Gender versus sex: What drives behavior?

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Almost everyone makes decisions involving money on a daily basis. Because of the importance of such economic decision–making, researchers have looked into what factors influence behavior. Gender has come out to be a key factor explaining differences in behavior. But how much can be associated with gender, and how much is based on the biological sex people are endowed with? In this paper, we take a systematic approach to test for gender and sex differences in behavior. We run an experiment where we first look into correlations of gender and sex with competitiveness, risk–taking, and altruism by comparing decisions of cisgender (cismen and ciswomen) and transgender (transmen and transwomen) individuals. Second, we prime our participants with either a masculine or a feminine gender identity. By subconsciously activating a gender, we can establish a causality between gender and behavior in our sample of cis- and transgender participants. We hypothesize that if gender (and not sex) is indeed a primary factor for decision–making, (i) individuals of the same gender (and different sex, i.e., ciswomen/transwomen and cismen/transmen) make similar decisions, and decisions significantly differ when gender differs (and sex is the same, i.e., cismen/transwomen and ciswomen/transmen), and (ii) priming changes behavior. Based on 780 observations collected online, we conclude that the role of gender (and sex) is not as decisive for economic behavior as we assumed. This paper contributes to the literature by having a transgender sample, two different approaches measuring gender effects, and considering gender on a continuous scale.

gender | sex | competitiveness | risk | altruism | priming

Worldwide, humans make economic decisions every day: Should I apply for a new job opportunity in a highly competitive environment? Should I invest in a risky asset or not? How much money should I donate to charities? A vast literature tries to determine the factors that affect decisions in domains such as competitiveness (1), risk–taking (2), and altruism (3). Researchers have looked, amongst others, into the role of institutional or marketrelated features (4–10), cultural background (11–15), individual characteristics (16–20), hormonal (21–26), or other biological factors, such as genetics, and neurological factors (27–30). Among those factors, gender has received a lot of attention. Over the last few decades, the flourishing research in economics has come to the conclusion that gender is a significant driver of how women and men behave: gender differences in behavior are a common finding for competitiveness (31), risk–taking (2), and altruism (3). We refer to the SI Section 10 for a detailed literature review.

But do observed data really show gender differences? Is it instead sex differences that influence behavior, or is it a mix of gender and sex? Importantly, sex and gender are two distinct concepts. Whereas sex is defined as "either of the two main categories (male and female) into which humans" are categorized based on their reproductive functions*, gender usually refers to the psychological, behavioral, social, and cultural aspects of being male or female (i.e., masculinity or femininity) (32). For cisgender individuals, their internal gender identity matches and presents itself by the externally determined cultural expectations of the behavior and roles considered appropriate for one's sex (32). However, the gender identity of transmen and transwomen and their gender roles are not the same as what is typically associated with their sex assigned at birth (33). So the question arises: how much of the differences of men and women often found in the economic literature can really be associated with gender as opposed to an individual's sex?

We investigate this question by using well–known behavioral economic experiments in the domain of *competitiveness*, *risky choices*, and *altruism*. As stated, for these three behavioral traits, gender differences are a common finding. However, these differences have usually been observed using cismen and ciswomen as subjects, which differ in their gender *and* sex. Distinguishing gender from sex effects is practically impossible when only investigating cisgender participants. As a novel approach, we run our experimental study with transmen and transwomen in addition to cismen and ciswomen. The advantage is that cisgender and transgender people differ in either their sex or their gender. To illustrate this consider an example: a ciswoman has female sex *and* feminine gender. A transman has female sex *but* masculine gender. So differences in the behavior of those two subject groups might be associated with gender instead of sex. The experimental method is excellent for studying the economic choices we are interested in because of its standardized and validated measures. We have information on the participants' gender and sex from self–reported categories and established scaling methods from psychological and medical science. Moreover, instead of just analyzing gender and sex effects correlationally, we elicit the causal impact of gender by exogenously varying gender identities with a priming method.

First, we test how gender correlates with the mentioned choices. By contrasting the behavior of the four different subject groups of cismen, ciswomen, transmen, and transwomen, we obtain insights into how far biology (sex) or the cultural and sociological construct of gender explains differences in economic behavior. Our study is the first investigating competitiveness, risk–taking, and altruism of transmen and transwomen. We hypothesize that if gender is the driving factor, individuals of the same gender (and different sex) make similar decisions, and decisions significantly differ when gender differs (and sex is the same). Second, we concentrate on the

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*See https://www.oed.com/view/Entry/176989?rskey=kwy0rq&result=1&isAdvanced=false, accessed 2021-10-12.

causal effect of gender on behavior – an analysis that is rarely done in the literature. The traditional experimental method of randomizing over the variable of interest is not possible with gender. Hence, we need a different approach to elicit causal effects. As our method to test a directional impact of gender, we employ a gender prime: either a masculine or feminine gender identity is subconsciously activated. Priming is a very powerful, easy–to–implement intervention to activate gender identities (34, 35). If cisgender and transgender individuals change their behavior when being primed, it indicates a causal effect of gender on individual economic decisions.

Based on 780 observations from experiments conducted online, our results generally show no correlational or causal effect of gender or sex for competitiveness, risk-taking, and altruism. The only exceptions are that cismen have a higher rate of entering the competition than all other subject groups when primed masculine. Besides, we find that subjects of male sex (i.e., cismen and transwomen) risk more than their female counterparts (ciswomen and transmen). Moreover, cismen risk more when primed with a masculine identity compared to the neutral priming condition. Thus, in general, we conclude that gender is not a consistent main factor influencing the economic decisions measured in this article.

Methods

To test our research questions, we set up an online economic experiment. We conduct our study (tasks and questionnaires) with oTree (36) on Prolific (www.prolific.com). Each participant completes six parts and several questionnaires. One part is randomly selected for payment at the end of the experiment. In Part 1, a participant is randomly assigned to either the baseline treatment (NEUTRAL) or a treatment condition that refers to one of the gender priming interventions: FEMININE (primes a feminine gender identity) or MASCULINE (primes a masculine gender identity). Participants are primed by a word search task where different words are used depending on the underlying treatment (37). The words in FEMININE are: female, woman, she, women, her, girl, hers, lady; in MASCULINE they are: male, man, he, men, him, boy, his, gentleman. In the baseline condition NEUTRAL, participants also solve the word search task, with the following (neutral) words: person, it, people, its, child, theirs, individual, neuter. Participants are shown the words and have two minutes to mark these words in a 10×10 grid. In case they find all words, they receive £5.

After the word search task, each participant enters the next parts of the experiments, which are the respective economic decision–making parts. As our first decision dimension, we employ monetary incentives to measure competitiveness (38). We measure performance in a real effort math task, where the participants are instructed to solve puzzles by finding two two–digit numbers that add up to 100 in 3×3 matrices for two minutes. In Part 2, they complete the math task under piece–rate incentives, which means they receive £0.50 for every solved puzzle. In Part 3, the same math task is performed under tournament incentives. The participants are divided into groups of four and receive £2 for every solved puzzle, but only if they solve more puzzles than every other group member. In Part 4, the participants have to choose, before performing, if their performance in this part will be paid based on the piece–rate incentives (like Part 2) or according to the tournament rules (like Part 3). Whenever a participant decides on the tournament incentives in Part 4, s/he is classified as competitive and competes against the group member's performance in the previous Part 3. In all parts, the participants do not receive feedback on how well they perform compared to the other group members until the end of the experiment and have no information on the other group members' identity or characteristics. Additionally, we measure the participants' confidence in Part 2 (how well they think they performed compared to the other participants in the session) and Part 3 (how well they think they performed compared to the other group members) with incentivized questions.

Our second decision dimension is the willingness to take risks in Part 5. It is measured using a simple lottery task (39). Participants receive £4 and can invest into a lottery with a 50% chance of success. The invested amount is multiplied by 2.5 in case of success. In case of no success, the invested amount is lost. The participants keep the amount not invested. Risk preferences are measured as the amount a participant invests, where higher investments indicate a higher willingness to take risks. The third decision dimension is altruism in Part 6. We investigate participants' altruistic preferences with a dictator game (40). Participants receive £5 and split up this amount between themselves and up to five different charities. Altruism is quantified as the sum donated by a participant.

The post–experimental questionnaire contains (1) a 30–items version of the Bem Sex Role Inventory (BEM) that explores a person's masculine and feminine self–identification on a continuous scale (41); (2) the Transgender Congruence Scale (TCS) (42) which evaluates if someone identifies as transgender; (3) demographic questions, as well as questions on the biological sex, gender, sexual orientation, and whether one self–identifies as transgender; and (4) the Steps to Transition (STT) questionnaire that describe typical steps transgender people undertake in their transition (42). In addition, we include debriefing questions to check if the participants are aware of the study topic and the priming intervention (43).

The last section of the supporting information (SI) provides a detailed description of all instructions and questionnaires of our experiment.

Results [†]

Descriptives. We collected a total of $n = 780$ observations, out of which 425 are cisgender (214 cismen and 211 ciswomen) and 355 transgender (215 transmen and 140 transwomen; see the SI Section 11, Subsection A for more details). As summarized in Table S1, the participants are on average 24.4 years old (SD = 6.60), have an average height in centimeters of 170 (SD = 10.8), and approximately half of them are students (47.2%). Around one–third holds a university degree, 69.4% have an income lower than £20,000, and 25.8% report to being religious. Our sample consists mostly of participants from the United States, followed by Continental Europe and the United Kingdom. Less than 10% are not residents of the three mentioned regions.

Responses to the BEM classify 28.5% as feminine, 19.4% as masculine, 24.1% as androgynous, and 28.1% as undifferenti-

[†] We use the following abbreviations for our results: Chi–squared test (χ^2), Kruskal–Wallis test (KW), Kendall's rank correlation coefficients test (KTAU), two–sided Mann–Whitney U test (MWU), Robust Wald test (W), and standard deviation (SD). The significance levels are defined as follows: $p < 0.05$ (*), $p < 0.01$ (**), and $p < 0.001$ (***), where a significant result must have at least $p < 0.05$. We summarize multiple p–values by $p's$.

ated. On the TCS scale ranging from 1 to 5, participants show an average score of 3.67 (SD = 1.1). The average score on the STT, which ranges from 0 to 16, is 4.35 (SD = 4.6). The various subject groups are comparable in several characteristics as indicated by the statistical tests added in Table S1. Descriptive statistics broken down by subject groups are presented in Table S2 and Table S3 (cisgender) as well as Table S4 and Table S5 (transgender).

For the outcomes of Part 1, the SI includes the detailed Section 2 summarizing descriptives on the participants' priming. On average, the participants marked 7.45 out of 8 words (S.D. = 1.53), and 83.97% (i.e., $n = 655$) marked all words from the list within the given time of two minutes.

Competitiveness. Figure 1 and Table S14 summarize the tournament entry rates in Part 4. In order to investigate whether gender and competitiveness are correlated, we focus on the baseline treatment NEUTRAL. No significant variation is reported across the four subject groups (χ^2, $p = 0.939$). Similar, when pooling the results by gender (Figure S2; cismen + transmen vs. ciswomen + transwomen), tournament entry rates do not differ for feminine and masculine subjects (χ^2, $p = 0.601$) and also no difference is found for male and female subjects when pooling the data by sex (Figure S3; cismen + transwomen vs. ciswomen + transmen; χ^2, $p = 0.867$). We compare the differences between the priming conditions (FEMININE and MASCULINE) and the baseline treatment (NEUTRAL) for the causal analysis. Priming does not influence competition entry rates for any subject group (χ^2, $p's > 0.073$). The result is marginally significant only for cismen when comparing the MASCULINE treatment to the NEUTRAL treatment (χ^2, $p = 0.073$). We shall see in the regression analysis that when adding further controls, the impact of MASCULINE priming on cismen becomes significant. Looking at the MASCULINE priming condition only, where the entry rates look very similar for all subject groups except for cismen, the competition entry rate is around 20 percentage points higher for cismen than for all other subject groups (χ^2, $p = 0.046$).

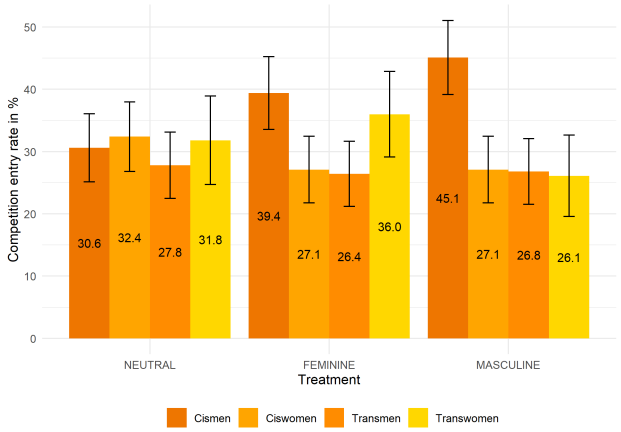

Fig. 1. Tournament entry rates in Part 4 by treatment and subject group ($n = 780$). The bars show the percentage of participants (between 0 and 100) who chose to compete rather than to perform under piece–rate incentives. The error bars represent the standard errors of the means.

In Table S15 we run Probit regressions for the baseline treatment (NEUTRAL) to disentangle the effects of gender and sex. As our basic regression framework, we have in column (1) just the subject groups and in (2) additionally control for the performance measures in the real effort task. In column (3), we further control for confidence and the willingness to take risks. In column (4), we add the variables age, height, student status, income, religion, and residence, whereas in (5), we control for the outcomes in the TCS and STT. Using joint coefficient tests (see Table S15), we find neither gender (W, $p's > 0.437$) nor sex (W, $p's > 0.214$) to have a significant effect on competitiveness. We thus conclude that there is no correlation between either gender or sex and competitiveness in our study.

To analyze a potential causal effect of gender, we run Probit regressions in Table S16. The non–parametrized analyses are confirmed for ciswomen, transmen, and transwomen. For cismen we find that the gender prime with MASCULINE has a significant impact increasing the competition entry rates in specification (2) ($p = 0.034$; controlling for performance) and (4) ($p = 0.021$; controlling for beliefs, risk attitude, and other person–specific covariates). Summing up, only cismen's competition entry rates seem to be influenced (positively) when priming them with their own gender identity. We do not find a significant impact of gender priming for all other subject groups and priming combinations. We will interpret those results in the Discussion.

Our experimental design does not only allow us to look into the choice to enter a tournament but also into participants' confidence (i.e., how well they believe they performed in the real effort task when competing, see Table S11). In NEUTRAL, there is no evidence that subjects of masculine gender have higher performance beliefs than subjects of feminine gender (MWU, $p = 0.362$). However, we do find differences between subjects of female and male sex (MWU, $p = 0.001$). For priming, no subject group increases or decreases their beliefs when being primed (MWU, $p's > 0.177$). Regressions in Table S12 confirm that beliefs depend on the participants' sex: male subjects generally have higher confidence in their performance than female subjects (W, $p's < 0.001$). And again, confidence does not differ across gender (W, $p's > 0.259$). That gender does not play a role in this setting is further confirmed when looking at the causal impact of gender priming on the participants' confidence. For none of the subject groups, we do find any effect of gender priming on the beliefs when using regression analyses (see Table S13, W, $p's > 0.178$).[‡]

Risk. Investment rates in the lottery are depicted in Figure 2 and stated in Table S19. When applying non–parametric tests, we do not find any differences between the various subject groups within the baseline treatment NEUTRAL (KW, $p = 0.194$). If anything, transwomen seem to be more risk–prone than transmen in a pairwise comparison (MWU, $p = 0.048$). This, however, does not point towards a systematic impact of gender and/or sex when pooling data (Figure S4 and Figure S5; gender: cismen + transmen vs. ciswomen + transwomen, sex: cismen + transwomen vs. ciswomen + transmen; MWU, $p's > 0.130$). Turning to the causal impact of priming, again, we see MASCULINE priming increases the risk attitude for cismen only (MWU, $p = 0.038$) bringing the level of cismen to the one of transwomen in the MASCULINE

[‡] It may be interesting in what payoffs behavior in the competitiveness task results. We provide details and different analyses on the performances in the real effort task of Part 2 to 4 in Section 3 of the SI.

priming (MWU, $p = 0.876$). For every other subject group, we do not find any significant impact of gender priming (MWU, $p > 0.206$).

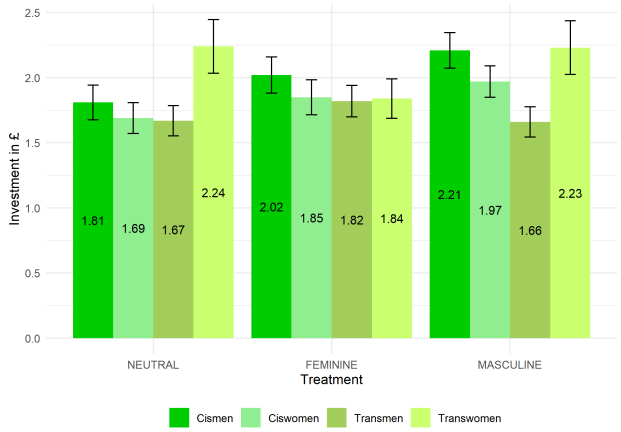

Fig. 2. Investments into the risky lottery in Part 5 by treatment and subject group ($n = 780$). The bars show the average investment rate, and the error bars represent the standard errors of the means.

Joint coefficient tests for the regressions (with and without control variables) in Table S20 show the correlational results for our baseline condition. We find no differences in risk–taking of subjects of feminine and masculine gender (W, $p's > 0.132$). However, we find a sex effect: male subjects risk more than female subjects (W, $p's < 0.042$).

Turning to priming, we have significant differences in risk–taking of cismen when being primed MASCULINE (W, $p's < 0.046$; see Table S21). We find no difference in risk–taking for all other subject groups when primed with a gender (W, $p's > 0.092$). The findings are independent of what other control variables are taken into account. The regression analysis for risk attitudes is thus similar to what we found for competition entry rates. There is no systematic influence of a gender prime on the participants. However, when being primed with their own gender, cismen significantly increase their risk taking behavior.

Altruism. Last, we test for differences in the donation task (see Figure 3 and Table S22). Donations in NEUTRAL are not distinguishable across subject groups (KW, $p = 0.933$). Neither pooled results for gender nor for sex yield a difference in donation rates (Figure S6 and Figure S7; MWU, $p's > 0.564$). Concerning the causal impact of gender priming, we do not find significant effects for any subject group and any priming condition (MWU, $p's > 0.260$).

The regression analysis in Tables S23 and S24 confirms these findings. Joint coefficient tests for gender or sex do not show significant correlations in the baseline condition (W, $p's > 0.580$). Moreover, the impact of all priming condition on all subject group remains insignificant, even after controlling for different sets of additional personal covariates (W, $p's > 0.214$).

To summarize, we find no correlation between gender or sex on altruism and do not detect any causal impact of gender priming on altruistic behavior in our setup.

Gender and sex differences within priming conditions. As we have shown so far, there is no systematic correlation between

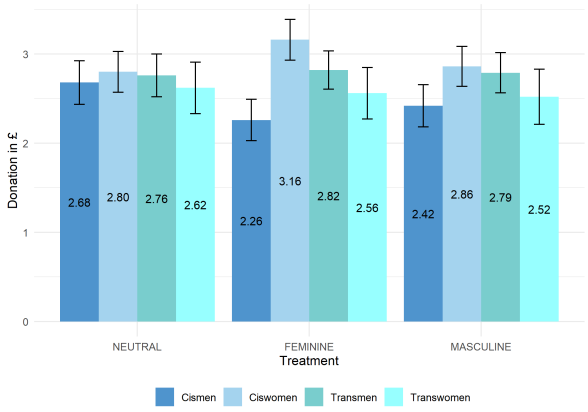

Fig. 3. Donation in Part 6 by treatment and subject group ($n = 780$). The average donations are indicated by the bars, and the error bars represent the standard errors of the means.

gender and behavior in the NEUTRAL treatment. Here we briefly test for gender and sex differences in behavior within the two priming treatments. Looking at Figure S2, Figure S3, Figure S4, Figure S5, Figure S6, and Figure S7 and analyzing the gender differences with non–parametric tests, we see no difference in competition entry rates (FEMININE: χ^2, $p = 0.725$, MASCULINE: χ^2, $p = 0.115$), risk–taking (FEMININE: MWU, $p = 0.560$, MASCULINE: MWU, $p = 0.507$), and altruism (FEMININE: MWU, $p = 0.132$, MASCULINE: MWU, $p = 0.532$). Turning to sex differences, the picture slightly changes. First, we see differences between subjects of male and female sex in both priming conditions (FEMININE and MASCULINE) for competitiveness. The differences are close to conventional levels of significance (FEMININE: χ^2, $p = 0.051$, MASCULINE: χ^2, $p = 0.067$). Second, for risk–taking, we find a significant difference in the MASCULINE treatment only, with subjects of male sex taking more risk than subjects of female sex (MWU, $p = 0.011$). Third, for altruism, we find subjects of female sex having significantly higher scores than those of male sex in the FEMININE treatment (MWU, $p = 0.023$). Hence, for risk and altruism we find that only those sexes show higher scores who are primed with the gender identity that they would cisgender–stereotypically be associated with.

Replication of the correlational analysis with a continuous gender measure. With just a handful of exceptions (44–46), researchers in economics always used a categorical way to measure gender. However, it is more and more discussed that gender might be a continuous characteristic rather than a binary (or categorical) one (47). Gender can be measured on a continuous scale by using the BEM sex role inventory (41), which is part of our post–experimental questionnaire. Thus we rerun all regression analyses and include, instead of the subject groups, the variables $BEMscore : Feminine$ (defined as the score participants reached on the BEM questions measuring femininity) and $BEMscore : Masculine$ (score on masculine questions in the BEM).

Results in Tables S25 to S27 show throughout that neither the feminine nor the masculine score significantly influence how the participants decide ($p's > 0.057$). This is not surprising since the BEM scores and the gender categories are

highly correlated (feminine: KTAU, $p = 0.001$, masculine: KTAU, $p = 0.003$), and we did not find correlational gender differences in the baseline condition for neither of the economic decisions we investigate.

Discussion

This paper applies well–known and extensively used experimental techniques to identify the influence of gender and sex on economic decision–making. First, we separate the impact of gender and sex on economic decisions by collecting data from participants whose gender and sex differ, which is new to the literature. We compare the competitive, risk, and altruistic behavior of four different subject groups – cismen, ciswomen, transmen, and transwomen. Second, we induce either a neutral, feminine, or masculine gender identity by having different priming conditions. Thus, with our experimental setup, we go beyond correlating gender and sex with decisions and try to evoke gender identities through a priming manipulation causally.

Even if this study was pre–registered and carefully designed following existing literature and the state of the art standards in experimental economics, the findings largely diverge from previous work. Our results do not show conclusive correlational or causal evidence for gender or sex as determinants of economic decision–making. Apart from some differences described in the previous sections, the pattern is essentially consistent: gender and sex differences in behavior remain mostly statistically indistinguishable. Moreover, as a side result, we see that cis- and transgender participants do not systematically differ from each other in their behavior. Additionally, the main correlational findings replicate when applying a continuous instead of a categorical gender measure. Our overall interpretation of the data is that gender and sex might not matter as much as we initially thought. But what can explain these findings?

First, one explanation could be that gender effects might depend on the underlying subject pool. The existing literature has treated gender differences in behavior as a pretty well–established and robust finding. However, the vast majority of these papers use standard student subjects (48). Studies that use other samples (49) or online samples are generally less likely to report gender differences, especially when controlling for a set of participants' characteristics (16, 50)

Second, almost two decades have passed since the first studies that looked into competitiveness, risk, and altruism were published and found gender differences in behavior. One can thus speculate that female empowerment, educational initiatives, and the broader awareness of gender and sex equality in private and professional settings have led to a narrowing of potential behavioral differences in the meantime.

Third, the absence of an effect of gender priming on the behavior of transgender subjects may be rooted in the connotation those subject groups have with gender. For transgender individuals, the concept of gender might be a relatively continuous spectrum whereas for cis–individuals it might be seen as a binary dimension. As such, gender might not be as decisive for transgender as for cisgender individuals. The fact that gender priming seems to work only for cismen but not for ciswomen might hinge on the role gender usually has played for those two subject groups. Whereas for cismen their gender usually comes with advantages and, as such, has a positive connotation, ciswomen might have negative experiences concerning the way society treats them based on their gender.

Despite the partly unexpected findings, we belief that there are several key "takeaways" from this study. For the first time, we present evidence from a sample of cis- and transgender participants in one framework, which allows for both a correlational and a causal approach, and look at how they decide in a competitive context and when making risky or altruistic decisions. Transgender individuals have become a more and more visible part of society. Thus, we think it is crucial to understand their economic preferences. Besides, having transgender participants in our sample makes it possible to look deeper into the part that an individual's gender - as opposed to sex - plays in economic decision–making. In our setting, we shed light on the part of gender effects that can be attributed to biological factors (which refer to a participant's sex) and other aspects of one's gender identity. Additionally, we do not measure gender only on a categorical scale; instead, we also apply a continuous gender scale. Our results are qualitatively the same, independent of what gender scale is used. Based on our findings, we conclude that the role of gender and sex is not as decisive for economic behavior as previously assumed.

Ethics and Preregistration Statement. This study received ethical approval from the UEBS Research Ethics Committee of the University of Exeter (Ethics application - eUEBS004241; 26.05.2021) and the Ethics Committee of the University of Regensburg (28.04.2021). It was preregistered on aspredicted.org (Nr. 68888) before data collection (see https://aspredicted.org/DCL_1VB).

Supporting Information Appendix (SI). The SI includes a detailed literature review, further tables, figures, and additional analyses. It will be published together with the article.

SI Datasets. The datasets generated and analyzed for this research project and the custom code that supports the study's findings will be published together with the paper. They are for now available on OSF (https://osf.io/tyzjh/?).

SI oTree code. The oTree code is available on request.

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