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How social structure shapes female competition throughout her lifetime

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ABSTRACT

Many studies find a consistent gender gap in competitiveness where men are more likely to compete than women given the same level of ability. Using data from experiments with women ages 12 through 90 in matrilocal and patrilocal communities in rural Malawi, we show that this gender gap does not exist uniformly for all women nor across their whole lifetime. We first replicate three main findings from the gender and competition literature: (i) women are less likely to compete on average; and the gender gap differs by (ii) culture and by (iii) age. In a new finding, we show that the gender gap changes in a theoretically-predicted manner with motherhood status. We argue that these results, when combined, point to an overarching theory of gender and competition–one that is driven by environmental constraints that vary with age, fertility, and social structure.

1. Introduction

The willingness to engage in competition has often been used as a proxy to examine and explain women's choices, particularly as it pertains to labor market outcomes. Many studies show that the average man seeks competition, and the average woman avoids it (Almås et al., 2016; Flory et al., 2015; Gneezy et al., 2003; Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007) - termed the gender gap in competitiveness. Early findings on the gender gap did not question whether the gap was constant across age or sociocultural contexts, leading some to interpret the gap as a *feature* of gender itself (as initially proposed by Daly and Wilson (1983) and Campbell (2002) and furthered by Gneezy et al. (2003), Gneezy and Rustichini (2004), Niederle and Vesterlund (2007)). However, subsequent studies indicate the gender gap can change with culture (Gneezy et al., 2009) and with age – both at adolescence (Andersen et al., 2012) and older ages (Flory et al., 2018; Mayr et al., 2012). These results highlight the need for a fuller understanding of what drives the expression of competition among women.

This study replicates findings from three key papers on the gender gap and its relation to culture and to age, then proposes a theoretical framework that can help organize and explain the variation in findings. We replicate studies showing (1) that women are less competitive than men on average even after controlling for ability, feedback aversion and self-confidence (Niederle and Vesterlund, 2007); (2) that the gender gap exists in patrilocal and not matrilocal settings (Gneezy et al., 2009) and (3) that the gender gap begins to appear as women enter adolescence (Andersen et al., 2012). We also encompass the result from Flory et al. (2018) —whose

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data are a subset of the data we use here—that the gender gap disappears when women become more competitive at ages commonly associated with menopause. Importantly, while the initial findings come from three different experimental designs and three different parts of the world, we replicate these findings within one context using one dataset. This paper also contributes a theory of preferences over competition that focuses on why the gender gap might exhibit the patterns seen in the studies replaced, and, following implications of this theory, we show an additional new finding - that the stages around childrearing impact the gender gap, which also supports the theory.

The theory of preferences over competition advanced in this paper is based in the evolutionary theory of inclusive fitness tied to how the resulting costs and benefits of competitive behavior depend on key elements of her culture. In particular, it focuses on variations in child-rearing environments, specifically whether women have and raise children in their natal communities—matrilocal societies—or communities away from related kin—patrilocal societies— and the important stages in a woman's life cycle that are relevant for child-rearing and passing one's genes to future generations: adolescence, survival of a first child, and menopause. We then test and verify this theory using an artefactual field experiment that provides variation in culture, gender and lifecycle stages—parameters that cannot be randomized in a laboratory setting (see discussion in Gneezy and Imas, 2017) —in a manner similar to Jakiela and Ozier (2016). Importantly, although we show that behavior is predicted by inclusive fitness the we discuss the role of socialization as a potential mechanism by which the gender roles dictated by inclusive fitness may still be imparted in present day societies long after they are relevant to their environments.

We use the Niederle and Vesterlund (2007) experimental protocol with a sample of women and men between the ages of 12 and 90 from matrilocal and patrilocal communities in rural Malawi. We show that women's expression of competitiveness varies with the type of society in which a woman lives and the stages of her life. In addition to replicating the patterns from the literature, we find sharp differences in the average choices that women make at precisely the additional points predicted by our theory, supporting the idea that competitiveness is shaped by social organization, and a woman's life cycle stage. In patrilocal societies, where women raise children isolated from their genetically related kin, women become less competitive than men after adolescence, but the 20-percentage point gender gap is eliminated when they have a child who survives early childhood. In contrast, in matrilocal societies, where women raise their children surrounded by genetically related kin, women are as competitive as men at all stages of their life. Our broader dataset and investigation allow us to show that women without a surviving child who raise their children in patrilocal societies *are the only group* of women who are significantly less competitive than either men or other women in either society. Thus, whereas past studies are often taken to suggest that women are less competitive than men on average, our findings suggest the suppression of competitiveness among women may represent but a sliver of a woman's competitive behavior over her lifetime.

Given that our data subsumes the data of Flory et al. (2018), it is important to mention how our papers differ. Flory et al. (2018) only examine one of the results outlined above, which is that female competitiveness changes around the age of menopause. They also do not investigate this result by culture – matrilocality or patrilocality. In addition, this paper uses supplemental data collected after Flory et al. (2018) that includes children and adolescents, key to replicating the findings of Andersen et al. (2012) and to developing an overarching theory on gender and competition that accounts for the role of culture and age.

In the following section, we outline the theory and its predictions, which are consistent with several past results in the gender and competition literature that we replicate here. Section II outlines the methodology employed in this study, which follows the protocol of Niederle and Vesterlund (2007), but in a new context. Our sample aims to encompass both cultural variation as well as variation in age of our participants. Section III highlights findings consistent with past studies as well as new results that support the theory outlined in Section I. Section IV concludes.

2. Expressed competitiveness driven by inclusive fitness

The evolutionary psychology theory of gender differences in competitiveness suggests that because mothers played a unique role in infant survival and had limited potential fertility, entering contests against others exposed their infants to significant risk with little upside for potential additional offspring (Campbell, 2002, 2004; Daly and Wilson, 1983). Although such a theory can help explain the gap observed in the broader literature on competitiveness, it cannot explain why competitiveness might vary over a woman's lifecycle or across societies. Instead, we propose a theory of expressed competitiveness driven by the imperatives of inclusive fitness.

A rich literature in evolutionary biology has long recognized that for animals living in a cooperative society, individual reproductive success is only part of a broader overall drive to maximize inclusive fitness. Inclusive fitness refers to the degree to which the genes one carries are present in subsequent generations–which can occur by directly passing on one's genes (individual reproduction) or by helping close genetic relatives pass on their genes (Hamilton, 1964; Stockley and Campbell, 2013). For humans, maximizing inclusive fitness implies maximizing the survival and fitness not only of their children, but also of their grandchildren, siblings, children of siblings, and cousins.

In a matrilocal community, since women live out their lives where they were born, surrounded by blood relatives, a woman has a greater ability to invest in the fitness of her genetic kin among whom she is living.[1] Furthermore, not only will the competitiveness of women vary across systems, but it will also vary with motherhood stages across systems. Women in patrilocal communities move from being surrounded by their own family at birth, to being completely isolated from their genetic kin, to having children, and later,

[1] Empirical evidence shows that genetic kin of the mother play a more important role than genetic kin of the father in child-rearing and survival (Fisher and Moule, 2013; Hawkes et al., 1998; Hrdy, 2011, 1999; Linney et al., 2017; Sear and Mace, 2009, 2008). Even in industrialized settings (where survival is less of an issue) matrilateral kin invest more than patrilateral kin (see for example, Gaulin et al., 1997).

grandchildren. Thus, even if the underlying competitive disposition is constant across a woman's lifetime, and equally distributed across types of society and across men and women, we should expect transitions in the expression of competitiveness at these stages – but only in patrilocal society. In other words, not only should the expression of competitiveness by women vary across systems of social organization, but it should also vary with motherhood stages across systems.

We begin by outlining these stages in a patrilocal society. First, note that an early adolescent female in either patrilocal or matrilocal society has no offspring and, in any society, is surrounded by close genetic kin. She can share resources won via contests with her kin (siblings, nieces, nephews, cousins, mothers and aunts, etc.) to increase their reproductive success (and thus the presence of the genes she carries in future generations). This is similar to competing on behalf of a team, which has been shown to increase competitiveness (Healy and Pate, 2011). Moreover, the reproductive cost of competitiveness at this stage is minimal since an adolescent has no young offspring of her own. Thus, at this pre-menarchal stage, competitiveness maximizes inclusive fitness in both societal types.

After early adolescence, the environments faced by women across the two systems sharply diverge. In a patrilocal society women move away from their natal community when they marry.[2] A woman at this point, therefore, has no genetic kin in which she can invest, narrowing her strategies of inclusive fitness to individual reproductive success. Furthermore, in a new environment surrounded by non-genetic kin, the potential loss in reproductive resources and reproductive success from engaging in contests with others rises. A woman in a patrilocal society has no genetic kin in which she can invest, narrowing her strategies of inclusive fitness to individual reproductive success. In addition, any harm to her ability to care for her offspring has significant consequences in an environment without genetic kin who can serve as alloparents. These factors simultaneously reduce the benefits of competitiveness to inclusive fitness and increase the cost. This sharp change in the costs and benefits to inclusive fitness of entering into contests should dampen the expression of competitiveness among women at this stage, but only in societies where they rear their children outside of their natal community – a result that can be seen in Andersen et al. (2012). We also see this pattern of diminished willingness to compete among young women in modern societies, where women are also not living in matrilocal communities – for example, in samples of university students, such as those used in Niederle and Vesterlund (2007).

Having a child who survives the vulnerable early childhood years represents another pivotal stage. Young children are uniquely dependent on their mothers and face a higher mortality rate than older children. As they grow and become of school age, children are ready to enter the care of other adults. This transition should mark a change in the specialized role of mothers in the outcomes of their children. For a woman in a patrilocal society, while her only available inclusive fitness strategy remains the same (propagate the genes she carries through her direct offspring), the cost of a competitive strategy has changed. A setback in the mother's ability to care for the child is now less dangerous; the child has passed out of the most vulnerable phase, has started to integrate into society, and has passed partly into the custodial care of other adults (mentors, teachers, etc.). Furthermore, resources acquired in contests can be invested in the child to increase his or her future reproductive success (further advancing the propagation of genes to future generations). This behavior has been noted in experiments where women are more willing to compete when the winnings are framed as being of direct benefit to their children (Cassar et al., 2016).

For women who are beyond their fertile years (post-menopausal), competition no longer presents a danger to potential children but still offers opportunities to invest in surviving children. Grandmothers in patrilocal society (if they have at least one son) have additional options for advancing inclusive fitness. They can invest in the quality (human capital) of the children of their sons, the children of their grandsons (their sons' sons), or even in the spouses of their sons. They are also likely to have more direct offspring than do younger women. Thus, not only does the reproductive cost of entering contests disappear for patrilocal women past menopause, but the reproductive benefits are also higher. This result is seen in Flory et al. (2018).

The dynamics of motherhood are different for a woman in a matrilocal society because she always lives among her close genetic relatives (parents, grandparents, sisters, unmarried brothers, etc.). This gives her more options for advancing inclusive fitness at all stages than in the patrilocal case and reduces the potential cost of a set-back. Thus, expression of competitiveness in women living in matrilocal environments should not be affected by lifecycle transitions nor childbearing. This broad difference (across all adult ages) of women in matrilocal and patrilocal societies is seen in Gneezy et al. (2009).

Note that men have no reason to suppress a competitive disposition at any age or in any society, and therefore, if the desire to compete is evenly distributed across the genders, women who are willing to express their competitiveness should be as competitive as the average man.

The patterns generated by the combination of motherhood stages and childrearing environments can be summarized most succinctly in one joint hypothesis: the only category of men or women with a reason to avoid expressing their competitive disposition are pre- and early mothers isolated from genetic kin. These are post-adolescent women who live in a patrilocal environment without a child who has survived the vulnerable stages of childhood.

3. Sampling and experimental design

The choice of rural Malawi to help replicate and expand our understanding of the underlying drivers of the gender-competition relationship is deliberate. We take advantage of its history and its location on the eastern edge of the African 'matriliny belt'

[2] In this setting, women do not move away from their natal village immediately at adolescence, but at that age they are seen as preparing to marry. This is, therefore, a stage in which parents' beliefs about the characteristics that improve marriage prospects could lead to strong socialization pressure to exhibit (or avoid) certain behaviors.

(Giuliano and Nunn, 2018; Lowes, 2020). The history of Malawi reflects the pressures of the continued Bantu expansion from the Congo in the 15th century (which brought matriliny and matrilocality with the Chewa), the arrival of the Portuguese and the slave trade in the 16th century, the arrival of the Ngoni who fled the Zulu from what is now South Africa in the 19th century and colonial pressures throughout the 19th and 20th centuries. Through this period of mixing, some groups were able to maintain their marriage and inheritance customs; others were converted from their original customs rapidly by the Ngoni or slowly by the British; and in some cases, the aggressors (some groups of Ngoni, for example) adopted the customs of the oppressed (Phiri, 1983). The Chewa ethnicity, for example, includes communities that have always been matrilocal, communities that were matrilocal in the distant past but have been patrilocal for hundreds of years (due to pressure from the Ngoni) and communities that more recently transitioned away from matrilocal customs due to pressures from the British colonialists (who believed that matrilocality and matriliny were contrary to modernity). Maize was introduced to Malawi in the 17th century (Iliffe, 2017), and all the regions of Malawi are now settled agricultural economies based on this primary food crop. Furthermore, as a small country there is less variation across rural areas in access to education, health care, and markets. Thus, the different groups of people share a similar economic setting but, due to historical events, observe differing marriage and inheritance institutions.

Despite being isolated from the original conditions in which they were formed, the continued existence of these different institutions is not particularly surprising given that many institutional forms are slow to change (even in cases where they are no longer optimal responses to current conditions). Marriage customs, in particular, are highly stable because parents make choices that reflect not only their idiosyncratic preferences but also their beliefs about the preferences (and beliefs) of the parents of potential marriage matches (Bisin and Verdier, 2001, 2000).

To focus on matrilocal and patrilocal customs, our sampling strategy sought communities that were both historically and currently identified with matrilocal or patrilocal marriage patterns. We define matrilocal (patrilocal) communities as places in which men (women) are more likely than women (men) to move away from their natal community at marriage. Working with local anthropologists and sociologists who study present-day practices in Malawi, agricultural and health extension workers familiar with local customs, and traditional authorities at all levels (including the top chief of the Chewa tribe), we found villages reported to be strongly matrilocal and patrilocal. We then visited these villages to follow up through in-depth interviews with multiple key informants per village about the nature, prevalence and duration of chitengwa (patrilocal) and chikamwini (matrilocal) practices. This process resulted in a final sample of 12 villages; 6 matrilocal and 6 patrilocal. More detail about the distribution of practices and tribes is contained in the Appendix.

In each of the twelve villages, we began by conducting experiments (outlined below) with adults 18 and older. Flory et al. (2018) combine this data with data from the United States and examine competition patterns with age in adults. That paper does not use the demographic or cultural data. With these data they show an important transition in competitiveness for all women at the typical age of menopause in both the US and Malawi. Subsequent to the original data collection, we returned to Malawi to collect more data on children between the ages of 12 and 17 in 4 villages: two matrilocal and two patrilocal. This paper combines the original data on adults with the new data on children and exploits both the matrilocal/patrilocal dimension and the detailed demographic data collected in both visits.[3]

3.1. Experimental design

To measure the expression of competitiveness we follow the design of Niederle and Vesterlund (2007)—henceforth NV—in which subjects (both men and women) perform a 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 a choice of whether to perform the task in a competitive or individual (piece-rate) environment. At the end, they are also asked whether they choose to submit past performance to a competitive evaluation.

As NV emphasize, an important challenge in identifying the effects of a given determinant (e.g., gender) on appetites for competition is the difficulty of isolating preferences for competition from other characteristics such as appetites for risk, aversion to receiving feedback on performance relative to others, and self-confidence. Their protocol resolves this issue by having participants make two choices: choice 1, choosing to compete against others, and choice 2, choosing to submit one's past performance to a competitive evaluation. Both choices are affected by risk preferences, relative feedback aversion, and self-confidence, but only one (choice 1) is affected by a taste for the act of performing competitively. Choice 2, which is affected by risk preferences, feedback preferences, and confidence (but not the latter "taste"), is used as a control in analyses of choice 1, the choice to compete.[4]

Our methodology differs from that of NV only in the task and the choice of subjects. The task that we use is specifically designed to involve a simple cognitive exercise—arranging shapes in a row from smallest to largest.[5] Each participant has a set of six blocks. Each

[3] Given the order (older people first), the unexpected return for a second visit and the unique set of materials, it is not possible that any subject took part in both sets of experiments and unlikely that participants would learn about or practice the task between visits. To the degree that there is a discontinuity in behavior between the two rounds of data collection, it would be between 17- and 18-year-old subjects, a distinction that is not indicated in theory or used in any of our empirical analysis.

[4] Note that this is an important distinction about the type of risk that the protocol exploits. We – as does the NV protocol – focus on the participants performing a task while facing risks as opposed to facing risks that do not depend on one's performance (e.g., submitting past performance).

[5] We chose a task that was relatively easy to explain, required no formal education and responded well to effort.

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 in arranging the blocks for the next shape. All participants work with identical blocks and face the same order of shapes to complete. Participants are paid based on the number of shapes completed in a 3-minute interval. There are four different rounds. Participants are informed that they will be paid for one of the four rounds, selected at random after the game. In round 1 (piece-rate), participants are paid X (0.32 USD) for each set of shapes successfully completed. In round 2 (tournament), they receive 4X (1.28 USD) per success if they complete the most successes in their group of four but receive nothing otherwise. Each group is randomly determined, and participants never know who is in their group. In round 3 (choice 1), they first choose which of the two payment schemes they want to work under (piece-rate or tournament) and then perform the task. In round 4 (choice 2), they do not actually perform the task. Instead, they choose to submit their past performance in round 1 either to the noncompetitive piece-rate scheme or the competition-based pay scheme.

Before making a choice for round 3, participants are informed that if they choose competition, their group is the same group that they were placed in for round 2, and the performances they compete against are the round 2 performances. That is, they would compete with individuals who had to compete, rather than with individuals who had self-selected into competition. Before making a choice for round 4, participants are again informed that their group is the same group that they were randomly placed in for round 2, and this time the performances they compete against are the round 1 (piece-rate) performances of the group. Thus, if they submit their piece-rate performance to competition, they compete with the (round 1) performance of all individuals in their group, not just with those who chose to compete. After all rounds are completed, participants are asked how they believe their performance compares to the others' performances in their group for rounds 1 and 2, and they earn an added amount Y (0.13 USD) for correct guesses.

The focus of the exercise is the choice of the compensation scheme for round 3 (choice 1), which is over whether participants choose to perform the task under competition against a group of individuals who had to compete, or instead under the piece rate. Rounds 1 and 2 serve to familiarize participants with each payment scheme. In addition, the number of successes in each of the first two rounds allows us to control for the influence of ability in the task (and any potential boost in ability under competition) on the decision to compete. This allows us to ensure, for example, that it is not simply a difference in ability that drives a lower average willingness to compete among women. The choice made in round 4 (choice 2) is whether participants want to submit a past performance to a competitive evaluation against their group's previous performances. As already mentioned, both choice 1 and choice 2 are subject to the influence of other factors that affect one's willingness to compete (risk-aversion, feedback-aversion, and self-confidence), but only choice 1 is affected by a preference for doing the task while *under* competition.[6] Therefore, the choice to compete in round 3 conditional on the choice in round 4 captures the preference for performing in competitive environments independent of other factors that can influence this choice.

The experiment took place in an isolated location, often inside a schoolhouse, in 12 villages. In each village, we conducted three or four sessions, with each session lasting about an hour. Each session had 16 stations, with a set of blocks and a pile of shape-indicator cards. We used facilitators to fill many of the functions of a computer in a typical experimental lab. Facilitators gave subjects a silent sign when their task was completed so they could move to the next shape arrangement, kept track of the number of successes and the time it took to complete each task, and recorded subjects' choices and beliefs. The facilitator sat facing the subject, handling two subjects at a time (with a barrier between the two subjects). Visual barriers prevented subjects from being able to observe each other's choices or performance. Communication between facilitators and subjects was nonverbal, using gestures and pictures (e.g., pointing to a card displaying the shape for the next task). The only speaker during the session was the script-reader, who read the instructions for the experiment translated into the local language.

4. Results

The experiment yielded 999 observations (504 women and 495 men) in 12 villages. We asked every participant in the experiment his or her age and gender. After the experiment, we collected more demographic data from a random subsample of participants.[7] We have experimental results for 504 women and more complete demographic data on 444 women.

4.1. Replication of previous experimental results

We first replicate several key results from past literature on the gender gap including: the overall difference to compete by gender; the difference in the decision to compete by gender and culture; and the difference in the decision to compete by gender and culture and age–adolescence and the age commonly associated with menopause. In describing our main results below, we rely on the reports of key informants to define villages as matri- versus patrilocal. In the Appendix we show that our results are robust to different village

[6] Booth and Nolen (2012) review the reasons why performance might differ in a competitive setting and discuss stereotype threats as particularly salient to girls who have been told that they are supposed to underperform relative to men. Iriberri and Rey-Biel (2017) further clarify that the performance suffers only when the threat is primed by the presence of rivals. Booth and Lee (2021) highlight the role of stress inherent in a tournament setting and it may be that women and men react differently to this stress.

[7] Since we did not have enough enumerators to interview every participant before they left, we interviewed people in a random order as they exited.

sources' responses to our question on marriage practices.

Table 1 reports the overall results for our full sample and shows the sample statistics of the experimental results disaggregated both by men and women across cultures. Within patrilocal villages, women are 10 percentage points less competitive than men ($p = 0.016$). Within matrilocal villages, women are broadly similar to men. They are not more competitive than men ($p = 0.528$). But they are slightly less confident about their performance in round 2 ($p = 0.004$). Women in matrilocal communities are also better at the task than women in patrilocal communities in both rounds ($p = 0.019$, $p = 0.059$). There are no significant differences for men across types of communities. Note that men and women, in each type of society, are equally willing to submit their past performance to tournament incentives (a result also highlighted in NV).

Table 2 compares our experimental results to those reported in NV as a benchmark. Following NV, it reports estimates from a linear regression where the choice to compete in round 3 is regressed on gender, performance, guessed rank, and round 4 choice as controls. We report the results for the full sample as well as for the sample restricted to participants between the ages of 18 and 25, the approximate range of ages in a university sample. The gender gap in choosing to perform under competition that we find in Malawi is statistically significant both for the full sample and for participants 18 to 25. The gap for the younger participants (a 14-point gap) is almost identical to the gap found in the NV sample of students (a 16-point gap). This shows the NV protocol is remarkably robust across very different populations and tasks and replicates their main result.

Table 3 compares our overall experimental results to those reported in Gneezy et al. (2009) [GLL], which used a different experiment design and task. As in Table 2, for the regressions in Table 3 the response variable is the choice of whether to perform a task under competition-based pay (versus piece-rate). GLL found that women in the Maasai society in Tanzania (patriarchal, patrilocal and patrilineal) were less competitive than men by 25 percentage points but that women in the Khasi society in India (matrilocal and matrilineal) were as competitive as men (in fact slightly more competitive). Despite the differences in experiment design, task, and geographical location, in our sample we find the same pattern. Women in a patriarchal, patrilocal and patrilineal society are less competitive than men, but women in matrilocal/matrilineal society are as competitive as men. The effect we find for gender in patri-society is statistically significant and not statistically different from the point estimate of GLL.

Table 4 compares our results to those found in Andersen et al. (2012) [henceforth AEGLM], who study competitiveness among children in different societies in India. Their study also uses a different experiment design and task. Since AEGLM report the percentage of each group that chose to perform under competition, Table 4 also follows this approach to facilitate comparison of results. AEGLM disaggregates results for children ages 7–12 versus 13–15. The youngest subjects in our study are 12 years of age, so we test the findings of AEGLM through three different approaches. First, we disaggregate results comparing 12-year-olds versus 13–15-year-olds. Then we compare 12–13 versus 14–15-year-olds. Finally, we also show results in an expanded older group that includes children aged 16 and 17. Overall, our results demonstrate the basic result of AEGLM, that competitiveness falls in girls in patrilineal and patrilocal society as they transition from childhood to adolescence.[8] Thus, while our age distribution does not exactly match that of AEGLM we find very similar patterns, replicating their results that the gender gap in competitiveness emerges around the age of adolescence.[9]

Table 5 shows how the results of our experiment compare to those found in Flory et al. (2018) [henceforth FGLL], who use the subset of this paper's data consisting only of adults and gathered during an earlier visit to Malawi. We first focus on the main result of FGLL, which is that women over 50 are no different from men of any age in terms of competitiveness.[10] This can be seen from the coefficients on Female and Female over 49 in columns 2 and 4 from FGLL Table 1 (which only includes adults). Columns 1 and 2 from the full sample (i.e., including 12- to 17-year-olds) replicate this result.[11] Columns 3 and 4 from the full sample disaggregate the results by matrilocal and patrilocal cultures (which is not addressed in FGLL). The estimates show that the main result in FGLL is, at least in the Malawi sample, driven by women in patrilocal societies. A second result from FGLL is that women 50 and older are different from women under 50. In the full sample we do not find that this difference is statistically significant. This data, which includes children 12–17, thus replicates the main finding in FGLL but not the second result.

The reason for the failure to replicate the second result when children are included is instructive, and consistent with the results in AEGLM (which we replicate above). The FGLL result that older women are significantly more competitive than younger women holds among adults, but not when the sample is expanded to include pre-adolescents because preadolescent women are more competitive than post-adolescent women (raising the average among younger women). This pattern is consistent with a theory of competition preferences rooted in the evolutionary logic of inclusive fitness.

4.2. *Testing the theory of inclusive fitness and expressed competitiveness*

In the previous section we established that our data support several past findings on the gender gap that come from distinctly different experiment designs, samples, and contexts. We now integrate these findings as part of a more unified theory on the expression of competitiveness–a theory that shows that competitiveness for women is not constant but varies across culture and lifetime. We first

[8] Note that, AEGLM found that boys in matrilocal society become less competitive after 12, whereas we find the opposite. However, when we look at other definitions of adolescence, we find that there is no effect with age in matrilocal boys in Malawi.

[9] It is reasonable to assume that the later divergence in competitiveness seen in Malawi is a feature of the age at which children begin to assume adult roles (initiation), but even if the effect at adolescence is biological, the onset of puberty can vary by nutritional status.

[10] FGLL find competitiveness of men does not vary by age.

[11] The sum of the coefficients Female and Female over 49 in columns 1 and 2 are of the full sample results, for example, is −0.039 (p-value = 0.62) and 0.003 (p-value = 0.97), thus, showing that women over 49 are not different from men.

Table 1
Experimental results for full sample.

	Females			Males			F/M p-value	
	Patri	Matri	p-value	Patri	Matri	p-value	Patri	Matri
Choice 1, compete in round 3	0.41	0.45	0.369	0.51	0.47	0.419	0.016	0.528
Choice 2, submit previous perf.	0.46	0.46	0.859	0.48	0.47	1.000	0.790	0.717
Successes in round 1	5.92	6.44	0.019	6.66	6.87	0.146	0.007	0.107
Successes in round 2	7.37	7.90	0.059	8.02	8.19	0.208	0.058	0.257
Belief of rank in round 1	2.12	2.10	0.777	1.78	1.91	0.217	0.006	0.327
Belief of rank in round 2	2.31	2.40	0.149	2.04	2.05	0.437	0.025	0.004
Observations	254	250		255	240			

Fisher's exact test is used for discrete variables and Wilcoxon rank-sum test used for continuous variables. Experimental results are shown for the full sample of experimental participants. All tests are two-sided. Matrilocal and Patrilocal communities are defined following the declaration of key informants in each community. Belief of rank (1 = best, 2 = second best, 3 = third best, 4 = worst).

Table 2
Replicating the results from NV.

	Univ. of Pittsburg Students	Malawi	
	(reported in NV)	Adults 18–25	Full Sample
Female	−0.162	−0.140	−0.068
	[0.05]	[0.079]	[0.019]
Tournament Performance	−0.009	−0.013	−0.001
	[0.42]	[0.471]	[0.927]
Improvement	0.011	0.037	0.016
	[0.44]	[0.304]	[0.355]
Submit piece rate to tournament	0.258	0.387	0.426
	[0.012]	[0.000]	[0.000]
Guessed Rank	−0.12	−0.043	−0.015
	[0.01]	[0.245]	[0.553]
Observations	77	288	998

Coefficients for University of Pittsburg drawn from Niederle and Vesterlund (2007) (NV). The dependent variable is the choice to compete in round 3. P-values are shown in brackets ([]) to facilitate comparison with NV. Improvement is measured as round 2 successes minus round 1 successes.

Table 3
Replicating results from GLL.

	Tanzania and India	Malawi
Female	−0.25	−0.108
	(0.12)	(0.024)
Matrilocal/Khasi	−0.11	−0.042
	(0.12)	(0.071)
Matrilocal/Khasi * female	0.39	0.080
	(0.17)	(0.047)
Male exp. / reader	0.007	0.009
	(0.08)	(0.066)
Observations	154	1000

Coefficients for Tanzania and India drawn from Gneezy et al. (2009) (GLL), Table 3, column 1, constant not shown. Standard errors in parentheses. Standard errors in Malawi are clustered at the village, visit level. In GLL, the experimenter was the only researcher present. In Malawi there was a script reader and an enumerator recording decisions. We include a dummy variable for male script reader to match the experimenter effect in GLL.

define categories informed by a theory of inclusive fitness, including those categories explored above when replicating past findings. We use the widely accepted age range of 15 to 49 for likely fertility[12] and categorize youth from 12 to 14 as early adolescents (who we henceforth call adolescents for simplicity). To examine the role of child survival, a category not previously investigated in the literature, we categorize women by whether they have a child past the most vulnerable age. The World Health Organization (WHO) suggests that the ages of zero to eight are the most vulnerable period for early childhood development,[13] and child mortality is

[12] The Demographic and Health Surveys (DHS), the major source of detailed fertility data in developing countries, only interview women who are between the ages of 15 and 49. Munthali and Zulu (2007) also report that 15 is the median age of first menarche in their study in Malawi.
[13] https://www.who.int/topics/early-child-development/en/

Table 4
Replicating the results from AEGLM.

	Meghalaya, India					Malawi			
	7–12		13–15			12		13–15	
Patrilocal	0.441	(0.07)	0.188	(0.10)		0.500	(0.076)	0.387	(0.089)
Female		[59]		[16]			[44]		[31]
Patrilocal	0.464	(0.07)	0.667	(0.12)		0.571	(0.202)	0.417	(0.103)
Male		[56]		[15]			[7]		[24]
Matrilocal	0.484	(0.06)	0.500	(0.13)		0.545	(0.109)	0.500	(0.093)
Female		[62]		[14]			[22]		[30]
Matrilocal	0.544	(0.06)	0.412	(0.06)		0.385	(0.140)	0.600	(0.091)
Male		[79]		[17]			[13]		[30]
	Malawi								
	12–13		14–15		14–17				
Patrilocal	0.500	(0.104)	0.350	(0.109)	0.421	(0.081)			
Female		[24]		[20]		[38]			
Patrilocal	0.538	(0.144)	0.389	(0.118)	0.588	(0.070)			
Male		[13]		[18]		[51]			
Matrilocal	0.513	(0.081)	0.538	(0.144)	0.564	(0.080)			
Female		[39]		[13]		[39]			
Matrilocal	0.545	(0.109)	0.524	(0.112)	0.500	(0.076)			
Male		[22]		[21]		[44]			

Estimates for Meghalaya, India drawn from Andersen et al. (2012) (AEGLM). The dependent variable is the choice to compete in round 3. Shown is the sample average, with standard errors in parentheses and observations in brackets.

Table 5
Replicating results from FGLL.

	FGLL Table 1		Full Malawi Sample			
	(2)	(4)	(1)	(2)	(3)	(4)
Female	−0.099	−0.105	−0.075	−0.079	−0.075	−0.080
	(0.039)	(0.042)	(0.025)	(0.033)	(0.025)	(0.033)
Female over 49	0.091	0.141	0.036	0.076		
	(0.064)	(0.071)	(0.079)	(0.101)		
Matrilocal					0.006	0.019
					(0.060)	(0.057)
Matrilocal					0.005	−0.010
Female over 49					(0.140)	(0.143)
Patrilocal					0.061	0.140
Female over 49					(0.080)	(0.105)
Piece Rate		0.007		0.002		0.001
		(0.008)		(0.009)		(0.009)
Improvement		0.013		0.016		0.016
		(0.015)		(0.017)		(0.017)
Submit piece-rate		0.391		0.427		0.430
to tournament		(0.035)		(0.038)		(0.037)
Guessed rank		−0.005		−0.014		−0.014
		(0.020)		(0.026)		(0.026)
Observations	730	728	1000	998	1000	998

Coefficients drawn from Flory, Gneezy et al. (2009) (FGLL), Table 1.
Standard errors in parentheses.

traditionally measured up to the age of five. This suggests markers between five and eight are the best candidates for a variable indicating that a child has passed the most vulnerable age. In the Appendix, we discuss our results with each of these definitions (5, 6, 7 and 8) and here we focus on the results for being older than seven as the cutoff for vulnerability because it agrees with the WHO

definition, is the common age at which children enter school and is a cultural marker of the end of early childhood.[14] The sample of women comprises 444 participants (229 / 215 in matrilocal and patrilocal, respectively) categorized into four groups. We have 85 adolescents (49 / 36), 166 women between 14 and 49 without a child older than 7 (92 / 74), 115 women between 14 and 49 with a child over 7 (54 / 61) and 77 women older than 49 (34 / 44).[15]

Fig. 1 shows the proportion of each subsample choosing to compete (along with the average across all males for comparison) in each type of community. The p-tests for the pairwise comparisons displayed in Fig. 1 are shown in Table 7, both without and with correction for multiple hypothesis testing.[16] We show the mutually exclusive categories by age, from early adolescents to post-menopausal women. We see that women in a patrilocal society experience at least two important transitions in their lifecycle: passing out of early adolescence is linked with an estimated 21 percentage point drop in the proportion competing, and having offspring survive the vulnerable early years of childhood leads to an estimated 23 percentage point increase in the proportion competing. Looking at the data this way, we see that having a child survive the vulnerable years is at least as important as aging beyond one's fertile years. Women 50 and older exhibit an 18-percentage point rise in the proportion competing compared to women below 50 without a child over the age of seven. Note that there are no evident patterns in matrilocal communities.

The most direct statement of our hypothesis is that pre- and early mothers isolated from genetic kin (women between 15 and 49 without a child over 7 in patrilocal communities) are less competitive than all other categories of women and men and that they are the only category less competitive than other groups. In Table 7, we can see that, without correcting for multiple hypotheses, women 15 to 49 without a child over 7 are different from all other women and men. Correcting for multiple hypotheses, these women are statistically different from women the same age who do have a child over 7 and from men.

To test this prediction of the theory more directly, we turn to probit regressions shown in Table 6. The table shows marginal effects in which the standard errors are clustered at the village-visit level with p-values of the coefficients in parentheses. (We test additional specifications for clustering at the village level or with wild bootstrapping in the Appendix.) Thus, the coefficients can be read directly as a percentage point change in the proportion of the group choosing to compete compared to the omitted category. We report the results of probit regressions with and without the NV controls. Recall that the additional NV variables control for the confounding influences of ability, beliefs over ability, risk aversion, and feedback aversion. As such, we include the number of successes in round 1 and the change in the number of successes between rounds 1 and 2, which control for the influence of ability and any potential boost in ability under competition. We also include participant guesses about how their performance in round 2 ranked in comparison to the rest of their group (1=best, 4=worst), which controls for confidence in one's relative ability. The final control variable is the choice made in round 4–whether to submit the round 1 piece-rate performance to a tournament pay regime.[17]

We restrict the sample to women and examine whether there are patterns in patrilocal society that do not exist in matrilocal society, using the same mutually exclusive categories as shown in Fig. 1. The coefficients and their p-values examine differences within society across age/motherhood categories and we also report the p-value for the test that the pattern observed in patrilocal communities is significantly different from that reported in matrilocal communities. To control for the fact that having a child over the age of 7 is associated both with having a child of any age *and* being married, we include these variables as control variables in Columns 2 and 3 and Columns 5 and 6, to see if either of these might be driving the effect that we see for having a child over 7.

Table 6 shows several important results. First, across all specifications, women in the reference group (age 15–49 without a child over 7) are substantially more competitive on average in matrilocal communities than in patrilocal communities. Second, there are key patterns in patrilocal communities that do not exist in matrilocal communities. Third, the inclusion of variables indicating whether a woman has ever married and whether she has a child of any age does not change the magnitude of the key coefficients. Across all specifications, the markers predicted by the theory of childrearing with inclusive fitness are important for female competitiveness in patrilocal environments but not matrilocal environments, except for the result for women over 50 in patrilocal societies in columns 2 and 3. Across all specifications, the coefficient for having a child over the age of 7 is significantly different across matrilocal and patrilocal communities and in column 4, with the inclusion of the NV controls, all three categories are significantly different across communities. Thus, we see that there are strong and significant patterns in patrilocal society that do not appear in matrilocal society and, when we include the NV controls, we can reject the hypothesis that there are important changes in matrilocal society for women over 50 and women with a child over the age of 7.

In the Appendix, we include additional specifications of culture and age and perform a number of robustness tests. Overall, we find that the patterns observed are robust to different specifications and the inclusion of continuous measures of age. We also examine the

[14] Leonard (1997) reports an interview with a traditional healer in neighboring Tanzania in which the healer did not consider the mother to have been cured of infertility until the child born to her reached the age of seven.

[15] Note that our sample size and the endogenous behavior implied in having children limits us from testing more fine-grained hypotheses on the transitions within stages. We do show that having a child is different from having a child who survives early childhood, but we cannot test the differences between survival markers of 5 and 6 for example, because there are too few women who have a child of exactly 5. Importantly, we cannot test whether the gender of the child makes a difference because that would require a significant number of women who have a surviving boy (girl) but not a surviving girl (boy), and we would need to assume that the decision to have a second child was not dependent on the gender of the first child.

[16] Following List, Shaikh and Xu (2019) and List, Shaikh and Vayalinkal (2023) we correct the standard errors for multiple hypotheses by assuming that `treatment' is assignment to one of four status categories for women or the category of all men, and testing within matri and patrilocal cultures for a total of twenty simultaneous tests.

[17] The coefficients for the NV controls in this table are shown in Appendix Table 1.

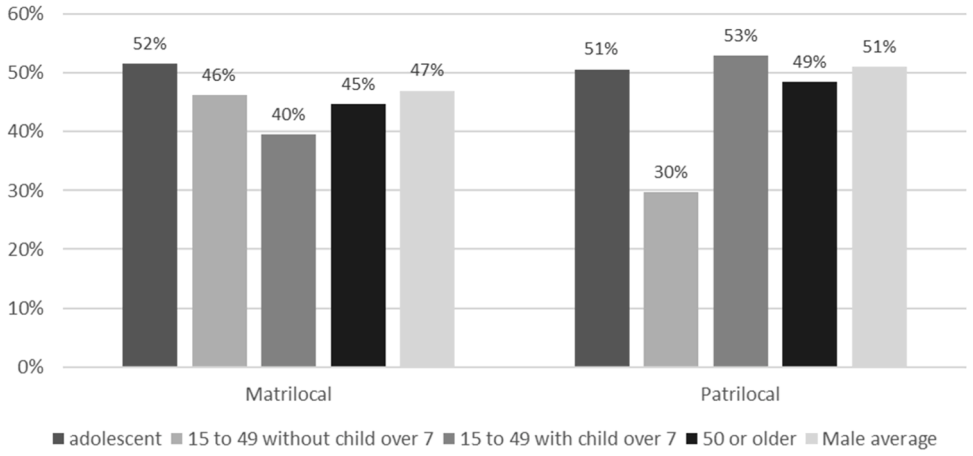

Fig. 1. Proportion of women choosing to compete in full sample.

Table 6
The choice to compete across motherhood stages and childrearing environment.

	(1)	(2)	(3)	(4)	(5)	(6)
Matrilocal effect	0.165	0.138	0.143	0.648	0.652	0.623
	(0.021)	(0.078)	(0.025)	(0.009)	(0.009)	(0.012)
Age and status categories						
Matri and adolescent	0.053	0.041	0.010	0.005	−0.040	−0.045
	(0.514)	(0.638)	(0.889)	(0.960)	(0.733)	(0.664)
Matri and 50 or older	−0.015	−0.027	−0.058	−0.182	−0.221	−0.226
	(0.915)	(0.854)	(0.668)	(0.321)	(0.253)	(0.212)
Patri and adolescent	0.209	0.170	0.144	0.229	0.170	0.150
	(0.005)	(0.032)	(0.098)	(0.001)	(0.019)	(0.074)
Patri and 50 or older	0.188	0.148	0.122	0.277	0.224	0.197
	(0.028)	(0.066)	(0.149)	(0.005)	(0.018)	(0.064)
Matri 15 to 49 with child over 7	−0.067	−0.040	−0.008	−0.148	−0.062	−0.087
	(0.585)	(0.766)	(0.954)	(0.277)	(0.662)	(0.557)
Patri 15 to 49 with child over 7	0.233	0.323	0.276	0.242	0.371	0.291
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Matri 15 to 49 with child		−0.040			−0.134	
		(0.587)			(0.090)	
Patri 15 to 49 with child		−0.134			−0.192	
		(0.328)			(0.130)	
Matri 15 to 49 and ever married			−0.110			−0.123
			(0.060)			(0.084)
Patri 15 to 49 and ever married			−0.116			−0.138
			(0.008)			(0.002)
Included NV controls	no	no	no	yes	yes	yes
Omitted category average*	0.297	0.412	0.419			
Observations	444	444	444	443	443	443
Clusters	16	16	16	16	16	16
P-value of the test for equality of coefficients across matri and patri						
Adolescent	0.155	0.273	0.226	0.088	0.129	0.146
50 and older	0.224	0.301	0.263	0.031	0.045	0.049
Has children over 7	0.023	0.022	0.045	0.008	0.007	0.018

The dependent variable is the choice to enter and perform under competition in round 3. The coefficients are marginal effects from a probit regression with p-values from errors clustered at the village-visit level reported in parentheses. The sample includes all female participants with available demographic information. Columns 4, 5 and 6 include the standard NV controls, with coefficients shown in the Appendix. Matrilocal and Patrilocal communities are defined following the declaration of key informants in each community.
*The omitted category is women between 15 and 49 in patrilocal communities without children over 7.

correspondence between what key informants say about marriage customs and the patterns observed in married subjects in our sample and show that our results are robust to alternative definitions of matrilocal and patrilocal customs. Those tables confirm that getting married or having a child do not change the competitiveness of women in patrilocal society. This corroborates our theory that post-adolescent girls avoid competition because it does not improve the chance of having a child. This is true even if girls do not move until after they are married. However, the behavior of unmarried women could also suggest that parents (by espousing and enforcing gender stereotypes and identities) play a role in socializing girls to display the traits that are desirable in married women, thus increasing the

Table 7
P-Values from pairwise comparisons of competitiveness within communities.

	Women 15 to 49 w/o child over 7	women adolescent	Women 15 to 49 with child over 7	women 50 and older	men
	Matrilocal				
15 to 49 w/o child over 7		0.547 (0.996)	0.429 (0.984)	0.879 (0.998)	0.895 (0.985)
Adolescent			0.220 (0.888)	0.542 (0.991)	0.653 (0.997)
15 to 49 with child over 7				0.632 (0.998)	0.254 (0.966)
50 and older					0.715 (1.000)
men					
	Patrilocal				
15 to 49 w/o child over 7		0.038 (0.534)	0.007 (0.074)	0.050 (0.432)	0.001 (0.005)
adolescent			0.817 (0.999)	0.842 (0.994)	0.895 (0.998)
15 to 49 with child over 7				0.636 (0.996)	0.858 (0.939)
50 and older					0.674 (0.994)
men					

The figure shows the proportion of women across four lifecycle categories and the average man within two types of communities. The sample includes all participants with available demographic information. Pairwise *t*-test without correction shown first, and results from MHT test are shown in parentheses.

probability that they will get married. The behavior of women who seek to be, yet are not married, and the fact that it conforms to the behavior of women who are married, suggests an important role of socialization, as we discuss below.

4.3. Additional contexts and samples

In this section we use samples from the studies we replicated above to examine our theory that women are more likely to avoid competition only at certain stages of their life and only in cultures that do not provide the support of their kin. We take advantage of the fact that Gneezy et al. (2009) and Flory et al. (2018) collected data on the ages of all participants. Furthermore, we assume that most college students are between the ages of 18 and 25 allowing us to categorize the ages of subjects in the Niederle and Vesterlund (2007) dataset. Thus, we can combine our data from Malawi with data from Tanzania in a patrilocal society and India in a matrilocal society (Gneezy et al., 2009), data from matrilocal and patrilocal societies in India (Andersen et al., 2012), and two samples from the US (Flory et al., 2018; Niederle and Vesterlund, 2007). These additional samples did not collect demographic data beyond age, but we can examine the data using age as a proxy for lifecycle stages. Note that most customs within developed countries can be described as neolocal, in which the couple forms a new household apart from the families of either spouse after marriage. If, as the theory suggests, the key feature discouraging competition is the isolation from genetic kin, then neolocal cultures should exhibit patterns similar to patrilocal cultures.

In Fig. 2, we combine all these data sets and group them into five age categories: preadolescent children (ages 7–12 in India, 7–13 in Malawi), post-adolescent children (13 through 15 in India,14 through 18 in Malawi), adults 18–25, adults 26–49, and adults 50+. Each of the three age groups for women older than 18 are compared to all men older than 18, whereas girls in the younger two categories are compared to boys of the same age category. Matrilocal societies are shown as solid lines and non-matrilocal societies are shown with a dashed line. As the figure shows, matrilocal societies in India and Malawi have a complete series oscillating around a zero gender gap, but no distinct pattern with age. On the other hand, the complete series of ages from patrilocal society in Malawi shows a clear U-shape, with a negligible gender gap among pre-adolescents, followed by a marked increase in the gender gap up until age 26, and then a gradual elimination of the gender gap after that point. The data for the US and patrilocal societies in India do not contain the complete range of ages, but they demonstrate the same U-shaped pattern with a gender gap appearing after adolescence and gradually disappearing after age 26. The data collected from college students in Niederle and Vesterlund (2007) fit in the U-shaped graph traced out by the other patrilocal and neolocal societies.

Although these results are drawn from small samples without detailed demographic information, they support the general pattern of changes in the gender gap predicted by the theory we advance and test within the Malawi data; the gender gap in competitiveness varies across cultures and with the lifecycle of women in a predictable way consistent with maximizing inclusive fitness. It is important to recognize that the precise ages at which theory predicts important reproductive status markers may vary across settings. The biological argument of inclusive fitness may be less important in driving behavior than the socialization pressures facing women in any particular society. We have been careful to derive a theory that drives either behavior or socialization pressures (socialization is not an ex post explanation), but the precise ages can vary by society. Indeed, although the ages in our data at which women in patrilocal society become less competitive broadly match the results in Andersen et al. (2012) and suggest that puberty plays a role in changing, the literature has not arrived at a unified finding on when competitiveness differences emerge particularly because the studies are

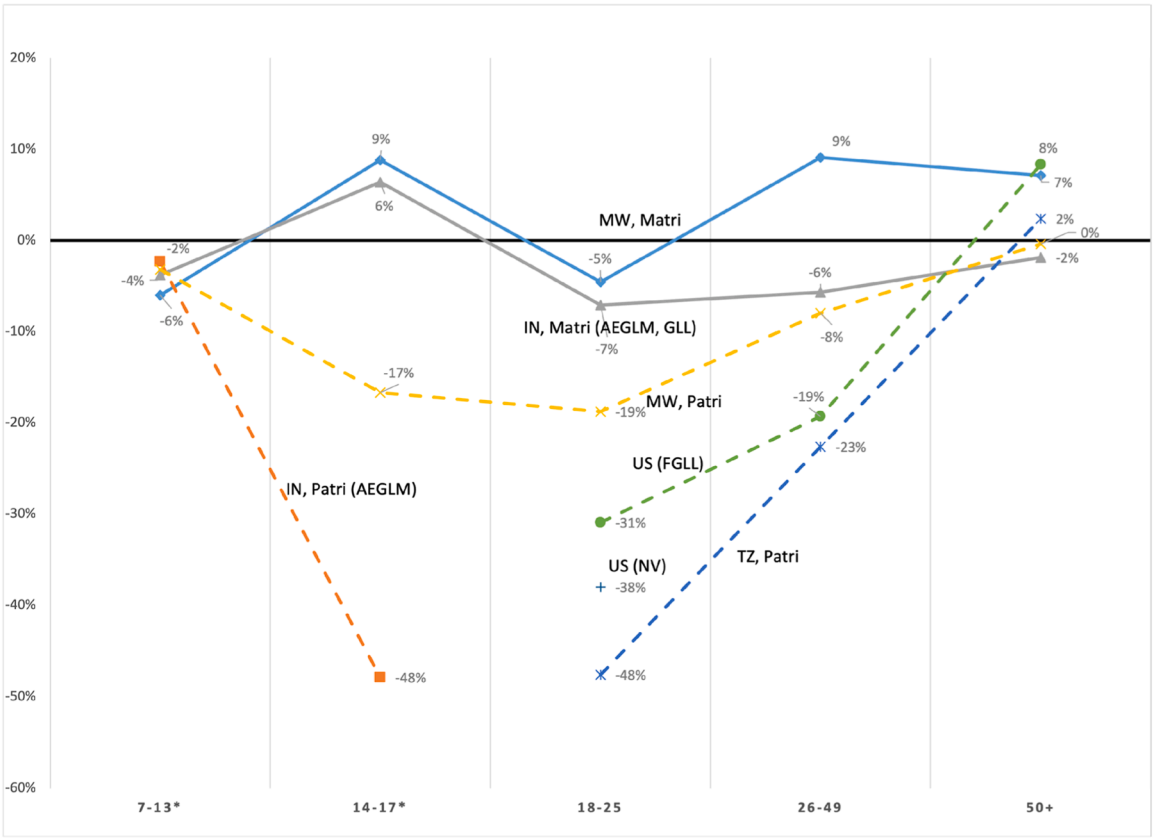

Fig. 2. The gender gap in competitiveness by ages and across multiple types of society.
The graph examines data from communities in India and Tanzania (Andersen et al., 2012; Gneezy et al., 2009), Malawi, a sample from the US (Flory et al., 2018) and college-aged women from the US (Niederle and Vesterlund, 2007). Except for the Niederle and Vesterlund (2007) study, we know the ages of each participant and can divide them into five separate groups: 7–12/13, 13/14–17, 18–25 26–50 and 50+. In India, the ages are 7–12 and 13–15 and in Malawi the ages are 12–13 and 14–17. All participants in NV are assumed to fit in the 18–25 category. Solid lines represent societies that are matrilocal and the dashed lines represent societies that are not matrilocal.

situated in different cultural contexts (see for example, Sutter and Glätzle-Rützler (2015) and Kharchatryan et al. (2015)). This does not challenge the idea that inclusive fitness might impact dynamic considerations of female competitiveness, but it does suggest that the markers (particularly of adulthood) could vary significantly by social context.

4.4. Replications and post-study probabilities

In this section, we follow Maniadis et al. (2014) in examining how our findings should inform beliefs about whether our results actually capture true associations. As they point out, while statistical significance in empirical science is a key part of identifying true associations, it is insufficient on its own – especially for new findings. Research priors and statistical power of the design also play a critical role in how we should adjust our beliefs after a new finding is reported. Here, we follow the procedures outlined in Maniadis et al. (2014) to calculate the post-study probability (PSP) that a given finding is true for two of our main results. Since our study was designed to better understand the finding of Niederle and Vesterlund (2007) that women are less likely to choose competition than men, we first replicate this result; using their protocol in a lab task with a nonstandard subject pool, we find the same result with a very similar magnitude among college-age adults (the sample for the original NV finding) as well as among participants of all ages (at a lower magnitude). Considering the scrutiny to which this finding has been subjected,[18] our replication of this result should not substantially adjust the post-study probability that the original NV finding discovered a true association, as this PSP should already be quite high. Rather, the importance of our replication is chiefly that it confirms we successfully implemented the NV protocol and that we capture the same gender-competitiveness relationship NV originally found among young adults at a US university.

The likelihood that our significant results replicating the finding of Gneezy et al. (2009) are discovering true relationships depends

[18] By 2017, over three dozen studies had replicated the gender gap – not only lab experiments, but also in field experiments, and over 110 studies have implemented the NV design in various settings (Dariel et al. 2017, Markowsky and Beblo 2022).

critically on the priors. We first highlight that when it comes to pre-study probabilities that a new finding may be true, its link to theory is important. A novel finding might be predicted by no theory at all, a new alternate theory, or a prevailing theory – with correspondingly increasing priors. Gneezy et al. (2009) found that there exist societies in which women are no less competitive than men and we consider three conservative initial priors for the original finding: 0.01 (no theory), 0.05, and 0.10 (alternate theory).[19] We then use the power of each study to calculate the evolution of priors on this finding from GLL to AEGLM (which also show that such a society exists) to our study. The results are shown in Table 8. The three priors move from {0.01, 0.05, 0.10} to {0.07, 0.30, 0.47}, {0.27, 0.66, 0.80}, and finally {0.86, 0.97, 0.98} across the three studies. Thus, even under the least generous interpretation of the prior for GLL, our study suggests it is highly likely that there exist societies in which there is no gender gap in competitiveness. Given that the initial GLL finding was in fact predicted by the alternative theory that socialization could reverse the gender gap, we interpret the findings in Table 8 as suggesting that our replication made a significant contribution to its PSP, bringing it to between 0.97 and 0.98.

Our novel result is that motherhood status is linked with competitiveness in patrilocal society, but not in matrilocal society – specifically, that women of typical fertile age without offspring beyond early childhood are less competitive than other women and than men, but only in patrilocal society. This finding is predicted by a direct extension of (or deduction from) a prominent theory embedded in this literature – that gender differences in competitiveness have their origins in human evolution. Accounting for the consensus that it is actually inclusive fitness—and not simply individual genetic fitness—that drives the process of evolution and natural selection reveals that the evolution theory predicts fertility, offspring survival past the vulnerable years, and proximity of mothers to close genetic relatives all matter. Since this prediction results from an extension or updating of existing theory, our preferred interpretation is that the initial prior lies between that for an alternate theory and that for prevailing theory, a prior as high as 20 percent. In Panel B of Table 8, we examine the evolution of beliefs with alternate assumptions of bias (u) and the number of other studies (k). With a prior of 0.20, a reasonable post-study probability that the link between motherhood status and competition truly exists, lies between 0.59 (bias factor of 0.10) and 0.80 (no bias). Note that, if our finding is considered an alternative theory (with a prior of 0.10) our surprising finding has a PSP>0.5 only under the assumption that there is no bias. This novel finding, therefore, merits further testing via replication, particularly in industrialized settings where there is active research on closing the gender gap in labor markets, and where the implications for this relationship could be quite large.

5. Conclusion

We show that the gender gap in competition entry frequently found in the literature is not a constant phenomenon, and that much of the variation it exhibits by age and culture can be explained by a more comprehensive version of the evolution-based theory of its origins. Several key previous findings in the literature are all exhibited in our single dataset that includes a broad range of ages in males and females and variation in child-rearing environments.

We first demonstrate that the initial finding of Niederle and Vesterlund (2007) of a 16-percentage point gender gap among college students is generalizable to our context and setting, which uncovers a nearly identical 14 percentage point gender gap for our sample of similarly aged men and women in rural Malawi. We then show that the Gneezy et al. (2009) finding that the gap in Niederle and Vesterlund (2007) can be found in patrilocal but not matrilocal societies, is also exhibited in our data. We also replicate the finding of Andersen et al. (2012) that the gap in patrilocal societies begins to emerge at adolescence. Our novel finding shows that this gap dramatically shrinks and begins to close as offspring age past the vulnerable early childhood years and women become more competitive, a new finding that ties the results more closely to a theory based on evolution. This theory is further supported by Flory et al. (2018), which utilizes a subset of these data, to demonstrate that the gap in patrilocal societies closes with menopause, which we also demonstrate here.

Using this same dataset we show that *only* women who are (i) of child-bearing age, (ii) without a child that has survived past the early vulnerable years, and (iii) in patrilocal systems are different from men. At all other age and motherhood statuses (whether in matri- or patri- local environments), women have the same expression of competitiveness as men. We argue that this is consistent with a more complete evolution-based theory of the origins on the gender gap, one which predicts this pattern in patrilocal (and potentially also neolocal), but not matrilocal, child-rearing systems.

These findings complement many of the policy recommendations that are being offered in response to the gender gap. Encouraging the participation of high-performance women by changing the role of competition in participation is likely to improve both social welfare (by better matching performance and task) as well as benefit women who would otherwise participate absent competition. For example, recent recommendations from the gender and competition literature suggest that firms can offer women alternative means to compete - for example in groups (Healy and Pate, 2011), alternative incentives - for example, benefits for their children (Cassar et al., 2016), alternative feedback - for example limiting negative feedback (Shastry et al., 2020) and encouraging positive feedback on performance (Buser et al., 2018), and alternative tasks - for example, randomly assigning low promotable tasks that are often taken on by women (Babcock et al., 2017). These policies are likely to have their highest impact when women are at the lowest point in their expression of competitiveness. Our results suggest this is in early adulthood, a crucial period for choosing professional tracks, early career positions, and other choices with lifetime ramifications. Designing and implementing policies that address dampened competitiveness is critical for closing the gender gap for women when it is most pronounced and will also have long-term repercussions for a woman's career trajectory since salary, promotion, and career progress are path dependent. Further, our findings suggest that

[19] We suggest, as a conservative approach, that the original GLL finding was not predicted by prevailing theory, since there was an emerging consensus at the time that the gender difference was universal.

Table 8
Replications and post-study probabilities of the gender gap.

Panel A:

	GLL		AEGLM		Malawi	
π	power	psp	power	psp	power	psp
0.01	0.40	0.07	0.23	0.27	0.80	0.86
0.05	0.40	0.30	0.23	0.66	0.80	0.97
0.10	0.40	0.47	0.23	0.80	0.80	0.98

Panel B:

		no bias, k=		$k = 1$ with bias as follows			
π	power	1	5	10	0.00	0.10	0.25
0.05	0.8	0.46	0.19	0.12	0.46	0.23	0.13
0.10	0.8	0.64	0.33	0.22	0.64	0.39	0.25
0.20	0.8	0.80	0.52	0.38	0.80	0.59	0.43

This table reports the post-study probabilities as defined in Maniadis et al. (2014). The power calculations for GLL, AEGLM, and this paper (Malawi) assume that the gender gap is 15 percentage points, the standard deviation is 0.45, alpha=0.05 with a one-sided test. The sample in GLL had 52 women and 28 men, which led to a relatively low power of 0.4. In AEGLM the sample consisted of 14 and 17 post-adolescent (13–15) boys and girls leading to a power of 0.23. In our sample of women in matrilocal society we have a sample size beyond what is necessary for a power of 0.8. We assume a competition level of 1 and no bias. Note that the PSP becomes the prior for the next study. For example, if we assume a prior of $\pi = 0.01$ and that women in patrilocal society are 15 percentage points less competitive than women in matrilocal society in GLL with a power of 0.40 then the PSP becomes 0.07 which is the prior for the AEGLM study.
The numbers in this table are drawn directly from Maniadis et al. (2014), Tables 2 and 3.

different policies may be needed for women in different stages of their life and career. For example, for women who are in more competitive stages of their lives, policies that actually offer more opportunities to compete (e.g. for more senior positions) may be best for helping to close the gender gap during these later stages of a woman's career. This should be considered in conjunction with existing findings - for example, that female managers are less likely to select competitive incentives in the workplace (Shurchkov and van Geen 2019).

Overall, we show that the many well-established findings previously found in the literature on the gender gap are present in one dataset and are consistent with a story in which a woman's competitiveness is shaped by culture and can change across her lifetime just as cultural expectations of women change with her social status in society. Policies aimed at reducing the gender gap in competitiveness should be developed with the understanding that decisions are made based on the environmental conditions in which competition takes place (not just the nature of competition itself) and that life transitions can change these same conditions so that women of different ages make different decisions in the same context.

Credit author statement

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Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

Appendix

Stricter definitions of matrilocal and patrilocal customs

The community-based sampling resulted in participants primarily drawn from one of eight ethnic groups: the Chewa, Yao, Sena, Nyanja, Ngoni, Tumbuka, Lomwe, and Mang'anja. The Chewa, Yao, Sena and Nyanja are identified in an ethnographic database as having originally followed matrilocal customs and the Ngoni and Tumbuka are identified as traditionally following patrilocal marriage (Giuliano and Nunn, 2018). The Lomwe and Mang'anja are not listed in the database but sources suggest the Lomwe are closely related to the Yao, and the Mang'anja are closely related to the Nyanja, which implies both groups historically practiced matrilocal marriage customs (Kayira and Banda, 2013). However, consistent with the history of Malawi, marriage patterns have changed, and our sample

includes both matrilocal *and* patrilocal communities of Chewa, Mang'anja, Lomwe and Ngoni as well as patrilocal communities of Sena. The Yao continue to practice matrilocal marriage and the Tumbuka continue to practice patrilocal marriage. In our sample, the Nyanja are only associated with matrilocal marriage customs.

Although we chose each village in the sample based on interviews with key informants, after we collected the data, it was clear that not all patrilocal villages practiced patrilocal marriage exclusively, and not all matrilocal villages practiced matrilocal marriage exclusively. We can test marriage patterns using the response to the question "were you raised here?" for married individuals. The individual reports broadly match the definitions of key informants: 78 % of married women but only 51 % of married men in matrilocal communities were born in their communities, whereas 48 % of married women and 84 % of married men in patrilocal communities were born in their communities. [The village and ethnic group marriage customs are reported in Appendix Table 2 and Appendix Table 3, respectively.] Restricting our sample to villages where the marriage pattern matches the statement of the key informant generates a sample of 297 women spanning eight villages and eleven sessions.

Appendix Fig. 1 shows the proportions of each group choosing to compete under this more restrictive definition of marriage customs. Our primary hypothesis—that pre- and early mothers isolated from genetic kin are the only group that is different—is evident in this figure and in the *t*-tests below. This key category is different from every other group in the data, and no other group is different from any other group. Furthermore, the largest difference among women in matrilocal communities is 9 percentage points, compared to 23 percentage points in patrilocal communities. In contrast to Fig. 1, the p-values show that pre- and early mothers isolated from genetic kin are significantly different from women in every other category within patrilocal and matrilocal society as well as men in each type of society.

In Appendix Table 8, we use this new definition to reexamine the results in Table 6. The results are broadly similar and, in most cases, more precisely estimated. In particular, the coefficients for the key markers within patrilocal communities are significant in each case, and not significant in matrilocal communities. The results for women 50 and older are less precisely estimated in matrilocal communities.

Age and cohort effects

Appendix Table 4 estimates the effect of getting married, having a child and having a child over the ages of 1 through 8 and shows that the results we find are similar for ages 5, 6 and 7. Appendix Table 5 includes three different specifications for the age of the participant to check if the results for women with children surviving the vulnerable period are driven only by the fact that these women are older than other women. That table shows the main results are robust to controlling flexibly for women's age.

Appendix Table 6 examines the model in Columns 1 and 4 of Table 6 as well as Columns 1 and 4 of Appendix Table 8 but for men. Our theory suggests there is no reason to expect men to change their expression of competitiveness over their lifetime, and therefore we should see no patterns in either society. However, to check that the patterns we see in women are not caused by cohort effects (people over 50 experienced different historical events, for example), we examine the patterns in men to ensure that they are not the same as for women. Although a few markers are significant, the patterns are distinct from those seen among women, suggesting the patterns we see in women are not driven by some external phenomenon that would affect everyone in a community in the same cohort.[20]

In Appendix Table 7, we examine the patterns in Table 6 without clustering and a linear probability model with wild bootstrapped standard errors clustered at the village-visit level (Cameron et al., 2008). We see the same patterns in the significance of the coefficients.

Appendix Table 1
NV Coefficients for Tables 6 and Appendix Table 8.

Table: Column	6: 4	6: 5	6: 6	A8: 4	A8: 5	A8: 6
Matrilocal effect	0.648	0.652	0.623	0.699	0.713	0.698
	(0.009)	(0.009)	(0.012)	(0.024)	(0.019)	(0.017)
Matri and adolescent	0.005	−0.040	−0.045	0.007	−0.067	−0.045
	(0.960)	(0.733)	(0.664)	(0.952)	(0.583)	(0.683)
Matri and 50 or older	−0.182	−0.221	−0.226	−0.102	−0.172	−0.155
	(0.321)	(0.253)	(0.212)	(0.716)	(0.571)	(0.587)
Patri and adolescent	0.229	0.170	0.150	0.286	0.248	0.249
	(0.001)	(0.019)	(0.074)	(0.000)	(0.000)	(0.000)
Patri and 50 or older	0.277	0.224	0.197	0.335	0.299	0.298
	(0.005)	(0.018)	(0.064)	(0.022)	(0.036)	(0.019)
Matri 15 to 49 with child over 7	−0.148	−0.062	−0.087	−0.046	0.108	0.025
	(0.277)	(0.662)	(0.557)	(0.680)	(0.255)	(0.852)
Patri 15 to 49 with child over 7	0.242	0.371	0.291	0.230	0.294	0.266

(*continued on next page*)

[20] There does appear to be an almost opposite pattern to that seen in women which may suggest that as women become more competitive, men become less competitive. This is similar to a result found in Uganda, in which some of the brothers of girls who received an empowerment treatment actually became less competitive (Buehren et al., 2022).

Appendix Table 1 (*continued*)

Table: Column	6: 4	6: 5	6: 6	A8: 4	A8: 5	A8: 6
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Matri 15 to 49 with child		−0.134			−0.218	
		(0.090)			(0.009)	
Patri 15 to 49 with child		−0.192			−0.113	
		(0.130)			(0.376)	
Matri 15 to 49 and ever married			−0.123			−0.136
			(0.084)			(0.208)
Patri 15 to 49 and ever married			−0.138			−0.085
			(0.002)			(0.133)
Matri and tournament performance	−0.026	−0.027	−0.028	−0.040	−0.042	−0.042
	(0.155)	(0.161)	(0.148)	(0.049)	(0.052)	(0.053)
Matri and improvement	0.012	0.015	0.015	0.031	0.037	0.034
	(0.689)	(0.645)	(0.643)	(0.357)	(0.328)	(0.348)
Matri and submit piece rate to tournament	0.458	0.465	0.458	0.469	0.481	0.470
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Matri and guessed rank	−0.063	−0.064	−0.060	−0.071	−0.069	−0.065
	(0.003)	(0.005)	(0.006)	(0.004)	(0.009)	(0.013)
Patri and tournament performance	0.007	0.007	0.006	0.003	0.003	0.002
	(0.481)	(0.451)	(0.583)	(0.848)	(0.868)	(0.900)
Patri and improvement	0.014	0.016	0.015	0.024	0.024	0.025
	(0.414)	(0.365)	(0.363)	(0.407)	(0.420)	(0.377)
Patri and submit piece rate to tournament	0.338	0.344	0.342	0.373	0.377	0.374
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Patri and guessed rank	0.066	0.071	0.065	0.046	0.047	0.046
	(0.071)	(0.055)	(0.069)	(0.381)	(0.368)	(0.380)
Observations	443	443	443	310	310	310
Clusters	16	16	16	11	11	11

Appendix Table 2
Village Classification and Marriage Customs.

	Key Inform.	Obs.		Proportion living in natal village			classification	
village		Male	Female	Male	Female	p-value	1	2
1	M	21	21	0.81	0.90	0.663	M	–
2	M	7	11	0.14	0.82	0.013	M	M
3	M	16	16	0.50	0.94	0.015	M	M
4	M	12	28	0.33	0.71	0.037	M	M
5	M	21	25	0.24	0.76	0.001	M	M
6	M	18	24	0.72	0.67	0.748	M	–
7	P	19	16	0.89	0.31	0.001	P	P
8	P	18	16	0.78	0.56	0.274	P	–
9	P	8	16	0.75	0.31	0.082	P	P
10	P	18	18	1.00	0.22	0.000	P	P
11	P	29	19	0.69	0.63	0.759	P	–
12	P	24	25	0.96	0.68	0.023	P	P
Observations							446	280
Clusters							16	11

The table reports the proportion of men and women who are married and who still live in their natal village compared and two types of classifications. The first classification takes, at face value, the declarations of key informants in the village about the customs of matrilocal and patrilocal marriage. The second definition examines, for matrilocal classification, whether it is more likely that a married woman is living in her natal village than a man and, for patrilocal classification, whether it is more likely that a married man is living in his natal village than a woman. The number of observations is the total number of married men and women interviewed in the detailed demographic survey, not the number of individuals who completed the competition experiment.

Appendix Table 3
Ethnic Groups and Marriage Customs.

	Matri villages				Patri Villages			
	women		men		women		men	
Chewa	11	73 %	4	50 %	7	29 %	2	100 %
Lomwe	21	81 %	24	38 %	3	33 %	8	75 %
Manganja	11	64 %	4	0 %	25	56 %	24	79 %
Ngoni	7	86 %	7	86 %	7	14 %	6	83 %
Nyanja	19	74 %	13	54 %	1	0 %		
Sena					41	61 %	47	87 %

(*continued on next page*)

Appendix Table 3 (*continued*)

	Matri villages				Patri Villages			
	women		men		women		men	
Tumbuka			1	100 %	16	38 %	17	88 %
Yao	51	82 %	39	56 %	1	0 %	1	100 %
missing/other	5	80 %	3	33 %	8	38 %	11	82 %
Total	125	78 %	95	51 %	109	48 %	116	84 %

The reports the number of men and women who report belonging to one of 8 ethnic groups within the collection of villages reported as being matrilocal and patrilocal. Missing includes multiple classifications, other smaller ethnic groups and no response. In addition, the table reports the proportion of married individuals who report residing in their natal village. For example, 11 women in matri villages and 7 women in patri villages are ethnically Chewa; 73 % of the women who live in matrilocal villages were born in that village but only 29 % of women who live in patrilocal villages were born in that village.

Appendix Table 4
Alternative Specifications for Children Surviving the Vulnerable Period.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Matrilocal effect	0.499	0.571	0.566	0.589	0.594	0.598	0.615	0.620	0.648	0.565
	(0.070)	(0.033)	(0.032)	(0.029)	(0.027)	(0.025)	(0.016)	(0.014)	(0.009)	(0.034)
Age and status categories										
Matri and adolescent	−0.037	−0.051	−0.031	−0.027	−0.021	−0.008	−0.019	−0.008	0.005	0.015
	(0.715)	(0.653)	(0.779)	(0.813)	(0.855)	(0.946)	(0.866)	(0.943)	(0.960)	(0.893)
Matri and 50 or older	−0.212	−0.230	−0.209	−0.207	−0.203	−0.190	−0.205	−0.196	−0.182	−0.171
	(0.252)	(0.234)	(0.255)	(0.265)	(0.227)	(0.289)	(0.254)	(0.284)	(0.321)	(0.358)
Patri and adolescent	0.123	0.173	0.180	0.197	0.202	0.215	0.210	0.214	0.229	0.184
	(0.156)	(0.010)	(0.008)	(0.004)	(0.003)	(0.004)	(0.006)	(0.003)	(0.001)	(0.006)
Patri and 50 or older	0.128	0.187	0.198	0.221	0.228	0.244	0.243	0.250	0.277	0.216
	(0.268)	(0.051)	(0.036)	(0.034)	(0.034)	(0.020)	(0.019)	(0.013)	(0.005)	(0.038)
Matri 15 to 49 and ever married	−0.163									
	(0.018)									
Patri 15 to 49 and ever married	−0.007									
	(0.902)									
Age Cutoff		0	1	2	3	4	5	6	7	8
Matri 15 to 49 with child over [#]		−0.195	−0.170	−0.164	−0.160	−0.147	−0.188	−0.173	−0.148	0.003
		(0.028)	(0.113)	(0.130)	(0.192)	(0.264)	(0.114)	(0.181)	(0.277)	(0.736)
Patri 15 to 49 with child over [#]		0.076	0.092	0.128	0.143	0.172	0.172	0.195	0.242	0.010
		(0.386)	(0.317)	(0.103)	(0.082)	(0.058)	(0.011)	(0.001)	(0.000)	(0.614)
Observations	443	443	443	443	443	443	443	443	443	443
Clusters	16	16	16	16	16	16	16	16	16	16
P-value of the test for equality of the coefficients across matri and patri										
Adolescent	0.233	0.091	0.108	0.095	0.094	0.101	0.088	0.087	0.088	0.185
50 and older	0.123	0.059	0.055	0.049	0.034	0.040	0.035	0.037	0.031	0.075
marriage, child and child age	0.071	0.028	0.063	0.030	0.042	0.048	0.009	0.011	0.008	0.031

The dependent variable is the choice to compete in Round 3. The regressions show the model from Column 4 of Table 6, with NV coefficients included as controls. The main results from Table 3 (women who have a child over the age of 7) is shown in Column 9 and replaced with ever married and child ages from 0 to 8 in the other columns.

Appendix Table 5
Alternative Specifications with Age.

	(1)	(2)	(3)	(4)	(5)	(6)
Matrilocal effect	0.135	0.600	0.295	0.653	0.885	0.761
	(0.334)	(0.040)	(0.099)	(0.065)	(0.022)	(0.030)
Age and status categories						
Matri and adolescent	0.018	−0.045	−0.098	−0.073	−0.127	−0.199
	(0.816)	(0.603)	(0.500)	(0.544)	(0.351)	(0.307)
Matri and 50 or older	0.185	0.226	−0.160	0.207	0.242	−0.342
	(0.433)	(0.381)	(0.406)	(0.384)	(0.312)	(0.183)
Patri and adolescent	0.162	0.250	0.193	0.167	0.258	0.192
	(0.068)	(0.029)	(0.175)	(0.035)	(0.007)	(0.142)
Patri and 50 or older	0.403	0.397	0.171	0.505	0.502	0.238
	(0.027)	(0.006)	(0.190)	(0.022)	(0.007)	(0.088)
Matri 15 to 49 with child over 7	0.002	0.079	0.046	−0.014	0.058	0.006
	(0.985)	(0.685)	(0.817)	(0.927)	(0.788)	(0.978)
Patri 15 to 49 with child over 7	0.298	0.215	0.242	0.317	0.230	0.260
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Matri Age	−0.005	−0.018		−0.010	−0.022	

(*continued on next page*)

Appendix Table 5 (*continued*)

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.273)	(0.286)		(0.107)	(0.211)	
Patri Age	−0.006	0.015		−0.008	0.014	
	(0.166)	(0.166)		(0.143)	(0.210)	
Matri Age^2		0.000			0.000	
		(0.410)			(0.475)	
Patri Age^2		−0.000			−0.000	
		(0.020)			(0.011)	
Matri Age 15 to 49			−0.008			−0.011
			(0.320)			(0.179)
Patri Age 15 to 49			−0.001			−0.002
			(0.863)			(0.746)
Included NV controls	no	no	no	yes	yes	yes
Observations	444	444	444	443	443	443
Clusters	16	16	16	16	16	16
P-value of the test for equality of coefficients across matri and patri						
Adolescent	0.224	0.040	0.154	0.098	0.022	0.100
50 and older	0.415	0.510	0.159	0.278	0.296	0.057
Has children over 7	0.025	0.497	0.342	0.044	0.437	0.245

The dependent variable is the choice to enter and perform under competition in round 3. The coefficients are marginal effects from a probit regression with p-values from errors clustered at the village-visit level reported in parentheses. The sample includes all female participants with available demographic information.

Appendix Table 6
Male Competitiveness across Similar Life Stages.

	(1)	(2)	(3)	(4)
Matrilocal effect	−0.124	−0.115	−0.131	−0.138
	(0.184)	(0.758)	(0.288)	(0.633)
Age and status categories				
Matri and adolescent	0.079	0.223	0.098	0.167
	(0.290)	(0.123)	(0.304)	(0.273)
Matri and 50 or older	0.052	0.114	0.090	−0.060
	(0.547)	(0.346)	(0.380)	(0.685)
Patri and adolescent	−0.073	−0.067	−0.061	−0.035
	(0.283)	(0.595)	(0.499)	(0.728)
Patri and 50 or older	−0.117	−0.189	−0.150	−0.322
	(0.082)	(0.254)	(0.022)	(0.000)
Matri 15 to 49 with child over 7	−0.035	−0.018	−0.100	−0.155
	(0.521)	(0.818)	(0.239)	(0.002)
Patri 15 to 49 with child over 7	−0.088	−0.106	−0.234	−0.326
	(0.557)	(0.543)	(0.046)	(0.000)
Included NV controls	no	yes	no	yes
Observations	420	420	296	296
Clusters	16	16	11	11
P-value of the test for equality of coefficients across matri and patri				
Adolescent	0.133	0.128	0.226	0.268
50 and older	0.121	0.140	0.046	0.056
Has children over 7	0.739	0.643	0.324	0.067

The dependent variable is the choice to compete in round 3. The coefficients are marginal effects from a probit regression. The sample includes all male participants from matrilocal and patrilocal society. P-values are in parentheses. For columns 1 and 2, matrilocal and patrilocal communities are defined following the declaration of key informants in each community. For columns 3 and 4, the sample includes all female participants with available demographic information in villages for which key informant declaration of matrilocal and patrilocal customs matches the proportion of married women who reside in their natal community.

Appendix Table 7
Alternative Cluster Specifications.

	(1)	(2)	(3)	(4)
Matrilocal effect	0.165	0.159	0.648	0.619
	(0.036)	(0.046)	(0.004)	(0.030)
Age and Status Categories				
Matri and adolescent	0.053	0.054	0.005	0.005
	(0.543)	(0.631)	(0.954)	(0.999)
Matri and 50 or older	−0.015	−0.015	−0.182	−0.153
	(0.878)	(0.941)	(0.135)	(0.461)
Patri and adolescent	0.209	0.203	0.229	0.196

(*continued on next page*)

Appendix Table 7 (*continued*)

	(1)	(2)	(3)	(4)
	(0.040)	(0.047)	(0.032)	(0.055)
Patri and 50 or older	0.188	0.180	0.277	0.240
	(0.051)	(0.065)	(0.017)	(0.019)
Matri ages 15 to 49 with child over 7	−0.067	−0.068	−0.148	−0.123
	(0.425)	(0.633)	(0.116)	(0.393)
Patri ages 15 to 49 with child over 7	0.233	0.227	0.242	0.208
	(0.008)	(0.013)	(0.012)	(0.031)
NV Controls				
Matri and tournament performance			−0.026	−0.021
			(0.120)	(0.247)
Matri and improvement			0.012	0.010
			(0.692)	(0.805)
Matri and submit piece rate to tournament			0.458	0.446
			(0.000)	(0.003)
Matri and guessed rank			−0.063	−0.051
			(0.076)	(0.073)
Patri and tournament performance			0.007	0.006
			(0.648)	(0.481)
Patri and improvement			0.014	0.012
			(0.635)	(0.427)
Patri and submit piece rate to tournament			0.338	0.319
			(0.000)	(0.003)
Patri and guessed rank			0.066	0.057
			(0.071)	(0.169)
Constant		0.297		−0.045
		(0.030)		(0.002)
Observations	444	444	443	443
Clusters	0	16	0	16

Columns 1 through 4 show the same model and specification as Columns 1 and 4 of Table 6. Columns 1 and 3 show regression results without clustering and columns 2 and 4 show regression results using Wild Bootstrapped Clustering.

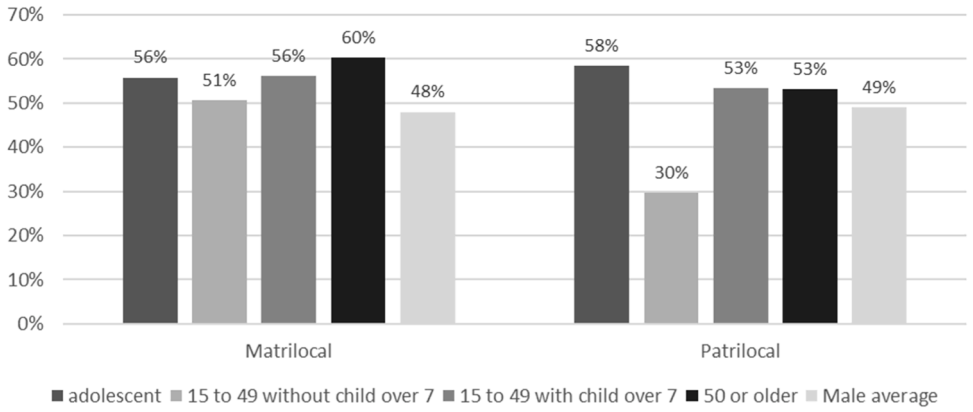
Appendix Table. 8

Choice to Compete with Stricter Definition of Society.

	(1)	(2)	(3)	(4)	(5)	(6)
Matrilocal effect	0.209	0.222	0.219	0.699	0.713	0.698
	(0.006)	(0.011)	(0.000)	(0.024)	(0.019)	(0.017)
Age and status categories						
Matri and adolescent	0.052	0.020	0.010	0.007	−0.067	−0.045
	(0.561)	(0.826)	(0.891)	(0.952)	(0.583)	(0.683)
Matri and 50 or older	0.097	0.065	0.055	−0.102	−0.172	−0.155
	(0.661)	(0.779)	(0.797)	(0.716)	(0.571)	(0.587)
Patri and adolescent	0.287	0.272	0.260	0.286	0.248	0.249
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Patri and 50 or older	0.234	0.217	0.204	0.335	0.299	0.298
	(0.045)	(0.047)	(0.036)	(0.022)	(0.036)	(0.019)
Matri 15 to 49 with child over 7	0.056	0.134	0.122	−0.046	0.108	0.025
	(0.465)	(0.096)	(0.169)	(0.680)	(0.255)	(0.852)
Patri 15 to 49 with child over 7	0.237	0.266	0.267	0.230	0.294	0.266
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Matri 15 to 49 with child		−0.109			−0.218	
		(0.174)			(0.009)	
Patri 15 to 49 with child		−0.050			−0.113	
		(0.744)			(0.376)	
Matri 15 to 49 and ever married			−0.120			−0.136
			(0.151)			(0.208)
Patri 15 to 49 and ever married			−0.068			−0.085
			(0.375)			(0.133)
Included NV Controls	no	no	no	yes	yes	yes
Omitted category average*	0.261	0.345	0.292			
Observations	310	310	310	310	310	310
Clusters	11	11	11	11	11	11
Test for equality of coefficients across matri and patri						
adolescent	0.012	0.014	0.002	0.033	0.017	0.011
50 and older	0.574	0.547	0.523	0.158	0.162	0.147
Has children over 7	0.042	0.224	0.157	0.022	0.060	0.084

The dependent variable is the choice to enter and perform under competition in round 3. The coefficients are marginal effects from a probit regression with p-values from errors clustered at the village-visit level reported in parentheses. Columns 4, 5 and 6 include the standard NV controls, with coefficients shown in the Appendix. The sample includes all female participants with available demographic information in villages for which key

informant declaration of matrilocal and patrilocal customs matches the proportion of married women who reside in their natal community.
*The omitted category is women between 15 and 49 in patrilocal society without children over 7.



Appendix Fig. 1. The Proportion of Women Choosing to Compete in the Stricter Sample.

P-Values of Pairwise Comparisons within Communities

	15 to 49 w/o child over 7	adolescent	15 to 49 with child over 7	50 and older	men
	Matrilocal				
15 to 49 w/o child over 7		0.579	0.591	0.466	0.957
adolescent			0.971	0.746	0.667
15 to 49 with child over 7				0.781	0.675
50 and older					0.519
men					
	Patrilocal				
15 to 49 w/o child over 7		0.021	0.034	0.045	0.005
adolescent			0.668	0.666	0.633
15 to 49 with child over 7				0.983	0.960
50 and older					0.942
men					
	Patrilocal (columns) to Matrilocal (rows)				
15 to 49 w/o child over 7	0.031	0.479	0.783	0.814	0.682
adolescent	0.012	0.787	0.830	0.821	0.814
15 to 49 with child over 7	0.019	0.822	0.817	0.809	0.804
50 and older	0.026	0.951	0.638	0.637	0.605
men	0.009	0.537	0.903	0.931	0.771

The figure shows the proportion of women across four lifecycle categories and the average man within two types of communities. The sample includes all participants with available demographic information in villages for which key informant declaration of matrilocal and patrilocal customs matches the proportion of married women who reside in their natal community. The table shows the P-values for each pairwise comparison within and across communities.

Experimental protocol and Instructions

The real effort task that we use was specifically designed to involve a simple cognitive exercise with very low education requirements to participate–arranging shapes in a row from smallest to largest. Each participant has a set of 6 blocks, shown in the figure below. Each side of a given block has one of 6 shapes. The task is to arrange all six blocks such that a given shape (e.g., star) appears facing up, and to align the 6 versions of that shape (e.g., all 6 stars) in order from smallest to largest (i.e., the bottom row shown in the figure). Upon completing one shape, the participant moves to the next shape. All participants work with identical blocks and face the same order of shapes to complete.

Fig. 3. The real effort task, incomplete (top) and complete (bottom).

All sessions were conducted in a room large enough to hold all participants, similar in size to standard experimental labs in the US. Since many adults are illiterate in rural Malawi, a script reader read the instructions aloud; the script-reader was the only person who spoke to the participants in the session. Facilitators demonstrated how to perform the task, kept track of participants' number of successes in each round, and recorded participants' choices. Each session lasted about an hour, and included on average, 16 participants equally balanced between men and women. Multiple sessions were completed in each village, with participants who had completed the experiment isolated from participants who had not yet begun the experiment. As in NV, participants are told that they will be paid for one of the four rounds, selected at random.

Instructions

These instructions were translated into Chichewa for use in Malawi, where X was 50 kwacha and used in English in the US. Amounts for the US: $X = \$1$, $Y = \$0.50$. Amounts for Malawi: $X = 50$ kwacha (approximately \$.33), $Y = 20$ kwacha (approximately \$.13). The show-up fee was divided into two payments of \$5 and two payments of 80 kwacha (approximately \$0.52)

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 5 min. 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 {amount} at the beginning and at the end you will receive {amount} for having completed the four rounds. In addition, you can earn more money based on your performance in one of the four rounds.

To participate in this study, you must be at least 18 years old and you must agree to participate in the study, or you must have the permission of your parent or guardian.

We will now give you some information about the study today. In each round, we will ask you to do something that can earn you money. When you are done here, you go to the cashier, he 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 [*speaker places cards in bag*]. You will be allowed to pick one just as this man is going to show you right now. He cannot see which card he will pick, but 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 {*amount*} and everyone who finishes will earn {*amount*} again.

This is the payment desk [*speaker points*]. 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.

Explanation and practice round

Welcome to this study. Now your helper will give you the {*amount*} that we promised to give to you at the beginning of the study. Today we will ask you to perform tasks and make decisions. 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.

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.

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. 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.

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 head. If you are incorrect, he will shake his head, and you must continue until the squares are arranged from smallest to largest.

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 3 min. 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 nods his 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 head this means you have not correctly completed the task and you need to keep trying. You have 3 min 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 1 is the task that you draw from the bag at the end, then you get {*X*} for each shape you successfully complete. For example, if you complete one set of shapes you receive {*X*}; if you complete two sets of shapes you receive {2*X*}; if you complete three sets of shapes you receive {3*X*}; if you complete four sets of shapes you receive {4*X*}, 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.

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?

Are the facilitators ready? *[When ready:]* Okay, go. *[When time is up:]* 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 other participants. Your group members may be in this room right now, but they may not be. 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 <u>not</u> 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.

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. If you complete the most shapes in 3 min out of anyone in your group, you receive {*4X*} for each set you complete. But if someone else in your group completes the most shapes, you receive nothing.

One times {*4X*} is {*4X*}. Two times {*4X*} is {*8X*}. Three times {*4X*} is {*12X*}. Four times {*4X*} is {*16X*}. 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. 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?

Are the facilitators ready? *[When ready:]* Okay, go. *[When time is up:]* 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 3 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 {*X*} 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 <u>for round 2</u>, 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 2, then you will receive four times the payment from the individual performance, which is {*4X*} 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 2.

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.

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? *[When ready:]* Okay, go. *[When time is up:]* 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 {*X*} 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 1, then you receive four times the earnings of the individual performance choice, which is {*4X*} per success. If you choose compared performance and you did not complete the task more times than others did in round 1 you will receive no earnings for this round. Do you have any questions? If you have any questions, please ask me now.

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. 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.

Belief-Assessment Questions

We will now ask you how you think you performed in the tasks, compared to the 3 other people in the group we assigned you to, for the first two rounds. You will earn *{Y}* for each correct guess. Please look at the picture of the four people. The highest person completed the most sets of shapes in your group; he is first in the group. The next person completed the second-most sets of shapes in your group; he is second. The next person completed the third-most sets of shapes; he is third. The final person completed the least sets of shapes in your group; he is fourth.

We will first ask you how you think you performed in Round 1, the *individual performance*. If you are correct, you will be paid an additional *{Y}* when we pay you your earnings. Before we ask you, do you have any questions? If you have any questions, please ask me now.

Please do not talk as you are making your decision. Now please, silently, show your helper how you think you performed in Round 1, the *individual performance,* compared to the other people in your group, by pointing to the position in the picture. Do you think you were the best? Do you think you were the second-best? Do you think you were third best? Or, do you think you were last?

We will now ask you how you think you performed in Round 2, the *compared performance*. If you are correct, you will be paid an additional *{Y}* when we pay you your earnings.

Please do not talk as you are making your decision. Now please silently show your helper how you think you performed in Round 2, the *compared performance,* compared to the other people in your group, by pointing to the position in the picture. Do you think you were the best? Do you think you were the second-best? Do you think you were third best? Or, do you think you were last?

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

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