Introduction

Women have surpassed men in education outcomes, like college attendance and graduation rates [@Blau2017; @Goldin2006; @Stoet2014], but continue to be underrepresented in top management positions in nearly all sectors [@Bertrand2001]. And, a sizable gender gap still persists worldwide [@Blau2017]. Traditional economic variables, such as household division of labor and discrimination, account for some, but not all, of these disparities [@Blau2017]. As such, researchers have begun to consider psychological gender differences, including the predilection for competition, as means of understanding persistent gender gaps in labor market outcomes [for review, see @Niederle2011].

Research suggests women are, on average, less competitive than men (for review, see @Niederle2011). Seminal work on gender differences in competitiveness operationalized competitiveness as the choice of a tournament payment scheme, that reaps potentially higher earnings but requires outperforming an opponent, over a piece-rate scheme, where participants are paid per unit of work they produce [@Niederle2007]. In this paradigm, women are less likely to enter tournaments while completing mathematical problems, even when they would have earned more by competing [@Niederle2007]. Numerous conceptual replications over the past 15 years suggests that the gender difference in willingness to compete is robust [see @Niederle2011; @Niederle2017a; @Niederle2017b for review]. Notably, this effect has been replicated in diverse populations (e.g., across age groups and cultures) [@Apicella2015; @Buser2014; @Sutter2016; @Andersen2013; @Buser2017b; @Sutter2010; @Dreber2014; @Mayr2012] and with a diverse set of tasks [@Apicella2015; @Saccardo2018; @Bjorvatn2016; @Sutter2015; @Frick2011; @Samek2019].

Importantly, this laboratory measure of competitiveness predicts labor market outcomes, including education choices [@Buser2014; @Zhang2012], entrepreneurial decisions [e.g., investment, employment; @Berge2015], and earnings [@Reuben2015]. In other words, competitive preferences may contribute to the gender gap in labor market outcomes [@Blau2017]. Thus, understanding why men and women differ in levels of competitiveness and whether treatments exist that can reduce or eliminate the difference may be key for solving the pernicious gender gaps in the labor market.

Both confidence and risk attitudes have been implicated in driving gender differences in willingness to compete [@Niederle2011; @Veldhuizen2017]. However, the extent to which confidence and risk attitudes account for the gender difference in willingness to compete is debated. The seminal research in this literature suggests that confidence and risk attitude do not completely explain gender differences in competitiveness, since there remained a residual gap after controlling for these factors [@Niederle2007]. As a result, the unexplained component of the original gender effect was taken as evidence of a distinct “competitiveness” trait, separate from risk attitude and confidence [@Niederle2007; @Niederle2011]. Conversely, recent work correcting for measurement error [@Gillen2019] and using experimental techniques to isolate the effects of the competitiveness trait [@Veldhuizen2017] suggests that risk attitudes and confidence can fully explain the gender gap in the choice to compete.

Regardless of whether competitiveness is a “stand-alone” trait, it is clear that both confidence and risk attitude influence how men and women react to competitions. For instance, even in the original study by Nierderle and Vesterlund (2007), 27% of the gender gap in tournament entry was explained by men being more overconfident than women about their relative performance on the task. As such, interventions designed to increase women’s confidence and decrease their perceptions of risk and uncertainty in competitive contexts may help reduce the gender gap in competitiveness.

Confidence is conceptualized as the accuracy of one’s perceived performance or ability on a task [@Beyer1997]. Within the literature on the gender gap in competitiveness, confidence is operationalized as the belief about one’s relative performance during a competition, where individuals who have inaccurately high (low) ratings of their performance are deemed overconfident (underconfident). If an individual does not believe their performance is higher than the individuals they are competing against, they are unlikely to make the decision to compete for fear of missing the opportunity to earn money.

While most individuals are overconfident [@Alicke2013; @Dunning2004b], there is ample research to suggest that women are less (over)confident on average than men across a number of domains [@Mobius2011; @Niederle2011; @Croson2009; @Lundeberg1994; @Niederle2007; @Bertrand2010a; @Beyer1990; @Beyer1997; @Jakobsson2013]. Because women are less overconfident, they compete less often than they should, given their actual ability [@Niederle2007]. Confidence too may help explain why, in some situations, the gender gap in competitiveness may be reduced or eliminated. For instance, women tend to compete more when tasks are female-typed or gender-neutral [@Iriberri2017; @Boschini2014; @Boschini2019; @Apicella2015; @Grosse2010; @Gunther2010; @Dreber2014; @Dreber2011; @Shurchkov2012], when they are facing other female opponents [@DattaGupta2013; @Booth2012], or when competing against themselves [@Apicella2017a]. For example, Apicella et al. (2017) document a gender difference in confidence when women and men are competing against other individuals, but not when they are competing against themselves (i.e., their own past performance). There are several non-mutually exclusive and potentially interacting explanations that could account for women’s relatively lower (over)confidence, including differences in performance or ability, experience, innate psychological differences, and stereotype threat [@Steele1997; @Spencer1999; @Spencer2016]. In the latter case, for instance, women may decide to forgo competitions because they either believe negative stereotypes about their ability to perform certain tasks, or because stereotypes provoke enough anxiety to reduce confidence [@Gunther2010; @Grosse2010; @Iriberri2017; @Shurchkov2012; @Burow2017]. Taken together, this body of research suggests that interventions designed to increase confidence in women, may embolden them to compete more.

A second variable that has been identified as a possible explanation for gender differences in competitiveness is risk attitude, typically construed as the preference for a certain gain over a gamble, even if the gamble has an equal or greater monetary expectation [@Kahneman1982]. Researchers investigating gender differences in risk attitudes find that men are typically more risk-seeking than women [@Eckel2008; @Charness2012; @Croson2009; @Bertrand2010a], including in hunter-gatherers [@Apicella2017], but see Harrison, Lau, & Rustrom (2007) for an exception. While most studies report a gender difference, the difference appears to be small to medium (cite a review that includes this) and culturally-dependent [Anderson, et al. 2013; @Gneezy2009].

Competitive payment schemes are inherently riskier than piece-rate payment schemes because the variance in returns is greater. With piece-rate payment schemes, individuals are guaranteed a certain amount for every unit they produce. Moreover, there typically exists uncertainty in competitions since one’s relative performance is unknown [@Niederle2011]. Indeed, some of the gender gap in competitiveness is explained by men and women’s differing risk attitudes [@Niederle2011]. In fact, some recent work suggests that nearly 30% of the gender gap in competitive choices can be explained by risk attitude [@Gillen2019; @Veldhuizen2017].

In the current study, we examine whether and how preparation may influence willingness to compete. Preparation or training on a task may improve confidence [@Gist1992; @Schunk1981; @Schunk1982; @Usher2008], since people usually able to observe improvement in their performance over time. @Lent1996 found that college students listed past accomplishments as the most influential factor in determining their confidence. Moreover, research directly comparing the effects of mastery experiences (via preparation), vicarious experiences (e.g., watching others perform a task), and a control treatment without any intervention on confidence, found that mastery increased confidence significantly more than vicarious experiences and the control treatment [@Bandura1977a]. Other research suggests that men and women’s confidence is similar in domains on which they have expertise, but the confidence gap emerges when it is assessed in less knowledgeable domains (Sarsons & Xu, 2016). This suggests that gaining expertise, perhaps through practicing, may selectively boost women’s confidence. Roll et al., (2011) found that practicing mathematics problems, using an intelligent tutoring system, significantly decreases under-confidence but has no effect on rates of over-confidence. This too suggests that practicing may preferentially benefit women who are more likely than men to be underconfident. That said, if practicing only helps with under-confidence, when most people, including women, are overconfident, then its application may be limited.

Preparation, and the feelings of preparedness or self-efficacy that follow, may also decrease the perceived riskiness of competitions. With increased self-efficacy, individuals may believe they can reduce risk or overcome adversity. Surprisingly little work has explored how preparation impacts men’s and women’s risk attitudes. However, some experimental work suggests that manipulating perceived competence on a task by giving participants positive feedback about their performance on a task can lead to significantly more risk-taking behavior (Krueger & Dickson, 1994). The researchers were able to rule out the role of mood in driving the results by giving some participants positive feedback on one task and negative feedback on another. For these participants, risk-taking increased in the positive feedback condition and decreased in the negative feedback condition. Interestingly, Gysler, Kruse, and Schubert (2002) find that knowledge – in this case, understanding of financial markets – and confidence in that knowledge, negatively correlate with women’s risk aversion, but positively correlate with men’s risk aversion. This suggests that preparation may disproportionately increase risk-taking in women. Finally, there is evidence that risk attitudes play a greater role in predicting participants’ decisions to compete when individuals are competing against other individuals, rather than themselves (i.e., their own past performance), possibly because there is more uncertainty in estimating an opponent’s ability versus one’s own ability [@Apicella2017a].

Surprisingly, little work has explored how preparation impacts men and women’s confidence, risk attitudes, or their willingness to compete. We know of only one study that has explored how a delaying a competition, and in some cases, offering an opportunity to study, affects decisions to compete. In a working paper, Charness, Dao, & Shurchkiov (2021) examine whether gender gap entry rates change when a future opportunity to study for the task is made available. The authors hypothesized that women would be more likely to compete when there is an opportunity to study for the task. Contrary to their prediction, the authors found that providing an option to study leads to directionally more male entries into future planned tournaments and directionally less female entries into these tournaments, resulting in a significant gender gap. However, this gap was only present during the initial, provisional sign-up period. When the actual choice was made later – sometime between one-five days – the gender difference disappeared. Of those men who returned to complete the study, some switched into the non-competitive payment scheme. The authors suggest that the results may be explained by men being overly confident in their future selves’ resolve to study.

We similarly examine the role role of preparation on the gender differences in willingness to compete through three experiments. However, unlike Charness et al. (2021), we do not introduce a significant time delay in our studies. That is, experiments took place in a single session, thus minimizing any potential for gender differences in beliefs about future selves to affect our results.

In the first experiment, we test whether simply knowing that there will be an opportunity to prepare before performing a task affects the gender gap in willingness to compete. That is, we manipulate participants’ knowledge of whether they will have time to prepare before they make their decision to compete. We anticipate that participants with this information would be more inclined to compete compared to participants without this information and that this effect would be stronger for women, who tend to be relatively less confident. Thus, we expected an interaction between gender and condition on the choice to compete, along with a main effect of condition. In the second experiment, we examined how actual preparation influences the decision to compete. That is, we manipulated whether participants were required to prepare before making the decision to compete. Again, we expected that women in the preparation condition would be especially inclined to compete. Finally, in experiment 3, we examine how an unlimited amount of preparation affects gender differences in the willingness to compete. Across all experiments, we measured gender differences in actual preparation after administering the treatment and eliciting preferences to compete. Finally, we monetarily incentivized participants in both studies to correctly predict which gender would prepare and compete more. The research design, hypotheses, measures and analyses were preregistered unless otherwise stated and all analyses were conducted in R statistical software (version 4.0.4).