Gender, Age, and Competition: the Disappearing Gap

By JEFFREY A. FLORY[a], URI GNEEZY[b], KENNETH L. LEONARD[c], AND JOHN A. LIST[d]

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Abstract:

Research on competitiveness at the individual level has emphasized sex as a physiological determinant, focusing on the gap between young men and young women. This study finds women's preferences over competition change with age such that the gender gap, while large for young adults, disappears in older populations due to the fact that older women are much more competitive. The finding that older women are just as competitive as men is robust across widely differing societies, and suggests a simple gender-based view of competitiveness is misleading; age is just as important as sex. These findings are consistent with the view that gender differences in competitive behavior stem originally from the costs and benefits of competition to reproductive success during human evolution.

Key Words: competitiveness, gender, age, field experiment

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a Robert Day School of Economics & Finance, Claremont McKenna College, 500 E. 9th Street, Claremont, CA 91711 (email: jflory@cmc.edu).

b Rady School of Management, University of California at San Diego, La Jolla, CA 92093 (email:ugneezy@ucsd.edu).

c Department of Agricultural and Resource Economics, University of Maryland, College Park, MD 20742 (email: kleonard@arec.umd.edu).

d Department of Economics, University of Chicago, Chicago, IL 60637 (email: jlist@uchicago.edu).

1. Introduction

The gender gap in willingness to enter competitive environments has captured a great deal of attention from economists. A burgeoning literature documents the male-female gap across a wide range of settings, explores its policy implications, and examines its role in the differential success of men and women in labor markets (Gneezy et al., 2003; Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007; Croson et al., 2009; Booth et al., 2012; Balafoutas et al., 2012; Almås et al., 2012; Niederle et al., 2013; Buser et al., 2014; Flory et al., Forthcoming). The existence of aversion to competition can be very costly – for firms as well as for individuals. For firms, the use of relative performance based incentives and promotions may lead to loss of talent if highly skilled workers self-select out of competitive environments. For individuals, the widespread use of competition-based allocation mechanisms means avoiding competition can entail large costs: whether for a high-paying job, a position of authority, or rights to scarce resources, to opt out of competition often means foregoing large potential gains. A full understanding of the determinants of attitudes toward competition is thus critical for understanding the costs of competition aversion and the design of mechanisms to mitigate undesired effects of differences in competition preferences.

Experiments have consistently found that women are generally less willing than men to compete, even when it is in their material interest to do so.[1] However, there is surprisingly little age diversity in existing evidence on this question when it comes to adults.[2] The findings come

[1] For evidence that highly competent women avoid competition even when they know they are likely to be successful, see for example Niederle and Vesterlund (2013).

[2] Many experimental studies examine the gender gap among children (e.g. Cardenas et al., 2012; Dreber et al., 2011; Dreber et al., 2014; Andersen et al., 2013; Sutter and Rützler, 2010), often identifying the absence of a gap among

largely from younger populations (e.g. university and primary or secondary school students), with little attention given to what happens to competitiveness as adults grow older. One important exception is a recent study by Mayr et al (2012), which finds changes in tournament entry across different ages of US adults from 25 to 74. Our study differs from Mayr et al (2012) in that we include a commonly used method for separating the effects of gender on preferences over competition from the confounding effects of gender on risk-aversion, feedback-aversion, and self-confidence; as well as test whether the pattern we find generalizes across widely differing cultural environments. Another study (Charness and Villeval, 2009) examines the effects of age on competitive preferences among adults ranging from their late teens to their early seventies, concluding that age has little, if any, effect. They find marginal evidence that being older is associated with slightly lower competitiveness (though only among retirees who have left the workforce); discuss important implications for labor markets, workplace discrimination, and personnel policies; and highlight the need for further work in this area. However, they do not examine the interaction of age and gender, or the effect of age on the gender gap.[3]

With the vast majority of work in this area focused on children and young adults, there is much that remains unknown about attitudes toward competition among the roughly two-thirds of the population in the middle and upper age ranges. This dearth of evidence among older

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pre-adolescent children and an 'age of onset' of gender differences in competitiveness. However, almost no studies examine the gender gap among older adults.

[3] Notably, they do mention that they find no evidence of a gender gap among the 129 individuals in their tournament entry analysis. As their sample is about evenly split between those below and above 50, with a roughly equal gender split in each group, this is consistent with our findings on the effects of age on the gender gap.

individuals compared to an abundance of evidence among youth is an important gap in a literature that places so much emphasis on a different physiological trait (sex) as a major determinant of behavior. Our findings suggest this omission is far from trivial: while we replicate the standard result among young populations that women are significantly less competitive than men, we find the gender gap completely disappears among more mature adults. The *age gap* between mature women and young women is just as large as the gender gap between young women and young men. Furthermore, more mature women are just as competitive as all men. For men on the other hand, we find no evidence that age affects preferences over competition. [4]

These findings are consistent with one of the leading explanations of gender differences in competition preferences: that they stem from human evolution.[5] To summarize, the general

[4] The degree of sensitivity to age that we find in competitive choice among adult women, while perhaps surprising at first blush, is consistent with recent evidence advancing a model that explains behavioral differences across sex as the result of differences between men and women not only in the mean, but also the variance, of preference distributions. DellaVigna et al. (2013) show that the patterns of gender differences in altruism and giving behavior observed in the literature can be explained by variation in both the mean and heterogeneity of preferences. In particular, they find the gender difference in both results in a large proportion of women on the margin of pro-social actions, making women especially sensitive to changes that affect the choice over whether to give. Even minor shifts in the preference distribution relative to the threshold for positive utility from pro-social actions can thus translate to large effects on women's choices and on the observed gender gap in pro-social behavior. If similar distributional differences play a role in the gender gap in competitiveness, even minor shifts in competition preferences can lead to large changes in the proportion of women choosing to compete.

[5] They are also consistent with a model that explains gender differences in competition and their variation across culture as the interaction of the drive to propagate genes with institutions for inter-generational wealth transfers (see Flory et al., 2015, for further discussion). For summaries of the evolution viewpoint in the economics literature, see Gneezy and Rustichini (2004) and Niederle and Vesterlund (2007). However, discussion of the origins of sex-based

argument from this viewpoint is that current differences in competitiveness by gender derive from natural selection and the prehistoric benefits and costs of competition for success in reproduction through both mating and parenting among human ancestors.[6] There are two major strands to the theory that men and women evolved to enjoy competition differently. According to one, for prehistoric males, winning competitions against other males in order to mate with many partners increased their number of children, maximizing the chances of passing their genes (and behavioral traits) to future generations. For females, however, there was little reproductive benefit to winning competitions against other females in order to mate with many partners, since their higher inherent investment in the reproductive process made them the scarce mating resource.

The other strand highlights the reproductive *cost* to women of being competitive – in particular, the cost to female human ancestors when they have young offspring (Campbell, 2004; Niederle and Vesterlund, 2007).[7] If a poor competition outcome left a mother significantly less

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differences in behavior from the evolutionary literature is classic, going back to Darwin (1871), Bateman (1948) and Trivers (1972). An extensive literature in evolutionary biology and socio-biology documents differences in competitiveness between males and females in many species (Knight, 2002).

[6] That is, contemporary attitudes toward competition exist because the process of natural selection fostered these behaviors since they maximized the survival of offspring among human ancestors.

[7] In discussing the two strands of evolutionary psychology theory suggesting that men and women have evolved to enjoy competition differently, NV note that one "focuses on one gender being responsible for parental care. While a man's death does not influence his current reproductive success, a woman's death may cause the loss of her current offspring [Campbell, 2002]. Thus, differences in potential losses as well as potential gains from competition may make males more eager to compete." In discussing constraints on competitiveness among women, Campbell (2004) also writes that a major reason for diminished competitiveness in women is based on the reproductive costs of

able to care for her offspring, her young children would face a higher probability of death. On the other hand, the mother's access to material resources also affects her inputs into the quality of offspring (and hence their survival chances). In any competition over access to such resources, the reproductive payoff of winning and using them to invest in offspring quality would be weighed against the reproductive cost of losing. When a mother's children have aged beyond the highly vulnerable stage, the cost of losing on offspring survival prospects would drop. The reproductive benefits of investing in one's children, however, remain.[8] Through the process of natural selection, these costs and benefits to reproductive success would hinder the survival of competitiveness as a trait among women with very young children, but not among those whose children have passed through the highly vulnerable period. One of the key physiological determinants of whether a mother has offspring in the vulnerable period is her *age*. While a woman who has aged beyond her child-bearing years is unlikely to have her own young children, her offspring are likely to have children of their own in the future (or may already have them), creating a reproductive benefit to competing for resources.

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competition in parenting, rather than its benefits in mating: "This proposal argues that the chief difference between the sexes lies in the costs rather than the rewards… In men, inclusive fitness depends crucially upon sexual access, but in women the critical factor is the mother's ability to shepherd her offspring safely through the dangerous selection funnel of the juvenile period…. Central to the survival of the young are the choices and competence of the mother, who delivers the bulk of direct care."

[8] A more mature mother can share resources with her adult children, to be shared with their own offspring, or might share resources directly with her grandchildren, in either case increasing the chances of passing on her genes to future generations.

These two strands of the evolution theory thus suggest humans evolved in such a way that women are less competitive during periods they may have young offspring, and that men are competition-loving during periods they can mate.[9] While the evolution-based interpretation has been part of the literature on gender and competition since its very beginning, it has been used chiefly as an explanation for greater competitiveness observed in men. There has been little attention paid to its other main prediction: preferences over competition among women may depend on age.[10]

If the evolutionary psychology arguments are true, humans did not merely evolve such that men are more competitive than women, but also such that the competitiveness of adult males should not be affected by age while women during childbearing ages should disproportionately

[9] Note that this does not require there were zero reproductive benefits to mothers of young children from winning competitions. What matters is whether, on average, a competitive disposition during this period of life raised or lowered the probability of offspring (and therefore trait) survival. The key behind this view is that the potential reproductive costs of losing in a competitive interaction are argued to be higher for a woman with young offspring, since offspring survival in the first few years depended heavily on the biological mother. For evolutionary models that discuss these questions more formally in the context of risk aversion, see Dekel and Scotchmer (1999), Robson (1996), and Robson and Samuelson (2009).

[10] According to the evolutionary perspective, since female human ancestors in the post-menopausal stage did not have young offspring, being competitive did not risk lowering the chances of offspring survival for this group. It was the potential loss of the biological mother of very young children that threatened offspring survival among human ancestors (Campbell, 2004). There is thus no evolutionary rationale for competition-aversion among women beyond childbearing ages, while the benefits of winning competitions could still be shared with children and grandchildren. On the other hand, since prehistoric men could mate at all ages after puberty, a competitive disposition across *all* ages would improve genetic fitness among human males.

avoid competition. Furthermore, it has been shown that hormones can be an important determinant of competition preference among women (Wozniak et al., 2014; Buser, 2012) and significant hormonal changes occur during the transition to non-child bearing years.[11] Despite these implications of the evolution argument, and despite the links suggested between hormones and competitive disposition among women, there is very little evidence on the impact of age on the gap between adult men and women in preferences over competition.[12]

To test for the effects of age, we use data from laboratory experiments on competition with men and women of all adult ages. One sample draws from an urban US population. The other draws from villages in rural communities of Malawi, a low-income country in sub-Saharan Africa. We use societies with very different economic and cultural histories to help address potential challenges in distinguishing between the impact of age itself and social, cultural, or other environmental factors that might have common effects on a specific age cohort in the same society. In addition to the consistency of our results both with prevailing theory on the origins of sex-based competition differences and with recent evidence on the key role of hormones in competitiveness among women, the fact that we find the same pattern across settings with highly

[11] Apicella et al. (2011) find that hormones in men (e.g. testosterone and cortisol) are not significantly correlated with preferences over competition, while Buser (2012) finds progesterone affects willingness to compete among women, and Wozniak et al. (2014) find that both progesterone and estrogen play a decisive role in competition choice. While effects differ between the last two studies, this is explained by the latter as arising from critical differences across the two settings and the ways that hormones interact with the parameters of the choice setting (e.g. the gender composition of one's choice environment). See Wozniak et al. (2014) for further discussion.

[12] A few studies examine the effect of accounting for age alone, without its interaction with gender, e.g., in the study of social preferences (List, 2004) or in the study of both social preferences and competition (Charness and Villeval, 2009).

divergent economic and social histories minimizes the possibility that environmental factors are behind the patterns we observe. Theory suggests, and our data confirm, there is a relationship linking sex, age, and competitiveness that is consistent across widely differing human populations and environments.

Competition experiments are typically performed using math (and sometimes vocabulary) problems, with student-subjects. Combining a rigorous experimental protocol with a task that is cognitive but requires no formal education, we identify competition preferences among populations from widely varying education levels, ages, cultural backgrounds, and social and economic environments. This approach contributes to a growing collection of studies that include extra-lab dimensions to the experimental design to help test for, and address, potential constraints that may exist in standard lab designs. It is perhaps often valid to generalize from choices of students, but it is important to identify which factors affect how behaviors in one population translate to another.[13] This is an important point for a line of research that emphasizes a physiological factor (sex) as a key determinant of behavior and preferences – particularly when the empirical basis to date comes chiefly from students.

The main contribution of this study is the finding that the gender difference in preference for competition depends critically on age. However, it also helps shed light on the initial underpinnings of differences between men and women in attitudes toward competition. The evolution-based explanation has remained one of the most compelling (and most cited) rationales

[13] One concern, for example, is that university students exclude the large number of people who never attend post-secondary school, a segment of the population that may systematically differ along relevant dimensions.

behind the origins of gender differences in competition preferences.[14] However, there is little evidence beyond the persistent finding that men prefer competition while women shy away from it. We expand the evidence by testing one of the argument's other key predictions and finding that it holds: in both societies there is a significant aversion to competition among women of childbearing age which disappears around the time of women's menopause, while men's competitiveness does not change with age.

In addition to our experimental results, we add support from experiments in two other settings. We also show that we replicate the main findings that helped launch this literature (Niederle and Vesterlund, 2007), as a special case within our experiment. Age is a factor that is often overlooked in experimental studies. However, doing so may prevent a full understanding of the behaviors we wish to understand. While not the only area of import, labor markets and the workplace have been major focal points for the implications of differences in competition preference, and adults actively participate in the labor force throughout the middle and upper age ranges – even more so as the age of retirement rises. Our findings also have practical

[14] Another class of determinants increasingly discussed in the literature focuses on the role of context. For example, socialization and culture (Gneezy et al., 2009) as well as variations in experimental conditions (Niederle et al., 2013; Balafoutas and Sutter, 2012; Gupta et al., 2013; Healy and Pate, 2011) can have important effects on the gender gap. These explanations are not mutually exclusive, as behavior is often understood as jointly determined by physiological and social factors (for example, the interplay of nature and nurture in affecting deportment, preferences, and personality). With regard to competitiveness, cultural factors and variations in context may magnify or dampen behaviors that originally stem from the logic of evolution. For an explanation of how the drive to maximize evolutionary fitness and reproductive success can lead to sharp differences in the gender-competition gap under different cultural institutions, see Flory et al. (2015).

significance for the design of incentives, for empirical researchers and policymakers, and for the rapidly growing body of research on competitiveness.

2. Experimental Design

To test the hypothesis that the gender gap in willingness to compete is a function of age, we use data from an experiment initially designed to examine gender differences in competitiveness among adults of a broad age range in rural Malawi. Upon discovery of a striking pattern with respect to age among women, we replicated the experiment in the US in order to test whether the age pattern would hold when we sharply change the cultural setting. In our procedure, we rely heavily on the experimental protocol designed by Niederle and Vesterlund (2007; henceforth NV). We augment their design by lowering the formal education requirements for the task, broadening the age-distribution among the participants, and incorporating multiple cultures within the experiment.

As NV emphasize in their seminal study, an important stumbling block in identifying the effects of a given determinant (e.g. gender) on appetites for competition is the confounding effects of other omitted characteristics correlated with the determinant of interest.[15] They note that gender differences in appetites for risk, in aversion to receiving feedback on performance relative to others, and in self-confidence can all create a gender gap in willingness to compete, in addition to a gender difference in tastes for competition itself. Their protocol resolves this

[15] Croson and Gneezy (2009) conclude women are more risk averse than men, for example, in a review of the literature on gender differences in risk preferences.

conundrum by having participants make two choices, both of which are affected by risk preferences, relative feedback-aversion, and self-confidence, but only one of which is affected by a taste for competing against others per se. The choice which is affected by just risk preferences, feedback preferences, and confidence is used as a control in analyses of the choice to enter competition, such that the residual effect of gender on the competition choice reflects the gender difference in preferences for competition per se.[16]

We are aware of no other design which so conclusively controls for these confounding effects in order to isolate the effects of determinants on the taste for competition. We therefore follow NV's lead, but lower the education requirements to complete the task, and manipulate the extra-lab parameters of the experimental design so as to isolate the effect of sex on tastes for competition per se across a variety of populations differing by age, social history, and culture.

The task that we use was specifically designed to involve a simple cognitive exercise – arranging shapes in a row from smallest to largest. Each participant has a set of six blocks. Each side of a given block has one of six shapes. The relative location of the shapes on each of the six blocks is different. The task is to arrange all six blocks such that a given shape (e.g., star) appears facing up, and to align the six versions of that shape (e.g., all 6 stars) in order from smallest to largest. Upon completing one shape, the participant moves to the next shape. The blocks are designed so that the order of the blocks for one shape does not confer any advantage to arranging

[16] For a more comprehensive discussion of the importance of these threats to identification, and of the need to eliminate them in order to identify the effects of a determinant (e.g. gender) on preference for operating in a competitive environment, see Niederle and Vesterlund (2007).

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 they will be paid for one of the four, selected at random.

- In round 1 (piece-rate), participants are paid *X* for each set of shapes successfully completed.
- In round 2 (tournament), they receive *4X* per success if they complete the most successes in their group of four, but receive nothing otherwise. The group is randomly determined, and participants never know who is in their group.
- In round 3, they first choose which of the two payment schemes they want to work under, then perform the task.
- In round 4, they do not actually perform the task. Rather, they simply choose to submit their past performance in round 1 either to the non-competitive piece-rate scheme or the competition-based pay scheme.

Before making the choice for round 3, participants are informed that if they choose competition, their group is the same group 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 been forced to compete, rather than individuals who had self-selected into competition. Before making the choice for round 4, participants are again informed that their group is the same group 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 those who chose to compete. At the end, participants are asked how they believe their performance compares to the others in their group for rounds 1 and 2, and earn an additional amount *Y* for correct guesses.

The choice of this well-established design allows us to measure preferences for competitive environments independent of ability and risk aversion. (For a more thorough discussion of the importance of eliminating the confounding effects of risk-aversion, feedback-aversion, and confidence in order to identify effects on competition preferences, see Niederle and Vesterlund, 2011.) The focus of the exercise is the choice of compensation scheme for round 3 – whether participants want to perform the task under competition. Rounds 1 and 2 serve to familiarize participants with each pay 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 the lower willingness to compete among young women. The choice made in round 4 isolates the effects of sex and age on the preference for performing in competition against others, independent from the effects they have on willingness to be rewarded based on a relative evaluation. That is, the round 4 choice captures the influence of other factors that affect willingness to compete besides a preference for performing under competition per se, such as risk-aversion, feedback-aversion or self-confidence. For example, since aversion to uncertainty affects both the round 3 and round 4 choices, but only in round 3 does the participant enter and compete in a tournament, the choice to compete in round 3 conditional on the choice in round 4 captures the preference for competitive environments independent of risk preferences.

The same instructions were used both in the Malawi villages and in the US. (In Malawi, they were translated into Chichewa). Since many adults are illiterate in rural Malawi, the instructions were read aloud. For comparability across the two environments, the script was also read aloud in the US.

Facilitators demonstrated how to perform the task, kept track of participants' number of successes in each round, and recorded participants' choices. The only speaker during the session was the script-reader, who read the instructions for the experiment. Amounts for the US: X = \$1, Y = \$0.50. Amounts for Malawi: X = 50 kwacha (approx \$.33), Y = 20 kwacha (approx \$.13). Each session lasted about an hour, and included on average 16 participants, equally balanced between men and women.

One subject pool comes from an urban area in the US. It includes three sets of sessions, drawing participants from staff and students at a large university, a swimming pool near the campus, and a local farmer's market. In total, we had 84 participants, with a mean age of 36. The split was 33% of participants below the age of 26, 42% between the ages of 26 and 49, and 25% are 50 or older. The gender split is nearly even, with 56% females.

The other subject pool includes over 700 participants in 12 villages of rural Malawi. As in the US, the Malawi participants represent a broad age distribution and an even split by sex: 39% below the age of 26, 40% between the ages of 26 and 49, and 21% age 50 or above (mean age of 36); 50% male, 50% female.

3. Experimental Results

In the US, the average success rate was 11.6 (11.5 for men; 11.7 for women) in round 1 and 13.2 in round 2 (13.1 for men; 13.3 for women). The gender difference in performance of the task in either round was not statistically significant (Mann-Whitney U-tests). In the full US sample, 51.1 percent of women and 66.7 percent of men choose the tournament (the Fisher's exact test shows no significant difference in these proportions). This differs sharply from the standard result in this literature, based on young individuals. In a sample of 80 student-subjects, for example, NV find that the percentage of men that enter the tournament is more than twice the percentage of women, the difference highly significant.

In Malawi, task performance and overall preferences for competing differ from that of the US. The average success rate was 6.1 in round 1 (6.5 for men, 5.7 for women, Mann-Whitney U-test $p<.01$) and 7.4 in round 2 (7.8 for men; 7.1 for women, $p<.01$). Overall willingness to compete is also lower: in round three, 47% of males and 39% of females chose the tournament.

Despite the differences in levels across the two samples, the determinants of the choice to compete are remarkably similar. We run four different Probit specifications that test for the presence of a gender gap in willingness to compete using the full samples from the US and Malawi (Table 1). Columns 1-4 of Table 1 report the results for the US and columns 5-8 report the results from Malawi. Columns 1 and 5 examine the gender gap without any controls. The remaining columns include the full set of variables available through the experimental protocol, in order to separate the effects of sex and age on competitiveness from 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 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 ranked in comparison to the rest of their group (1=best, 4=worst), which controls for confidence in one's own relative ability. The final variable is the choice made in round 4 – whether to submit the round 1 piece-rate performance to a tournament pay regime. The difference between the decision in round 4 and that in round 3 is that only in the round 3 decision does the participant choosing the tournament actually perform against others. Since risk-aversion, feedback-aversion, and confidence affect both choices, including the round 4 decision controls for the influence of these factors on the decision to enter into competition against others.

Column 1 of Table 1 shows that, in the US, there is *no* statistically significant gender gap in our sample, and Column 5 shows that although the gap in Malawi is statistically significant, it is relatively small. Furthermore, as columns 2 and 6 show, including the full set of controls employed through this experimental protocol to identify the effect of gender on competition preferences per se does not alter the magnitude or significance of the gender gap – it is either non-significant, or significant and small. At first blush, these results appear inconsistent with the robust findings in the literature on large and highly significant gender differences in preferences for competition.[17]

Accounting for age, however, reveals a striking pattern: the gap between men and women is large among younger individuals, but non-existent among more mature individuals. Columns 3

[17] Notably, however, these findings are consistent with one of the only other experiments on competition using adults of a broad age range, Charness and Villeval (2009), who find no evidence of a gender gap across their sample as a whole. (They do not examine whether the gap interacts with age.)

(US) and 7 (Malawi) report results from a model which allows the age of women to have an independent effect on the preference for competing, in addition to gender, by including an indicator for being female and 50 or older. We use age 50 since it is the most widely accepted age after which women are unlikely to be able to give birth[18] and thus evolutionary psychology suggests this as the place where an age effect should occur. Important hormonal changes also occur among women during this period, and prior studies document the importance of hormones in competition preferences (Wozniak et al., 2014; Buser 2012). Appendix 1, supposing instead no priors, tests all possible age cutoffs between 21 and 55 for a change in the relationship between gender and competition, and confirms the existence of a significant change in the relationship at age 50 in both samples.[19]

As column 3 shows, as soon as we control for women's age, the estimated effect of being female is large and significant: in the US, women under the age of 50 are 25 percentage points less likely to compete than men, even after controlling for the influences of risk, feedback, ability, and confidence. This estimate is consistent with the gender effect reported in other studies, which sample young individuals.[20] The estimated effect of being 50 or older on women's

[18] Demographic and Health Surveys (DHS), the standard bearer for internationally comparable demographic statistics in developing countries, defines the ages in which women are potentially fertile as between 15-49 (Rutstein and Rojas, 2006).

[19] We find changes after the age of 46, with the largest breaks occurring at age 48, 49, and 50 in the US (not significantly different from each other) and at age 50 in Malawi. The main findings from columns 3 and 4 of Table 1 do not depend on which cutoff is used for the US sample (estimates for the female and female-age interaction are stronger when the cutoff is 48 or 49).

[20] For example, among studies using student-participants, Gupta et al. (2013) find a marginal effect of -.36 without controlling for performance, Niederle and Vesterlund (2007) find a marginal effect of -.38 when controlling for

preferences for competition is significant and large (0.339) – enough to completely erase the gap between men and women. Turning to Malawi, while overall levels differ somewhat, we observe the exact same pattern of effects by sex and age on the preference for competing. In column 7, we see that when we control for women's age, the effect of being female is not quite as large as in the US (11 percentage points) but is still 34% larger than if we ignore age. Turning to the coefficient estimate for female × over 49, we see the effect of being 50 or older on women's preferences for competition is once again significant and large enough to erase the gender gap (0.136). In both the US and Malawi, older women are significantly more competitive than younger women, and they are as equally competitive as men of all ages.[21]

The theory of gender differences based on evolutionary psychology predicts the preference for competition among men does not change with age. Columns 4 (US) and 8 (Malawi) report results from a model that tests this hypothesis by including an indicator for the age of men. As the coefficient estimates for male × over 49 show, the age of men does not have a significant effect on their preference for competing against others in either the US or Malawi.[22]

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performance, Niederle et al. (2013) find a marginal effect of -.36. Flory et al. (Forthcoming) find a smaller marginal effect, -.15, among participants a little older than the typical student age (mean age 28).

[21] Women 50 and older are in fact marginally more inclined toward competition than men of all ages in both cultures, though this is not significant. Appendix Table B reports results from Probit regressions analogous to the specification in columns 2 and 6 of Table 1, but where the sample is restricted to all men and women 50 or older, for both the US and Malawi. The estimated effect of being female is 0.11 in the US subsample, and 0.07 in Malawi, though neither estimate is statistically significant.

[22] Appendix 1 confirms this is true for all possible age thresholds for men (see Figure 1). There is also no evidence of a continuous effect of age for men (see Table 4 and discussion below).

To summarize, Table 1 displays a pattern which is consistent across the US and Malawi: women's preferences for competition significantly increase after the approximate age of menopause (becoming just as strong as for men), while men's preference for competition does not change with age.[23]

4. Competitive Behavior in Other Samples

The data from the US and Malawi support the hypothesis that female aversion to competition changes with age, whereas male competitiveness does not change with age. In this section, we more closely examine the relationship between these data patterns and other studies on competitiveness. We also test for a continuous effect of age, suggested by the findings of the one other study on the effects of aging.

First, as verification that we are indeed picking up changes in the gender-competition relationship first identified in NV, and as further evidence of the robustness of that relationship across multiple environments, we compare the data patterns in their study to the patterns among the student-aged participants in our two samples.

The similarities between the three samples are shown in Table 2. The patterns are almost identical across the three samples. After conditioning on performance in the task, NV find that being female reduces the probability of competing by an estimated 38 percentage points in their sample of 80 students (significant at the .01-level), while we find an estimated 41 percentage

[23] Appendix Table A shows results from Probit regressions of the choice to compete in which women are the omitted category.

point reduction in our sample of 28 similarly aged adults (significant at the .10-level). When adding the additional variables to control for other factors which may also affect willingness to compete, the magnitude of the estimated effect in NV drops by over 50% and the significance reduces substantially. Similarly, when conditioning on the full set of controls in our sample of 18-25 year-olds from the US, the estimated magnitude drops by nearly a half and the significance drops considerably. While the sample size limitations make the estimate in column 4 imprecise, the basic pattern is similar to that of the students in the earlier study. The Malawi sample has many more individuals in the 18-25 age range, enabling a more precise estimate. As can be seen in column 6, in the specification which best isolates the effect of gender on a preference for performing against others, we see a precisely estimated effect of gender very close to that found in NV. On the one hand, this helps verify that our experimental design replicates the findings of previous studies when using populations of similar ages. On the other, it suggests that by focusing on young populations, this literature has tended to restrict attention to one case of a more general relationship that involves gender, age, and competitive disposition over the life cycle.

As further evidence of the importance of age in the willingness of women to compete, we examine a fourth sample, using data from a competition experiment among men and women in Maasai villages in Tanzania (Gneezy et al., 2009). Though considerably smaller than the Malawi sample, this sample also includes men and women of all ages. The experimental protocol is not the same; individuals were asked to choose between a competitive payment scheme and a piece rate payment scheme before attempting to toss 10 balls into a bucket. (A parallel experimental task measuring risk-aversion eliminated risk preferences as a potential driver.) Nonetheless,

examining the inclination to compete and focusing on the differential behavior of the women aged 50 and above, provides further support to our findings in the US and Malawi.

Column 1 of Table 3 reports the results from a Probit model of the choice to compete. Females under 50 are significantly less likely than men to compete, but women over 50 are not less likely than men to compete. The coefficient for females over 50 is similar in magnitude but the opposite sign as the coefficient for females – the exact same pattern we observe among urban Americans and rural Malawians in columns 3 and 7 of Table 1. With only seven women aged 50 and above, we cannot draw strong conclusions from this data set alone, but its consistency with our findings from the US and Malawi highlights the robustness of the pattern.

As an additional exercise, to further examine whether our results from the US and Malawi might be driven by an environmental factor affecting women currently over 50 that is somehow shared across these extremely different environments, we take advantage of the fact that the data from Tanzania was collected five years earlier than the data from Malawi. Adding five years to the age of each person in the Tanzanian sample would put the individuals in this sample in age-cohorts comparable to those for the US and Malawi samples. When we rerun the same regression on this adjusted sample, the coefficient for women aged 50 and above drops to half its previous magnitude. This suggests that women in the Tanzania sample who were younger than 50 at the time of that experiment, but who belong to the "post-49 cohort" in the US and Malawi samples, were substantially less competitive in their choices. While the small sample size limits precise inference (the difference is not significant), these results add further evidence that the patterns in our data are not driven by an environmental influence on a particular age-group of women who exhibit the same behavior over their whole lives. Instead, the patterns in the Tanzania data support the hypothesis that women's behavior *changes* around the age of 50.

The hypothesis of a discontinuous change in behavior of women around the age of 50 is directly linked to the evolution-based theory and is also suggested by the hormonal changes that occur at this time. However, Mayr et al. (2012) find evidence of a *continuous* increase in the likelihood to enter tournaments up to the age of 50 among both men and women in the US, followed by a decrease thereafter.[24] Notably, they also find that women in their sample are less likely than men to enter competitions at all ages between 25 and 75. This appears to conflict with our findings. Importantly, however, the experimental design does not include a method to separate the effects of age (and gender) on competition preferences from age and gender effects on other factors that affect choices to enter tournaments. This complicates interpretation of their results: the pattern they find may reflect the effects of age and gender on competition preferences, risk preferences, feedback-aversion, or on some combination of all three as they change across gender and different US age-cohorts.

This well-known concern in studies on competition is addressed in the seminal study by NV through their clever design. Mayer et al. (2012) are forthright on this issue, noting for example that their findings could be picking up differences in appetites for risk across the age-groups in their sample. Indeed, their results conflict with the only other experiment on age and competition we are aware of, Charness and Villeval (2009), who find no gender difference in competition preferences in their sample of adults aged 18 to 77, after controlling for risk preferences. Nevertheless, the findings of Mayr et al. (2012) suggest an important alternative relationship between gender, age, and competition preferences that deserves closer examination

[24] Their data suggest the possibility of a quadratic relationship between age and tournament entry, peaking around the age of 50. However, the authors note the downward trend after 50 is less well established.

– particularly since it is not one that stems from the evolution-based explanation or the fundamental hormonal changes of menopause.

We therefore examine our data for evidence of a continuous relationship between age, sex, and preferences over competition. Table 4 reports results from Probit regressions that test for evidence of a smooth change in preferences for competition as age increases among men and women. In columns 1 (US) and 5 (Malawi), the coefficient estimates for *Female* × *age* are positive but not significant. In columns 2 (US) and 6 (Malawi), the coefficients for *Male* × *age* are similarly not significant. Thus there is little evidence of a continuous relationship between age and tastes for competition among either men or women, when looking across all ages. Columns 3, 4, 7, and 8 restrict the sample to adults under the age of 50 to test for the possibility that there is a continuous age effect among just younger adults. The coefficient estimates for *Female* × *age* and *Male* × *age* are not significant in any of the four models. In sum, we find little evidence of a continuous relationship between age and competitiveness among either men or women, whether in the US or Malawi. We therefore conclude that, when isolating the effects of gender and age on the preference for competition (separate from their effects, for example, on risk-aversion), the discrete age cut-off for women suggested by the evolutionary biology explanation is a superior fit with the data.

6. Conclusion

This study sheds new light on the limits to gender differences in competition preferences. While other studies have shown the difference can be influenced by culture (Gneezy et al., 2009), we show that it also critically depends on age. To the extent that understanding

competitiveness is important only insofar as it helps explain career choices of young men and women, these findings do little to challenge the current literature: young women clearly avoid competitive environments. However, the pattern in the literature has often been taken to suggest a general difference across sexes that we find is not supported by the data. Our results indicate that gender by itself does not in fact have a general effect on competitiveness. When looking across adults of a broad age range, the gender gap, if it exists at all, is much smaller than when looking at young adults. There is at least as much difference between younger and older women as there is between younger women and men, and there is no evidence that more mature women are any less fond of competition than men. Student populations appear to represent one case of a more general relationship between sex, age, and tastes for competition. Recognizing this more general relationship is important, as it helps clarify the broader pattern of systematic differences in preferences across all populations (not just young individuals), and the physiological determinants of these preferences. It is also important for understanding the behavior of more mature adults, and how older workers react to competition incentives.

These findings also provide novel evidence in support of one of the leading theories on the origins of differing competition preference across men and women. According to the evolution-based theory of gender differences in competitiveness, the behavior of men and women derives from the prehistoric costs and benefits for success in reproduction, and thus the perpetuation of specific traits. This is regardless of whether these traits are relevant to the survival of offspring in the modern world. As predicted by the evolutionary mechanism, we find a strong link between age and competition preferences among women. In both Malawi and the US, age has no effect on men, whereas women's preference for competition is higher among older participants, causing the gender gap observed among younger individuals to vanish among

older individuals. The effect is discrete, not continuous, occurring at the approximate age of menopause, further supporting the theory that gender differences derive from the costs and benefits of competitiveness to the production of offspring among human ancestors. While additional research is required before drawing firm conclusions, these findings expand the empirical basis for the hypothesis that evolution played a role in shaping the differences between men and women in attitudes toward competition.

The importance of biological factors in competition preferences remains an open question. However, several studies (e.g. Wozniak et al., 2014; Buser, 2012) suggest hormones play a key role – in particular, among women. While the exact mechanism through which hormone levels interact with the parameters of the choice setting is still unclear, the extant evidence suggests they heavily influence women's choices.[25] Our study – in particular, the robustness of the data patterns across such widely differing societies in combination with the major hormonal changes that occur around the focal age in the pattern – also strongly suggests a biological driver. While a strong role played by physiology may at first blush appear to run counter to recent findings in the literature that context can also matter (e.g. Gneezy et al., 2009;

[25] While Apicella et al. (2011) find little evidence that hormonal differences among men affect willingness to compete, Buser (2012) finds in a between-subjects study that women are significantly less likely to compete in all-female groups during predicted high levels of progesterone, and Wozniak et al. (2014) find in a within-subjects study that women are significantly more competitive in mixed-gender groups when estrogen and progesterone levels are high. Wozniak et al. (2014) explain the differing effects of hormones across the two settings as stemming from several factors – most notably, the effect of gender composition of groups on competitiveness among women and on the behavioral effects that hormones have. Taken together with the neuroendocrinological literature examining how hormones affect brain activity and behaviors (see Wozniak et al., 2014 for a review), these studies suggest hormones play a decisive role in competitiveness among women.

Niederle et al., 2013; Andersen et al., 2013), physiological determinants do not preclude an important role played by culture, context, or the effects of socialization. On the one hand, cultural factors may interact with physiological factors so as to magnify or dampen behavioral differences that may originally stem from the logic of evolution. On the other, behavior may be understood as jointly determined by physiological and social drivers. Flory et al. (2015) propose a model explaining how the same underlying evolutionary logic of maximizing genetic fitness can lead to differing competitive behaviors by men and women, depending on the cultural context (in particular, the institutional arrangements for wealth inheritance and household location). Further studies exploring the mechanisms through which physiological determinants and social determinants interact represent an important area for future research.

In closing, some words of caution are in order regarding the implications of our results. While the importance of the age right around 50 on women's competition preferences is remarkably consistent across very different cultures and also aligns exceptionally well with the average age marking the end of women's fertility, our data do not permit an explicit test of menopause itself (or the hormonal changes associated with it) as the proximal cause of the sharp change in women's attitudes toward competition. We interpret the robustness of the pattern across diverse human environments, the fact that a critical fertility threshold lies at the center of the pattern, and the pattern's consistency with a model of maximizing reproductive success as strongly suggesting that menopause is likely to drive these results. However, clarifying the specific physiological mechanism underlying the change in behavior constitutes another important avenue for further study.

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Tables

Table 1. Effects of Gender and Age on Tournament Entry

	US Sample				Malawi Sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-0.156	-0.14	-0.246**	-0.266**	-0.079**	-0.078**	-0.105**	-0.105**
	(0.106)	(0.114)	(0.120)	(0.126)	(0.037)	(0.039)	(0.042)	(0.044)
Female x Over 49			0.339***	0.334***			0.141**	0.141**
			(0.114)	(0.116)			(0.071)	(0.071)
Male x Over 49				-0.109				0.003
				(0.227)				(0.074)
Piece Rate		-0.02	-0.005	-0.010		0.003	0.007	0.007
		(0.024)	(0.026)	(0.028)		(0.008)	(0.008)	(0.009)
Improvement		-0.019	-0.01	-0.014		0.009	0.013	0.0133
		(0.040)	(0.041)	(0.042)		(0.014)	(0.015)	(0.015)
Guessed Rank		-0.097	-0.121	-0.122		-0.007	-0.005	-0.005
		(0.085)	(0.090)	(0.090)		(0.020)	(0.020)	(0.020)
Submit Piece-Rate		0.365***	0.373***	0.378***		0.386***	0.391***	0.391***
to Tournament		(0.111)	(0.114)	(0.114)		(0.035)	(0.035)	(0.035)
Observations	84	84	84	84	730	728	728	728

Estimated marginal effects from a Probit regression of the choice to select tournament for round 3. Omitted category is men. Columns 1-4 are drawn from the US sample and columns 5-8 are drawn from the Malawi sample. The variable *Female* is an indicator for whether the participant is a woman. *Piece Rate* measures the number of successes in the first round, under the piece-rate regime. *Improvement* measures the increase in number of successes between the first and second round. *Guessed Rank* indicates the participant's stated belief about how well she performed, relative to the three other individuals in her group. *Submit Piece-Rate to Tournament* is an indicator for whether the participant chose to submit her past performance in round 1 (piece-rate) to a tournament against the past piece-rate performance of the other members in her randomly assigned group. *Over 49* is an indicator for whether the participant is at least 50 years old. Standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2. Comparing Results Across Different Experimental Settings

	Univ. of Pittsburgh Students (Reported in NV)		US Adults 18-25		MW Adults 18-25	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.38	-0.162	-0.410	-0.242	-0.180	-0.144
	[0.00]	[0.05]	[0.07]	[0.43]	[0.00]	[0.03]
Tournament Performance	-0.015	-0.009	-0.0615	0.0313	-0.0204	-0.0134
	[0.41]	[0.42]	[0.31]	[0.75]	[0.13]	[0.35]
Improvement	-0.015	0.011	-0.198	-0.170	0.0446	0.0402
	[0.50]	[0.44]	[0.06]	[0.24]	[0.07]	[0.12]
Guessed Rank		-0.120		-0.809		-0.0485
		[0.01]		[0.047]		[0.14]
Submit Piece-Rate to Tournament		0.258		0.829		0.389
		[0.012]		[0.037]		[0.00]
Observations	80	77	28	28	291	291

Estimated marginal effects from Probit regressions in 3 different samples of participants which experienced the same basic experimental protocol. Columns 1 and 2 contain results reported in NV, for which students from the University of Pittsburgh are used. Columns 3 and 4 show the results from the 28 individuals (14 men and 14 women) between the ages of 18 and 25 from our sample in the urban US. Columns 5 and 6 show results from the 291 individuals (140 men and 151 women) between the ages of 18 and 25 from our rural Malawi sample. Brackets contain p-values, to facilitate comparison with the results reported in NV.

Table 3. Probit Regression of Tournament Entry Choice in Tanzania (Marginal Effects)

	Tanzania	
	(1)	(2)
Female	-0.279**	-0.260**
	(0.114)	(0.117)
Female x Over 49	0.240[a]	
	(0.211)	
		0.119
Female x Over49 Cohort		(0.202)
Observations	76	76

Data from Gneezy et al. (2009) based on the choice to compete in a one-time ball tossing task. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, a p=0.26. The sample includes seven women over the age of 49. *Female x Over49 Cohort* is an indicator for whether the participant belongs to the same "post-49 cohort" as the women over 49 in the US and Malawi samples (the experiments were 5 years apart).

Table 4. Continuous Effects of Age on Tournament Entry

	US				Malawi			
	Full Sample		Under 50		Full Sample		Under 50	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-0.415**	-0.321	-0.089	0.076	-0.167**	-0.182**	-0.177*	-0.268*
	(0.201)	(0.282)	(0.336)	(0.475)	(0.073)	(0.087)	(0.107)	(0.138)
Female x age	0.008	0.009	-0.006	-0.006	0.002	0.002	0.003	0.002
	(0.006)	(0.006)	(0.011)	(0.011)	(0.002)	(0.002)	(0.003)	(0.003)
Male x age		0.004		0.006		-0.001		-0.004
		(0.007)		(0.012)		(0.002)		(0.004)
Piece Rate	-0.007	0.001	-0.033	-0.026	0.007	0.005	0.005	0.003
	(0.026)	(0.030)	(0.036)	(0.039)	(0.008)	(0.009)	(0.010)	(0.010)
Improvement	-0.015	-0.008	0.004	0.011	0.013	0.012	0.020	0.018
	(0.040)	(0.042)	(0.051)	(0.053)	(0.015)	(0.015)	(0.016)	(0.016)
Guessed Rank	-0.129	-0.131	-0.225*	-0.229*	-0.006	-0.006	-0.009	-0.009
	(0.090)	(0.091)	(0.120)	(0.121)	(0.020)	(0.020)	(0.023)	(0.023)
Submit Piece-Rate	0.349***	0.347***	0.364**	0.369**	0.386***	0.386***	0.374***	0.373***
to Tournament	(0.114)	(0.114)	(0.144)	(0.144)	(0.035)	(0.035)	(0.040)	(0.040)
Observations	84	84	63	63	727	727	579	579

Estimated marginal effects from a Probit regression of the choice to select tournament for round 3. Columns 1-4 are drawn from the US sample and columns 4-8 are drawn from the Malawi sample. Columns 3 and 4 are restricted to participants under the age of 50 in the US, columns 7 and 8 are restricted to participants under the age of 50 in Malawi. The variable *Female* is an indicator for whether the participant is a woman. *Age* is the continuous age of the individual, in number of years. *Piece Rate* measures the number of successes in the first round, under the piece-rate regime. *Improvement* measures the increase in number of successes between the first and second round. *Guessed Rank* indicates the participant's stated belief about how well she performed, relative to the three other individuals in her group. *Submit Piece-Rate to Tournament* is an indicator for whether the participant chose to submit her past performance in round 1 (piece-rate) to a tournament against the past piece-rate performance of the other members in her randomly assigned group. Standard errors are shown in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendix 1: Testing for a Structural Break in the Effect of Gender Across All Ages

We test for a discrete effect of age on the willingness to compete among women around age 50 because theory motivates this from two directions: significant hormonal changes occur around this age; and changes in reproductive ability around this age are likely to have changed the benefits of competiveness to offspring survival among human ancestors, influencing traits passed down to humans today. In this section, we take advantage of the broad spectrum of adult ages in our data to examine the evidence for alternative possible age cut-offs not connected to either explanation.

We test for a structural break in the effect of gender on competition preferences between younger and older individuals, using all possible ages between 21 and 55 as the cut-off for being categorized as "young" or "old". [26] Beginning with the same specification for the regressions reported in columns 2 and 6 of Table 1 (the specification which best isolates impacts on the preference for competition), we add a term interacting gender with an indicator for whether an individual is above a given age (i.e. in the older group):

$$y_i = \beta_0 + \beta_1 Female_i + \beta_2 Female_i \times Old_i + x_i'\theta + \epsilon_i$$

where the response variable is whether the individual chose to compete in round 3, and x_i is a vector of the standard controls available from the experimental protocol (piece-rate performance, improvement, guessed rank, and submit to tournament). We run the regression 35 times – once for each possible age threshold between 21 and 55. The coefficient on the interaction term represents the impact of being above the given age threshold on the effect of being female on an individual's preference for the competitive environment. We then alter the specification by replacing the gender variable with an indicator for being male instead of female:

$$y_i = \beta_0 + \beta_1 Male_i + \beta_2 Male_i \times Old_i + x_i'\theta + \epsilon_i$$

[26] The sample of men older than 52 is too small to identify the coefficient for the US.

We again run the regression using each of the 35 possible age thresholds. We do this in both the US and the Malawi sample. The 140 resulting coefficients on the interaction term thus represent the effect of being above each given age threshold on an individual's preference for the competitive environment, for men and women separately, in each society.

The coefficient estimates and confidence intervals for β_2 (the effect of each possible age cutoff between 21 and 55 on the preference for competing) are displayed separately by gender and society in Figure 1. As shown in the figure, for women, the sign of the estimated effect of being in the older group is always positive – whether in the US or in Malawi. The largest estimate occurs at age 48 in the US, and age 50 in Malawi – both estimates significant at the .05 level.[27] For men on the other hand, the estimated effect of being in the older group is sometimes positive and sometimes negative. More importantly, the 95% confidence interval of the estimated effect of being in the older group always includes zero by a wide margin when looking at men.

Thus, for males, there is little evidence that being below or above any age cutoff affects their propensity to compete. For females, however, we find that being older in both societies significantly increases propensity to compete, when "older" is defined as being above the average age of menopause. This is consistent with the evolutionary explanation of the origins of gender differences in competition preferences, as well as with the existence of a connection between hormones and competitive disposition.

Interestingly, there is evidence in Malawi of an additional structural break in the effect of gender (being female) around the age of 30. The fact that this pattern does not exist in the US sample, and that it is not clear whether or how it might be linked to biological drivers, point to the likelihood that cultural factors still play an important role. The interaction of social and physiological determinants of gender differences in preferences remains an important area for future research.

[27] In the US, the estimated effect of age cutoffs for 48, 49 and 50 are statistically indistinguishable from each other.

Figures

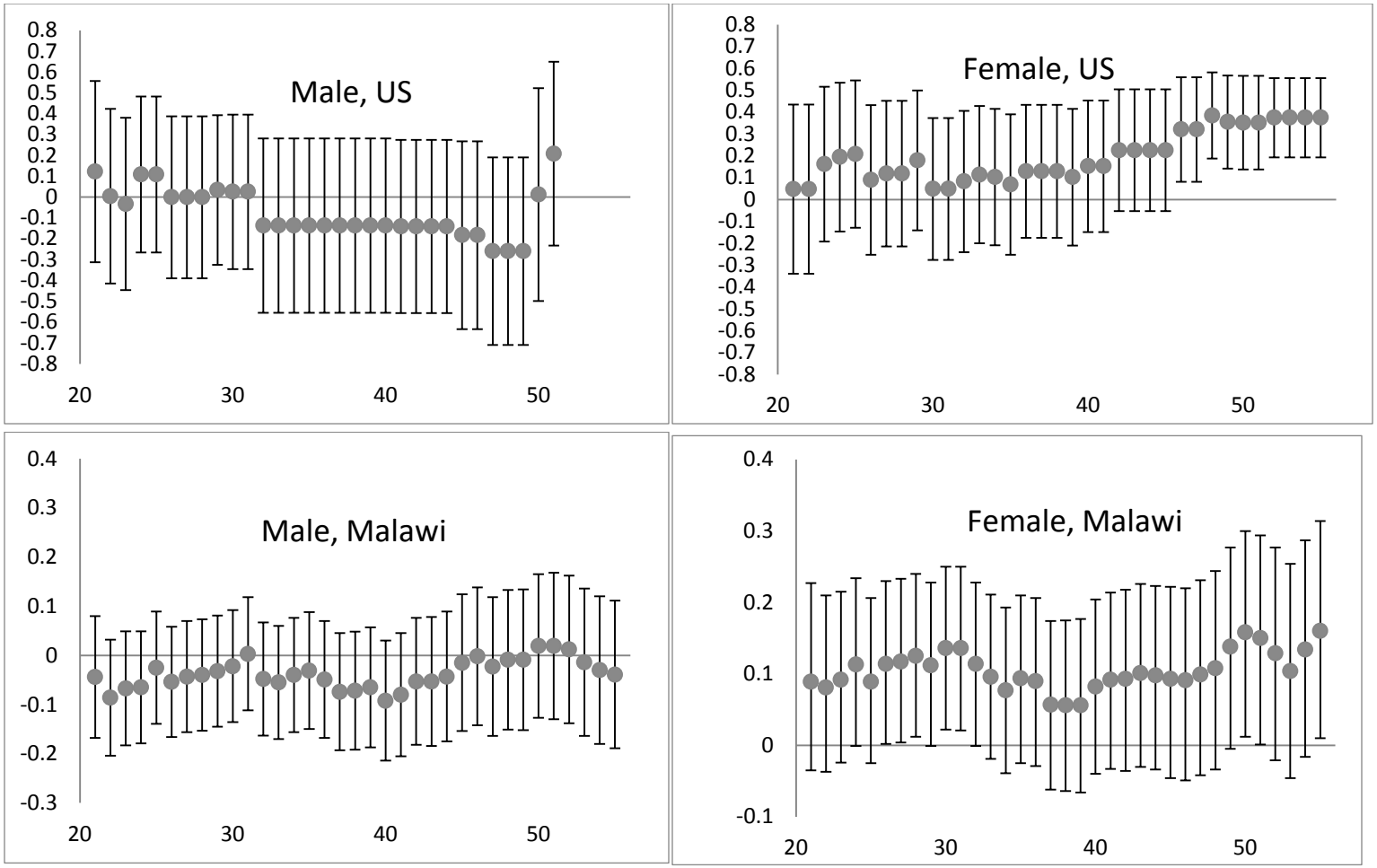

Figure 1 Coefficients for regression testing for structural break at each age between 21 and 55

The four figures above show the estimates and 95% confidence intervals for the coefficient on gender interacted with an indicator for being older than the given age cutoff, in a regression of the choice to experience competition on gender and the standard NV controls. The estimates for the structural break parameter are shown for 35 different regressions for each sample and gender. Where the coefficient is significantly greater than zero, it suggests that all participants above the cutoff are more likely to compete than those below the cutoff.

Appendix 2: Tables A-B

Table A. Effects of Gender and Age on Tournament Entry (Omitted Category Women)

	US	Malawi
	(1)	(2)
Male	0.266**	0.105**
	(0.126)	(0.0443)
Over 49	0.356***	0.141**
	(0.137)	(0.0715)
Male × Over 49	-0.490**	-0.132
	(0.203)	(0.0876)
Piece Rate	-0.00985	0.00697
	(0.0278)	(0.00889)
Improvement	-0.0140	0.0133
	(0.0416)	(0.0148)
Guessed Rank	-0.122	-0.00468
	(0.0897)	(0.0200)
Submit Piece-Rate	0.378***	0.391***
to Tournament	(0.114)	(0.0350)
Observations	84	728

Estimated marginal effects from a Probit regression of the choice to select tournament for round 3. Omitted category is women. Column 1 is the US sample and column 2 is the Malawi sample. The variable *Male* is an indicator for whether the participant is a man. *Piece Rate* measures the number of successes in the first round, under the piece-rate regime. *Improvement* measures the increase in number of successes between the first and second round. *Guessed Rank* indicates the participant's stated belief about how well she performed, relative to the three other individuals in her group. *Submit Piece-Rate to Tournament* is an indicator for whether the participant chose to submit her past performance in round 1 (piece-rate) to a tournament against the past piece-rate performance of the other members in her randomly assigned group. *Over 49* is an indicator for whether the participant is at least 50 years old. Standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B. Comparing Mature Women to All Men

	US	Malawi
	(1)	(2)
Female	0.107	0.0737
	(0.146)	(0.0725)
Piece Rate	-0.00734	0.0231**
	(0.0290)	(0.0110)
Improvement	0.0166	0.0154
	(0.0428)	(0.0208)
Guessed Rank	0.0324	0.000985
	(0.108)	(0.0274)
Submit Piece-Rate	0.458***	0.428***
to Tournament	(0.136)	(0.0440)
Observations	51	440

Estimated marginal effects from a Probit regression of the choice to select tournament for round 3. The sample includes all men, but among women restricts to individuals 50 and older. Column 1 is from the US sample and column 5 is from the Malawi sample. The variable *Female* is an indicator for whether the participant is a woman. *Piece Rate* measures the number of successes in the first round, under the piece-rate regime. *Improvement* measures the increase in number of successes between the first and second round. *Guessed Rank* indicates the participant's stated belief about how well she performed, relative to the three other individuals in her group. *Submit Piece-Rate to Tournament* is an indicator for whether the participant chose to submit her past performance in round 1 (piece-rate) to a tournament against the past piece-rate performance of the other members in her randomly assigned group. Standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix 3: Experiment Details and Instructions

A. Sampling

In the US, we recruited participants in three waves. The first set of sessions was conducted at a major university campus near the end of the work-day. We recruited participants from staff, graduate students, and undergraduates. The second set of sessions was on a Saturday afternoon on campus, with participants recruited from a farmer's market, a flea market, and a local swimming pool. The third set of sessions was conducted at a farmer's market, with participants recruited from the market, the nearby commuter rail station, and the surrounding community.

In Malawi, we drew from twelve different villages, recruiting from the entire village population. Each village was visited a few days prior to the experiment, to notify residents and advertise the significant show up payment. We then randomly selected participants from the large pool that arrived.

B. Instructions

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 minutes. Because we are not simply asking you questions, but asking you to perform a task, we will pay your 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.

In order 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 minutes. As soon as you finish arranging the blocks for one shape, look to your helper and he or she will indicate to you whether you may move to the next shape. If he 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 minutes to complete as many shapes as possible. The number of tasks that you complete is recorded on the paper but we will never tell anyone else how you have done.

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

Round One: Individual Performance.

We will now begin round one. Before we begin, we will explain how you will be paid for the tasks this round: If Round 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 $\{2X\}$, 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 minutes 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.