete. Both of these effects are statistically significant, and so is their difference ($\hat{\beta}_2 > 0$).[15]

To put these magnitudes in the context of the literature, we note that Cameron et al. [2013] estimate that the impact of being an only child (in China as a result of the One-Child Policy) is a reduction in the probability of entering tournament of about 9pp (equivalent to 20% reduction in their sample). The robustness of the findings across specifications suggests that the psychological mechanism for the sisters effect is a change in the “pure” taste for competition, because we hold constant several possible alternative mechanisms with the experimental controls. Taken together with the evidence in Bandiera et al. [2020], our results suggest that the long-lasting impacts of the ELA program on the empowerment of girls caused a structural shift forward in their brothers’ competitiveness.

3.2.4. Comparison with Girls

Our analysis has focused on the impact of having sisters on their brothers’ willingness to compete. We replicated the analysis in the subsample of girls and found that in both control and treated communities, girls’ competitiveness is largely insensitive to the sex composition of their siblings (these results are reported in Online Appendix Table A2). This is intriguing since the mechanisms through which sisters may shape competitiveness, discussed in the introduction, can, in theory, apply to boys and girls equally. We note, however, that our evidence is consistent

[15] As a robustness check, we considered an alternative specification using the proportion of siblings who are female rather than the number of sisters. Online Appendix Table A1 shows that although slightly nosier, the results are qualitatively unchanged when using this alternative measure.

with that of Almås et al. [2016]. They show, in a sample of Norwegian adolescents, that boys' but not girls' competitiveness is sensitive to the family environment – in particular, to the socioeconomic status of fathers.

We can only speculate on the reasons for this gender difference in competitive behavior. Based on a review of the literature on gender differences in economic experiments, Croson and Gneezy [2009] suggest that women are more sensitive than men to the features of the experimental design and implementation, possibly due to greater sensitivity to social cues. This leads girls' competitive behavior in the lab to reflect a response to the immediate setting, potentially obscuring how they would compete at home. Boys, on the other hand, are less sensitive to what and who is in the experimental room, and, therefore, their behavior may more closely mirror how they compete at home. An alternative explanation is that adolescent girls' competition preferences are indeed less responsive to the family environment. More research is clearly warranted.

4. Conclusion

Emerging research shows that measures of competitiveness in the lab translate into real-world outcomes. For example, Reuben et al. [2015] show that among a pool of MBAs at the Booth School of Business of the University of Chicago, more competitive MBAs earn more (9%) and are more likely to work in high-paying industries nine years out from graduation. Berge et al. [2015] show that among entrepreneurs in Dar es Salaam, Tanzania, the decision to compete in the lab is associated with increased investment in their businesses, where total investments in their businesses increase by 13–20%, a higher number of employed and fired workers, and a greater number of bonuses offered. Buser et al. [2014] find that competitiveness in students in grades 10-12 in the Netherlands increases the choice to enter more prestigious academic tracks by 20%.[16] These findings suggest that competitiveness impacts important real-world outcomes over an individual's lifetime. For this reason, studying the determinants of competition preferences is an important line of research.

In this paper, we provide novel evidence on the role of the family environment – namely the socioeconomic status of sisters – in shaping adolescent boys' competitiveness. Study participants were recruited from the sampling frame of the Bandiera et al. [2020] randomized evaluation of a large-scale adolescent girls' empowerment intervention. They found that the program led to substantial advances in the economic and social empowerment of adolescent girls in treated communities relative to girls in control communities. We explore the randomized placement of the program across communities, together with natural variation in sibling sex composition within communities, to estimate the causal impact of empowering girls on the effect of having sisters (instead of brothers) on boys' competitiveness.

First, we find that girls are as competitive as boys in both control and treated communities. This is in contrast to previous studies on gender gaps in competitiveness, which found that girls are less likely to compete than boys. That said, we find that the empowerment of girls affected their brothers' competitiveness. In control communities, where girls are economically and socially disempowered, the presence of sisters suppresses boys' competitiveness. However, this pattern is reversed among boys in treated communities, where the program raised girls' engagement in

[16] More prestigious tracks are defined as disciplines that are math and science intensive.

self-employment activities, control over their bodies, and aspirations. There we find that the presence of sisters raises boys' competitiveness. Interestingly, we do not observe these patterns for girls.

Our results demonstrate that boys' competitiveness is malleable and increasing in the socioeconomic status of their sisters. While the specific mechanisms remain difficult to identify, and more research is certainly needed, our results provide a clear illustration of how policy interventions targeting adolescent girls can have important spillover impacts onto their brothers. These indirect effects will need to be considered as we broaden the scope and reach of female-focused programs across the developing world.

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Table 1. Background Characteristics

Means, standard deviations reported in parentheses, p-values reported in brackets

	Boys			Girls		
	(1) Control	(2) Treatment	(3) Test of Equality [Col.1 = Col.2]	(4) Control	(5) Treatment	(6) Test of Equality [Col.4 = Col.5]
Age	16.7	16.9	[.587]	17.2	16.9	[.523]
	(2.81)	(3.25)		(3.05)	(3.33)	
Currently enrolled in school	.791	.797	[.903]	.700	.708	[.900]
	(.408)	(.404)		(.460)	(.456)	
Total number of siblings	5.10	5.15	[.889]	5.83	5.83	[.993]
	(2.59)	(2.66)		(2.88)	(2.69)	
Number of sisters	2.44	2.50	[.793]	3.02	3.06	[.796]
	(1.78)	(1.75)		(2.10)	(2.25)	
Observations	129	172		151	237	

Notes: Columns 1 and 2 (4 and 5) refer to boys (girls) in control and treatment communities, respectively. Column 3 (6) shows p-values on tests of equality obtained from an OLS regression of the corresponding variable on a dummy for whether the boy (girl) comes from a treatment or control community, using the subsample of boys (girls). The regressions allow the standard errors to be clustered by community, the unit of randomization of the ELA program. Total number of siblings and sisters are winsorized (capped) at the 99^{th} percentile.

Table 2. Experimental Results by Gender and Treatment Status

Means, standard deviations reported in parentheses, p-values reported in brackets

	Control		Treatment		
	(1) Boys	(2) Girls	(3) Boys	(4) Girls	(5) Test of Equality [Cols. (1)=(2)=(3)=(4)]
Chooses tournament in round 3	.372	.360	.372	.322	[.667]
	(.484)	(.482)	(.485)	(.468)	
Performance in round 1	8.62	8.61	8.61	8.82	[.623]
	(1.98)	(1.91)	(1.90)	(1.82)	
Performance in round 2	10.2	10.3	10.3	10.6	[.297]
	(2.04)	(1.99)	(2.03)	(1.95)	
Submits round 1 to tournament	.419	.340	.378	.369	[.516]
	(.495)	(.475)	(.486)	(.483)	
Guesses to the best in round 1	.364	.300	.395	.254	[.014]
	(.483)	(.460)	(.490)	(.436)	
Observations	129	151	172	237	

Notes: Columns 1 and 2 (3 and 4) refer to boys and girls from control (treatment) communities, respectively. Column 5 shows p-values on tests of equality obtained from an OLS regression of the corresponding variable on two dummy variables (in isolation and interacted with each other) for whether the subject is a girl, and whether the subject comes from a treatment community. The regression allows the standard error to be clustered by village, the unit of randomization of the ELA program. "Chooses tournament in round 1" is dummy variable equal to one if the participant selects a tournament over a piece rate in round 3. "Performance in round 1 (2)" is the number of correctly completed tasks during round 1 (2). "Submits round 1 to tournament" is a dummy variable equal to 1 if the participant retroactively selects a tournament over a piece rate for past round 1 performance. "Guesses to be the best in round 1" is a dummy variable for whether the participant guesses to have ranked first in round 1 performance.

Table 3. The Sisters Effect on Boys' Tournament Entry by Treatment Status

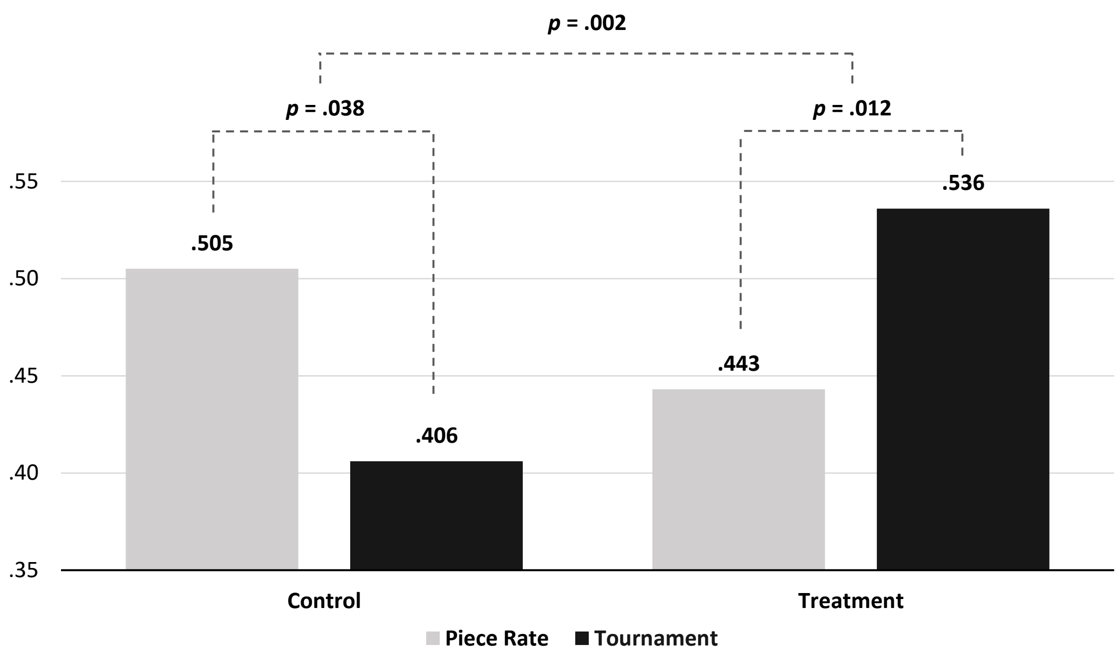
Dependent variable: =1 (=0) if boy chooses tournament (piece) rate in round 3

OLS linear probability estimates, standard errors (in parentheses) clustered by community

	(1) Number of siblings and community dummies	(2) Plus performance	(3) Plus confidence	(4) Plus general factors
Sisters | control group (β_1)	-.102**	-.105**	-.107**	-.093**
	(.041)	(.043)	(.045)	(.045)
Sisters | treatment group (β_1+β_2)	.074*	.086**	.090**	.086**
	(.040)	(.043)	(.044)	(.041)
Diff-in-diff (β_2)	.176***	.191***	.197***	.179***
	(.058)	(.061)	(.063)	(.062)
Number of siblings dummies	Yes	Yes	Yes	Yes
Community dummies	Yes	Yes	Yes	Yes
Round 1 and 2 performances	No	Yes	Yes	Yes
Guesses to be best in Round 1	No	No	Yes	Yes
Submits round 1 to tournament	No	No	No	Yes
R-squared	.455	.493	.498	.571
Observations (clusters)	301 (93)	301 (93)	301 (93)	301 (93)

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The sample comprises adolescent boys. The outcome is a dummy variable equal to one for whether the boy selects a tournament rate over a piece rate in round 3. OLS estimates are shown. In Column 1 we control for the number of sisters, a set of indicators for the total number of siblings, their interactions with a dummy for whether the boy resides in a treated community, and a set of community fixed effects. Column 2 additionally controls for the number of successfully completed tasks in rounds 1 and 2 and their interactions with the treatment dummy. Column 3 additionally controls for a dummy for whether the boy believes to have ranked first in round 1 performance and its interaction with the treatment dummy. Column 4 additionally controls for whether the boy chooses to retroactively submit round 1 performance to tournament and its interaction with the treatment dummy. Standard errors are clustered at the community level and shown in parentheses.

Figure 1. Proportion of Sisters among Boys, by Choice of Compensation Scheme and Treatment Status



Notes: The figure uses the subsample of boys. Means reported at the top of each bar. P-values on tests of equality across means obtained from an OLS regression of proportion of sisters on a dummy for choosing tournament over piece rate in round 3, a dummy for whether the boy comes from a treatment community, and their interaction, with standard errors clustered at the village level.

Table A1. Robustness: Using Share of Sisters

Dependent variable: =1 (=0) if boy chooses tournament (piece) rate in round 3

OLS linear probability estimates, standard errors (in parentheses) clustered by community

	(1) Number of siblings and community dummies	(2) Plus performance	(3) Plus confidence	(4) Plus general factors
% Sisters | control group	-.424**	-.463**	-.482**	-.409**
	(.212)	(.209)	(.213)	(.204)
% Sisters | treatment group	.433**	.452**	.461**	.414**
	(.179)	(.181)	(.189)	(.173)
Diff-in-diff	.857***	.915***	.943***	.823***
	(.279)	(.278)	(.285)	(.268)
Number of siblings fixed effects	Yes	Yes	Yes	Yes
Community fixed effects	Yes	Yes	Yes	Yes
Round 1 and 2 performances	No	Yes	Yes	Yes
Guesses to be best in round 1	No	No	Yes	Yes
Submits round 1 to tournament	No	No	No	Yes
R-squared	.454	.492	.497	.569
Observations (clusters)	301 (93)	301 (93)	301 (93)	299 (93)

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The sample comprises adolescent boys. The outcome is a dummy variable equal to one for whether the boy selects a tournament rate over a piece rate in round 3. OLS estimates are shown. In Column 1 we control for the percentage of sisters and a set of indicators for the total number of siblings interacted with a dummy for whether the boy resides in a treated community, and a set of community fixed effects. Column 2 additionally controls for the number of successfully completed tasks in rounds 1 and 2 and their interactions with the treatment dummy. Column 3 additionally controls for a dummy for whether the boy believes to have ranked first in round 1 performance and its interaction with the treatment dummy. Column 4 additionally controls for whether the boy chooses to retroactively submit round 1 performance to tournament and its interaction with the treatment dummy. Standard errors are clustered at the community level and shown in parentheses.

Table A2. The Sisters Effect on Girls' Tournament Entry by Treatment Status

Dependent variable: =1 (=0) if girl chooses tournament (piece) rate in round 3

OLS linear probability estimates, standard errors (in parentheses) clustered by community

	(1) Number of siblings and community dummies	(2) Plus performance	(3) Plus confidence	(4) Plus general factors
Sisters | control group (β_1)	-.034	-.019	-.018	-.007
	(.034)	(.037)	(.038)	(.035)
Sisters | treatment group (β_1+β_2)	-.030	-.028	-.029	-.040
	(.037)	(.038)	(.038)	(.034)
Diff-in-diff (β_2)	.009	-.009	-.012	-.033
	(.050)	(.054)	(.054)	(.049)
Number of siblings dummies	Yes	Yes	Yes	Yes
Community dummies	Yes	Yes	Yes	Yes
Round 1 and 2 performances	No	Yes	Yes	Yes
Guesses to be best in round 1	No	No	Yes	Yes
Submits round 1 to tournament	No	No	No	Yes
R-squared	.336	.350	.351	.479
Observations (clusters)	388 (106)	388 (106)	388 (106)	388 (93)

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The sample comprises adolescent girls. The outcome is a dummy variable equal to one for whether the girl selects a tournament rate over a piece rate in round 3. OLS estimates are shown. In Column 1 we control for the number of sisters, a set of indicators for the total number of siblings, their interactions with a dummy for whether the girl resides in a treated community, and a set of community fixed effects. Column 2 additionally controls for the number of successfully completed tasks in rounds 1 and 2 and their interactions with the treatment dummy. Column 3 additionally controls for a dummy for whether the girl believes to have ranked first in round 1 performance and its interaction with the treatment dummy. Column 4 additionally controls for whether the girl chooses to retroactively submit round 1 performance to tournament and its interaction with the treatment dummy. Standard errors are clustered at the community level and shown in parentheses.

Online Appendix: Instructions [English translation]

{Everyone Together at Beginning}

Welcome

In the study today, we will ask you to complete a simple task in four different rounds. None of these rounds will take more than five minutes. Because we are not simply asking you questions, but asking you to perform a task, we will pay you for your work. You will receive 400 UGX at the beginning, and at the end you will receive 400 UGX for having completed the four rounds. In addition, you can earn more money based on your performance in one of the four rounds. If you listen carefully, you can earn a large amount of money. So pay close attention to the instructions, and ask questions if you do not understand, because it may affect how much money you earn.

We will now give you some information about the experiment. In each round, we will ask you to do something that can earn you money. When you are done here, you go to the payment desk *{point to desk}*, where the cashier will put four cards into a bag, and you will pick one of these cards from the bag without seeing the cards. These are the four cards: this one is for the first round, this one is for the second round, this one is for the third round, and this one is for the fourth round *{put the cards in a bag as you say this}*. You will be allowed to pick one card, just as the person is going to show you right now. You cannot see which card you will pick, and we are not choosing the card. You will receive money according to how well you have done for the round that you pick from the bag without seeing.

We will explain to you exactly how you can earn money in each round. Some people will only earn the show up fee today. Others will earn more. But everyone who begins will earn 400 UGX and everyone who finishes will earn 400 UGX again.

This is the payment desk {*point to desk*}. When you are finished with the tasks, please go here to answer some questions that we will ask and after that please come here to receive your payment.

Please do not talk with one another at any time during this study. I am happy to answer any questions you have at any time. But please direct your questions only to me. The person sitting in front of you is here to help show you the task, and to record the decisions that you make. They are not allowed to help you make decisions; please do not ask them for help with the decisions we ask you to make.

Practice Round: Explanation of Task

You see the blocks that are in front of you. Please look at them and see the shapes and colors on each of the blocks. Take one of the blocks and show your helper each of the shapes on the block as he points to it on the paper in front of you. Every shape shown on the paper is shown on each of the blocks.

{Pause and wait until every facilitator has signaled to you that the participant has shown him/her all of the shapes on the block.}

Demonstration One

The task we will ask you to perform today is to arrange the shapes in order from smallest to largest. The person helping you will now demonstrate for you how to complete the task. First, your helper will show you how to find all of the circles. When all of the circles are facing up, he or she will put them in order from the smallest circle to the largest circle. The circles are now finished and they are finished correctly. The task is complete.

Demonstration Two

We will now ask *you* to practice doing the task one time. Your helper will now turn your card to the next shape, which is a square. We want you to perform the task for the squares. When you think you are finished, look at your helper for confirmation. If you have completed the task correctly, your helper will nod his or her head. If you are incorrect, he/she will shake his/her head, and you must continue until the squares are arranged from smallest to largest.

{Wait until all helpers indicate that everyone has finished the first task}.

The way you are paid for this task will change each round. So pay close attention to these rules each round and be sure you understand them, because they will affect how much money you can earn in that round. For each round, we will explain the rules, before we ask you to begin. Please do not begin until we tell you to.

We will ask you to perform this task as many times as you can within three minutes. As soon as you finish arranging the blocks for one shape, look to your helper and he or she will indicate to you whether you may move to the next shape. If he/she nods his/her head, then turn the paper in front of you to show the next shape and then begin the next shape. If your facilitator shakes his/her head this means you have not correctly completed the task and you need to keep trying. You have three minutes to complete as many shapes as possible. The number of tasks that you complete is recorded on the paper but we will never tell anyone else how you have done.

Does anyone have any questions about how to perform the task?

Round One: Individual Performance

We will now begin round one. Before we begin, we will explain how you will be paid for the tasks this round.

If round one is the task that you draw from the bag at the end, then you get 400 UGX for each shape you successfully complete. For example, if you complete one set of shapes you receive 400 UGX; if you complete two sets of shapes you receive 800 UGX; if you complete three sets of shapes you receive 1,200 UGX; if you complete four sets of shapes you receive 1,600 UGX, and so on for as many shapes as you complete. We call this individual performance. This is represented by the single person standing alone in the picture in front of you. *{Facilitators, point to the picture of the single stick figure for each participant.}*

Please do not talk during the task or after you have finished. This is very important. If you have any questions, please raise your hand and ask me now. Once we begin, you cannot ask any questions.

Do you have any questions before we begin? *{If someone asks a question, repeat that question for the entire group, and then explain the answer to the entire group.}*

Are the facilitators ready? *{Wait until ALL of the helpers show you that their finger is on the start button of the timer.}*

Okay, go!

{When the time is up, say:} Okay, everyone please stop now.

Round Two: Compared Performance

Now we will move to the second round. For this round, the task is exactly the same. However, the way you are paid is now different. In this round, your payment depends on your performance compared to a group of other participants. Each group consists of four people. The three other members of your group come from the rest of today's participants. They may be in this room or they may have been here before you or they may come after you. You will never know the names of the other people in your group and they will never know your name. The person sitting next to you is not in your group.

Do you have any questions about who is in your group? If you have a question, please raise your hand and ask me now. *{Pause and wait to see if there are any questions.}*

We will now explain how your payment is determined in this round. If round 2 is the task that you draw from the bag at the end, then your earnings depend on your number of successes compared to the three other people in your group. The member of the group who completes the most shapes in 3 minutes will receive 1,600 UGX for each set successfully completed, and all of the other members of the group will receive nothing. That is, if you complete the most shapes out of anyone in your group, you receive 1,600 UGX for each set you complete, and the others in your group receive nothing.

But if someone else in your group completes the most shapes, he/she receives 1,600 UGX for each set successfully completed, and you receive nothing.

One times 1,600 UGX is 1,600 UGX.

Two times 1,600 UGX is 3,200 UGX.

Three times 1,600 UGX is 4,800 UGX.

Four times 1,600 UGX is 6,400 UGX.

And so on.

We call this compared performance. This is represented by the group of 4 people standing together in the picture in front of you *{facilitators point to the picture of the four stick figures for each participant.}* You will not know how you did in the compared performance until the end of today's activity, when you receive your earnings

Please do not talk during the task or after you have finished. This is very important. If you have any questions, please raise your hand, and ask me now. Once we begin, you cannot ask any questions.

Do you have any questions before we begin? *{If someone asks a question, repeat that question for the entire group, and then explain the answer to the entire group.}*

Are the facilitators ready? *{Wait until ALL of the helpers show you that their finger is on the start button of the timer.}*

Okay, go!

{When the time is up, say:} Okay, everyone please stop now.

Round Three: Choice of Payment Scheme (Before Doing Task)

Now we will move to the third round. The task in this round is exactly the same, but now you can choose which way you want to be paid. If round three is the one that you draw from the bag, then your earnings for this task are determined as follows.

If you choose individual performance, you receive 400 UGX per success and you will not be compared to anyone else. If you choose compared performance, your payment for this round is similar to the payment in round two. The only difference is that your performance in this round is compared to the performance of the other three members of your group for round two, the one we just finished, instead of being compared to their performance this round. If you complete the task more times than the other people in your group did for round two then you will receive four times the payment from the individual performance, which is 1,600 UGX per success. You will receive no earnings for this round if you choose compared performance and you do not complete more sets of shapes than the other people in your group did for round two.

Notice that this round is a little different than last round because nothing you do in this round can affect the earnings of other people in your group, and nothing that other people in your group do this round can affect your earnings from this round.

You will not know how you did in the compared performance until the end of today's activity, when you receive your earnings.

Do you have any questions? If you have any questions, please ask me now. *{If someone asks a question, repeat that question for the entire group, and then explain the answer to the entire group.}*

Please do not talk as you are making your decision. If you would like to choose individual performance, please point to the picture of one person. If you would like to choose compared performance please point to the picture of the group.

Please do not talk during the task or after you have finished.

Are the facilitators ready? *{Wait until ALL of the helpers show you that their finger is on the start button of the timer.}*

Okay, go!

{When the time is up, say:} Okay, everyone please stop now.

Round Four: Choose Scheme for Past Performance

For this new round, you do not have to do any tasks. Instead, you may be paid one more time for how you did in the first round of the experiment. Now we are going to ask you how you would like to be paid for the tasks that you completed in the first round. You can choose to be paid for your individual performance or compared performance.

If the fourth round is the one selected for payment, then your earnings for this round are determined like this. If you choose individual performance, you receive 400 UGX per success you had in round 1. If you choose compared performance, your performance will be compared to the performance of the other three members of your group in the first round. If you completed the task more times in round 1 than they did in round one, then you receive four times the earnings of the individual performance choice, which is 1,600 UGX per success. If you choose compared performance and you did not complete the task more times than others did in round one you will receive no earnings for this round.

Do you have any questions? If you have any questions, please ask me now. *{If someone asks a question, repeat that question for the entire group, and then explain the answer to the entire group.}*

Please do not talk as you are making your decision.

Now your helper will show you how many times you successfully completed the sets of shapes in the first round. *{Wait until the helpers have shown the participants how many sets they completed.}* Now your helper will show you a picture. If you would like to choose individual performance, please point to the picture of the one person. If you would like to choose compared performance please point to the picture of the group.

{Wait until all helpers indicate that everyone has decided.}

Thank you very much for your participation today. You can go now. Please go to there to answer some questions for our study.