



# Competition and Gender Inequality: A Comprehensive Analysis of Effects and Mechanisms

BSE Working Paper 1292

September 2021 (Revised: Mayo 2023)

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## A comprehensive analysis of effects and mechanisms\*

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May 2023

### Abstract

This study uses data from a series of laboratory experiments to provide a comprehensive analysis of gender differences in performance caused by two different dimensions of competition –rivalry for resources and status ranking. It also examines two mechanisms behind such differences. The results indicate that in the absence of any competitive dimension the performance difference between men and women is not statistically significant at the usual levels. Any competitive dimension, however, leads to women performing statistically significantly worse than men. These results are explained by the two mechanisms: (1) men’s beliefs that they are better than women under competition, and (2) women’s adherence to a prescribed stereotype of not harming others. This suggests that gender differences under competition are endogenous to situational contexts.

Keywords: gender inequality, competition, status characteristics theory, mechanisms, experiments

JEL codes: C91, J16

### \*Acknowledgments

We thank the EUI (Grant IP53), the Spanish Ministry of Economics and Competitiveness through Grant: ECO2017-88130 and through the Severo Ochoa Program for Centers of Excellence in R&D (CEX2019-000915-S), the Generalitat de Catalunya (Grant: 2017 SGR 1136), and the Research Priority Area Behavioral Economics of the University of Amsterdam for financial support. We thank Arnout van de Rijt, Robb Willer, and Ezra Zuckerman, for helpful suggestions at various stages of this project.

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## INTRODUCTION

Competition is omnipresent and almost unavoidable in both professional and recreational life. We regularly compete for jobs, mates, leadership, wealth, recognition, and more. Having to compete may, however, affect how people perform. In particular, competition makes women underperform compared to men (Gneezy, Niederle, and Rustichini 2003). There are various aspects of competition that may differentially affect men and women. To illustrate, think of an opening for a professorship in academia. The competition between candidates has the following two important dimensions (Schram, Brandts, and Gërkhani 2019). First, there is a *rivalry for resources* because a single position is to be allocated amongst the candidates. Second, competition leads to a ranking of the competitors. This is a *private ranking* if only the candidates learn how they compare to (some of) the other applicants. The ranking becomes public if also other people know it. Public ranking reflects a *social-status ranking* dimension of competition (Ball et al. 2001).<sup>1</sup>

The rivalry and ranking dimensions can be distinguished in most instances of competition. Either dimension or both can affect how men and women respond to competitive environments and may therefore lead to gender differences in performance. Gneezy et al.'s (2003) result that competition makes women underperform compared to men is based on the rivalry dimension. A similar gender difference in performance is observed when men and women compete for a social-status ranking (Schram et al. 2019). At this point, however, little is known

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<sup>1</sup> The role of other people in social-status ranking is important. "Status ... [is] based on the prestige, honor, and deference accorded her by *other members*" (Lovaglia, Lucas, and Thye 1998, p. 202; italics added). Henceforth, we will use the labels 'private ranking' and 'social-status ranking' when referring separately to the private and public aspects of ranking in competition, respectively. When referring more generally to the ranking dimension of competition, we will use the label 'status ranking'.

about how the effects of rivalry and social-status ranking compare, let alone whether and how they interact. Even less is known about *why* men's and women's performances differ under the two dimensions of competition. We aim to contribute to this knowledge by theoretically and experimentally addressing two research questions. First, *are there gender differences in how people respond to rivalry for resources, to status ranking, and, in particular, to their interaction?* Second, *what mechanisms underlie such gender differences if they exist?*<sup>2</sup>

Gender differences in performance under competition are well-established in the behavioral economics literature (e.g., Gneezy et al. 2003; Niederle 2016; Schram et al. 2019). Yet, this finding has barely been incorporated into the established literature on gender inequality in sociology and social psychology (e.g., Correll and Ridgeway 2006; Ridgeway 2014). The dominance of economists in the gender and competition literature leaves an abundance of accumulated knowledge on the causes and consequences of gender inequalities unused. Indeed, a better understanding of gender inequalities requires an exchange between these social sciences. For this reason, our exploration of the underlying causes of gender differences in competitive settings is guided by important insights from the sociological and social-psychological approach. In particular, we will argue that expectation states theory (Berger, Conner, and Fisek 1974), status characteristics theory (Correll and Ridgeway 2006), and the stereotype content model (Fiske et al. 2002), all have direct implications for understanding gender differences in competitive environments.

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<sup>2</sup> When referring to a 'mechanism' we apply the concept as discussed by (i.a.) Kazdin (2007). A mechanism describes "the processes or events that are responsible for [a] change; the reason why change occurred or how change came about" (Kazdin 2007, p.3).

We rely on such inputs from sociology and social psychology to motivate two principal mechanisms that can potentially explain the observed gender differences in performance under competition. These two mechanisms are the activation of (1) *beliefs about gender differences in performance*; and (2) a *warmth stereotype* that prescribes that women should take into account how their actions affect others.<sup>3</sup> By identifying potential explanatory mechanisms, we hope to contribute to a better understanding of the *processes* that lead to gender inequalities under competition.

Our results indicate that in the absence of any competitive dimension men and women perform equally well. Any competitive dimension, however, leads to women doing worse than men. We show that these results can be explained by men's beliefs that they are better than women under competition, and by women's adherence to a prescribed stereotype of not harming others. In line with sociological insights that gender differences in behavior are often context dependent, our findings indicate that differences in how men and women perform under competition are endogenous to situational contexts.

## **GENDER AND COMPETITION IN ECONOMICS**

In economics there is now an established strand of experimental research on gender differences in relation to competitive circumstances. Two related but distinct issues have been studied. First, starting with Gneezy et al. (2003) there is a stream that studies gender differences in performance under tournament incentives, that is, in an environment where only top performers obtain a scarce

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<sup>3</sup> The warmth stereotype is also based on beliefs. As discussed below, however, it reflects a 'prescriptive' stereotype about how women ought to behave as opposed to a 'descriptive' stereotype of how they actually are (Prentice and Carranza 2002).

resource (as opposed to a situation where rewards are proportional to performance). It has been repeatedly observed that under such rivalry for resources women underperform relative to men. Second, following Niederle and Vesterlund (2007) there is a stream of work that studies gender differences in the disposition to work under competition, measured by the willingness to enter a tournament. These studies show that, compared to men, women tend to avoid competitive environments when they can. In both streams, the observed gender differences under competition appear to be quite robust. In her recent survey of the experimental literature in economics on gender, Niederle (2016) writes that the evidence for gender differences in competitiveness is more solid than that for gender differences in altruism or risk aversion (two other behavioral features that have been studied extensively).<sup>4</sup>

The literature on gender and competition in economics has been very influential in establishing the importance of competition for creating gender differences. It has, however, focused very strongly on one dimension of competition – rivalry for resources – and much less so on the effects of the ranking of individuals that competition involves. Various recent studies (Schram et al. 2019; Brandts, Gërkhani, and Schram 2020; Gërkhani 2020) show that social-status ranking creates a stark difference in men’s and women’s performances in the absence of any rivalry for resources. When there is no social-status ranking (and no rivalry for resources), they find no gender differences in performance. With social-status ranking, men perform statistically significantly better than women.

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<sup>4</sup> For earlier surveys, see Niederle and Vesterlund (2011) and Azmat and Petrongolo (2014).

Previous research in economics tends to focus less on possible mechanisms behind observed behavior under competition. This may be due to economics having been traditionally more focused on (equilibrium) outcomes than on the processes leading to outcomes. In the next section we draw on some important insights from sociology and social psychology and discuss how these insights allow us to delineate the mechanisms that help us better understand gender differences in performance under competition.

## **GENDER INEQUALITY IN SOCIOLOGY AND SOCIAL PSYCHOLOGY**

### **Social Relational Contexts and Commonly Shared Gender Beliefs**

Sociological theory has generated several concepts that are useful in building a broader framework for studying competitive environments. We would argue that competition creates a 'social relational context', a setting extensively studied by Ridgeway and Correll (2004). This is defined as follows: "Social relational contexts comprise any situation in which individuals define themselves in relation to others in order to act." (Ridgeway and Correll 2004, p. 511). In such a context, expectation states theory and its best-known branch status characteristics theory apply (Berger, Wagner, and Zelditch 1985; Correll and Ridgeway 2006). Traditionally, expectation states theory has focused on social relational contexts in which individuals are oriented toward accomplishing a collective goal (Wagner and Berger 1997), that is, in 'collectively oriented task groups' (Berger et al. 1974). These include most work and educational contexts but also many informal and personal goal-oriented contexts. The theory argues that, when gender is effectively salient (i.e., easily perceivable) in such settings, beliefs about men's greater competence and status can implicitly shape the expectations that participants form

for their own competence relative to that of other group members in the setting. Gender is considered a powerful status characteristic, because beyond being salient, it carries wide or diffuse 'cultural expectations for competence', implying that men are typically better than women at most things and not only on specific tasks (Correll and Ridgeway 2006).

By now, numerous studies have shown that status hierarchies and their implications for individuals' performances are also present in 'individual evaluative tasks' without collective goal (Foschi, Lai and Sigerson 1994; Erickson 1998, Lovaglia et al. 1998; Correll 2001). Whenever individuals feel that they will be socially evaluated, they may experience some pressure to assess their competence relative to others "who they imagine are also being or have been evaluated" (Correll and Ridgeway 2006, p. 47).<sup>5</sup> This social comparison leads to a (possibly implicit) ranking of expected performance. When objective information on one's (relative) competence is lacking –and at times even when it is known (Foschi et al. 1994)– prominent characteristics such as gender, race or age may be used as a 'status characteristic' where one category (e.g., men) is believed to perform better than the other (women). Individuals may thus resort to a status characteristic like gender even when the task at hand is individualistic, as long as there are commonly shared gender beliefs that one gender is generally more competent and has a higher status than the other.

As argued by status characteristics theory, the more 'hegemonic' (Ridgeway and Correll 2004) the gender beliefs are –that is, the more widely they are shared across a society– the stronger will be the role of status hierarchies based on

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<sup>5</sup> This is related to the views of symbolic interactionists, who argue that for individuals acting alone the social environment is still highly relevant if they expect an evaluation of their performance (e.g., Stryker and Vryan 2006).



gender. Irrespective of actual abilities, hegemonic gender beliefs can change how people see their own ability and subsequently how they perform (Biernat and Kobrynowicz 1997; Spencer, Steele, and Quinn 1999; Foschi 2000; Correll 2004; Ridgeway and Correll 2004). When it is a priori ambiguous what constitutes a 'good' performance and it is also uncertain how others perform, hegemonic gender beliefs provide a benchmark for expectations about one's own performance. Consequently, once status hierarchies have been established, they can have a strong influence on performance in individual tasks (as confirmed experimentally by Lovaglia et al. 1998).

In short, when a status characteristic like gender is salient and diffuse, i.e., men are generally believed to outperform women, then even in individual evaluative tasks men are predicted to indeed outperform women. Moreover, both women themselves and outsiders will consider women less 'able', even if they perform equally to men (Correll and Ridgeway 2006, p. 47). Such beliefs –while suppressing women's performance– may have the opposite effect on men, making them believe to be better and boosting their performance (Correll 2001).

These predictions are highly relevant for gender differences in performance under competition. Status characteristics theory can be directly applied to the two dimensions of competition. For status-ranking, this is perhaps clearest. Social-status ranking implies an explicit social evaluation (Lovaglia et al. 1998) while such an evaluation is implicitly made by an individual in private ranking (Gërkhani 2020). As for the rivalry-for-resources dimension, the social evaluation involves a dichotomous ranking dividing those who obtain the resource from those who do not. Hence, when competition involves either a gendered salient task or a mixed-gender setting where a comparison with the other gender

category becomes salient, gender is expected to come into play as a status characteristic. Indeed, a salient gendered task and a mixed-gender setting have traditionally been considered as two important scope conditions for status characteristics theory to apply (Ridgeway and Correll 2004). Under these conditions, hegemonic gender beliefs evoke 'stereotype threats' (Steele 1997) and 'social evaluative threats' (Dickerson and Kemeny 2004) that may negatively affect women's performance. We propose that such beliefs may also be activated by another characteristic of the social relational context. This is the context of competition *per se*, which may serve as an "environmental trigger" (DiMaggio 1997, p. 279) that activates gender beliefs and stereotypes.<sup>6</sup>

We thus expect social evaluative threat to arise in competitive settings. This is because one is explicitly compared to others (the status-ranking dimension of competition) and because one ends up either as a 'winner' or as a 'loser' of the competition (rivalry for resources). In comparison to performing in a non-competitive environment, the heightened state of social evaluative threat that comes with competition *per se* could make men and women more likely to act on the beliefs that they hold. In other words, the hegemonic gender beliefs that men are better than women will be more strongly activated in a competitive environment, which in turn will affect individual performances. In this way, gender may come into play as a status characteristic in the social relational context of

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<sup>6</sup> See Castilla and Benard (2010) for a similar line of argument about meritocracy.

competition because of the gendered-salient task being competed on, because of a mixed-gender environment, or because of the competition per se.

In our experimental studies, we create distinct environments (or ‘arenas’) in which individual tasks are conducted. These environments differ in the competitiveness of the relational contexts involved. This distinction allows us to vary the extent to which gender beliefs are activated by competition per se, and thus, how competition may impact men’s and women’s performances (Deaux and LaFrance 1998; Ridgeway and Smith-Lovin 1999). When the context involves no explicit comparison with others’ task performance, gender beliefs are expected not to be explicitly activated. Nevertheless, the mere fact that one knows that others have done, are doing, or will do the same task may *implicitly* activate such beliefs (Ridgeway and Correll 2004). This has the following consequences for our experimental setting. With competition, the environment we create involves *explicitly* comparing individual task performances. Without competition, they may be implicitly activated. We expect gender beliefs to be more strongly activated in the former case.

Beliefs about gender differences play a key role in our argument that competition causes gender differences in performance. Indeed, as discussed above, gendered beliefs are one of the mechanisms in our theoretical understanding of this causal relationship. The next section provides a more detailed discussion of our mechanisms and their role in explaining the relationship between competition and gender differences in performance.

## Social Relational Contexts and the Warmth Stereotype

Aside from gendered beliefs related to competence, a social relational context (like competition) may also activate other stereotypical behavior. In particular, while men are perceived to be more competent, the ‘stereotype-content model’ in social psychology argues that women are expected to be ‘warmer’ than men (e.g., Ebert, Steffens, and Kroth 2014).<sup>7</sup> In this context, warmth refers to being, e.g., empathetic, good natured, sincere, and caring (Ebert et al. 2014; Connor and Fiske 2018); a stereotype that originates from traditional gender roles. Importantly, such a stereotype is not descriptive of how women behave *per se*,<sup>8</sup> or even how women are believed to be. Instead, this stereotype *prescribes* expected gender behavior both in terms of what women should and should not do in certain situations. As described by Heilman and Okimoto (2007, p. 81):

“The dictates of prescriptive sex stereotypes are highly specific and widely shared. They specify that women should behave communally, exhibiting nurturing and socially sensitive attributes that demonstrate concern for others, such as being kind, sympathetic, and understanding. They also specify what women should not do—engage in behaviors typically prescribed for men that are thought to be incompatible with the behaviors prescribed for women. Thus,

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<sup>7</sup> Fiske et al. (2002) allow for various mixed stereotypes beyond the warmth-competence dichotomy. As will become clear from the arguments that follow, the warmth-competence distinction suffices to explain the effects of gender differences in competition.

<sup>8</sup> The empirical evidence is mixed on whether women are warmer towards others than men. On the one hand, Stuijzand et al. (2016) find in two observational studies that female adolescents are more empathic than male adolescents and Willer, Wimer, and Owens (2015) report that men give less to poverty relief than women do (and attribute this to gender differences in levels of empathy). On the other hand, in an extensive survey of the experimental literature, Niederle (2016) finds no evidence of a gender difference in altruism. This mixed evidence reinforces the idea that such gender differences may be situationally dependent.

agentic behavior, behavior that demonstrates dominance, competitiveness, and achievement orientation, is generally considered out of bounds for women.”

The latter prescription implies that women should avoid success in competition and should instead exhibit communal behavior.

It follows that gender differences in warmth are not to be considered stable behavioral tendencies that are exogenous to situational contexts. Women may, however, show more warmth than men because it is expected from them in specific interactions. In fact, women may expect sanctions, retribution, conflict, or diminished likeability for ‘cold’ behavior, such as performing relatively better than others (e.g., Heilman et al. 2004). Combining an audit study with a survey experiment, Quadlin (2018) finds that competence and commitment are highly valued by employers when considering men applicants, while likeability is perceived more important for women applicants. As a consequence, high-achieving women are viewed with skepticism, while sociable moderate-achieving women are highly rated. Bursztyn, Fujiwara, and Pallais (2017) report similar results for the ‘marriage market’. They find that three-quarters of single women at an elite US MBA program report having avoided activities they thought would help their careers to prevent looking ambitious, assertive, or pushy. They are more likely to have avoided these activities than non-single women or men. For more related evidence, see also King et al. (2017) and Gino, Wilmuth, and Brooks (2015).

The question, then, is how someone who is expected to exhibit warmth behaves in a competitive environment. Because one’s standing in a competition is relative, competitive success imposes costs on others (Frank, 2004; Willer et al. 2013). ‘Warm’ behavior in competition then involves taking into account the costs

that success invokes in one's competitors. In particular, a warm response would involve avoiding these costs by reducing one's own chances of competitive success.

In summary, an environment where gender is salient may yield hegemonic stereotype beliefs that women *should* behave in a way that exhibits warmth. Such beliefs are reinforced by sanctions when women do not behave accordingly. In turn, displaying warmth may be an important attribute that affects behavior in a competitive environment. In this line of reasoning, relative to men, women may underperform in competition in order to diminish the costs to others.

### **EXPLANATORY MECHANISMS**

A variety of supply- and demand-side explanations have been advanced in the literature to understand gender differences in the access to high-level positions in society.<sup>9</sup> Demand-side factors are barriers that hinder women's access to high positions, often related to different kinds of discrimination (e.g., Heilman and Parks-Stamm 2007; Neumark 2018). Supply-side factors are differences in perceptions held, decisions made, or behaviors enacted by men and women themselves, 'whether free or constrained', that contribute to gender differences (Ceci and Williams 2010; Gino et al. 2015).

Per design, our focus is on supply-side explanations, and in particular those that affect performance. Based on the literature discussed above, we consider two mechanisms that potentially influence behavioral outcomes under competition in our experimental studies. Aside from investigating directly whether the mechanisms are at play, we also dig deeper by analyzing in more detail how they operate. We do not claim this to be an exhaustive list of supply-side factors. For

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<sup>9</sup> See Gino et al. (2015) for a summary of the most-heard demand- and supply-side explanations.

example, fertility choices, work-home balance, career preferences and ability differences have all independently or in combination been shown to be important for understanding gender differences in performance (e.g., Ceci and Williams 2010). Our choice of mechanisms is guided on the one hand by the existing theoretical and empirical knowledge of the relationship between competition and gender differences and on the other by a desire for parsimony in the method we apply.

To start, Figure 1 summarizes the role of the two principal mechanisms that we consider, based on the sociology and social psychology literature discussed above. Both mechanisms describe direct causal links from competition to gender differences in performance. The importance of these mechanisms for understanding gender inequality is well established in sociology. Our contribution lies in showing how they are also activated under different competitive settings and how they explain the gender differences in competitive settings that have been primarily studied in economics.<sup>10</sup>

<Figure 1 about here>

The first mechanism, which we denote by M1, is based on the performance-beliefs-activation arguments provided above. If competition per se serves as an environmental trigger, then the degree to which beliefs about expected gender differences (related to a particular task) will be activated will vary with the competitiveness of the environment. To investigate this possibility, we will elicit beliefs under no competition and under diverse competitive environments. Note that at this stage, we do not know how either or both dimensions of competition

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<sup>10</sup> Such mechanisms are typically not studied in economics. One exception is a recent working paper by Buser, Cappelen, and Tungodden (2021). They study the role of fairness concerns in the willingness to compete. They find that fairness considerations cannot explain why women (relative to men) shy away from competitive environments. They do not, however, study the effects of these considerations on performance.

affect beliefs about gender differences in performance. For this reason, we will elicit such beliefs separately for both rivalry for resources and social-status ranking. If either of these competitive environments triggers a social evaluative threat where gender is salient, we should observe stronger beliefs that men perform better than women under one or both dimensions of competition than without competition. Because these beliefs are hegemonic, they are widely held. We therefore assume that such beliefs are held by men and women involved in a competitive setting, but also by observers who evaluate a competitive setting. Assuming a feedback from beliefs to behavior, we expect that for those competing, the beliefs of men performing better than women under competition will be self-fulfilling in the sense that they lead to men indeed performing better than women.

The second mechanism (M2) builds on the observation that competition generates an environment where a good performance has a negative impact on others, that is, there is a negative externality of good performance. As argued above, competition may then activate a prescriptive gender stereotype of women's warmth, where women are expected to show concerns about how their performance affects others. We will test this mechanism by creating an environment where the competition is with others who have already finished the competition in the past. In this setting, one's own competitive success has no consequences for others and concerns for others should play no role.

Note that our two main mechanisms are not completely orthogonal. As mentioned in fn. 3, the warmth stereotype is also based on beliefs. Moreover, the warmth stereotype may play a role in the activation of beliefs about expected gender differences. Even if this is the case, however, we expect it to be one of



multiple ways in which these beliefs are activated and therefore opt for a separate analysis of the two mechanisms.

To further understand how these mechanisms operate, we explore two additional questions. These are depicted in Figure 2, which builds on Figure 1.

<Figure 2 about here>

The first question, shown in the top panel, examines whether the process through which competition activates gendered performance beliefs and a prescriptive warmth stereotype –which consequently lead to gender differences in performance– is moderated by the *gender composition of the group of competitors*. As mentioned above, hegemonic gender beliefs are most expected to play a role in mixed-gender settings. This is because individuals in mixed groups can compare themselves to others, thus activating widely shared beliefs about gender differences in performance (Ridgeway and Correll 2004). Similarly, prescriptive stereotypes about women’s warmth may not be activated in non-mixed gender environments. As proposed above, however, such beliefs and stereotypes might also be activated and therefore affect performance by competition *per se* if the anticipation of rivalry or status ranking that this involves serves as an environmental trigger. In other words, even if competition is with others of the same gender, the mere fact that one is competing might generate M1 and M2. Though it is *a priori* unknown how the social evaluative threat caused by competition *per se* relates to that caused by a mixed gender environment, we intuitively expect that the mechanisms will be stronger when competition and mixed gender are combined than when competition is with others of the same gender.

If gender composition moderates the activation of gender beliefs and stereotypes under competition, women will underperform (relative to men) more

in a mixed-gender than in a same-gender competition. Indeed, studying rivalry for resources, Gneezy et al. (2003) find evidence of reduced gender differences under same-gender competition than when competition involves both men and women. Also, Niederle and Vesterlund (2010) argue that girls' performance on math tests and their willingness to compete in high-stakes testing environments are influenced by the gender of the other competitors and test takers. This is confirmed in a high-stakes field setting by Van Dolder, Van Den Assem, and Buser (2020). We will investigate whether these findings replicate in our data and whether they also hold for the status-ranking dimension of competition. Note that in this theoretical reasoning, we assume that the gender composition under competition affects performance by moderating the activation of mechanisms M1, gendered performance beliefs, and M2, prescribed warmth stereotype. Empirically, we will test whether the gender composition of the group of competitors affects gender differences in performance; we represent the intermediary position of beliefs and stereotypes by the dashed-line box in the top panel of Figure 2.

The second additional question that we explore to further understand how the two principal mechanisms operate is depicted in the lower panel of Figure 2. We ask whether the gender effects of competition on performance (via mechanisms M1 and M2) are caused by differential effects on effort. The idea here is that either of the two mechanisms may demotivate women relative to men (Correll 2001, p. 1699; Correll and Benard 2006), which may make them reduce their efforts and subsequently lead to gender differences in performance. Such demotivation was observed in a recent study, that tries to understand the gender gap in the highly competitive STEM fields (Penner and Willer 2019). The authors argue that not only do many women 'under-persist' by failing to pursue careers in

science and mathematics despite sufficient qualifications, men also often make an extra effort and ‘over-persist’, by choosing STEM even when it might lead to less success than non-STEM options would. A possible explanation for this discrepancy originates in the demand side. In STEM fields high-achieving women are considered less committed (Rivera 2017) or less ‘likeable’ (Quadlin 2018). Competition may play an important role in this line of argument. It is precisely in highly-competitive environments that men are believed to outperform women and that men who excel are considered differently than women who excel. In short, competition may make women feel demotivated or withdrawn due to expected poorer performance or negative consequences of performing better than men. Such a response to these beliefs and stereotypes will make women put in less effort than men. In turn, these effort responses could yield a gender gap in performance and thereby contribute to gender inequality.

## **FIVE STUDIES**

Our research questions, the two principal mechanisms, and their elaboration lead us to conduct five distinct studies. Study 1 delineates the impact of the rivalry and status-ranking dimensions of competition and their interaction on performance. The focus in Study 2 is on the first mechanism (M1), whereas Study 3 explores the second mechanism (M2). Studies 4 and 5 consider the further questions depicted in Figure 2. We provide detailed overviews of the experimental designs and procedures of our five studies in Appendix A. In what follows, we highlight the elements of the design that are necessary to follow the line of argument in the main text. All data used in this study are publicly available at <https://www.creedexperiment.nl/creed/>.

## STUDY 1 – DISENTANGLING THE DIMENSIONS OF COMPETITION

### Experimental Design

For Study 1 we conducted sessions with six treatments involving performance on a cognitive task under different combinations of rivalry and ranking. The task is a search-and-sum exercise taken from Weber and Schram (2017). Participants are asked to search the highest number in each of two 10x10 matrices and to add these up. They do so repeatedly for 15 minutes.<sup>11</sup> Treatments vary in the monetary incentives participants face and in the information they and others receive related to their social-status ranking.

The way in which participants are rewarded for task performance is our first treatment variable. As in Gneezy et al. 2003, we use two different payment schemes. One is an individual piece-rate payment, with each correct answer yielding €1. The other is a tournament payment scheme, where only the two participants with the highest score in a group of six receive €3 for each correct answer, while the remaining four receive nothing. The idea underlying this treatment variation is that the tournament payoff creates a rivalry for resources, while the piece rate does not. For this reason, we use the acronyms *nRfR* (no rivalry for resources) and *RfR* (rivalry for resources) for the piece-rate and tournament incentive treatments, respectively.

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<sup>11</sup> Our participants thus perform a so-called real-effort task (as opposed to stated effort, which is often used in experimental work). Real effort is a necessary component of our design, *i.a.*, because we consider exerted effort as one of our explanatory mechanisms. As an alternative real-effort task, we could have used the summation task applied in Niederle and Vesterlund (2007). Shurchkov (2012, fn 21), however, reports evidence of a stereotype threat in this task *per se*, where women feel a priori that men have an advantage. To avoid this, we decided to use a task that we have applied before (Weber and Schram 2017; Schram et al. 2019). In these previous studies there was no evidence of gender differences and our data for B-players in this Study 1 confirm this. This is why we believe there to be no stereotype threat for the task *per se*. This result allows us to focus on the effects of competition on gender inequality, without needing to deal with noise from the task itself.

Our second treatment variation is used to study the status-ranking dimension of competition, building on Schram et al. (2019). In particular, we vary whether participants receive ranking feedback. In one treatment, participants receive no such feedback; we call this the no-ranking treatment (*nR*). In two other treatments, participants do receive feedback, which may be one of two types. Recall that status ranking has two distinct characteristics. It informs an individual of her own ranking vis-à-vis others and it informs others of her ranking. By varying the feedback participants receive, we isolate the former. This allows us to differentiate between the effects the two characteristics might have. In the first type of feedback participants are only informed about their own ranking; they are privately given this information. We call this the private-ranking treatment, *PR*. The second type of feedback is provided in the social-status ranking treatment (*SR*), which involves participants (individually, and one at a time) reporting their score and rank to a peer, who does not take part in the real-effort task and whose only task consists in listening to these reports. The peer is the same for all participants in a session, so that this person will end up knowing the rank of each of the participants in the real-effort task. In all cases, the ranking condition is common information. Importantly, both private and social-status ranking information consist in knowing one's own position in the ranking, but not the complete ranking of all relevant participants. The only person who has this complete knowledge is the peer.

We crossed tournament pay and piece-rate pay with the three ranking treatments in a full-factorial design, yielding the total of six treatments. Table 1 provides an overview of these treatments.

<Table 1 about here>

## Testable Hypotheses

Our first goal is to study the relative importance of rivalry for resources and social-status ranking and their interaction. For this purpose, we combine the designs of Gneezy et al. (2003) and Schram et al. (2019). As a consequence, we expect to replicate the Gneezy et al. (2003) results on the effects of rivalry for resources when there is no status ranking ( $RfR/nR$ ) and, *vice versa*, we expect to replicate the Schram et al. (2019) results on the effects of status ranking when there is no rivalry for resources ( $nRfR/SR$ ).<sup>12</sup> This yields, respectively, Hypotheses 1.1 and 1.2. Preceding these, our first hypothesis (1.0) is that there are no gender differences in performance if neither of the two dimensions of competition is active ( $nRfR/nR$ ). This assumes that there is no stereotype threat related to the task per se, that is, that gender beliefs and stereotypes are not activated when individuals do the task in isolation. This assumption is based on the benchmark results summarized in Gërxhani (2020).

### Hypothesis 1

- 1.0: Without rivalry for resources and without either kind of status ranking, men and women perform equally. In other words, no gender differences in performance are expected in the treatment combination  $nRfR/nR$ .
- 1.1: Without either kind of status ranking, men perform better than women under rivalry for resources. In other words, men are expected to perform better than women in  $RfR/nR$ .

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<sup>12</sup> Cf. Table 1 for a reminder of the acronyms we use.

1.2: Without rivalry for resources, men perform better than women under either kind of status ranking. In other words, men are expected to perform better than women in *nRfR/PR* and *nRfR/SR*.

An important part of our research questions concerns the interaction between rivalry for resources and the social-status ranking dimensions of competition. A priori, we can conceive of no solid theoretical basis for predicting the interaction, nor do we have previous results to rely on. We can think of two opposing ways in which this interaction may take place. We illustrate this for mechanism M1 (gendered beliefs). If the effects of the two dimensions are completely separated, then we should consider them as complements. In that case, gender beliefs are already activated if there is only status ranking<sup>13</sup>. They are activated more strongly, however, if rivalry for resources is added. With complements the same holds if status ranking is added to a pre-existing rivalry for resources. As a consequence, the combination of rivalry for resources and status ranking will yield a larger gender difference than either dimension of competition alone. On the other hand, both dimensions of competition might have the same effect on men and women but without reinforcing each other. In other words, the two dimensions might act as substitutes. With gendered beliefs, this would mean that these are already activated when one of the dimensions is in place, while adding the other dimension does little to strengthen these beliefs. There is then somehow a 'ceiling' for gender performance differences.<sup>14</sup> Because we have no hypothesis

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<sup>13</sup> For ease of presentation, we do not distinguish here between private- and social-status ranking. When formulating our empirical question below, we will make this distinction.

<sup>14</sup> To illustrate, assume that there is no performance difference without any competition and that men score  $x$  units better than women under dimension 1 and  $y$  better under dimension 2. Assume without loss of generality that  $y > x$ . If the two dimensions are perfect complements, then adding dimension 2 to dimension 1 or vice versa increases the gender difference to  $x + y$ . If they are perfect substitutes, then adding dimension 2 to dimension 1 increases the gender difference from  $x$  to  $y$  while adding dimension 1 to dimension 2 keeps the gender difference at  $y$ .

about whether the competitive dimensions are complements or substitutes, we pose the following empirical questions:

### Empirical Questions 1.

1.1 Are private ranking and rivalry for resources complements or substitutes?

In other words, are gender differences in  $RfR/nR$  similar to or smaller than in  $RfR/PR$  and are gender differences in  $nRfR/PR$  similar to or smaller than in  $RfR/PR$ ?

1.2 Are social-status ranking and rivalry for resources complements or substitutes? In other words, are gender differences in  $RfR/nR$  similar to or smaller than in  $RfR/SR$  and are gender differences in  $nRfR/SR$  similar to or smaller than in  $RfR/SR$ ?

## **Results**

Study 1 was run at the BLESS laboratory of the University of Bologna with 432 participants (219 men, 213 women).<sup>15</sup> Table 2 offers an overview of the numbers of men and women in each treatment (we aimed at a minimum of 25 men and 25 women in each treatment; cf. the power analysis reported in Appendix A). It also identifies four outliers that were excluded from the analyses and shows the treatments they were in. These four participants were identified as outliers because they repeatedly entered sums that were impossible, given the task at hand. Our results do not change if we include these outliers.

<Table 2 about here>

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<sup>15</sup> In all studies, students from the BLESS subject pool were invited to participate on a voluntary basis. We randomized the sessions available to any participant wanting to register for the experiment. The BLESS subject pool consists of approximately 5500 potential participants. About 85% of these are undergraduate or graduate students, evenly spread across all disciplines of the University of Bologna.



Figure 3, below, shows average performance for men and women in each of the six treatment combinations of Study 1. We use this to first consider hypothesis 1.0, which predicts no gender differences in  $nRfR/nR$  (the case without competition). The figure indeed shows only a small performance difference (the difference is 1.2 correct summations in 15 minutes). This difference is not statistically significant at the usual levels (PtT;  $p = 0.260$ ,  $N = 60$ )<sup>16</sup> when testing a null of no gender difference against an alternative hypothesis that a gender difference exists. Note, however, that our hypothesis 1.0 does the opposite; it has an alternative hypothesis of no gender difference. This invalidates testing against a null of no difference (e.g., Raftery 1995). Finding support for the hypothesis requires testing our hypothesis of no difference against a hypothesis where there is a difference. To do so, we apply Bayesian testing (Berger 2013). In particular, we compare two models that predict outcomes in  $nRfR/nR$ . One model is based on our hypothesis that there is no gender difference in performance. The other model predicts that behavior in  $nRfR/nR$  is similar to the behavior observed when there is (only) social-status ranking,  $nRfR/SR$  (where a gender difference is observed, as discussed below). Bayesian analysis then allows us to determine the likelihoods that the behavior that we observe in  $nRfR/nR$  can be attributed to either of the two models. The results show that ‘our’ no-difference hypothesis is three times more likely to have generated the observed behavior than the  $nRfR/SR$ -based model. This provides evidence in favor of hypothesis 1.0. More details are presented in Appendix C.

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<sup>16</sup> PtT refers to a permutation t-test, as explained in Appendix A.

To investigate hypotheses 1.1 and 1.2, Table 3 shows the mean performance difference between men and women in the various treatments and the  $p$ -values for PtT tests on the null that there is no gender difference.<sup>17</sup> This shows that the gender differences in the other five treatments are much larger than in  $nRfR/nR$ , and that men perform significantly better than women in all these cases.

<Figure 3 about here>

<Table 3 about here>

For now, we disregard the last two columns of Table 3 and focus on the cases where the two dimensions of competition are not simultaneously active. Hypothesis 1.1 predicts that men perform better than women when there is only rivalry for resources ( $RfR/nR$ ). We find strong evidence in favor of the hypothesis. This replicates the results first observed by Gneezy et al. (2003) that rivalry for resources makes women underperform in comparison to men. Hypothesis 1.2 predicts that men perform better than women when there is only (private or social-status) ranking ( $nRfR/PR$  and  $nRfR/SR$ , respectively). Again, both predictions find strong support in our data. The effect for  $nRfR/SR$  replicates the effects of social-status ranking reported in Schram et al. (2019). Here, we observe a significant gender difference even when participants are only privately informed about their ranks ( $nRfR/PR$ ), though this difference is smaller (2.71) than when a peer is informed about this ranking (3.45). We show in Appendix C that this difference-in-difference (2.71 vs. 3.45) is not statistically significant at the usual levels ( $p=0.45$ ). All in all, we find support for each of the hypotheses 1.0–1.2.<sup>18</sup>

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<sup>17</sup> As just discussed, for the  $nR$  case the more appropriate statistical procedure is Bayesian. Nevertheless, for comparability, Table 3 also shows the result of the PtT for  $nR$  ( $p=0.256$ ).

<sup>18</sup> Below, we investigate whether the observed gender differences under competition can be attributed to women underperforming, men overperforming, or both. Here, we follow much of the literature in focusing on the net effect: the gender difference in performance within each treatment.

*Result 1a:* Our data support the hypothesis that there is no gender difference without competition of any kind (hypothesis 1.0). When there is either rivalry for resources or (private or social) status ranking, men perform significantly better than women (hypotheses 1.1 and 1.2).

Now consider the joint effects of rivalry for resources and status ranking on performance. This joint occurrence of two dimensions of competition has, to the best of our knowledge, not been previously studied explicitly. Notice in Table 3 that the gender difference is highly significant in both cases when testing against a null of no gender difference. Empirical Questions 1.1 and 1.2 ask whether or not the gender difference when both dimensions of competition are active is different than when participants only face one dimension, that is, whether the dimensions are complements or substitutes. To address this, we adopt a Bayesian approach.<sup>19</sup>

The substitutes model predicts that the gender difference observed when only one dimension of competition is active does not change if a second dimension is added. Note, however, that in the data the gender difference in (only) one dimension might be different than in (only) the other. For example, Table 3 shows that the difference is 3.63 when there is only rivalry ( $RfR/nR$ ) and 2.71 when there is only private ranking ( $nRfR/PR$ ). When both dimensions are active ( $RfR/PR$ ) the difference is 4.89. To test the substitutes model, it may matter whether we compare 4.89 to 3.63 or to 2.71. We solve this by making both comparisons. In other words, we compare  $RfR/PR$  to  $RfR/nR$  (4.89 to 3.63) and to  $nRfR/PR$  (4.89 to

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<sup>19</sup> In particular, we compare the probability (1) that the substitutes model explains our data, to the probability (2) that the complements model explains the data. Dividing the probability (1) by (2) gives the so-called odds ratio. An odds ratio of 10/1 implies that the substitutes model is 10 times as likely to have generated the data than the complements model, while an odds ratio of 1/10 implies the reverse.

2.71), separately. We refer to the treatment that  $RfR/PR$  is compared to as the “baseline comparison”.

In the complements model, the gender difference increases when adding a second dimension. Once again, we need to specify the baseline comparison that is made. Here, we also need to predict by how much the gender difference will increase. To do so, we take as a benchmark a comparison to the case without competition,  $nRfR/nR$ . By comparing the case with a single dimension of competition to this non-competitive treatment, we obtain a benchmark prediction of how this single dimension affects gender differences. The model of complements predicts that the gender difference will increase by the same amount when adding that dimension to the another. For example, the gender difference without competition ( $nRfR/nR$ ) is 1.2, and with only rivalry ( $RfR/nR$ ) it is 3.63. The benchmark prediction for the effect of rivalry is then  $3.63 - 1.2 = 2.43$ . The complements model thus predicts that the gender difference is also 2.43 larger in rivalry with private ranking ( $RfR/PR$ ) than in only private ranking ( $nRfR/PR$ ).

The preceding description summarizes the general procedure that we used to study empirical questions 1.1 and 1.2. A more detailed description of the statistical implementation is presented in Appendix C. Table 4 summarizes the results.

<Table 4 about here>

The results for combining rivalry for resources with private ranking do not provide much support for either model relative to the other. For example, when adding rivalry to private ranking (column 2), a model that assumes that they are complements is more than twice as likely to be correct. For the reverse (adding private ranking to rivalry) both models are more or less equally likely. The evidence for combining rivalry for resources with social-status ranking, however,

strongly favors the model of substitutes. In both cases (columns 4 and 5) this model is more than 24 times more likely to be correct than a model where they are complements. This gives our next result.

*Result 1b:* Social-status ranking and rivalry for resources are much more likely to be substitutes than complements. Neither the complements model nor the substitutes model is favored when combining private ranking and rivalry for resources.

From these results we conclude that the task we use does not generate gender differences in performance when done in a non-competitive setting, while either dimension of competition does generate such gender differences. Moreover, the effects of rivalry for resources and social-status ranking are similar and do not reinforce each other but rather act as substitutes.

## **MECHANISMS**

### **Study 2 – M1: Beliefs**

The first mechanism that we consider (M1) is that competition activates *beliefs* about how men and women are expected to perform in the cognitive task.<sup>20</sup> The previous literature has discussed not only a role of beliefs, but also the activation of these beliefs by the social relational context. As we argue above, gender beliefs might reflect the gendered task being competed on or the gender of the people one is competing with, but they might also be activated by an environmental trigger such as competition itself. Investigating whether beliefs can be a mechanism behind the performance differences in Study 1 then requires eliciting such beliefs

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<sup>20</sup> Though our focus here is on the supply side of the labor market, it is interesting to note that beliefs may also affect gender discrimination at the demand side of the labor market (Coffman, Exley, and Niederle 2021, Sarsons et al. 2021).

in relation to the specific competitive conditions under which performance takes place.

In three new sessions, we therefore elicited beliefs about gender differences in performance in the absence of any competitive setting ( $nRfR/nR$ ), under (only) social-status ranking ( $nRfR/SR$ ), and under (only) rivalry for resources ( $RfR/nR$ ). These sessions were run at the BLESS laboratory in Bologna, Italy, with 96 participants (48 men, 48 women)<sup>21</sup>. Each session consists of four parts. In the first, participants got acquainted with the task by doing the summation task with piece-rate remuneration of €0,50 per correct answer. In the following three parts, we explained that previous participants (i.e., those of Study 1) (i) had done the same task for €1,00 per correct answer; or (ii) had done the same task for €1,00 per correct answer and then had to report their rank to a peer; or (iii) had done the same task and received €3,00 per correct answer (only) if they were in the top two in a group of six.<sup>22</sup> In each part, they were asked to predict whether the mean score of men was better than that of women or vice versa. We excluded the possibility of predicting exactly equal mean scores because this is an event with extremely low probability. One of these three parts was randomly chosen at the end of the experiment and every participant that had predicted correctly in that part received an additional payoff of €5.00.

Our design of eliciting beliefs, (1) by creating distinct environments that differ in the competitiveness of the relational contexts involved; and (2) by asking participants in Study 2 to predict how well men and women did in Study 1, is based

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<sup>21</sup> It is a coincidence that the numbers of men and women are equal; the power analysis is reported in Appendix A.

<sup>22</sup> To avoid order effects, each of the four sessions had a different order of (i), (ii), (iii) in parts 2-4. The order does not affect the reported beliefs, so we pool the data in our analysis. More details are available upon request.

on the notion of ‘hegemonic beliefs’ of status characteristic theory, as discussed above. Hegemonic beliefs about gender differences are widely shared beliefs that women are less ‘able’, even if they are as competent as men. Because these beliefs are widely held, they are shared by men and women involved in a competitive setting, but also by observers who evaluate a competitive setting (Correll and Ridgeway 2006, p. 47). We therefore assume that performers’ beliefs in Study 1 about men’s and women’s performance are similar to evaluators’ beliefs in Study 2 about men’s and women’s performance in Study 1.<sup>23</sup>

As a measure of beliefs, we use the fraction of participants (per gender) that predict that women will perform better than men. To derive testable hypotheses for these sessions, we assume that gender beliefs are not systematically activated for the case where the task is done in isolation (that is, without competition). In other words, we assume that there are no descriptive gender stereotypes for this task. As mentioned above, this assumption finds support in the benchmark results summarized in Gërkhani (2020). Any belief that women do better than men or *vice versa* is then driven by individual idiosyncrasies and roughly half the participants are expected to predict that women will do better. Under either dimension of competition, however, we assume gender beliefs to be activated and we expect that less than half of the participants believe that women will do better than men.<sup>24</sup> This gives:

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<sup>23</sup> We are grateful to an anonymous reviewer for pointing this out.

<sup>24</sup> We base the number of participants on a power analysis that would allow us to detect fractions of 0.3 or lower and 0.7 and higher (cf. Appendix A). We accept a wide margin of fractions that we might not detect (0.3-0.7) because our main interest lies in the effects of belief activation on performance, not in the beliefs *per se*. We do not expect small differences in beliefs to have a large impact on performance. Nevertheless, we see an investigation of the beliefs themselves as an interesting topic for future research.

## Hypothesis 2

- 2.1: 50% of the women and 50% of the men believe that women perform better than men when no competitive dimension is active.
- 2.2: Less than 50% of the women and less than 50% of the men believe that women will perform better than men when the task is done under social-status ranking.
- 2.3: Less than 50% of the women and less than 50% of the men believe that women will perform better than men when the task is done under rivalry for resources.

Table 5 summarizes the elicited beliefs by showing the fraction of participants that think that women perform better than men in the environment concerned. Without competition, it holds for both men and women that the proportion that believes that women are better does not differ statistically significantly from 0.5 (as indicated by the binomial test result reported in the final column). We conclude that, in support of hypothesis 2.1, men and women believe there to be no performance differences when there is no competition.<sup>25</sup>

<Table 5 about here>

This provides further support for our assumption that there are no descriptive gender stereotypes for this task. When there is (only) social-status ranking, women expect no difference, but men believe that women will underperform relative to men (the binomial test has a significance level of 0.029). This supports hypothesis 2.2 for men, but not for women. Finally, with only rivalry for resources, men again

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<sup>25</sup> Ideally, we would prefer to conduct a Bayesian analysis for this hypothesis of no expected gender difference. This would require, however, specifying a hypothesis predicting a specific fraction of women and a specific fraction of men believing that women score better than men. Bayesian analysis could then be used to compare this alternative to our hypothesis 2.1 that these fractions are 0.5. We are unaware of any suitable candidate for such an alternative.



expect underperformance by women relative to men while women do not. This supports hypothesis 2.3, but only for men.<sup>26</sup>

*Result 2:* The gender differences in performance that we observe under competition may be driven by men's beliefs about their performance under competition.

From this result we conclude that there is a difference between the role of beliefs for men and women, but only under competition. Men think that they will outperform women when submitted to either dimension of competition. Interestingly, these are precisely the cases where we indeed observe that men perform better than women. Men's beliefs thus become a self-fulfilling prophecy. On the other hand, competition does not appear to activate gender beliefs amongst women. Importantly, however, we only elicit first-order beliefs (i.e., 'what I think'). As argued in the status literature (e.g., Anderson et al. 2012, and Correll et al. 2017), second- and third-order beliefs (e.g., 'what I think that others believe') can be powerful in affecting those categories with lower status (women in our study). We will discuss this further in the concluding section.

### **Study 3 – M2: Warmth Stereotype**

In Study 3 we consider the second mechanism. Point of departure is that all treatments in Study 1 involving ranking or rivalry have one thing in common. This is that a participant's performance is compared to a group of participants who are performing the cognitive task at the same time. For such contemporaneous comparisons a participant's performance can have a negative impact on others in

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<sup>26</sup> Note that the fraction of women believing that women score better is higher under rivalry for resources (0.5) than without competition (0.4). This difference is, however, not statistically significant at the usual levels (proportions test,  $p=0.30$ ).

the group. These consequences stem from either reducing others' ranking (as in treatments with private ranking or social-status ranking), or reducing others' chances of winning the contest (as with rivalry for resources), or both. We proposed that competition may activate a *warmth stereotype*, where women are expected to show concerns about such a negative impact. In other words, the warmth stereotype is activated when two conditions simultaneously hold: (1) there is competition and (2) success in the competition has a negative impact on others (i.e., others suffer a lower rank or less success if one performs well).

To identify whether this mechanism may be at work under competition, we introduce a Study 3, which differs from Study 1 with respect to condition (2) but not with respect to (1). Put differently, Study 3 eliminates the negative impact on others while being otherwise equivalent to Study 1; we can then attribute any observed differences between the results in Studies 1 and 3 to the negative impact (2) in Study 1.<sup>27</sup>

We investigate the role of warmth stereotype in the treatment with private ranking but without rivalry - *nRfR/PR* (cf. Appendix A). In this treatment earning a high rank by definition makes other participants be ranked lower than they would have otherwise been. To circumvent this impact on others, we created a new treatment where this ranking is not vis-à-vis others in the same session. Instead, to determine a private rank, we randomly selected for each participant five other

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<sup>27</sup>Our behavioral measure of the warmth stereotype differs from the way it has typically been operationalized in the literature (Fiske et al., 2022). Other studies often rely on participants' self-reports of shared societal stereotypes about warmth traits (i.e., friendly, good natured, tolerant, trustworthy, warm, and sincere) of different groups. Our behavioral measure can be seen as complementary to such self-reporting measures; if shared warmth stereotypes are present, they will manifest themselves more strongly when others suffer from one's good performance under competition. Put differently, if participants in our experiment share the stereotype that women are expected to be warm, friendly and good natured, we assume that women will internalize this stereotype and perform worse if their competing behavior negatively affects others than when no one is affected.

participants from previous *nRfR/PR* sessions and anonymously ranked her performance in relation to theirs. Importantly, these others were not informed about this ranking. In this way, each participant in Study 3 is privately ranked in a group of six participants, but her rank cannot affect anyone else's rank and, therefore, cannot harm others. We denote this new treatment as *private historic ranking (nRfR/PHR)*. For this new treatment, we recruited 65 participants (34 men, 31 women) at BLESS in Bologna, Italy.

Because there is no impact of a good performance on others, we expect that a warmth stereotype will play no role in this new treatment. Therefore, we expect no gender differences in performance. This yields:

### Hypothesis 3

Women and men perform equally well when private ranking does not negatively affect any other participant. That is, there is no gender difference in performance in *nRfR/PHR*.

For a first impression of the results, Figure 4 shows mean performance of men and women in *nRfR/PHR* and compares this to the cases where there is no ranking (*nRfR/nR*) or private ranking within the same session (*nRfR/PR*). The figure suggests that the gender difference in the new treatment is comparable to the benchmark of no competition (*nRfR/nR*), and smaller than when private ranking affects others (*nRfR/PR*). Recall from Table 3 that the gender difference is 1.20 in *nRfR/nR* and 2.71 in *nRfR/PR*. In *nRfR/PHR*, the difference is 0.91 correct summations. This confirms the impression from the figure.

<Figure 4 about here>

Once again, hypotheses 3 predicts no difference and therefore requires Bayesian analysis. For this purpose, we compare a model with no gender difference to a

model with such a difference. For the no-difference case, we use  $nRfR/nR$  (no competition, where we observed no gender differences). Alternatively, if a warmth stereotype plays no role in the effects of private ranking, we expect that excluding the negative impact on others does not change anything and the gender difference in private historic ranking ( $nRfR/PHR$ ) will be similar to private ranking ( $nRfR/PR$ ). Thus, we compare a model where  $nRfR/PHR$  is like  $nRfR/nR$  to one where  $nRfR/PHR$  is like  $nRfR/PR$ . For more details, see Appendix C. The resulting odds ratio is 43 : 1 in favor of the former, indicating that an environment where own performance has no impact on others yields the same result as when there is no competition at all. This provides strong support for hypothesis 3:

*Result 3:* A warmth stereotype activated amongst women under competition is a possible mechanism underlying the gender differences in performance that we observe.

This result shows a gender difference in the role of a warmth stereotype under competition. Women appear more concerned about how their performance may impact others, which leads to women underperforming. Men do not appear to have such concerns, leaving their performance unaffected.

#### **Study 4 – Gender Composition**

The goal of this study is to explore whether the process through which competition activates gender beliefs and prescriptive stereotypes and consequently leads to gender differences in performance depends on the *gender composition of the group of competitors*. Our starting point is that a mixed-gender setting is an important scope condition for gender to come into play as a status characteristic. Therefore, in line with status characteristics theory and some empirical findings in behavioral

economics, we propose that both gendered beliefs and prescriptive stereotypes may be more strongly activated in mixed-gender environments, where competitors can directly compare themselves to those of different gender, than when all competitors have the same gender.

To test whether the gender composition affects behavior under competition, we organized additional sessions at BLESS in Bologna, Italy. Eight of these sessions consisted of only men, and the other eight of only women. We ran treatments with either only private ranking (*nRfR/PR*), only social-status ranking (*nRfR/SR*) or rivalry for resources with private ranking (*RfR/PR*) (cf. Appendix A). Because we expect that gender beliefs and prescriptive stereotypes are less likely to be activated in same-gender competition than in mixed-gender competition, we predict that women's performance will be less negatively affected in same-gender competition than in the mixed-gender case, while men will be less positively affected when grouped with only men. This gives:

#### Hypothesis 4

- 4.1: In the same-gender treatments, women perform better than in the corresponding mixed-gender cases.
- 4.2 In the same-gender treatments, men perform worse than in the corresponding mixed-gender cases.

For a first impression of the effects of gender composition, Figure 5 shows how men and women respond to same-gender competition.

<Figure 5 about here>

A first thing to notice is that gender differences in performance are more or less the same for mixed- and same-gender groups. In all three same-gender treatments, the gender difference is statistically significant (PtT; *nRfR/PR*:  $N = 59$ ,  $p = 0.016$ ;

*nRfR/SR*:  $N = 58$ ,  $p = 0.022$ ; *RfR/PR*:  $N = 72$ ,  $p < 0.001$ ). Thus, gender differences occur in same-gender competition just like we observed in mixed-gender competition. Moreover, the effects of gender composition on the performance of either gender in any treatment appear to be small. To formally test hypothesis 4.1, we compare women's performance in mixed- and same-gender groups for each treatment. In all cases, the null of no effect cannot be rejected (PtT; *nRfR/PR*:  $N = 61$ ,  $p = 0.328$ ; *nRfR/SR*:  $N = 63$ ,  $p = 0.937$ ; *RfR/PR*:  $N = 72$ ,  $p = 0.656$ ). For men (hypothesis 4.2), we also cannot reject the null of no difference in any case (PtT; *nRfR/PR*:  $N = 70$ ,  $p = 0.636$ ; *nRfR/SR*:  $N = 64$ ,  $p = 0.270$ ; *RfR/PR*:  $N = 72$ ,  $p = 0.539$ ).

*Result 4:* The process through which competition activates gender beliefs and prescriptive stereotypes, and leads to the gender differences in performance that we observe, does not depend on the gender composition of the group of competitors.

All in all, we conclude that the gender composition does not affect women's or men's performance. As discussed earlier, this suggests that gender beliefs and prescriptive stereotypes are also activated when competition is within-gender.

## **Study 5 – Effort**

This study asks whether the differential gender effect of competitive dimensions (via M1 and M2) is caused by gender differences in the effort provided. To answer this question we use the experimental data collected for Study 1, which provides information on men and women's effort levels in the task. The across-treatment pattern we observe for effort should then mirror what we found for performance.

This is formalized in hypothesis 5:

### Hypothesis 5

Women exert less effort than men when one or both dimension(s) of competition is (are) active, but not when there is no competitive dimension.

We directly measure effort in our experiment by the number of attempted summations. This number captures the visible outcome of effort as opposed to other dimensions, such as innate ability or concentration that are unmeasurable. For a first impression of the results, Figure 6 shows the mean efforts of men and women for each treatment reported in Study 1 (c.f. Figure 3).

<Figure 6 about here>

Eyeballing Figures 3 and 6 suggests that there is little correspondence in the patterns of effort and performance across treatments. Indeed, no clear pattern is obvious in Figure 6. For example, compared to the  $nRfR/nR$  benchmark of no competition, women make more effort (on average) in some treatments and less in others. The difference with the benchmark varies between  $-0.53$  and  $+2.24$  attempted summations. For women, none of the differences between, on the one hand, effort in the benchmark of no competition and, on the other, effort in any of the competition treatments is statistically significant at the 5% level. Men's effort is also not statistically significantly different than in the benchmark at the 5% level in any of the treatments with competition. As for within-treatment gender differences, the only significant effect at the 5% level that we observe is that men make significantly more effort than women in the benchmark of no competition (PtT,  $p = 0.046$ ,  $N = 60$ ). The benchmark is precisely the scenario where we observed *no* significant gender difference in performance. The big picture is that the strong pattern observed for performance (no significant gender difference in the benchmark of no competition; all differences significant in the competition treatments) is not mirrored in gender differences in effort. We thus reject hypothesis 5.

*Result 5:* The differential gender effect of competition is not caused by gender differences in effort.

To conclude, the effort mechanism cannot explain the performance differences that we observe under competition. As pointed out by an anonymous reviewer, however, we measure effort when participants are forced to compete. Alternatively, one could consider the effort to enter the competitive environment altogether. Studies in social psychology show that stereotype threats may distract from task focus and performance (e.g., Schmader et al. 2008), which may have stronger negative effects on participants' efforts to enter a competition than on their efforts once engaged in a competitive environment.

### **GENDER-SPECIFIC RESPONSE TO COMPETITION**

The rich data we have collected (altogether more than 750 active participants) allows us to address one final and important question. Given the gender differences that we observe under any competitive dimension, we ask whether this can be attributed to men responding positively to competitive incentives, or to women responding negatively. To optimize statistical power for this analysis we pool data for the two non-competitive environments we have ( $nRfR/nR$  and  $nRfR/PHR$ ), where 'non-competitive' refers to participants' performance having no negative effect on others. We also pool all of our competition treatments ( $nRfR/PR$ ,  $nRfR/SR$ ,  $RfR/nR$ ,  $RfR/PR$ ,  $RfR/PR$ ). This gives us 125 observations for the non-competitive setting (61 men, 64 women) and 344 observations with at least one competitive dimension (180 men, 164 women); note that we do not use the same-gender data for this analysis because our interest lies in uncovering the differences in gender gaps across treatments that we observe in the mixed-gender



environment (cf. Figure 3). Figure 7 shows mean performances for these categories.

<Figure 7 about here>

A first thing to observe is that comparisons at this level of aggregation confirm our earlier findings. In the non-competitive case, performance by men and women does not differ significantly (PtT,  $N = 125$ ,  $p = 0.122$ ). When at least one dimension of competition is active, men perform significantly better than women (PtT,  $N = 344$ ,  $p < 0.001$ ). Our goal here, however, is not to compare genders but to compare whether women or men perform differently with competition than without. We observe that men have on average 1.0 more correct summations when there is competition than when there is not. This difference is marginally significant (PtT,  $N = 241$ ,  $p = 0.095$ ). Women, on the other hand, have 1.4 *fewer* correct summations when there is competition. This difference is highly significant (PtT,  $N = 228$ ,  $p = 0.006$ ). We conclude that competition makes men overperform, but it especially makes women underperform.

## **DISCUSSION AND CONCLUSION**

It has long been recognized that the labor market is a major source of gender inequality. Despite increasing awareness and action, compared to men, women remain in a disadvantageous position. Men receive higher salaries, better jobs, and easier promotions than women do. Such gender inequality is affected by both demand-side and supply-side factors (Gino et al. 2015). Our focus in this study is on the supply side. In particular, we consider a phenomenon that is omnipresent in professional and recreational life, namely competition, and investigate how it differentially affects the behavior of men and women and what the consequences

are for gender inequality. The literature on the effects of competitive environments on gender inequality is rich and has been recently dominated by contributions from economics. This literature argues that competition makes men excel in their performance, relative to women (Gneezy et al. 2003). Such studies tend to attribute gender differences in the response to competition –and therefore gender differences in labor market success– to individual preferences and constraints. For example, a mainstream conclusion in the economics literature is that women simply do not like competitive environments (Niederle and Vesterlund 2007, 2011; Niederle 2016). By contrast, the experimental evidence that we present shows that gender differences in performance under competition are endogenous to situational contexts. Behavior is consistent with shared gendered beliefs and the warmth stereotype.<sup>28</sup> In this way, insights from sociology and social psychology have proven to be essential for understanding why competition differentially affects men’s and women’s performance. On the other hand, the sociology literature has to a large extent disregarded the study of competition and its importance to gender inequality. We hope that our study has narrowed the gap between the two disciplines.

A first step in our approach is the acknowledgment that competition involves more than just rivalry for scarce resources. It also creates a status ranking amongst those competing (Schram et al. 2019). Here, we have shown that such a ranking leads to gender inequality in performance that is very similar to the inequality observed under rivalry for resources. Moreover, we show that the two dimensions of competition are substitutes; in any competitive environment where

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<sup>28</sup> This result refers to average behavior. There is, of course, heterogeneity across individuals. Some individuals are affected by shared gendered beliefs or the warmth stereotype while others are not.

both are active, removing one dimension (for example, by reducing the rivalry) has little effect if the other remains. We also show that the observed gender inequality that is caused by competitive environments is not only driven by men overperforming, but especially by women underperforming. These are remarkable findings that, to the best of our knowledge, have not been established before.

To better understand *why* men and women respond in opposite ways to the dimensions of competition, we studied two explanatory mechanisms that may underlie the observed differences. Our results reveal evidence that both mechanisms are at play. First, hegemonic gender beliefs about how competition affects men's and women's performance appear to be activated in a competitive environment, but only amongst men. Men believe to be better than women (only) when there is competition, and this belief seems to make men actually perform better.

Second, prescriptive stereotypical warmth appears to be activated (only) in women, such that concerns about how a good performance may harm others play a role in women's underperformance when there is competition. In a setting where a good performance did not negatively affect anybody else –while the performer was still ranked *vis-à-vis* other participants–, women performed as well as men did.

When exploring in more detail how these mechanisms work, we found no evidence that the mixed-gender composition of the group with which one competes moderates the activation of gender beliefs or prescriptive stereotypes and therefore performance. Moreover, our results cannot be attributed to differences in the amount of effort that men and women make when engaged in a competitive environment.

Because both mechanisms appear to be at work, gender differences in the response to competition cannot simply be attributed to acontextual differences

between men and women. Instead, these differences are a product of context, in the way predicted by status characteristics theory and the stereotype content model. Moreover, we contribute to these theories with three important and novel insights. First, we show that gender comes into play as a status characteristic in the social relational context of competition because of the competition *per se*. In our experimental studies, gender beliefs and prescriptive stereotypes are activated by the competitive environment itself and not by the particular task men and women had to perform; this task was the same in all treatments.

Second, it is remarkable that competition affecting men's beliefs only suffices to yield a gender gap in performance; men's sense of superiority under competition may cause them to excel even if women's beliefs remain unaffected. This difference in men's and women's beliefs may, however, be related to our focus on first-order beliefs. These beliefs may be affected by women's growing participation in the labor force: "Perhaps reflecting women's greater labor force involvement, women now describe themselves (but men do not describe them) as significantly more instrumental than did earlier cohorts, narrowing the gender gap in self-descriptions of instrumental competence." (Ridgeway and Correll 2004, p. 527-528). As mentioned above, second- and third-order beliefs (which we did not elicit) may also be activated under competition and could negatively affect women's performance if they believe that they are expected by others to perform worse than men (even when women do not personally think that they will perform worse than men). With our beliefs elicitation procedure we are, however, able to show that competition acts as an environmental trigger that activates hegemonic beliefs about gender differences in performance, even when these beliefs are first-order beliefs. A very promising avenue for future research would be to study

whether distinct (non)competitive environments activate different second- and third-order beliefs among men and women, which in turn could lead to gender differences in behavior.

Third, when considering competition, social-status ranking matters as much as rivalry for resources does. Both activate gender differences in beliefs and prescriptive stereotypes. Remarkably, the two dimensions lead to comparable levels of gender inequality.

Our research is based on a series of laboratory experiments, which naturally raises questions about the external validity of our results. What do these findings tell us about the world outside of the laboratory? Much of the previous research has shown how the results from experiments relate to what happens under competition in natural environments, in particular in education and at the workplace<sup>29</sup>. This external validity is important, but it is equally important to realize that the choice of laboratory experiments as our method is founded in their internal validity. For the questions we ask, laboratory control is key. It allows us to isolate the two dimensions of competition and directly measure the causal effect each has on performance. It also allows us to directly measure performance, effort, and beliefs. Finally, by introducing simple changes to the design of Study 1, while keeping all other aspects of the design constant, we were able to systematically investigate the effects of the explanatory mechanisms in the consecutive studies. None of these analyses would be possible with observational field data. The

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<sup>29</sup> For example, laboratory competitiveness explains why women avoid jobs with competitive compensation regimes (Flory, Leibbrandt, and List 2015) and predicts student participation in a competitive university entry exam (Zhang 2013). It also predicts American students' expectations about future salaries (Reuben, Wiswall, and Zafar 2017) and explains gender differences in academic career choices (Buser, Niederle, and Hessel 2014).

possibilities that laboratory control offers thus make it the most suitable method for our purposes. As an alternative, one could consider collecting data in field experiments instead. Indeed, some of the questions we ask could also be addressed by properly designed field experiments. Others, however, require a level of control that would override possible advantages of experimentation in the field. In particular, studying competition while isolating status ranking from rivalry for resources seems hard to realize with the diminished control that is inherent to field designs. In our view, the internal validity offered by the laboratory outweighs at this stage possible considerations of higher external validity in the field.

The fact that our conclusions rest on laboratory data provides a solid first step to better understand what could possibly be going on in the world outside. Future research, either through field experiments or observational data, can build on our findings obtained under laboratory control and explore further their replication as well as implications to the world outside of the laboratory. The fact that various studies have indeed found that behavior under competition in the laboratory is highly informative for actual educational and labor environments gives us confidence that this future research will find our results to be very useful to understand gender inequalities in the world at large.

It is vital for decision-makers in all sorts of organizations to be aware of gender differences in the response to competition if they wish to provide an equitable work environment that fosters the organization as a whole. We cautiously put forward some suggested policies aimed at reducing gender inequality. First, when it comes to mitigating the effects of a competitive setting, both the rivalry for resources and the social-status ranking dimensions of competition should be considered; addressing only one does not reduce gender

inequality. Second, updating information and increasing awareness on men and women's true abilities may help to reduce the gender gap. Such information should target both men and women and emphasize that if women can do as well as men without competition, they are capable of doing equally well with competition. A final and perhaps more radical suggestion to reduce gender inequality is that organizations should reconsider their competitive models and create an environment where one's hiring or promotion is not necessarily determined by the assessment of one's relative performance to others but by the performance *per se* (based on a set of pre-determined criteria), irrespective of how others perform.

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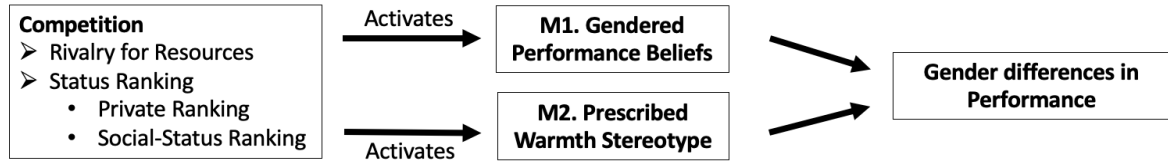
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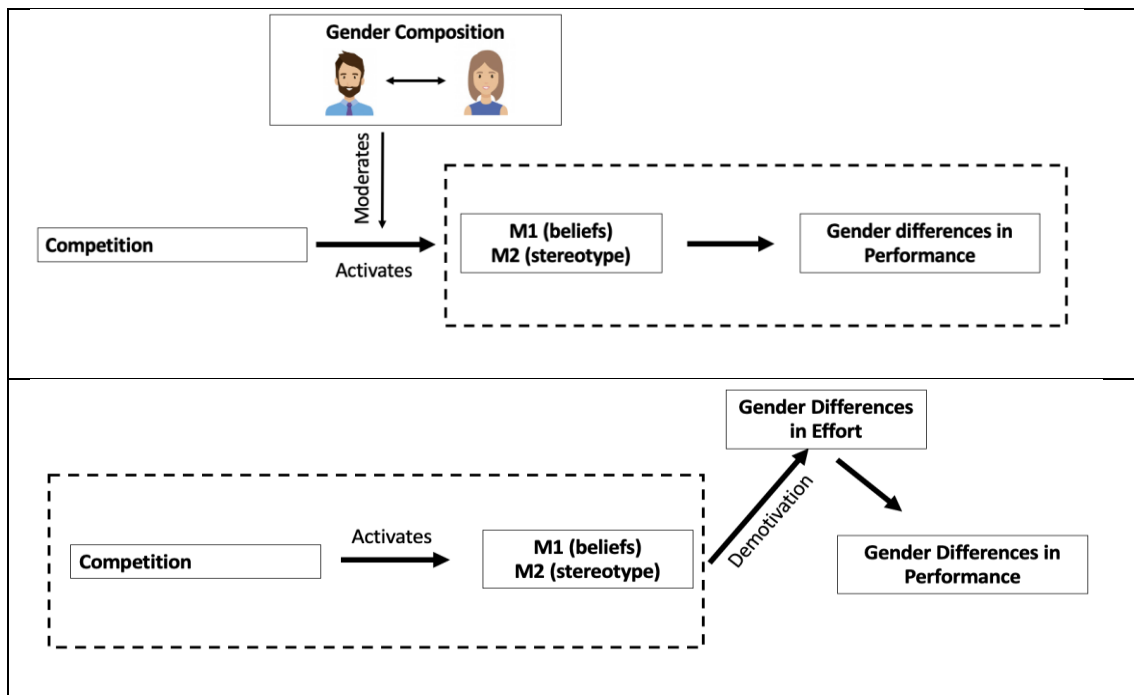
## List of figures

**Figure 1: Principal Mechanisms**



*Notes.* The dimensions of competition cause gender differences in performance via mechanism M1 if the dimensions activate gender differences in performance beliefs, which in turn yield gender differences in performance. Mechanism M2 leads to such differences if the dimensions of competition activate stereotypes where women are prescribed to show warmth towards others in the competition.

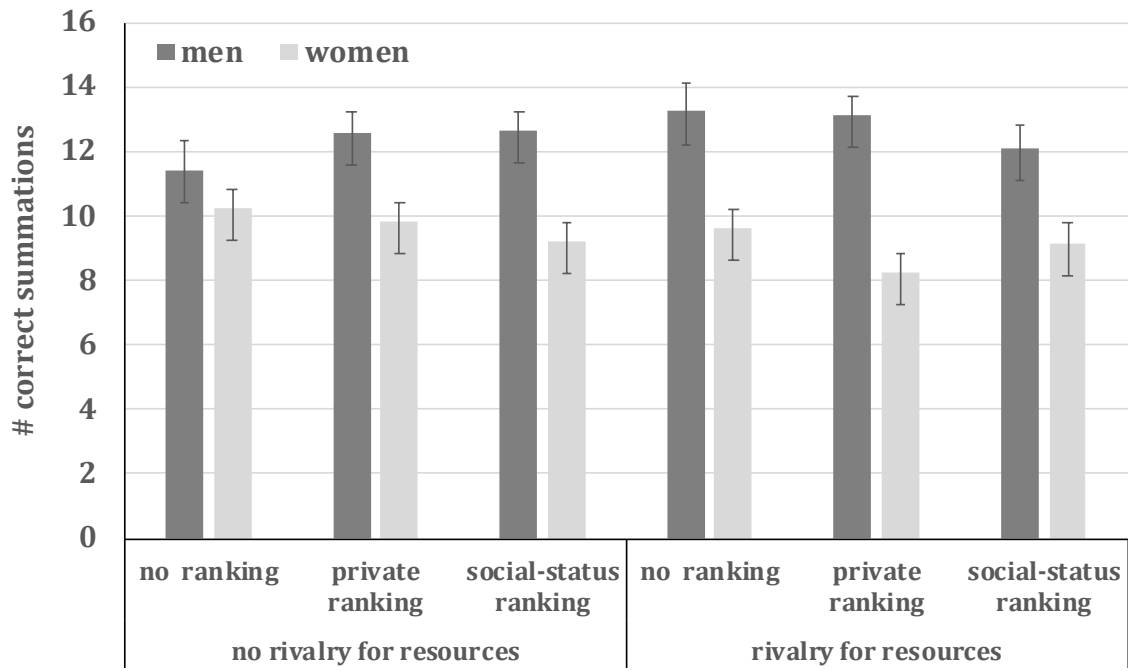
**Figure 2: Fine-tuning the Principal Mechanisms**



*Notes.* Upper panel: the gender composition of the competitors determines the extent to which competition activates gendered performance beliefs and a prescribed warmth stereotype; these beliefs and stereotypes yield gender differences in performance. Because we cannot separately measure whether gender composition moderates the activation of gender beliefs and stereotypes under competition, but argue that it does, we jointly depict the effects of gender composition on the mechanisms and performance. Lower panel: competition activates gendered beliefs and a prescribed warmth stereotype; these two mechanisms demotivate individuals and yield gender differences in effort that result in gender differences in performance. Because we assume competition affects effort indirectly via M1 and M2, these are jointly depicted.

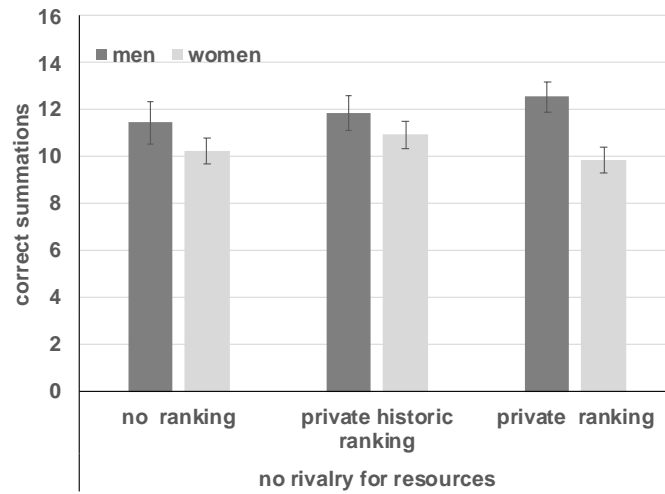


**Figure 3: Performance and Competition**



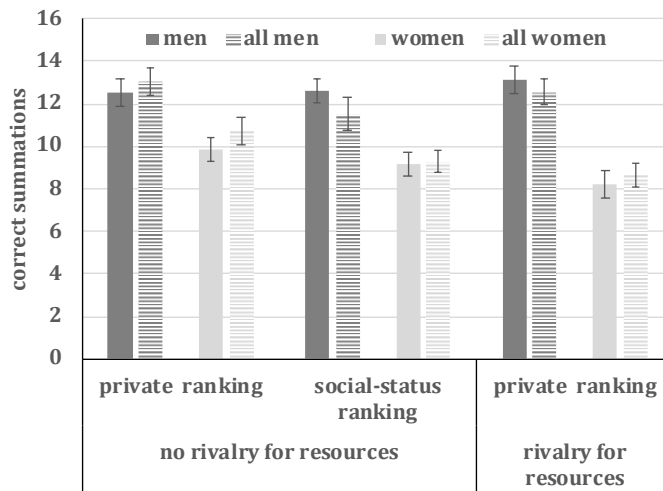
*Notes.* Bars show the mean number of correct summations for men and women in each treatment. Error bars show standard errors.

**Figure 4: Performance and Warmth Stereotype**



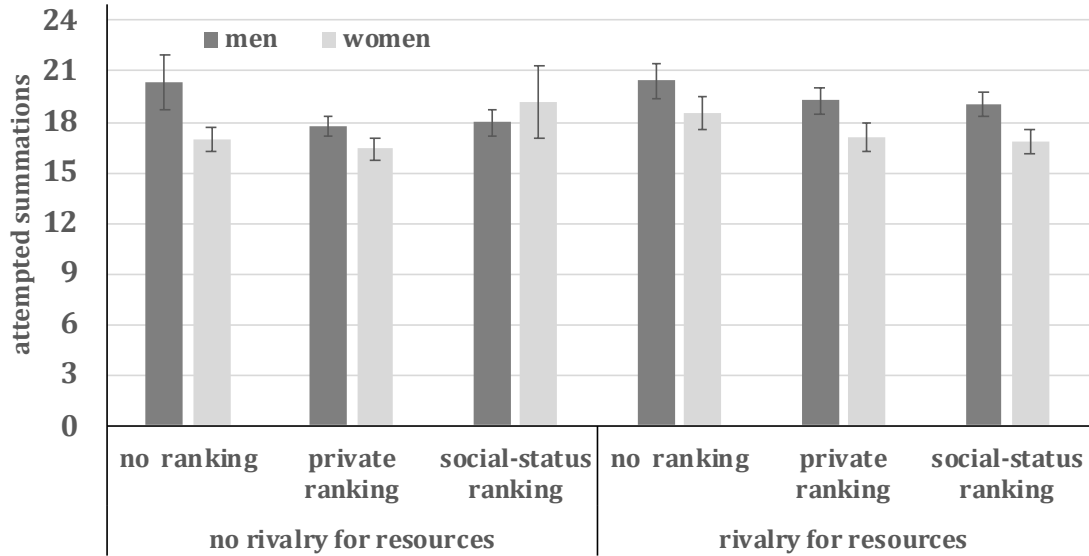
*Notes.* Bars show the mean number of correct summations for men and women in each treatment. Error bars show standard errors.

**Figure 5: Performance and Gender Composition**



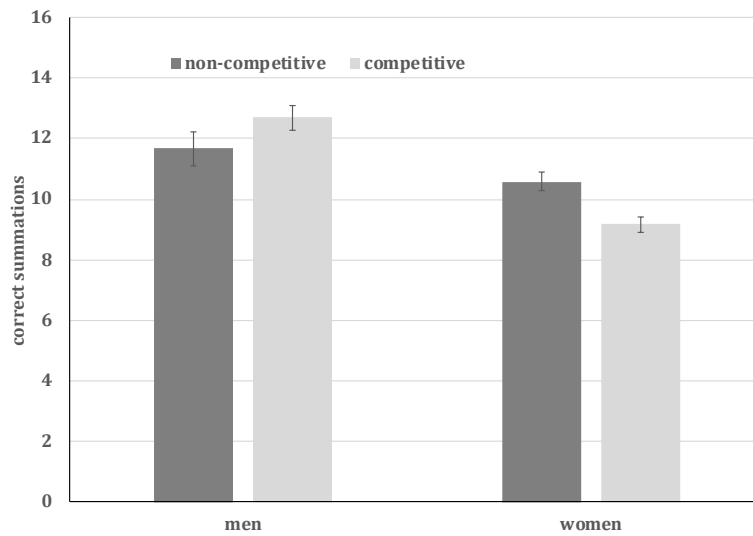
*Notes.* Bars show the mean number of correct summations for men and women. Neighboring bars show the mixed-gender and same-gender cases. In each treatment there are four bars: men in mixed-gender competition (dark-solid gray), men in all-men competition (dark-striped gray), women in mixed-gender competition (light-solid gray), women in all-women competition (light-striped gray). Error bars show standard errors.

**Figure 6: Effort and Competition**



*Notes.* Bars show the mean number of attempted summations for men and women in each treatment. Error bars show standard errors.

**Figure 7: The Effects of Competition per Gender**



*Notes.* Bars show the mean number of correct summations. Error bars show standard errors.

## List of tables

**Table 1: Overview of treatments and participant types**

Treatment	Acronym	Report to peer	Information	Payoff
no rivalry for resources, no ranking,	nRfR/nR	no	None	piece rate
no rivalry for resources, private ranking,	nRfR/PR	no	Rank	piece rate
no rivalry for resources , social-status ranking	nRfR/SR	yes	Rank	piece rate
rivalry for resources, no ranking,	RfR/nR	no	None	tournament
rivalry for resources, private ranking,	RfR/PR	no	Rank	tournament
rivalry for resources , social-status ranking	RfR/SR	yes	Rank	tournament

*Notes.* ‘Information’ denotes whether a participant is told her rank within the group. In ‘piece-rate’ payoffs, every participant is rewarded for the own score. In ‘tournament’ only the top two performers in a group are rewarded.

**Table 2: Numbers of Observations**

		Men	Women
Non Rivalry (nRfR)	No Status Ranking (nR)	27	33
	Private Ranking (PR)	40	32
	Social-Status Ranking (SR)	35	37(3)
Rivalry (RfR)	No Status Ranking (nR)	30	30
	Private Ranking (PR)	36	36
	Social-Status Ranking (SR)	39	33(1)
Total		207	201

*Notes.* Cells show the number of observations by treatment. In addition to the numbers of participants reported here, 12 men and 12 women acted as a peer (as described in the main text). Numbers in parentheses show the number of outliers in a cell. Outliers are defined as participants who repeatedly enter summations that were not possible, given the task at hand (cf. Appendix B). Outliers were excluded from the analysis. Our results do not change if we include these outliers.

**Table 3: Gender Differences**

	No Rivalry for Resources (nRfR)			Rivalry for Resources (RfR)		
	nR	PR	SR	nR	PR	SR
Difference	1.20	2.71	3.45	3.63	4.89	2.94
N	60	72	69	60	72	71
p-value	0.256	0.004	<0.001	0.001	<0.001	0.004

*Notes.* nR: No Status Ranking; PR: Private Ranking; SR: Social-Status Ranking. ‘Difference’ shows the difference between men and women in mean performance (measured as the number of correct summations), with a positive number indicating that men perform better. *N* is the number of observations, and the *p*-value is the result of a PtT testing against the null of no gender difference in mean performance.

**Table 4: Substitutes or Complements?**

	RfR/PR to	RfR/PR to	RfR/SR to	RfR/SR to
Baseline comparison	nRfR/PR	RfR/nR	nRfR/SR	RfR/nR
Benchmark comparison	RfR/nR	nRfR/PR	RfR/nR	nRfR/SR
Odds ratio	1 : 2.3	1.2 : 1	28.3 : 1	24.8 : 1

*Notes.* Odds ratios report the likelihood that a model that assumes that the two dimensions are substitutes is correct divided by the likelihood that a model that assumes they are complements is correct. *RfR* = rivalry for resources; *PR* = private ranking; *SR* = social-status ranking. The ‘baseline comparison’ x to y refers to a comparison of (1) gender differences where dimensions x and y are both included to (2) the gender differences when only dimension y holds.

**Table 5: Beliefs**

		fraction	N	p-value
No Competition	women	0.40	48	0.193
	men	0.42	48	0.312
Social-Status Ranking	women	0.40	48	0.193
	men	0.33	48	0.029
Rivalry for Resources	women	0.50	48	1.000
	men	0.33	48	0.029

*Notes.* The column 'fraction' shows the fraction of participants (per gender) who think that women perform better than men. The *p*-values in the last column refer to a binomial test that the fraction concerned is equal to 0.5.