Competing for Its Own Sake: Experimental Evidence on the Welfare Effects of Competition

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Abstract

Economists often view competition as a means to motivate effort, improve efficiency, and therefore enhance welfare. However, this instrumental perspective may overlook that competition itself can directly influence individuals' welfare. This paper investigates how competition affects utility derived solely from the act of competing, independent of material outcomes. I conduct a series of experiments which show that competition shapes utility through two channels: a belief channel, in which competition lowers expectations of success and reduces utility; and a preference channel, through which individuals derive enjoyment directly from competing. The overall effect depends on the relative strength of these channels. I also show that these welfare effects influence future choices: competition induces attribution bias, leading individuals to misattribute the enjoyment of competition to the underlying task and increase their willingness to re-engage even without competition. These effects also extend to social interactions, reducing post-competition zero-sum thinking and fostering altruism.

Keywords: Competition, Reference-dependent Utility, Attribution Bias, Zero-sum
JEL Codes: C91, D60, D91, I31

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1 Introduction

One of the central principles in economics is that markets are generally an effective way to organize economic activity, and that perfect competition maximizes social welfare (Mankiw, 2018). This classical perspective emphasizes the incentives that competition creates and the economic benefits it yields. Yet it overlooks a subtle aspect of welfare: the direct utility consequences of how people experience competition. Consumers may experience excitement when competing for limited-edition products during sales events, while job seekers may experience anxiety when competing for scarce positions in the labor market. Such experienced utility,[1] arising directly from the act of competing, can have a meaningful impact on overall welfare. Ignoring these effects may lead us to overestimate welfare when competition brings distress, or underestimate it when competition generates enjoyment.

This paper investigates how competition affects individuals' utility derived solely from the act of competing, independent of material outcomes.[2] I examine whether this impact is context dependent, specifically, when competition generates positive utility and when it yields disutility. I also explore the implications of these welfare effects: I conjecture that they may shape individuals' beliefs about the enjoyment of specific tasks and thus their future decisions about whether to undertake these tasks again, and may even affect their attitudes toward social and strategic interactions.

To address these questions, I develop a conceptual framework and conduct a series of pre-registered randomized controlled experiments on Prolific[3] with two treatment dimensions: (i) competition versus no competition, and (ii) reward structures framed as gains versus losses. The typical design in the experimental literature on competition employs a gain-framed reward structure in which participants compete for a prize: the winner receives the reward, while the loser receives nothing (Niederle and Vesterlund, 2007; Croson and Gneezy, 2009; Abbink et al., 2010; Fallucchi et al., 2020; Reuben et al., 2024). Although some designs incorporate proportional-prize structures in which second- and third-place participants receive smaller payoffs, the lowest-ranked participant still earns no reward (Harbring and Irlenbusch, 2003, 2011; Cason et al., 2010, 2020). I introduce a loss-framed design in which competition imposes explicit losses on losers: only the winner retains their endowment and remains at the status quo, while the loser forfeits part

[1] Experienced utility refers to hedonic and affective experience, which can be derived from immediate reports of current subjective experience or from physiological indices (Kahneman et al., 1997).

[2] "Material outcomes" is used in a broad sense, including tangible rewards as well as recognition, status, or any other benefits realized through competition.

[3] Prolific is a widely used online platform for recruiting high-quality participants for social science research (Peer et al., 2022).

of their endowment. This design highlights a key feature of many real-world competitive environments: losing a competition entails real losses, not merely the absence of gains. For example, in the workplace, "winning" may mean keeping one's job, while losing could mean being laid off. I hypothesize that competition has a positive impact on utility when rewards are gain-framed but a negative impact when loss-framed, as individuals are more sensitive to potential losses than to equivalent gains (Tversky and Kahneman, 1979). This design creates four experimental treatments: gain-framed competition, gain-framed control, loss-framed competition, and loss-framed control.

To conduct the experiment, participants were randomly assigned to one of the four experimental treatments and asked to complete a timed quiz. The quiz consists of fifty puzzles similar to the Raven Progressive Matrices, a widely used measure of cognitive ability (Malamud and Pop-Eleches, 2011; Gill and Prowse, 2016; Alan et al., 2019; Drobner and Goerg, 2024; Willadsen et al., 2024). Participants have four minutes to complete the quiz. Each correct answer earns one point, each incorrect answer deducts one-quarter of a point, and skipped questions receive zero points.[4]

In the competition treatments, participants were randomly paired and competed for a monetary prize based on their quiz performance.[5] Within each pair, under the gain-framed reward structure, each participant received a $2 show-up fee. The participant with the higher quiz score earned an additional $4 reward, while the other received no additional payment. Under the loss-framed structure, each participant started with a $6 show-up fee. The participant with the higher score kept the full $6, while the other forfeited $4. During the competition, participants observed their opponent's raw score in real time through a live score bar, which displayed the opponent's cumulative points earned for correct answers without deductions for incorrect ones. Because participants received no feedback on their own performance, this noisy feedback about the opponent's performance allowed them to gauge their relative standing in the competition but not to perfectly infer the final outcome.[6] Since participants cannot physically observe their rivals online, which often limits competitive engagement, the live score bar helped mitigate this limitation and foster a stronger sense of competition.

In the non-competition treatments, participants completed the quiz individually. Under

[4]This scoring rule encourages participants to engage thoughtfully rather than guess randomly. The cognitive task is an IQ quiz. I chose this task for two reasons. First, it mirrors cognitively demanding real-world work, enhancing the external validity of the experimental findings. Second, IQ test performance is ego-relevant and naturally elicits utility responses, making it easier to identify competition's utility effects.

[5]The real-time online matching was efficient: the average waiting time for pairing was 19 seconds.

[6]Providing partial information about opponents approximates real-world situations, where people often know something but not everything about their rivals. Preventing participants from learning the final outcomes was crucial for this study's objective: isolating the utility effects of competition itself.

the gain-framed reward structure, each participant received a $2 show-up fee and earned an additional $4 reward if their quiz score exceeded a *predetermined threshold*;[7] otherwise, they received no additional reward. Under the loss-framed structure, each participant received a $6 show-up fee and retained the full amount if their score surpassed the threshold; otherwise, they forfeited $4. The threshold was set at the median score from the competition treatments, ensuring that participants across all treatments faced the same ex-ante success probability of one-half and the same expected monetary payoffs.[8] With monetary incentives held constant, the presence of competition and the framing of rewards were the only factors that varied across treatments.

After completing the quiz, participants filled out a survey evaluating their enjoyment of the task and their willingness to take a similar quiz again in the future.[9] They then answered questions assessing their zero-sum thinking and participated in decision-making tasks designed to elicit attitudes toward social interaction, including a dictator game and a public goods game. At the end of the experiment, and before learning the final outcomes,[10] participants were asked to indicate whether they believed they had won the competition or, in the non-competition treatments, whether they had exceeded the threshold.

The experiment shows that competition increases utility not only under the gain-framed reward structure but also, unexpectedly, under the loss-framed structure. While the treatment effect of competition does not differ significantly across frames, utility levels are consistently higher in the gain frame. To better understand this pattern, I disentangle the overall effect of competition on utility into two channels: a belief channel, through which competition reduces utility by lowering individuals' beliefs about their chances of winning, and a preference channel, through which individuals derive enjoyment directly from the act of competing. The positive preference channel outweighs the negative belief channel, resulting in a net positive effect of competition on utility. Interestingly, participants who believe they rank lower in the quiz experience greater enjoyment from competition than those who believe they rank higher. The utility gains from competition do not vary system-

[7] Before the quiz, participants were informed that the threshold was a prior session's median score. I depart from the standard piece-rate design (Niederle and Vesterlund, 2007; Möbius et al., 2022) for non-competition treatments because a linear payment scheme would introduce confounding factors such as inequality aversion or risk aversion, which could contaminate the estimated effect of competition on utility.

[8] The gain- and loss-framed controls use the median scores from their respective competition treatments. Because participants are randomly paired in the competition treatments and the non-competition threshold is set at the median, the ex-ante success probability is one-half across all treatments.

[9] Participants in competition treatments were asked about taking a similar quiz without competition; those in non-competition treatments were asked about taking another similar quiz under the same conditions.

[10] In competition treatments, final outcomes included participants' quiz score, their opponent's score, and whether they won. In non-competition treatments, final outcomes included participants' quiz score and whether they exceeded the predetermined median threshold.

atically across demographic characteristics such as gender, age, education, or income.

These welfare effects have important implications. Intrinsically enjoyable competition increases individuals' preferences for the underlying task and their willingness to engage in it again, even in the absence of competition. This pattern suggests attribution bias in competitive settings:[11] individuals may misattribute the enjoyment derived from competition to the inherent qualities of the task itself, leading them to be more willing to undertake it again even after the competitive element has been removed. The positive welfare effects of competition also extend to social interactions. Participants who engaged in competition exhibited weaker zero-sum mindsets afterward and allocated more money to their partners in a dictator game. This finding contradicts the preregistered hypothesis that competition would foster stronger zero-sum thinking. One possible explanation is that the pleasurable experience of competing fostered more positive social attitudes, leading them to act more cooperatively and generously in subsequent social interactions.

This paper contributes to several strands of literature. First, it connects to the literature on experienced utility, which demonstrates how individuals' immediate affective responses to ongoing experiences shape their utility. This literature defines experienced utility and develops various methods for measuring subjective well-being (Kahneman et al., 1997, 1999; Kahneman and Krueger, 2006; Kahneman and Deaton, 2010; Benjamin et al., 2014). It also shows that individuals derive utility from the process of political participation (Frey et al., 2004; Frey and Stutzer, 2005) and from the intrinsic experience of work (Benz and Frey, 2008). I contribute to this literature by showing that competition, a central feature of economic interaction, generates its own experienced utility independent of final outcomes. This paper also relates to the behavioral welfare economics literature, particularly studies documenting the emotional value individuals attach to their own decisions and extending the traditional welfare framework to incorporate decision utility (Bartling et al., 2014; Bernheim et al., 2024). My findings suggest a related extension: individuals derive utility from the act of competing, and therefore comprehensive welfare assessments in competitive environments should account for not only outcomes but also the utility generated by the competition itself.

Second, this work contributes to the literature on state-dependent preferences, particularly attribution bias. Prior work shows that individuals misattribute temporary states such as thirst, weather, and fatigue to the stable properties of goods or activities (Haggag et al., 2019, 2021; Bushong and Gagnon-Bartsch, 2023). I contribute to this literature by showing that attribution bias also arises in strategic settings: individuals engaged in com-

[11] Attribution bias refers to the tendency to misattribute the influence of a temporary emotional state to a stable property of an activity (Haggag et al., 2019).

petition misattribute the enjoyment derived from competition to the underlying task and express greater willingness to undertake the task again in the future.

Finally, this paper speaks to the experimental literature on competition. A large body of work examines how competition affects effort, performance, tournament entry, and beliefs such as self-confidence, typically by comparing behavior under piece-rate and tournament payment schemes (Gneezy et al., 2003; Niederle and Vesterlund, 2007, 2011; Möbius et al., 2022; Hauge et al., 2023; Englmaier et al., 2024). I contribute to this literature by introducing a novel noncompetitive benchmark: a threshold-based incentive scheme that preserves the binary payoff structure of tournaments, thereby eliminating potential confounds arising from differences between linear and binary payment structures. This approach enables a cleaner estimate of the causal effect of competition.[12] Moreover, most laboratory studies of competition employ gain-framed tournaments, in which winners receive a prize and losers receive nothing (Carpenter et al., 2010; Cason et al., 2010; Dohmen and Falk, 2011; Buser et al., 2014; Krishna et al., 2025). Only a few examine loss-framed contests (e.g., Hong et al., 2015; Dato et al., 2018). I contribute to this literature by introducing a loss-framed competitive environment and providing experimental evidence on the welfare consequences of competition in such settings.

The remainder of the paper proceeds as follows. Section 2 introduces a conceptual framework of the experienced utility from competition. Section 3 describes the experimental design, procedures and data. Section 4 provides a explicit definition of competition in the experimental context. Section 5 presents the main results on how competition affects utility and decomposes the total effect into belief and preference channels. Section 6 discusses the implications of the welfare effects of competition. Section 7 concludes.

2 Conceptual Framework

This section introduces a conceptual framework for utility derived solely from the act of competing, independent of final outcomes. The framework builds on the classical winner-take-all tournament model introduced by Lazear and Rosen (1981) and incorporates reference-dependent preferences from Kőszegi and Rabin (2006) to allow utility to vary across different contexts. Section 2.1 presents the model setup, while Section 2.2 outlines its testable predictions. The non-competitive setting can be viewed as a special case of this framework in which individuals compete against a fixed performance threshold rather than against another person.

[12] If the objective were to compare the effects of competitive versus piece-rate payment schemes, this threshold design would be unnecessary.

2.1 Setup

Consider a winner-take-all competition with $N \geq 2$ competitors, indexed by $i \in \{1, \ldots, N\}$. Each competitor i possesses an ability parameter $a_i > 0$ that is drawn independently from a common distribution F and then simultaneously chooses an effort level $e_i \geq 0$. Exerting effort entails a cost $c : \mathbb{R}_+ \to \mathbb{R}_+$ that is differentiable, strictly increasing, and convex, with $c(0) = 0$, $c'(\cdot) > 0$ and $c''(\cdot) \geq 0$. The monetary payoffs for the winner and the loser of the competition are denoted by $(w^{win}, w^{lose}) \in \mathbb{R}^2$.

Each competitor i has reference-dependent utility. The reference point $r \in \mathbb{R}$ is exogenously given and represents a monetary endowment. Payoffs can be framed in two ways: as gains or as losses. In the gain frame, each competitor i receives an initial endowment b ($r = b$). The winner receives a reward w^{win}, yielding a final payment of $b + w^{win}$, while the loser receives no reward, ending up with b. Under the loss frame, each competitor is initially endowed with $b + w^{win}$ ($r = b + w^{win}$). The winner keeps the full endowment $b + w^{win}$, while the loser forfeits w^{win}, ending up with b. Holding all else equal, expected payoffs are identical across both frames.[13]

Competitor i's utility from the act of competing consists of two components: pecuniary and non-pecuniary. The pecuniary component reflects the expected utility from monetary rewards net of the cost of effort.[14] It is expressed as the weighted average of the perceived probabilities of winning and losing, multiplied by their respective monetary payoffs, minus the cost of effort. The non-pecuniary component, denoted by ψ_i, captures utility derived from competing per se, independent of monetary outcomes. It comprises two elements: immediate affective responses such as excitement or stress experienced during competition, and anticipatory utility from envisioning winning or losing.[15] Anticipated success may bring satisfaction the prospect of outperforming others, feelings of superiority, or a sense of self-fulfillment, whereas anticipated failure may generate feelings of diminished status, disappointment, or self-doubt. Taken together, competitor i's experienced utility from competing can be expressed as

[13] In the gain frame, the winner takes all, so $(w^{win}, w^{lose}) = (w^{win}, 0)$. With an initial endowment of b, the final payoffs are $(b + w^{win}, b)$. In the loss frame, $(w^{win}, w^{lose}) = (0, -w^{win})$ and the initial endowment is $b + w^{win}$, yielding the same final payoffs of $(b + w^{win}, b)$. Thus, with equal winning probabilities across frames, expected payoffs are also identical.

[14] The cost of effort is considered part of the pecuniary component because effort is often driven by monetary incentives. This study aims to isolate utility from the act of competing, separate from the material outcomes that ultimately result from competition. The monetary rewards considered here reflect the *anticipated* payoffs during the competitive process and therefore contribute to the experienced utility of competition.

[15] Anticipatory utility has been documented in the literature, showing that individuals derive utility from anticipating future outcomes (Caplin and Leahy, 2001; Brunnermeier and Parker, 2005; Marzilli Ericson and Fuster, 2011).

$$P_i(e_i) \cdot v\left(w_i^{win}\right) + \left(1 - P_i(e_i)\right) \cdot v\left(w_i^{lose}\right) - c(e_i) + \psi_i$$

The first three terms represent the pecuniary component of utility, while the fourth term captures the non-pecuniary component.[16] The perceived probability of winning is given by

$$P_i(e_i) = \Pr\left(\theta(a_i, e_i) > \max_{j \neq i} \theta(a_j, e_j)\right)$$

where $\theta(a, e)$ is a performance function that is continuous and strictly increasing in both ability a and effort e. Competitor i wins if their performance exceeds that of all others; in the event of a tie, the winner is selected uniformly at random, with probability $\frac{1}{N}$. $v(x)$ is a reference-dependent value function (Kőszegi and Rabin, 2006)

$$v(x) = \begin{cases} x & \text{if } x \geq 0, \\ \lambda x & \text{if } x < 0, \end{cases}$$

with a loss aversion parameter $\lambda > 1$.

In the non-competitive scenario, the comparison benchmark $\max_{j \neq i} \theta(a_j, e_j)$ is replaced by a fixed threshold θ^*, with all other elements of the model remaining unchanged. An individual succeeds if their performance exceeds θ^*, so payoffs depend solely on their own ability and effort. The threshold θ^* is set to match the objective probability of success in the corresponding competitive condition. For example, when $N = 2$, the threshold is set at the median of its performance distribution, ensuring a 50 percent ex-ante success probability. When $N = 10$, it is set at the 90th percentile of the performance distribution, so that the probability of surpassing the threshold matches the 10 percent winning probability in a winner-take-all tournament.[17]

More generally, let $s \in \{C, NC\}$ denote the setting, where C represents competition and NC represents non-competition. Let $f \in \{G, L\}$ denote the framing of the reward structure, where G corresponds to the gain frame and L to the loss frame. Individual i's experienced utility in scenario (s, f), denoted $U_i^{s,f}(e_i)$, can be written as

$$P_i^{s,f}(e_i) \cdot v\left(w_i^{win,f}\right) + \left(1 - P_i^{s,f}(e_i)\right) \cdot v\left(w_i^{lose,f}\right) - c(e_i) \; + \; \psi_i^{s,f}$$

[16] Utility from merely performing the task itself is normalized to zero and thus not explicitly modeled as part of the competitive experience.

[17] Winner-take-all is used in its strict sense: a contest with exactly one winner.

The first three terms capture the pecuniary component of utility, denoted as $U^{s,f}_{i,\text{pec}}(e_i)$, while the fourth term captures the non-pecuniary component, denoted as $U^{s,f}_{i,\text{nonpec}}$. The perceived probability of winning, $P^{s,f}_i(e_i)$, depends on scenario (s, f), reflecting that the same effort level may translate into different perceived probabilities depending on the competitive setting and reward framing. The non-pecuniary utility $\psi^{s,f}_i$ also varies across scenarios, as affective responses and anticipatory utility may differ between settings and frames. Monetary payoffs (w^{win}, w^{lose}), by design, vary only with framing; this ensures that within each frame, competition is the sole distinguishing factor, allowing us to cleanly isolate its impact. The effort cost function, $c(e_i)$, is assumed to be identical across all scenarios. Any variation in the subjective burden of effort, such as potentially increased stress under competition or loss frames, is captured by the non-pecuniary component $U^{s,f}_{i,\text{nonpec}}$.

To compare utilities across competitive and non-competitive settings, I introduce two empirically testable assumptions. Unlike axiomatic assumptions, these will be validated through intermediate results from the experimental evidence.

Assumption 1 . *Fix a frame $f \in \{G, L\}$. For every effort level $e \geq 0$,*[18] *the perceived probability of success is (weakly) lower in the competitive setting than in the non-competitive setting:*

$$P^C_i(e) \;\leq\; P^{NC}_i(e) \quad \textit{for all } e \geq 0.$$

In the competitive setting, success requires exceeding $\max_{j\neq i} \theta(a_j, e_j)$, an endogenous and uncertain benchmark determined by opponents' abilities and effort choices. In the non-competitive setting, success is measured against a fixed and transparent threshold θ^* calibrated to match the corresponding objective success probability. Although the objective probability of success is identical across the two settings by design within each frame, the strategic uncertainty (Bruttel et al., 2023; Balafoutas and Sutter, 2019) in competition may depress individuals' beliefs about their prospects,[19] lowering perceived chances of success relative to fixed standards. Formally, for any effort level e, $P^C_i(e) \leq P^{NC}_i(e)$.

[18] This assumption may be strong. A more general model that relaxes assumptions and derives the relationship between utilities using distributional information on ability will be developed in subsequent work.

[19] Bruttel et al. (2023) show that when the source of uncertainty is strategic rather than exogenous, beliefs are systematically reshaped; Balafoutas and Sutter (2019) show that uncertainty and ambiguity in tournament rules shifts competitive behavior.

Assumption 2 *The non-pecuniary utility from competing is weakly higher than under non-competition in the gain frame and weakly lower in the loss frame:*

$$\psi_i^{C,G} \geq \psi_i^{NC,G} \quad \textit{and} \quad \psi_i^{C,L} \leq \psi_i^{NC,L} \qquad \textit{for all } i.$$

In the gain frame, losing a competition simply means not obtaining the reward, but at least remaining at the status quo. In other words, one does not incur any deterioration relative to the initial position. In this case, the nonpecuniary utility from competition, including feelings of excitement or satisfaction, is likely to outweigh negative emotions such as stress or competitive pressure. This means $\psi_i^{C,G} \geq \psi_i^{NC,G}$. In contrast, in the loss frame, losing in competition entails a reduction from the initial endowment. According to loss aversion, whereby losses evoke stronger negative affect than equivalent gains (Tversky and Kahneman, 1979; Kahneman et al., 1991; Brown et al., 2024), such losses in competition may heighten psychological costs, such as stress and anxiety, to the point that they surpass enjoyment of competing. This implies $\psi_i^{C,L} \leq \psi_i^{NC,L}$.

2.2 Predictions

The simple theoretical framework provides two main predictions that guide the empirical analysis. The first one concerns the belief about winning $P_i^s(e_i)$. Competition affects utility through affecting the perceived success probability. The second concerns the intrinsic utility of competition ψ_i^f. Individuals derive direct utility from the act of competing. I experimentally test the predictions in Section 5. Proofs and auxiliary assumptions are in Appendix A.

PREDICTION 1. *(Belief channel.) Fix a frame $f \in \{G, L\}$ and hold the intrinsic utility channel ψ_i^f fixed. Under Assumptions 1, the competitive setting, relative to the non-competitive benchmark, yields lower expected utility from monetary payoffs:*

$$U_{i,\text{pec}}^{C,f}\left(e_C^{f,*}\right) \;\leq\; U_{i,\text{pec}}^{NC,f}\left(e_{NC}^{f,*}\right).$$

Intuitively, in the non-competitive (threshold) task, the target is fixed and transparent: an extra unit of effort moves performance toward a known cutoff, so the perceived chance of success rises clearly. In the competitive setting, the target is the opponents' maximum, which is uncertain and may shift with others' abilities and efforts. This moving target

makes success feel less likely and less responsive to one's own effort: both the level of the perceived success probability falls and the slope with respect to effort becomes smaller. As a result, each unit of effort is believed to buy less success probability. Evaluated at the respective optima, the expected utility from monetary payoffs is lower because payoffs are probability-weighted, and belief utility, which rises with the perceived chance of winning and is independent of money, also declines. Holding the intrinsic utility channel ψ_i^f fixed, both mechanisms reduce experienced utility in the competitive setting relative to the threshold benchmark.

PREDICTION 2. *(Preference channel) Fix $f \in \{G, L\}$ and hold the belief channel fixed. Under Assumption 2, the competitive setting, relative to the non-competitive benchmark, yields:*

i *Gain frame: higher intrinsic utility from the act of competing, i.e.,*

$$U_{i,\text{nonpec}}^{C,G} \geq U_{i,\text{nonpec}}^{NC,G}$$

ii *Loss frame: lower intrinsic utility from the act of competing, i.e.,*

$$U_{i,\text{nonpec}}^{C,L} \leq U_{i,\text{nonpec}}^{NC,L}$$

Intuitively, intrinsic utility is the utility of competing itself, separate from money and separate from whether one ultimately wins or loses. The act of competing can bring joy, excitement, pride, or stress and dread. The frame may determine which force dominates. In the gain frame the worst case is to stay at the status quo, so the extra randomness from facing others is not tied to material losses. The arousal of competition is coded as opportunity and tends to feel exciting and rewarding, yielding a positive intrinsic evaluation of competing. In the loss frame participants start from an endowment they may forfeit. Loss aversion makes the potential shortfall salient, and the added uncertainty of competing heightens anticipation of that shortfall. The same arousal now feels threatening rather than thrilling, so the intrinsic evaluation becomes negative. Holding beliefs about success and monetary payoffs fixed, the act of competing is therefore valued more in the gain frame and less in the loss frame.

3 Experiment

The experiment is designed to investigate whether competition itself carries utility or disutility independent of realized outcomes, whether this utility varies across different contexts, and the implications of these effects. To provide clean and reliable causal evidence, I conduct a series of experiments. Section 3.1 introduces the experimental design, Section 3.2 describes the experimental procedures, and Section 3.3 summarizes the data.

3.1 Experimental Design

A. Treatments

The experiment employs a between-subjects design that varies two treatment dimensions: competition versus non-competition, and reward structure framed as gains versus losses. Participants are randomly assigned to one of four treatments: Gain Framing with Competition, Gain Framing without Competition, Loss Framing with Competition, and Loss Framing without Competition. All participants complete a timed IQ quiz under their assigned treatment, then respond to a post-task survey. Figure 1 presents a visual summary of the experimental design, with details outlined below.

Incentives. In the Gain Framing with Competition treatment, participants were randomly paired and competed for a monetary prize based on their performance in an IQ quiz. Each participant received a $2 show-up fee. Within each pair, the participant with the higher quiz score earned an additional $4 reward, while the participant with the lower score received no additional payment. In the Gain Framing without Competition treatment, each participant also received a $2 show-up fee but completed the quiz individually. Participants earned an additional $4 reward if their quiz score exceeded a predetermined threshold; otherwise, they received no reward. In the event of a tie, one participant was randomly selected to receive the reward. The performance threshold was set at the median score from the Gain Framing with Competition treatment, and participants were informed of this median benchmark before starting the quiz. This design ensured an identical ex-ante success probability across treatments. In the competition condition, the pairing structure yields a one-half probability of winning. In the non-competition condition, because the median represents the midpoint of the score distribution, half of all participants scored above it and half below it, yielding a one-half success probability by design. With the same reward structure ($2 base payment plus $4 performance bonus) across both treatments, expected payoffs were also identical.

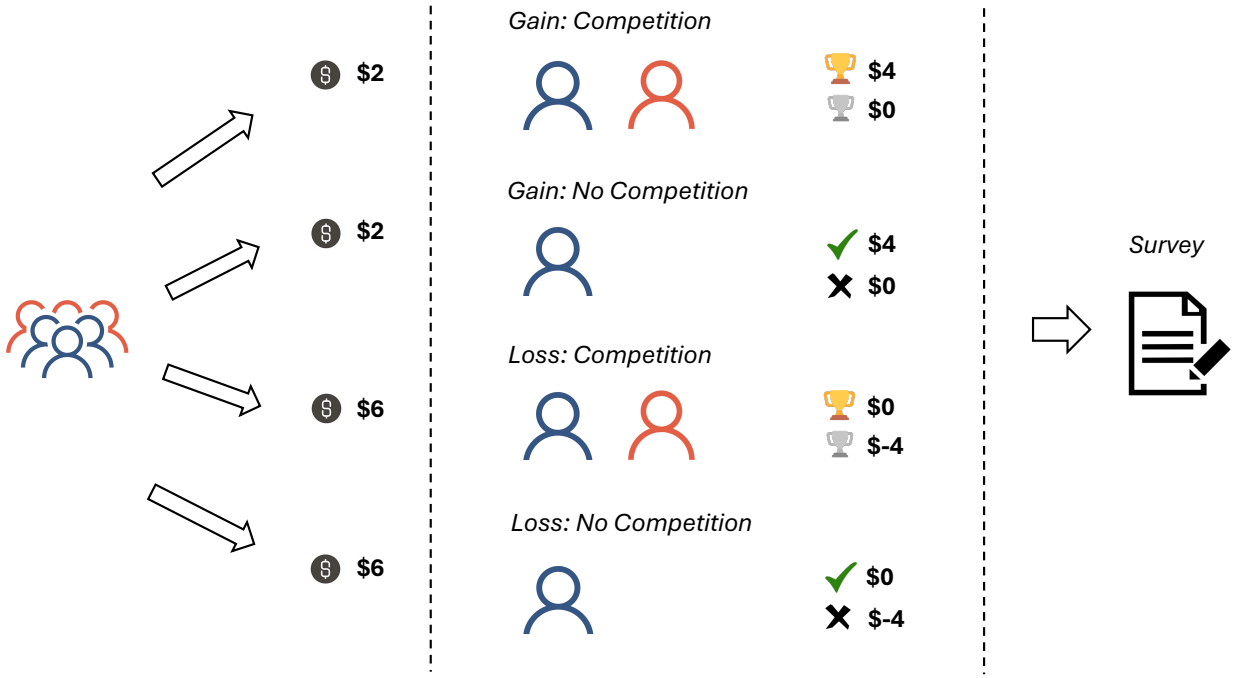


Figure 1: Visual Representation of Experimental Design

Notes: This figure illustrates the structure of the experimental design. Participants are randomly assigned to one of four treatments that vary competition (competition vs. no competition) and reward framing (gain vs. loss).In gain-framed treatments, participants receive a $2 show-up fee and can earn $4 more by winning in competition or exceeding a threshold in non-competition. In loss-framed treatments, participants receive a $6 show-up fee and can lose $4 by losing in competition or failing to exceed the threshold in non-competition. The threshold is set at the median score from the competition treatment with the same reward framing. All participants complete a post-task survey after the experimental task.

In the Loss Framing with Competition treatment, the structure paralleled the gain framing but shifted the reference point. Each participant started with a $6 show-up fee and was randomly paired with a competitor. Within each pair, the participant with the higher quiz score retained the full $6, while the participant with the lower score forfeited $4, keeping only $2. In the Loss Framing without Competition treatment, participants completed the quiz individually. Those whose scores exceeded a predetermined threshold kept the full $6, while those falling short forfeited $4, keeping only $2. In the event of a tie, one participant was randomly selected as the winner. The threshold was set at the median score from the Loss Framing with Competition treatment,[20] and participants were informed of this median benchmark before starting the quiz. This median threshold design ensured that participants in both loss-framed conditions faced a one-half probability of avoiding the loss, yielding expected payoffs equivalent to those in the gain-framed treatments ($2

[20]In practice, quiz scores in the Gain Framing with Competition treatment and the Loss Framing with Competition treatment were very similar.

base payment plus expected $2 from performance). In fact, expected monetary payoffs across all four treatments were identical.[21] With monetary incentives held equal, the presence of competition and the framing of the reward structure were the only factors that varied across conditions, enabling clean identification of competition effects.

IQ Quiz. The choice of an IQ quiz as the experimental task is motivated by two factors. First, performance on IQ tests is inherently ego-relevant, naturally eliciting utility responses from participants. This feature increases the likelihood of observing potential utility effects of competition, should they exist. Second, the cognitively demanding nature of the IQ quiz resembles tasks commonly encountered in real-world work environments, enhancing the external validity of the experimental findings. One potential concern with using an IQ quiz is that some participants might be particularly averse to IQ-related competition, leading to higher attrition in competition treatments relative to non-competition treatments and creating imbalance across conditions. Fortunately, attrition rates were similar across all treatments in practice, alleviating this concern.

The IQ quiz was designed as follows. It consists of 50 puzzles adapted from Civelli and Deck (2017), similar to Raven's Progressive Matrices, a widely used measure of cognitive ability (Drobner and Goerg, 2024; Willadsen et al., 2024). Each puzzle provides four answer choices, only one of which is correct; an example is shown in Figure 2. All treatments use the same set of puzzles. The scoring rule awards one point for each correct answer, deducts one-quarter point for each incorrect answer, and assigns zero points for skipped questions. Participants cannot return to questions they have answered or skipped. This is designed to incentivize thoughtful engagement: answering a question yields a higher expected payoff than skipping it, and the penalty for incorrect answers discourages random guessing. Participants have four minutes to complete as many puzzles as possible. This fixed time limit ensures that all participants spend the same amount of time on the task, eliminating potential confounds from variations in task duration.

Online Matching. In the competition treatments, participants in both framing conditions are randomly matched in real time with another participant. The maximum waiting time is five minutes, though the average was 19 seconds, making systematic treatment differences unlikely. Appendix Figure D.2 displays the matching screen at this stage. Once matched, participants begin the IQ quiz immediately. In the non-competitive treatments, participants proceed directly to the quiz without matching.

[21] In both gain-framed and loss-framed conditions, participants had a one-half probability of receiving $2 and a one-half probability of receiving $6, yielding an expected payoff of $4.

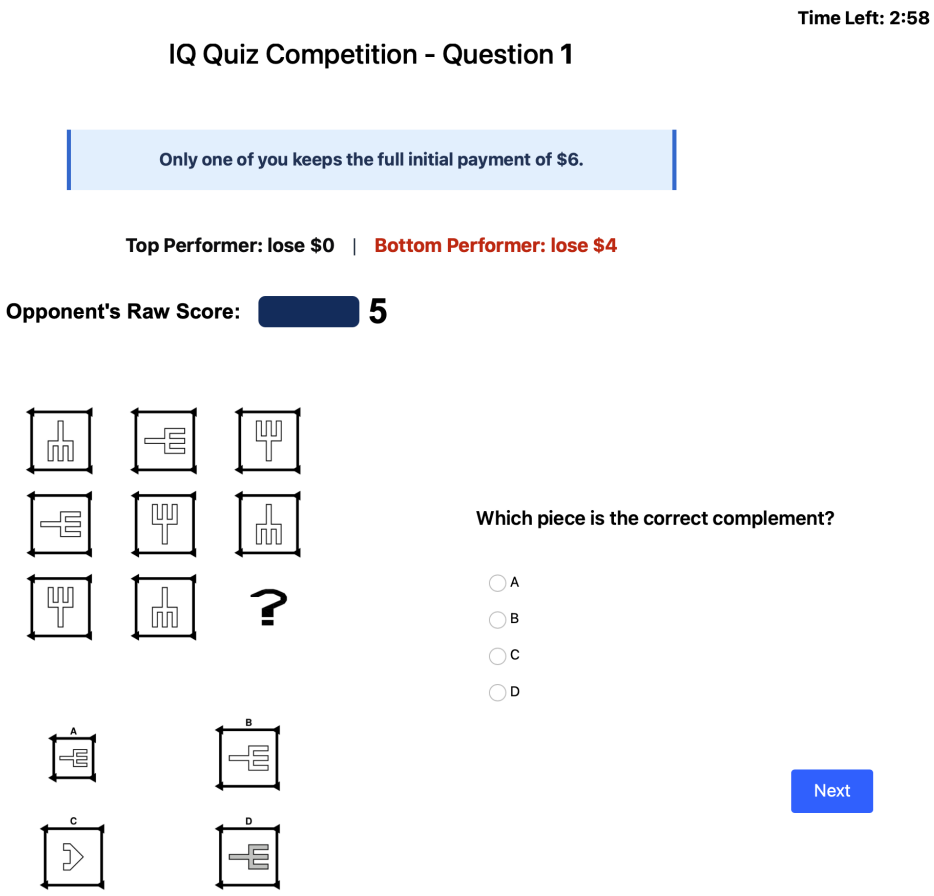


Figure 2: IQ Quiz Interface

Notes: This figure shows the experimental interface used in the IQ quiz competition task for the loss-framed competition treatment. Participants are informed that only one of the two competitors retains the full initial payment of six dollars, while the other loses part of it based on relative performance. The top performer loses zero dollars and the bottom performer loses four dollars. Each question presents a matrix reasoning problem in which participants select the correct complement from four options labeled A, B, C, and D. The opponent's raw score is displayed to enhance the sense of competition, while the remaining time indicates the total time left to complete the four-minute task.

Interface. Figure 2 shows the IQ quiz interface for the loss-framing competition group. The interfaces for the other three groups are presented in Section C.. Two design features of the task screen merit attention. The first is the *real-time opponent score bar*. In both competitive treatments, participants observe their opponent's *raw* score in real time. The raw score represents the cumulative number of correct answers without deductions for incorrect answers. This design serves two purposes. First, its dynamic nature heightens the salience of competition and may evoke emotions such as excitement, nervousness, or stress, enabling detection of whether participants derive utility from competing. Online

experiments often limit engagement because participants cannot physically observe rivals; the score bar mitigates this limitation by making competition more tangible. Second, because only raw scores are shown, participants learn about their opponents' performance only partially and cannot infer the final outcome. This feature is crucial for isolating the effect of competition itself. The score bar appears only in the competitive treatments. The second design feature is treatment-specific interface wording to reinforce treatment salience. In the competitive conditions, the interface states "Only one of you earns the $4 bonus" in the gain frame and "Only one of you keeps the full initial payment of $6" in the loss frame, underscoring both rivalry and the zero-sum nature of the task. In the non-competitive conditions, the wording emphasizes individual performance: "Reach the target score to earn the $4 bonus" in the gain frame and "Reach the target score to keep the initial payment of $6" in the loss frame.

IQ Quiz Performance Feedback. Participants receive no information about their own performance during the quiz. At the end of the experiment, they are informed of their own quiz score, their opponent's score, and whether they beat their opponent (in competition treatments) or met the threshold (in non-competition treatments). This design ensures isolating the utility derived from competition itself, independent of realized outcomes. Although in competitive conditions the display of the opponent's real-time score may enable participants to form beliefs about outcomes, this concern is mitigated by showing only raw instead of final scores.

B. Outcome Measures

The outcome variables are measured through survey questions and incentivized decision-making tasks administered after the IQ quiz, as shown in Figure 1. Utility, task preferences, and zero-sum thinking are elicited through the survey, while altruistic behavior is measured using a dictator game and a public goods game.

Measuring Utility. A self-reported measure of well-being is commonly used to capture individuals' perceptions of their experience (Kahneman and Krueger, 2006; Kahneman et al., 1997; Frey et al., 2004; Haggag et al., 2019). Following this approach, I use a survey question with a seven-point Likert scale to measure experienced utility: "On a scale from 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ Quiz (or, in treatment groups, the IQ Quiz Competition)?" To capture specific emotional components of utility, I adapt the approach of Bernheim et al. (2024), who elicit the feelings

associated with individuals' choices. Participants are asked: "Thinking back to how you felt during the IQ Quiz (or IQ Quiz Competition for the treatment groups), please indicate the extent to which you experienced the following emotions (excitement, satisfaction, stress, embarrassment, and anxiety) on a scale from 1 (not at all) to 7 (extremely)." The first two emotions are classified as positive and the latter three as negative. These measures are administered uniformly across all experimental conditions.

Measuring Task Preference. Individuals are generally aware of state-dependent preferences. For example, food tastes better when one is hungry and vacations are more enjoyable when the weather is sunny. However, they may fail to account for the transient nature of such states and instead misattribute their influence to stable characteristics of the good or activity (Haggag et al., 2019; Bushong and Gagnon-Bartsch, 2023). While the literature has documented such attribution biases in non-strategic contexts such as hunger and thirst, less is known about whether similar biases arise in strategic environments. This study provides an opportunity to examine whether competitive settings shape individuals' preferences for a task through such biases.

To measure task preferences, I adapt survey questions from Haggag et al. (2019). The primary measure asks respondents whether they would accept the task under varying hypothetical payments. They are presented with the following scenario: "Imagine you have another IQ quiz in front of you right now, similar to the one you just completed but with a different set of fifty questions. You again have four minutes to answer as many as possible. If you get at least six questions[22] correct within the four minutes, you will receive a payment. For each amount ($0.20, $0.40, $0.60, $0.80, $1.00, $1.20, $1.40, $1.60, $1.80, $2.00, $2.50, $3.00, and $5.00), please indicate 'Yes' if you would be willing to take the quiz for that payment, or 'No' otherwise." As a complementary measure, respondents are also asked: "On a scale from 1 (not at all likely) to 7 (extremely likely), how likely would you be to voluntarily take another set of 10 IQ questions, similar to the ones you just completed, with no monetary rewards?"

Measuring Zero-Sum Thinking. Following the approaches used in the World Values Survey (Inglehart et al., 2014) and Carvalho et al. (2023), I measure zero-sum thinking using two survey questions. The first asks respondents to position their views on a scale between two opposing statements: (1) "Wealth can grow so there's enough for everyone" and (2) "People can only become wealthy at the expense of others." Participants select a number

[22] Six correct answers correspond to the median performance in the sample.

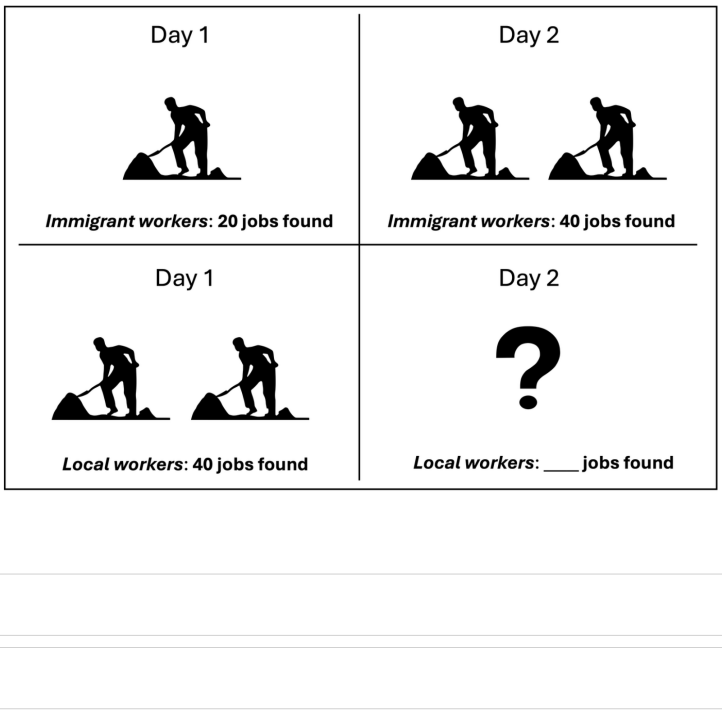


Figure 3: Measure of Zero-Sum Thinking

Notes: The figure illustrates the vignette used to measure zero-sum thinking. Participants are presented with a simple scenario comparing the number of jobs found by immigrant and local workers over two consecutive days. On Day 1, immigrant workers find 20 jobs and local workers 40. On Day 2, immigrant workers find 40 jobs, and respondents are asked to determine how many jobs local workers find on Day 2, choosing between 20 and 80. Selecting 20 reflects a zero-sum view, in which the total number of available jobs is fixed and gains for one group imply losses for another. Selecting 80 reflects a non-zero-sum view, consistent with a positive-sum understanding that overall economic opportunities can expand.

from 1 to 10 that best represents their view, where 1 indicates complete agreement with the first statement (non-zero-sum thinking) and 10 indicates complete agreement with the second (zero-sum thinking), with intermediate values representing intermediate views. The second question adapts the measure from Carvalho et al. (2023). Respondents are presented with a scenario in which both immigrants and locals work as day laborers (see Figure 3). On Day 1, immigrant workers find 20 jobs while local workers find 40 jobs. On Day 2, immigrant workers find 40 jobs. Respondents are asked to estimate the number of jobs found by local workers on Day 2, choosing between 20 and 80. Choosing 20 reflects zero-sum thinking: if the total number of jobs is fixed, then when immigrants take more, fewer remain for locals. Choosing 80 reflects non-zero-sum thinking: if a common demand shock doubled the number of jobs for immigrants, then the number of jobs for locals would also double.

Measuring Altruistic Behavior. I measure altruistic behavior using a dictator game and a public goods game. In the dictator game, I follow Enke et al. (2023): participants are asked to split $100 between themselves and a randomly selected participant (see Figure 4). This design provides a vivid and efficient measure of altruism. In the public goods game, participants are randomly paired. Each receives a $0.50 endowment and must decide whether to keep it or contribute it to a common pool. Payoffs are determined as follows: if both keep, each earns $0.50; if both contribute, each earns $0.80; if one keeps while the other contributes, the keeper earns $0.90 and the contributor $0.40. The decision interface is shown in Figure 5. All payments are real and paid as part of participants' final bonuses. After making their decision, participants are asked to estimate the share of others who chose to keep their endowment. This belief elicitation is incentivized: correct answers earn a monetary bonus.

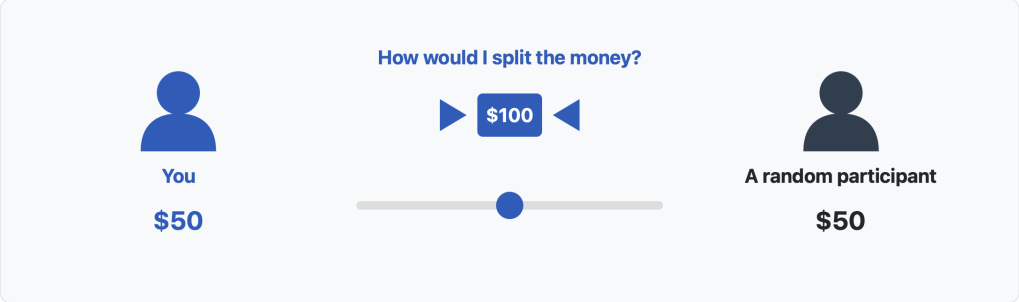


Figure 4: Dictator Game

Notes: This figure shows the experimental interface used in the dictator game. Participants are hypothetically given one hundred dollars and use a slider to decide how to divide it between themselves and a randomly selected participant. As they move the slider, the displayed amounts for each side adjust in real time to reflect the chosen allocation. The task measures altruistic behavior by capturing participants' willingness to share resources in a non-strategic context.

Additional Measures. As suggested by the theoretical framework in Section 2, beliefs about the probability of winning and perceived relative ability are important components of utility. I therefore elicit both in the survey. To measure beliefs about winning, I follow Niederle and Vesterlund (2007). Participants in the competition treatments are asked whether they believe they were the top performer in the IQ Quiz Competition (yes/no). In the control treatments, they are asked whether they believe their score exceeded the threshold (yes/no). These questions are incentivized: participants receive a bonus for correct answers. Perceived relative ability is measured by asking participants to rate their performance relative to others on a 0–10 scale, where 0 indicates believing they performed

worse than almost everyone and 10 indicates better than nearly everyone. For instance, a response of 7 corresponds to believing one performed better than about 70% of participants. In addition, I collect basic demographics (gender, race, income, education). To ensure data quality, participants are also asked how well they understood the instructions, with response options "fully understand," "almost," "partly," or "none." The full survey is provided in Section D.7.

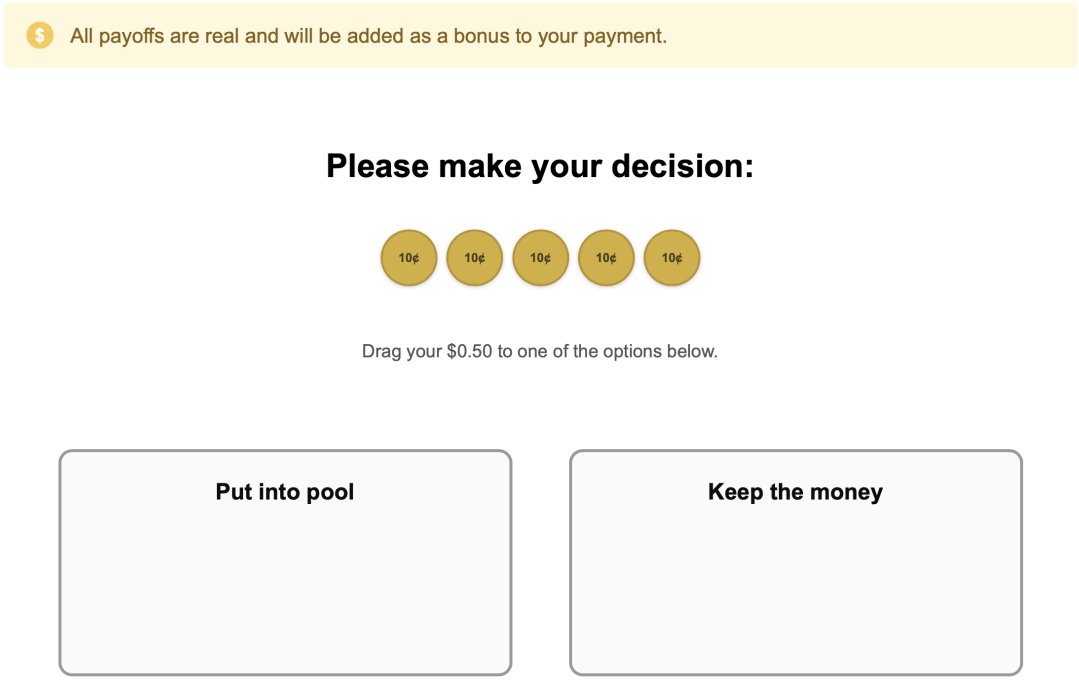


Figure 5: Public Goods Game

Notes: This figure shows the experimental interface used in the public goods game. Participants are given an endowment of fifty cents and decide whether to keep it or contribute it to a common pool. To make their decision, they drag the dollar representation into one of the two boxes labeled "Put into pool" or "Keep the money." All payoffs are real and added to participants' final bonuses. This task measures cooperative behavior by observing contributions to a shared resource when personal and collective incentives conflict.

C. Comprehension and Attention Checks

To further ensure data quality, I implement comprehension questions, bot detection, and attention checks. Before the IQ quiz, participants are required to complete a practice question; only those who answer correctly can proceed. A second comprehension question is administered before the public goods game to verify participants' understanding of the payment rules. Participants must answer correctly to continue. I also record the number of

attempts taken on each comprehension question, which serves as a screening criterion in the data analysis. To prevent automated participation, reCAPTCHA verification is included at the start of the experiment. Only participants who pass this verification can continue. For attention checks, I adopt the method used in Bernheim et al. (2024). Specifically, one survey item embedded among the main questions instructs participants not to select any option. Selecting an option indicates a failed attention check, and the participant's data is excluded from the analysis.

3.2 Experimental Procedures

Participant Pool. Participants were recruited via Prolific, a widely used online platform for social science research (Peer et al., 2022). All participants resided in the United States and were at least 18 years old. To ensure high data quality, I applied several screening criteria. First, participants were required to have completed at least 100 prior submissions on Prolific. Second, their prior approval rate had to be at least 95%. Third, the sample was balanced by gender within each experimental condition.[23] Fourth, each participant could access only one recruitment posting and participate in a single experimental condition.[24] Finally, to ensure smooth implementation, only desktop or laptop devices were permitted; responses from mobile phones and tablets were excluded.

Procedures. The experiment was conducted on June 4, 2025, with the four experimental groups implemented over the course of the day in the following order: Gain Framing with Competition, Gain Framing without Competition, Loss Framing with Competition, and Loss Framing without Competition. In all groups, the study title read "A short quiz and a set of survey questions (15–25 minutes)." In the study description, participants in the Gain Framing condition were told the study paid $2 with the possibility of earning a bonus, whereas participants in the Loss Framing condition were told the study paid $6 with the possibility of a deduction.[25]

[23] This step was necessary because Prolific's participant pool contains more females than males; simple random assignment would otherwise risk gender imbalance.

[24] Because the median IQ quiz score from competitive treatments was used as the benchmark for non-competitive treatments, experimental conditions were conducted sequentially. Preventing multiple participation was therefore essential. No participant took part in more than one condition.

[25] In the Gain Framing condition, the description stated: "The base payment for participating in the study is $2.00. You can earn a bonus of up to $4.00 in the first section, and additional bonuses in later sections." In the Loss Framing condition, the description stated: "The base payment for participating in the study is $6.00. You may lose up to $4.00 of this amount in the first section. Bonuses are available in later sections."

Upon entering the study, participants first viewed a welcome page outlining the study purpose and compensation. They then read the informed consent form, entered their Prolific ID, and completed a reCAPTCHA verification. Next, participants received the main instructions, which varied slightly across treatment arms. The instructions described the IQ quiz, the follow-up survey, the expected duration, and the payment rules. In the Gain Framing conditions, participants were informed that they would begin with $2 and could earn up to a $4 bonus based on their quiz performance. In the Gain-Competition condition, the bonus required outperforming a randomly matched online opponent. In the gain-framed control condition, the bonus was tied to meeting a prespecified threshold, which was the median quiz score from a prior session. In the Loss Framing conditions, participants were told they would begin with $6 and could lose up to $4. In the Loss-Competition condition, avoiding the deduction required outperforming a random opponent, while in the Loss-No Competition condition, it required meeting a prespecified threshold.[26]

All participants were required to answer comprehension questions after reading the instructions, and they had to correctly answer all questions before proceeding. Data indicate that 94.3% of participants passed within two attempts. Participants then completed a practice question to familiarize themselves with the quiz format, followed by a reminder page reiterating the payment rules. In the competition condition, participants were additionally reminded that they would be matched in real time with another participant and would observe their opponent's raw score bar updating live. On the matching page, a five-minute countdown timer was displayed. Participants who were not matched within this period received $0.50 compensation for their time. In practice, 99.7% of participants were matched, with an average wait time of 19 seconds, ranging from a minimum of 1.8 seconds.[27] Once matched, or proceeding directly in the non-competition condition, participants completed the four-minute IQ quiz. Afterwards, they answered survey questions on utility, task preferences, zero-sum thinking, and made decisions in a dictator game and a public goods game. Questions on beliefs about winning, perceived relative ability, and demographic characteristics were asked at the end. On the final page, participants were shown their quiz performance and informed whether they had beaten their opponent or, in the non-competition condition, whether they had passed the threshold score.[28]

[26] In practice, the median quiz scores in the Gain–Competition and Loss–Competition groups were similar (6.25 and 6.75, respectively). For simplicity, I set the threshold at 6 in the non-competition conditions under both gain and loss framing.

[27] The experiment was programmed in oTree and hosted on Heroku. Matching was implemented in oTree. To maintain server stability during peak recruitment, participation slots were released in staged batches, for example, 50 positions at a time, until the target sample size was reached.

[28] In the Loss Framing conditions, participants were informed they might lose part of their payment. At the

Pre-registration. The experiment was preregistered on the AEA RCT Registry[29]. The preregistration specified the experimental design, interventions, planned sample sizes, and the primary hypotheses concerning competition and the main outcomes.

3.3 Data Description

A total of 798 participants enrolled in the study. Of these, 198 participated in the Gain-Framed Competition session, and 200 participated in each of the other three sessions: Gain-Framed Control, Loss-Framed Competition, and Loss-Framed Control. Eight participants failed the attention check and three submitted incomplete responses. Excluding these eleven participants yields a final sample of 787.[30] Attrition was minimal. The median completion time was eighteen minutes.[31]

Demographic characteristics and balance tests are presented in Table 1. The sample is well balanced across experimental conditions. Roughly half of all participants identify as female, and the average age is forty years. About sixty percent identify as White and twenty-eight percent as African American. Nearly one quarter of participants have a high school education or less, forty-six percent hold a bachelor's degree, and twenty-nine percent have a graduate or professional degree. Around one third report annual household income between thirty-five thousand and seventy-five thousand dollars, and two thirds are employed full time. Across the four sessions, demographic differences between groups are small. In the gain-framed sessions, means for age, gender, education, income, and political orientation are nearly identical between competition and control conditions. In the loss-framed sessions, two variables show modest differences: the share with a high school education or less and the share with incomes between ten thousand and thirty-five thousand dollars. However, these differences are not concerning when evaluated jointly: *F*-tests show no evidence of systematic imbalance (*F*-test, $p = 0.61$ for gain-framing competition vs. control; *F*-test, $p = 0.17$ for loss-framing competition vs. control).

end of the experiment, a debrief clarified that, consistent with Prolific policy, advertised payments could not be reduced; all participants received the full $6 regardless of performance. Participants in the competition groups also received an additional debrief because competition had not been disclosed in the consent form. While some participants may have known Prolific's policy, comments from study participants suggest this was rare. Random assignment ensures any such effect was balanced across conditions.

[29] ID: AEARCTR-0015723, https://doi.org/10.1257/rct.15723-2.3.

[30] The excluded participants included three from Gain-Framed Competition, four from Gain-Framed Control, one from Loss-Framed Competition, and three from Loss-Framed Control.

[31] The target sample size was eight hundred, with two hundred participants per group. The shortfall of two resulted from minor technical issues on the Prolific platform. The median completion time was eighteen minutes in Gain-Framed Competition, seventeen minutes in Gain-Framed Control, nineteen minutes in Loss-Framed Competition, and seventeen minutes in Loss-Framed Control.

Table 1: Descriptive Statistics and Balance Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Gain Framing		**Loss Framing**		**Diff.**	
	Full Sample	Competition	Control	Competition	Control	(2)-(3)	(4)-(5)
Gender: Female	0.50	0.51	0.52	0.50	0.50	-0.01	0.00
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	[0.84]	[0.96]
Age	40.12	39.72	40.21	38.97	41.55	-0.50	-2.58*
	(13.41)	(13.64)	(13.13)	(13.75)	(13.06)	[0.71]	[0.06]
Race: White	0.60	0.62	0.59	0.56	0.61	0.03	-0.05
	(0.49)	(0.49)	(0.49)	(0.50)	(0.49)	[0.52]	[0.34]
Race: African American	0.28	0.30	0.27	0.30	0.25	0.03	0.05
	(0.45)	(0.46)	(0.45)	(0.46)	(0.43)	[0.46]	[0.25]
Race: Hispanic	0.05	0.04	0.07	0.06	0.04	-0.03	0.02
	(0.22)	(0.20)	(0.25)	(0.23)	(0.18)	[0.27]	[0.33]
Race: Asian	0.05	0.02	0.05	0.05	0.07	-0.03	-0.02
	(0.21)	(0.14)	(0.22)	(0.21)	(0.26)	[0.11]	[0.29]
Education: High school and less	0.24	0.22	0.29	0.16	0.30	-0.07	-0.14***
	(0.43)	(0.41)	(0.45)	(0.37)	(0.46)	[0.12]	[0.00]
Education: Bachelor's degree	0.46	0.45	0.45	0.51	0.44	0.00	0.07
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	[0.99]	[0.15]
Education: Graduate or professional degree	0.29	0.33	0.26	0.33	0.26	0.07	0.07
	(0.46)	(0.47)	(0.44)	(0.47)	(0.44)	[0.13]	[0.14]
Income: Less than $10,000	0.03	0.03	0.03	0.03	0.03	0.00	0.00
	(0.16)	(0.16)	(0.17)	(0.16)	(0.16)	[0.77]	[0.99]
Income: $10,000 - $34,999	0.14	0.14	0.19	0.09	0.16	-0.05	-0.06**
	(0.35)	(0.35)	(0.39)	(0.29)	(0.36)	[0.19]	[0.05]
Income: $35,000 - $74,999	0.33	0.29	0.31	0.35	0.36	-0.02	0.00
	(0.47)	(0.45)	(0.46)	(0.48)	(0.48)	[0.63]	[0.95]
Income: $75,000 - $149,999	0.37	0.40	0.33	0.38	0.35	0.07	0.03
	(0.48)	(0.49)	(0.47)	(0.49)	(0.48)	[0.15]	[0.51]
Income: $150,000 or more	0.13	0.14	0.14	0.15	0.11	0.01	0.04
	(0.34)	(0.35)	(0.35)	(0.35)	(0.31)	[0.85]	[0.29]
Employment: Full time	0.65	0.64	0.57	0.69	0.69	0.08	0.00
	(0.48)	(0.48)	(0.50)	(0.46)	(0.46)	[0.12]	[0.97]
Policy: Extreme or leaning left	0.36	0.31	0.30	0.40	0.42	0.01	-0.02
	(0.48)	(0.47)	(0.46)	(0.49)	(0.50)	[0.77]	[0.64]
Policy: Extreme or leaning right	0.42	0.46	0.48	0.36	0.37	-0.02	0.00
	(0.49)	(0.50)	(0.50)	(0.48)	(0.48)	[0.76]	[0.95]
Policy: Center	0.22	0.22	0.22	0.24	0.21	0.00	0.03
	(0.42)	(0.42)	(0.41)	(0.43)	(0.41)	[0.96]	[0.53]
Residence: U.S.	1.00	0.99	1.00	1.00	0.99	-0.01	0.01
	(0.06)	(0.10)	(0.00)	(0.00)	(0.07)	[0.15]	[0.32]
Nationality: U.S.	0.99	0.99	0.98	0.99	0.99	0.01	-0.01
	(0.11)	(0.10)	(0.14)	(0.10)	(0.07)	[0.42]	[0.56]
Observations	787	194	196	198	199	390	397

Notes: Means are reported with standard deviations in parentheses. P-val in brackets. All variables are coded as indicators and shown as proportions. Column (1) reports statistics for the full sample. Columns (2)–(3) present treatment and control groups under gain framing, and Columns (4)–(5) present treatment and control groups under loss framing. Column (6) shows mean differences between groups under gain framing, with p-values from two-sided t-tests in brackets, while Column (7) reports the same for loss framing. "Observations" indicates the number of responses in each condition.

4 Interpretation of the Competition Treatment

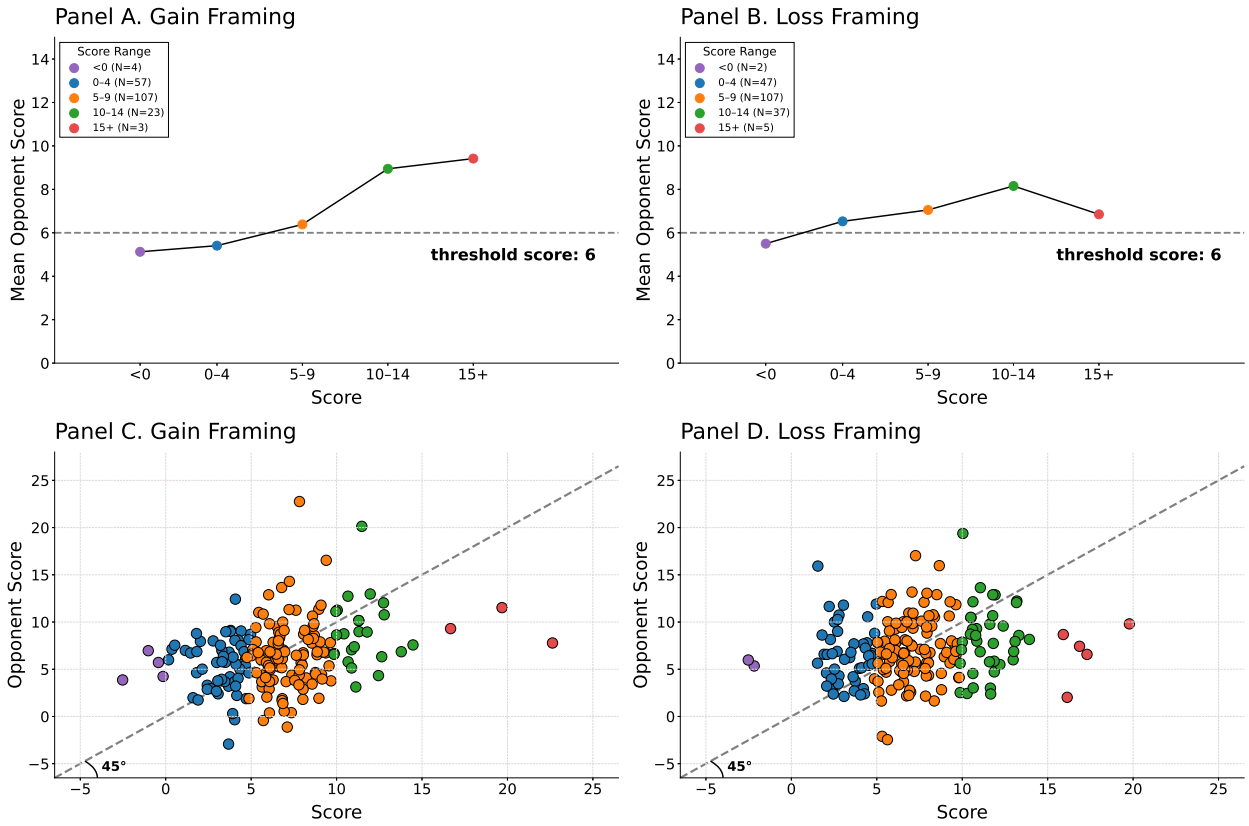
Competition is typically defined as a situation in which an individual's monetary payoff depends not only on their own performance but also on the performance of others or, more generally, on their relative ranking (Niederle and Vesterlund, 2007; Bartling et al., 2012; Gill and Prowse, 2012; Delfgaauw et al., 2013). In this experiment, apart from this payoff structure, competition manifested through two key design features.[32] The first feature is the presence of another person. In the competition treatments, individuals are paired with another person working on the IQ quiz and are made explicitly aware of this pairing through the matching stage, whereas participants in controls work independently with no interaction with others. The second feature is the *opponent's raw score bar*, which appears only in the competition treatments. This live bar provides partial information about their opponent's performance through the raw score, which reflects only the number of correct answers without accounting for penalties from incorrect ones. Moreover, it intensifies the competitive experience, potentially eliciting feelings such as excitement and stress. The former may influence participants' beliefs about their chances of success, while the latter captures the intrinsic utility of competition independent of expected monetary payoffs. Figure 6 shows the detailed matching patterns, and Figure 7 illustrates the dynamic evolution of the opponent's raw score during the experiment.

Panels A and B of Figure 6 present binned scatter plots in which the horizontal axis shows participants' quiz scores and the vertical axis shows the mean quiz scores of their opponents. Across both framings, the mean opponent score remains close to six for participants at all performance levels. The gray dash line marks the threshold score used in the control groups, which is identical at six. Thus, in both competition and control treatments, the average performance level that participants needed to surpass is approximately the same. The key difference is that in the control treatments, all participants faced a predetermined target score of exactly six, whereas in the competition treatments, some faced opponent scores above six and others below, although the average was close to six.[33] Moreover, throughout the quiz, participants in the competition treatments observed a noisy signal of their opponent's score evolving in real time, whereas control participants faced an unchanging target score of six, with no variation during the task.

[32] A third, minor feature is the wording of the instructions: competition treatments use terms such as *competition* and *opponent*, whereas control treatments use phrases like *work independently* and *target score*.

[33] In the experiment, participants did not observe their opponent's final score; they only saw the opponent's final *raw score* near the end of the quiz. The matching pattern of raw scores relative to participants' own scores is shown in Appendix B.1 and is very similar to that of the final scores.

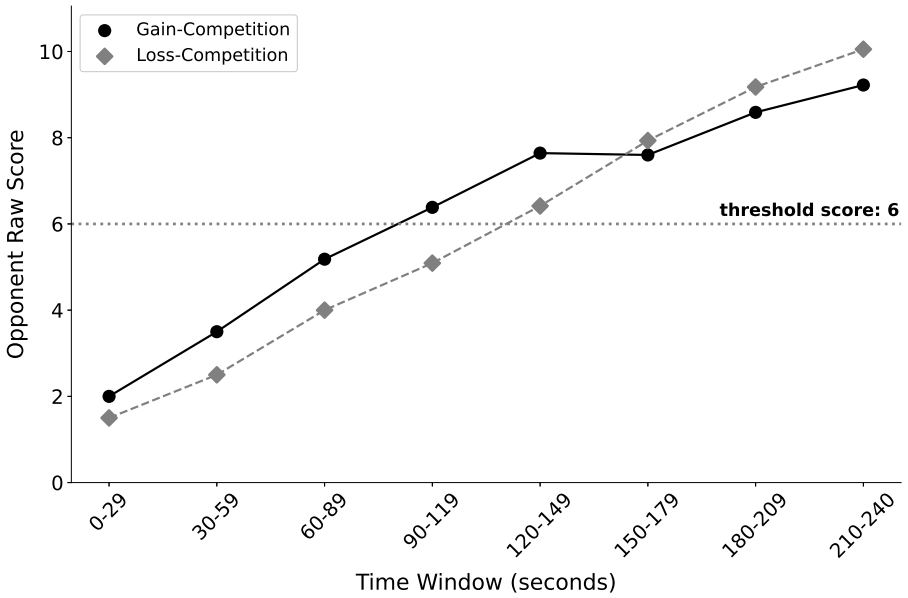
Figure 6: Matching Patterns



*Notes:*This figure shows the realized matching patterns among participants in the competition treatments. Panels A and B present binned scatter plots of participants' quiz scores (horizontal axis) and the mean scores of their matched opponents (vertical axis) under gain and loss framings. The dashed gray line marks the threshold score of six used in the control treatments. In both framings, the mean opponent score stays close to six, indicating similar average difficulty across treatments. Panels C and D display individual-level scatter plots, with each point representing a participant–opponent pair. The dotted 45-degree line denotes equal scores. Participants with lower scores tend to face stronger opponents, while higher-scoring participants tend to face weaker ones. Matching patterns are broadly similar across framings.

Panels C and D unpack the binned scatter plots to show individual observations. Panel C shows the pattern under gain framing, and Panel D under loss framing; the two are broadly similar. The dotted 45-degree line represents equal scores between a participant and their opponent. Purple and blue dots, representing participants with relatively low performance (scores below zero and between zero and five, respectively), generally lie above the line, indicating that these participants tended to face stronger opponents. Those with scores between five and ten were matched roughly evenly with stronger and weaker opponents, as reflected in an approximately equal number of points above and below the line. High-performance participants (green and orange dots, scores above ten) typically faced weaker opponents, with most observations falling below the line. This pattern is consistent across both gain and loss framings.

Figure 7: Opponent Raw Score over Time



Notes: This figure shows how the average opponent's raw score evolves over time in the competition treatments. The horizontal axis divides the four-minute quiz into 30-second intervals, and the vertical axis plots the mean opponent score within each window. The solid line represents the gain-framed competition condition, and the dashed line represents the loss-framed competition condition. In both framings, the opponent's score rises steadily by about one point every 30 seconds. The dotted horizontal line marks the fixed threshold score of six in the control treatments, highlighting that, unlike the fixed benchmark in the control condition, the competitive setting features a continuously rising reference point.

Figure 7 illustrates the evolution of the average opponent's raw score faced by participants in the competition treatments over the four-minute quiz. In both gain- and loss-framing competition conditions, the opponent's score increases steadily by roughly one point every 30 seconds. The gain-competition line lies slightly above the loss-competition line during the first two minutes but in the final 30 seconds, the rate of increase slows in the gain condition, likely reflecting time pressure as the task nears completion. The dotted horizontal line marks the fixed threshold score faced by participants in the control condition, which is a constant target score of six throughout the entire task. This contrast highlights a key difference between the competitive and non-competitive environments: in the non-competitive setting, the performance target remains fixed, whereas in the competitive setting, the reference point, which is likely to be the opponent's score, rises continuously. This moving benchmark tends to evoke emotional responses such as pressure or excitement, as well as sense of strategic uncertainty, which may in turn influence participants' subjective beliefs about their chances of winning and their overall utility.

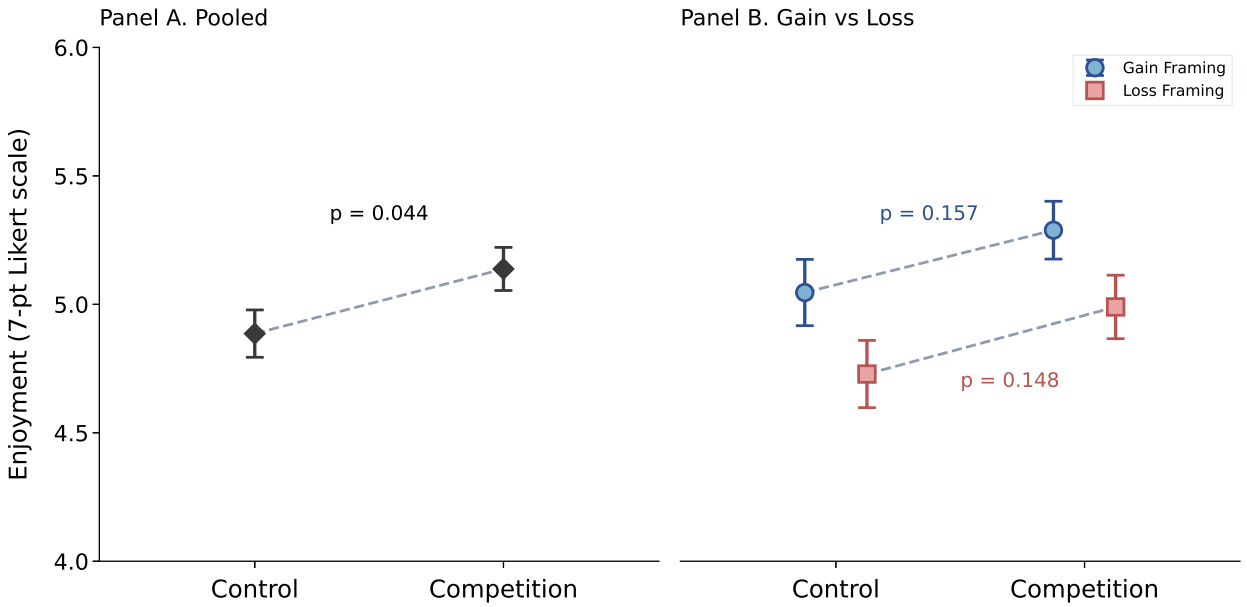
5 Results

This section provides experimental evidence that individuals derive utility directly from competition itself, independent of final outcomes. Section 5.1 presents the average treatment effect of competition on utility. Section 5.2 and Section 5.3 examine two underlying mechanisms: a negative belief channel, in which competition reduces utility by lowering individuals' winning expectations, and a positive preference channel, through which individuals enjoy competition for its own sake. Section 5.4 explores heterogeneity in these effects and discusses how they contribute to welfare evaluation.

5.1 Effects of Competition on Utility

Figure 8 illustrates the average treatment effects of competition on utility. As shown in the figure, participants in the competitive treatments had significantly higher levels of utility than those in the non-competitive treatments.

Figure 8: Effects of Competition on Utility



Notes: This figure plots the treatment effects of competition on utility. Panel A presents pooled results, while Panel B shows results separately for the gain and loss framing conditions. In both panels, the horizontal axis indicates the treatment groups (Control vs.Competition), and the vertical axis presents the average response to the survey question: "On a scale from 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ quiz (or IQ quiz competition)?" Each point in the figure represents the mean enjoyment within the corresponding group, with 95% confidence intervals indicated. Corresponding regression results are provided in Table 2.

Panel B of Figure 8 shows the average reported enjoyment in the gain- and loss-framing conditions, separately for the control and competition treatments. Under gain framing, average enjoyment rises from 5.05 to 5.29 ($p = 0.157$); under loss framing, it increases from 4.73 to 4.99 ($p = 0.148$). Panel A pools observations across both framing conditions, combining the control groups into a single control category and the competition groups into a single competition category. Pooling is appropriate because the patterns under gain and loss framing are qualitatively similar, and the expected payoffs are identical by design across framings. Pooling increases statistical power. In the pooled sample, the mean enjoyment is 4.89 in the control group and 5.14 in the competition group, a 5.1% increase ($p = 0.044$). These findings suggest that competition increases participants' utility. Notably, as shown in panel B, average enjoyment under gain framing is significantly higher than under loss framing ($p = 0.014$), while the difference in treatment effects between the two framing conditions is negligible ($p = 0.941$).

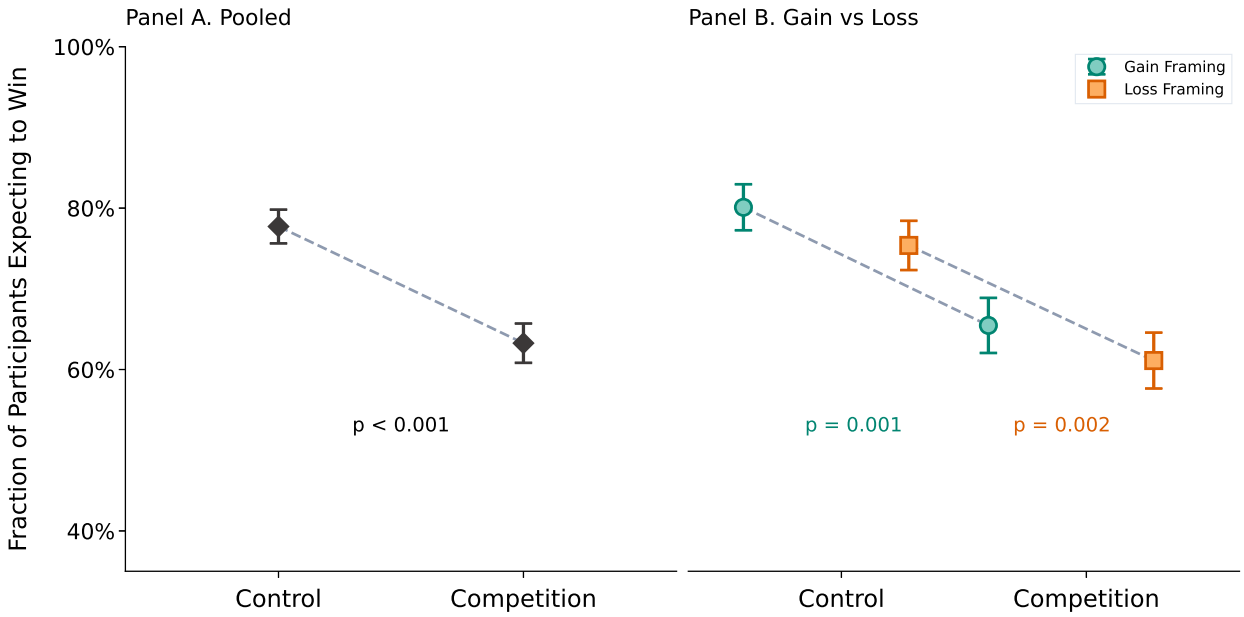
RESULT 1. *Competition itself generates utility, independently of final outcomes.*

5.2 Belief Channel

Competition affects utility through two channels: a belief channel that lowers utility, and an intrinsic utility channel that raises it. This section focuses on the belief channel; the intrinsic utility channel will be discussed in Section 5.3. Through the belief channel, competition reduces utility by making participants less optimistic about their chances of winning. Lower expectations of success, in turn, lower experienced utility. The negative effect of competition on beliefs about winning is illustrated in Figure 9. The relationship between beliefs about winning and reported enjoyment is shown in Figure 10.

Panel B of Figure 9 shows the share of participants who believe they won the competition or met the pre-specified performance threshold, separately for the control and competition groups under gain and loss framing conditions. Under gain framing, 85% of participants in the control condition believe they reached the median threshold score, whereas only 65% in the competition condition believe they outperformed their opponent, a decline of 20 percentage points ($p = 0.001$). Under loss framing, 75% believe they reached the median threshold, compared to 61% who believe they won the competition, a decline of 14 percentage points ($p = 0.002$). Panel A aggregates observations across framing conditions, pooling the control groups into a single control sample and the competition groups into a single competition sample. In the pooled control group, 78% believe they reached the threshold, while only 63% in the competition group believe they outper-

Figure 9: Effects of Competition on Belief in Winning

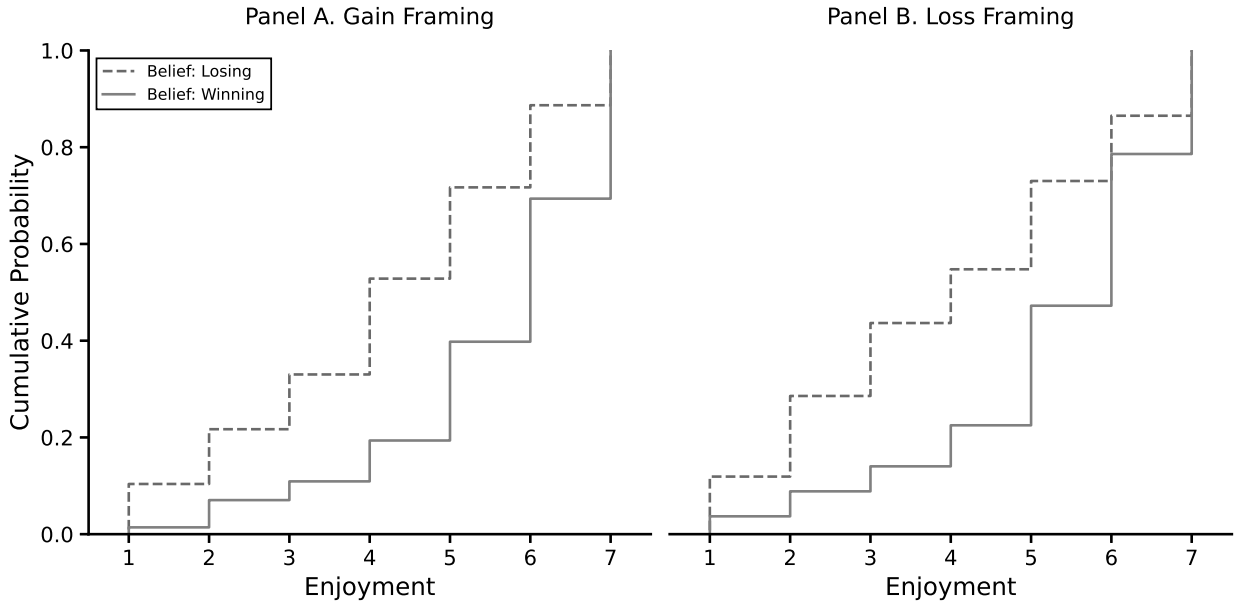


Notes: This figure illustrates how competition affects whether participants believe they can win. Panel A shows the pooled effect across all framing conditions, while Panel B separates results by gain versus loss framing. The y-axis represents the fraction of participants who expected to win. Across both panels, participants in the competition condition were significantly less likely to believe they would win compared to those in the control condition.

formed their opponent, a 15 percentage points decline ($p < 0.001$). Taken together, these results indicate competition lowers beliefs about winning.

As for why competition lowers individuals' expectations of winning, I propose two hypotheses. First, the opponent score bar, a key feature of the experiment, likely played an important role. This bar, shown only in the competition condition, displayed the opponent's raw score, which rose monotonically over time as it counted only correct but not incorrect answers. By contrast, participants in the control condition faced a fixed performance threshold that remained constant throughout the task. Given that participants received no feedback on their own performance, the ever-rising opponent score bar likely generated competitive pressure and biased participants toward pessimistic beliefs about their chances of success. Second, competition inherently ties one's payoff to others' performance. In the competition condition, outcomes depended on an unpredictable opponent, adding perceived uncertainty that may have undermined participants' confidence in their likelihood of winning. In contrast, the control group's fixed threshold provided a transparent and seemingly attainable target, enabling participants to calibrate effort more effectively. In sum, the dynamic opponent score bar and the opponent-dependent payoff offer plausible explanations for why competition reduced participants' belief about winning.

Figure 10: Cumulative Distribution of Enjoyment by Winning Expectations



Notes: This figure plots the cumulative probability distributions of participants' self-reported enjoyment (1–7 scale) across two framing conditions: gain framing (Panel A) and loss framing (Panel B). Within each panel, the solid line represents participants who believed they were winning, and the dashed line represents those who believed they were losing. The figure shows that participants who believed they were winning reported higher enjoyment (distribution shifted to the right) compared to those who believed they were losing.

Figure 10 shows the cumulative distributions of reported enjoyment for participants who believe they won[34] and those who believe they lost.[35] Panel A presents results under gain framing, and Panel B presents results under loss framing. In both framing conditions, the distribution for participants who believe they are winning lies to the right of that for those who believe they are losing (Kolmogorov–Smirnov test, $p = 0.031$ under gain framing; $p = 0.035$ under loss framing), indicating that participants who think they are winning report greater enjoyment throughout the distribution.

A plausible mechanism behind this positive relationship between winning expectations and utility is belief-based utility, meaning that individuals derive utility directly from their beliefs about future outcomes (Caplin and Leahy, 2001). For instance, people often feel anxious before a visit to the dentist; their utility changes at the moment of anticipation, even before any outcome occurs. In this experiment, participants may similarly experience utility from anticipating success, either from expected monetary rewards or from the

[34]Winning refers to outperforming one's opponent in the competition condition and to passing the performance threshold in the control condition.

[35]Losing refers to underperforming relative to one's opponent in the competition condition and to failing to reach the performance threshold in the control condition.

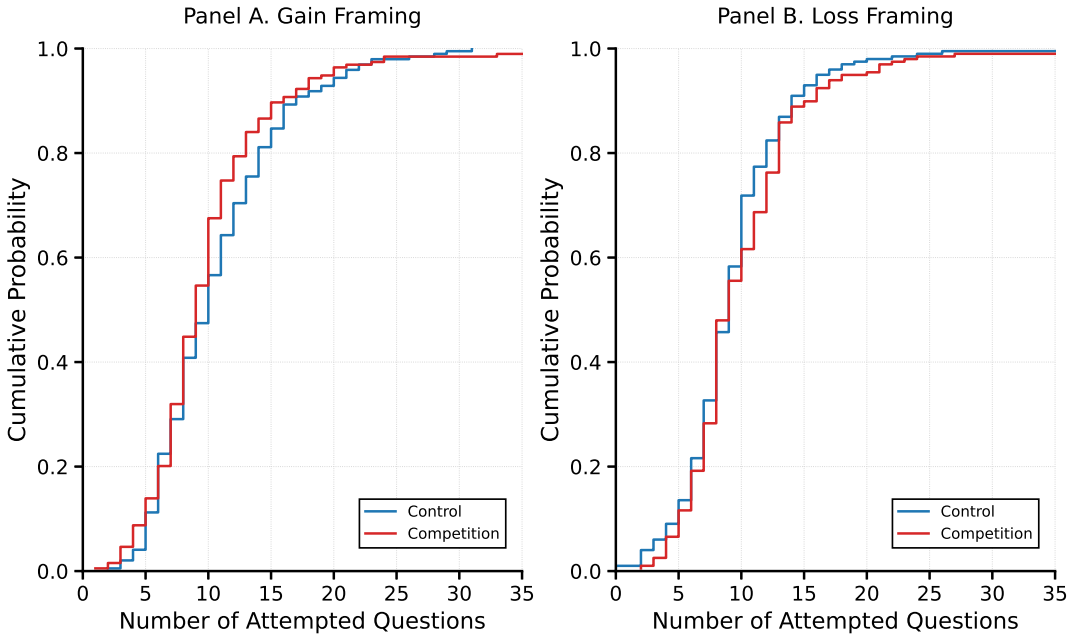
psychological satisfaction of winning, such as a sense of superiority when outperforming others in the competition condition or a feeling of achievement when meeting a performance threshold in the control condition.

RESULT 2. *Competition affects utility through a belief channel: it reduces utility by lowering individuals' beliefs about winning.*

5.3 Preference Channel

Competition affects utility through a preference channel: individuals derive enjoyment directly from the act of competing, independent of final outcomes. As shown in Table 2, the baseline specification (columns 1, 4, and 7) captures the overall effect of competition on utility, reflecting the combined contribution of the effort, belief, and preference channels described in the conceptual framework in Section 2.

Figure 11: Cumulative Distribution of Effort Proxy: Attempted Questions



Notes: This figure shows the cumulative distribution of the effort proxy, measured by the total number of attempted questions in the IQ quiz, for the control and competition groups under gain and loss framings. Panel A corresponds to the gain-framed condition and Panel B to the loss-framed condition. In both framings, the distributions for competition and control groups almost perfectly overlap, indicating that participants exerted similar levels of effort regardless of whether they competed against another participant or faced a fixed threshold. Kolmogorov–Smirnov tests confirm no significant differences across treatments ($p = 0.198$ under gain framing; $p = 0.249$ under loss framing).

Figure 11 shows the cumulative distribution of the effort proxy, the number of attempted questions in the quiz, for the control and competition groups under gain and loss framing conditions. Effort levels appear nearly identical across treatment groups under both framings (Kolmogorov–Smirnov test, $p = 0.198$ under gain framing; $p = 0.249$ under loss framing).[36] These results indicate that competition does not significantly affect effort, implying that the overall effect of competition on utility primarily reflects the preference and belief channels. When beliefs are included as controls (columns 2, 5, and 8), the estimated coefficient on competition nearly doubles. This pattern suggests that, once differences in beliefs are accounted for, the remaining effect, which reflects intrinsic utility from the act of competing, is both positive and sizable. The estimates in columns 2, 4, and 6 thus isolate the intrinsic utility from competition.[37] The preference channel is robust across both gain and loss framings, with no statistically significant difference in magnitude between the two.

RESULT 3. *Competition affects utility through a preference channel: individuals derive enjoyment from the act of competing itself.*

5.4 Discussion

A. Heterogeneity

Figure 12 shows heterogeneous treatment effects of competition on utility by beliefs about winning and perceived relative ability. Panel A illustrates that competition increases enjoyment for both participants who believe they won and those who believe they lost. In the pooled sample, the effect is somewhat larger among those who believe they lost, although the difference between the two groups is not statistically significant ($p = 0.242$). The pattern differs across framing conditions. Under gain framing, competition increases reported enjoyment for participants who believe they are losing but not for those who believe they are winning. Under loss framing, the opposite pattern emerges: competition raises reported enjoyment for participants who believe they are winning but not for those who believe they are losing.

[36] For robustness, the effort proxy is also included as a control variable in columns 3, 6, and 9 of Table 2. The results remain virtually unchanged.

[37] Attributing this residual effect to intrinsic utility follows directly from the structure of the model. The belief channel operates through subjective expectations of monetary payoffs; once this channel is controlled for, the remaining utility must be independent of expected payoffs and derive intrinsically from the act of competition itself.

Table 2: Treatments Effects of Competition on Utility

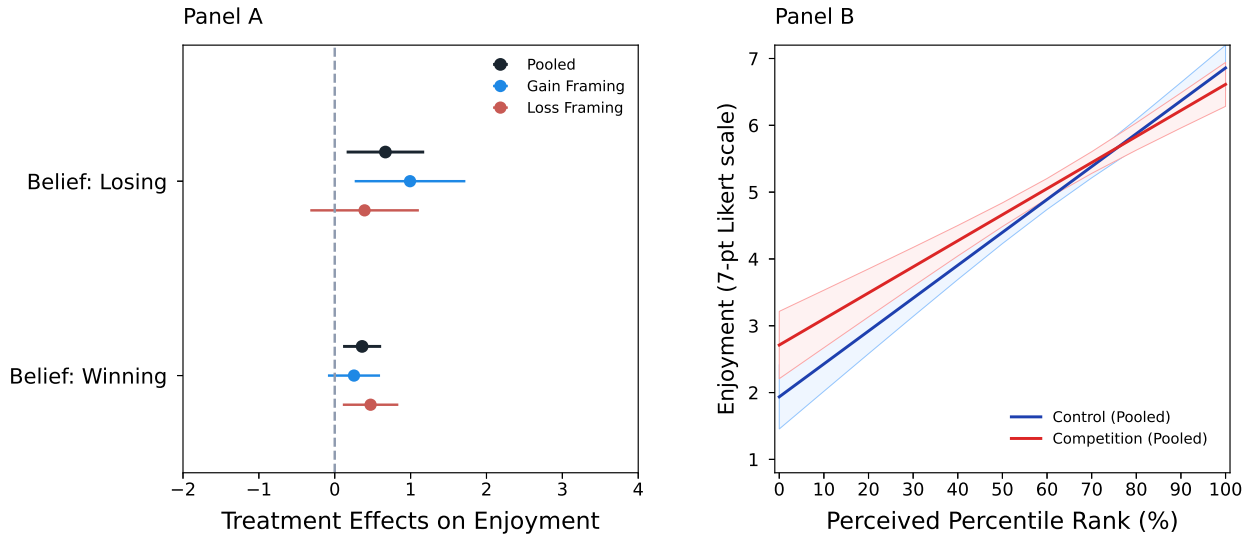
	Dependent Variable: Enjoyment								
	Pooled			Gain Framing			Loss Framing		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Competition	0.25**	0.45***	0.45***	0.24	0.45***	0.43***	0.26	0.45***	0.48***
	(0.12)	(0.12)	(0.12)	(0.17)	(0.16)	(0.16)	(0.18)	(0.17)	(0.17)
Belief in Winning		1.36***	1.37***		1.39***	1.39***		1.31***	1.33***
		(0.14)	(0.14)		(0.20)	(0.20)		(0.20)	(0.20)
Effort proxy			✓			✓			✓
Control mean	4.89	4.89	4.89	5.05	5.05	5.05	4.73	4.73	4.73
Observations	787	787	787	390	390	390	397	397	397
R^2	0.01	0.13	0.13	0.01	0.13	0.14	0.01	0.12	0.13

Notes: This table summarizes OLS estimates of the effect of competition on utility, both overall and net of the belief-updating channel. The dependent variable is participants' responses to the question: "On a scale of 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ Quiz Competition (or IQ Quiz)?" Competition is a binary indicator equal to 1 for participants in the competitive treatment and 0 for those in the control group. Belief in Winning is an indicator based on post-treatment responses to "Do you think you were the top performer in the IQ Quiz competition?" (or "Do you think you scored 6 or higher on the IQ Quiz?"). The cutoff of 6 corresponds to the median score in the competition group. Columns (1)–(3) use pooled data, while columns (4)–(6) and (7)–(9) report estimates separately for the gain and loss framing conditions. Control means refer to average enjoyment in the control group. Robust standard errors are in parentheses. The effort proxy in this table is the number of questions each participant attempted. A check mark (✓) indicates that the effort proxy is included in the specification. Alternative proxies for effort, including quiz score, number of correctly answered questions, and average time spent per question, are reported in the Appendix Table B.1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Panel B shows that enjoyment increases monotonically with perceived rank, indicating that individuals who perceive themselves as more capable derive greater utility overall. Comparing the control and competition groups, the increase in enjoyment under competition is mainly driven by participants below the 70th percentile of perceived rank, suggesting that competition enhances enjoyment particularly among those who view themselves as less capable. Notably, the competition line (red) starts at a higher intercept than the control line (blue), demonstrating that even low-ability individuals benefit from competitive environments. Beyond the 70th percentile, enjoyment levels are nearly identical between the two groups, implying that competition yields little marginal gain in enjoyment for participants who already perceive themselves as highly capable.

Figure 13 presents heterogeneity in the effect of competition on enjoyment across demographic groups. With respect to age, the effect of competition on enjoyment is concentrated among individuals aged 40–59 ($p = 0.053$, pooled sample), whereas the effects for younger participants (18–39) and older participants (60–80) are small and statistically in-

Figure 12: Heterogeneity in Utility by Beliefs in Winning and Perceived Ability



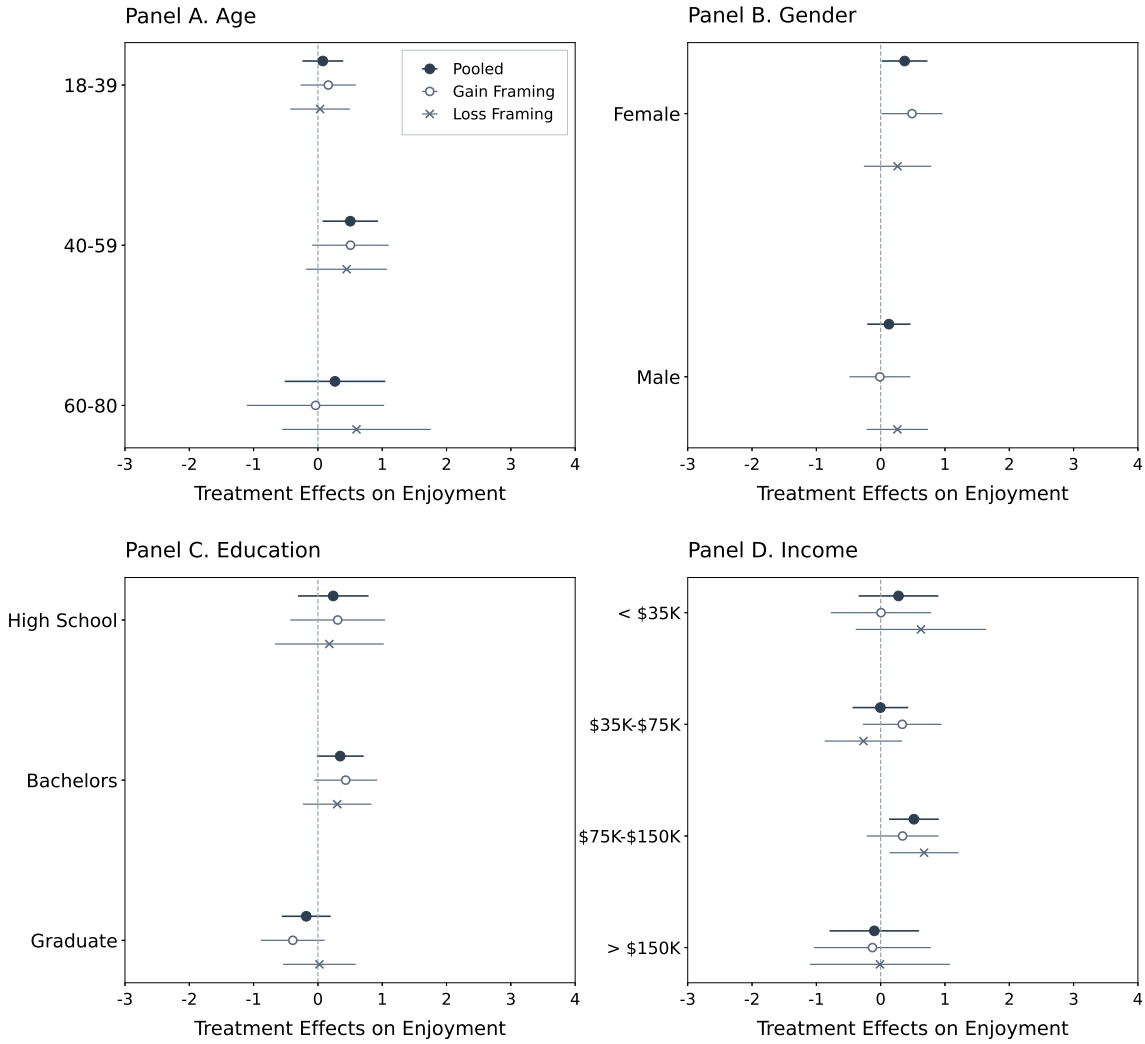
Notes: This figure shows the heterogeneous effects of competition on enjoyment by participants' beliefs about winning and their perceived performance rank. Panel A presents the estimated treatment effects of competition on reported enjoyment, conditional on participants' beliefs about whether they expect to win or lose. The results are shown separately for the pooled sample (black), the gain framing condition (blue), and the loss framing condition (red). Each point corresponds to the estimated mean, with horizontal bars denoting 95% confidence intervals. Panel B illustrates the relationship between perceived percentile rank (as a proxy for perceived ability) and self-reported enjoyment on a 7-point Likert scale. The blue and red lines represent the pooled control and competition conditions, respectively, with shaded regions indicating 95% confidence intervals.

significant. By gender, competition significantly increases enjoyment among women ($p = 0.040$, pooled sample), but not among men; however, the gender difference in treatment effects is not statistically distinguishable ($p = 0.327$, pooled sample). Education patterns show that the treatment effect is strongest among respondents with a bachelor's degree ($p = 0.063$, pooled sample), while those with only a high school degree or with graduate training exhibit smaller and insignificant effects. Finally, heterogeneity by income indicates that competition significantly increases enjoyment for individuals with household incomes between \$75,000 and \$150,000 ($p = 0.009$, pooled sample), but not for those with lower or higher income levels.

B. Welfare Evaluation with Utility from Competition

A complete welfare assessment of competition should account not only for the utility derived from final outcomes but also for the direct utility costs and benefits generated by the act of competing itself. Omitting this process utility component would bias welfare assess-

Figure 13: Heterogeneity in Utility Across Demographic Groups



Notes: This figure shows the heterogeneous effects of competition on enjoyment across demographic groups. Enjoyment is measured by asking participants to rate, on a scale from 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable they found the IQ quiz in the control group or the IQ quiz competition in the treatment group. The filled circle denotes the treatment effect for the pooled sample, the hollow circle the gain framing condition, and the star the loss framing condition. All estimates are reported with 95% confidence intervals. Panel A presents results by age groups (18–39, 40–59, and 60–80), Panel B by gender, Panel C by education level (high school, bachelor's, and graduate), and Panel D by income categories ($<$\$35K, \$35K–\$75K, \$75K–\$150K, and $>$\$150K).

ments, underestimating welfare when competition brings enjoyment and overestimating it when competition induces stress. This distinction is also important in settings where individuals self-select into competitive environments, as their choices may be driven by anticipated process utility rather than solely by expected material payoffs.

The experimental findings reveal three key channels through which competition affects

this crucial welfare component: effort, belief, and preference. This framework provides a useful lens for understanding when competition enhances well-being and when it diminishes it. Holding constant the effort channel, as well as factors such as stakes and the importance individuals attach to outcomes, a negative belief channel, along with a negative preference channel[38] can make competition feel oppressive and unpleasant. This helps explain why highly competitive labor markets or academic environments often generate anxiety and dissatisfaction: a sharp decline in the perceived probability of success translates into a substantial loss of utility, while the act of competing itself generates heightened emotional strain. Conversely, when the intrinsic channel is positive and dominant, competition becomes a source of enjoyment. This pattern helps explain why casual games with competitive elements are engaging, as the intrinsic pleasure of competing outweighs the utility costs associated with lower beliefs about winning.

6 Implications

6.1 Does competition affect future choices?

The experiment demonstrates that competition enhances individuals' enjoyment at work. I now investigate whether this increase in utility shapes their subsequent decisions, specifically whether it affects their willingness to perform the same task again in the future. According to the concept of attribution bias,[39] people may develop a more favorable attitude toward an activity when they experience it in a particularly satisfying environment. In this context, participants may mistakenly attribute the enjoyment generated by competition to the intrinsic features of the task itself.

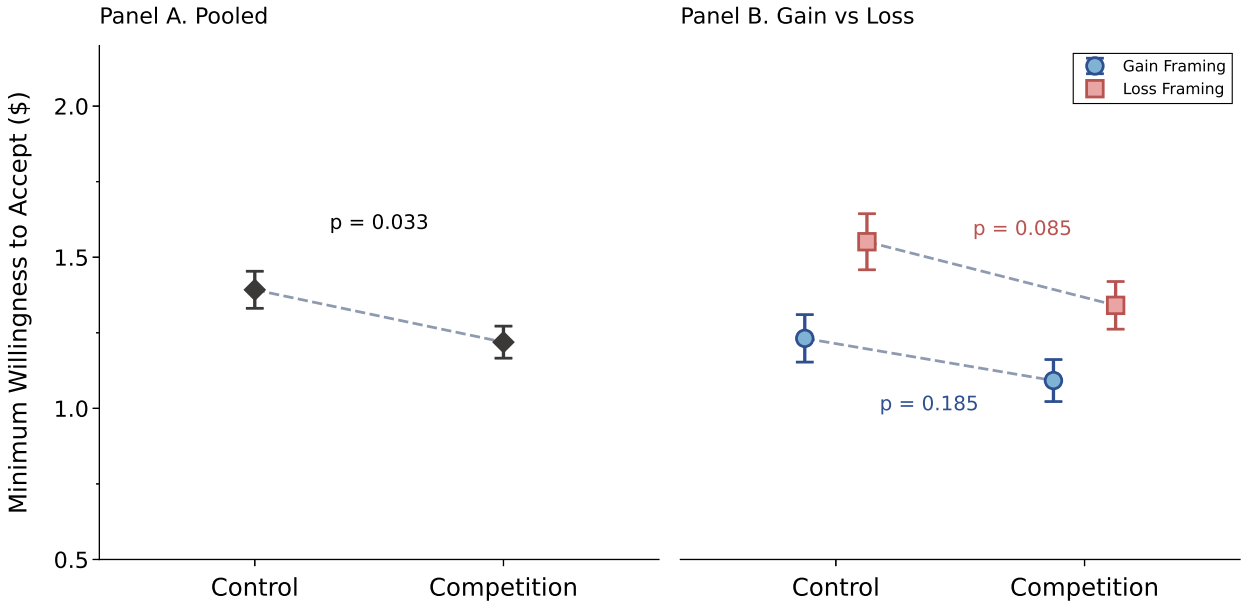
Consistent with this hypothesis, I find that participants exposed to enjoyable competition are more likely to perceive the underlying task as pleasant and express a stronger willingness to engage in it again. Figure 14 provides supporting evidence. The figure displays the average minimum amount of money participants would require to undertake the IQ quiz again. A higher required amount indicates a lower preference for the task and a reduced willingness to repeat it in the future. Panel B of Figure 14 presents results by framing condition. Under the gain framing, participants in the control group require

[38] In this experiment, intrinsic utility from competing is positive. In theory, however, intrinsic utility could be negative, characterized by stress and pressure.

[39] Attribution bias refers to the tendency to misattribute the influence of a temporary state to a stable property of an object or activity. For example, individuals who visit a new restaurant while very hungry may later judge the restaurant as high quality, even if the food itself is mediocre,(Haggag et al., 2019).

at least \$1.23 on average to undertake the task again, whereas those in the competition group require \$1.09. This difference corresponds to a decline of \$0.14 ($p = 0.185$). Under the loss framing, the control group requires at least \$1.55, while the competition group requires \$1.34, a decline of \$0.21 ($p = 0.085$). Panel A pools data across framing conditions. On average, control group participants require at least \$1.39 to repeat the task, while those in the competition group require \$1.22 ($p = 0.033$). These findings indicate that participants in the competition group find the task more appealing.

Figure 14: Effects of Competition on the Task Choice



Notes: This figure shows how competition affects participants' willingness to undertake the same task again in the future. The vertical axis plots the average minimum willingness to accept (WTA) payment required to perform the IQ quiz again, where a higher value indicates a lower preference for the task. Panel A pools data across gain- and loss-framed conditions, while Panel B presents the results separately by framing. In both framings, participants in the competition condition require a lower WTA than those in the control condition, implying a greater willingness to repeat the task after experiencing competition. The difference is statistically significant when data are pooled across framings ($p = 0.033$) and marginally significant under the loss framing ($p = 0.085$).

RESULT 4. *Enjoyable competitive experience increases participants' preference for the underlying task and increase their willingness to undertake it again in the future. This pattern indicates the presence of attribution bias in the strategic context of competition.*

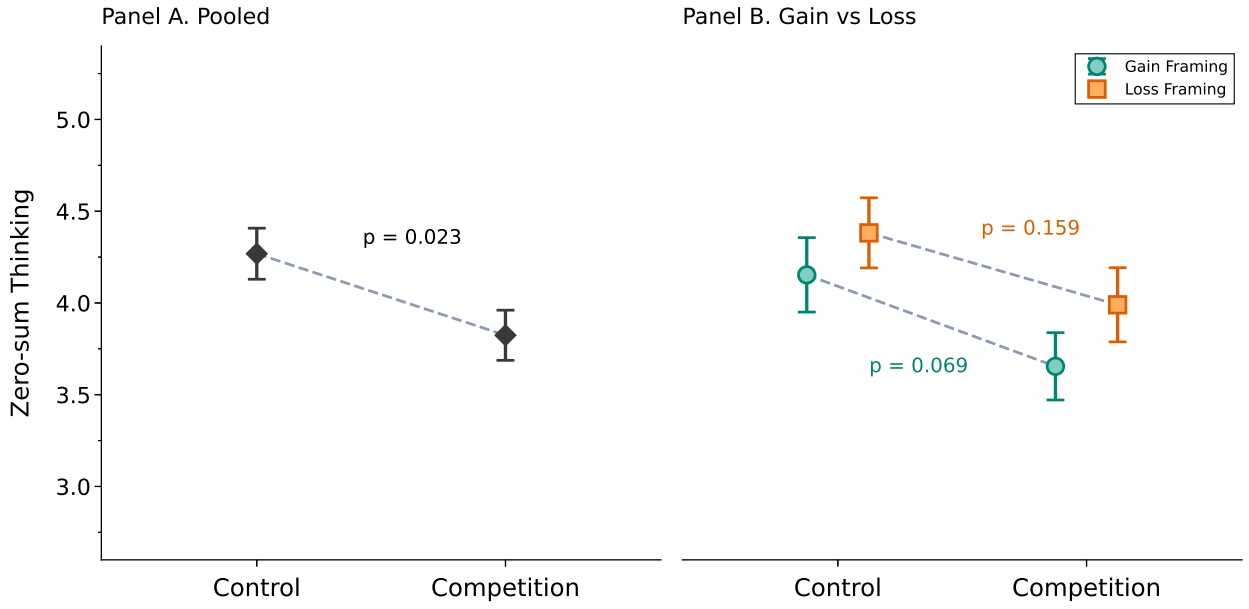
6.2 Does competition affect subsequent social interactions?

The utility gain from competition not only affects individuals' preferences for certain tasks, but also influences social behavior. This subsection examines a second implication of competition-induced enjoyment: its impact on people's attitudes toward social interactions. In particular, I consider the impact on zero-sum thinking and altruism.

A. Zero-sum Thinking

Figure 15 shows that competition unexpectedly reduces individuals' zero-sum mindsets. Panel A presents the pooled results, combining both gain and loss framing conditions. The mean zero-sum score in the pooled control group is 4.24, while in the pooled competition group it is 3.85 ($p = 0.023$). These results indicate that participants exposed to competition exhibit lower levels of zero-sum thinking.

Figure 15: Effects of Competition on Zero-sum Thinking



Notes: This figure shows the effect of competition on zero-sum thinking. Zero-sum thinking is measured using a World Values Survey question (Inglehart et al., 2014) in which respondents rate their agreement, on a 1–10 scale, between two statements: "Wealth can grow so there's enough for everyone" (1, indicating minimal zero-sum thinking) and "People can only become wealthy at the expense of others" (10, indicating strong zero-sum thinking). Higher values on the y-axis therefore represent stronger zero-sum thinking. The figure displays the average response values for the four treatment groups (gain framing vs. loss framing; control vs. competition), with 95% confidence intervals. Panel A presents results for the pooled sample, while Panel B show results by gain and loss framing separately. Regression estimates are reported in Appendix Table B.8.

Panel B of Figure 15 reports the mean value of zero-sum thinking for the control and competition groups under both gain and loss framing conditions, separately. The zero-sum thinking measure, based on the World Values Survey question described in Section 3.1, is normalized on a 1-10 scale, where 10 indicates a highly zero-sum view of the world and 1 represents a non-zero-sum view.[40] Under the gain framing, the mean declines from 4.12 in the control group to 3.69 in the competition group ($p = 0.069$). Under the loss framing, the decline is from 4.36 in the control group to 3.99 in the competition group ($p = 0.159$).

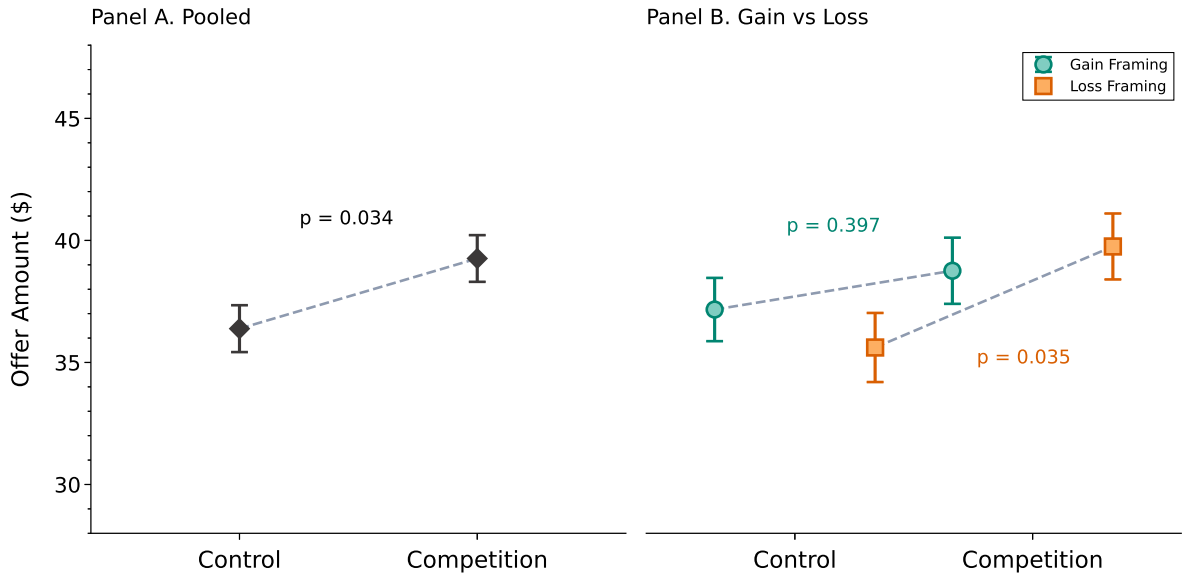
This finding runs counter to the pre-analysis plan, which predicted that exposure to competition would increase zero-sum thinking, given that the competitive environment in this experiment is, by design, zero-sum in nature. I propose two plausible explanations for this unexpected result, both of which point to a common underlying mechanism: the competitive experience in this setting is enjoyable and positive. First, the elevated enjoyment in the competition condition may have induced a more positive affective state, leading individuals to perceive the world as less zero-sum. Second, because humans are inherently social beings, an enjoyable and interactive experience, even one that is zero-sum in structure, may generate positive social emotions that, in turn, reduce zero-sum perceptions. Importantly, these explanations suggest that the effect could reverse if the competitive experience were negative rather than enjoyable.

B. Altruism

Competition also affects people's altruistic tendencies. Figure 16 shows the amount of money participants chose to offer to their randomly matched partner from a total endowment of $100. A larger offer indicates greater altruism. Panel A of Figure 16 presents results for the pooled sample. Participants in the control group offered an average of $36.38 to their partner, while those in the competition group offered $39.26, representing an increase of 7.92 percent ($p = 0.034$). Panel B of Figure 16 shows the results by framing condition. Under gain framing, offer amounts increased from $37.16 to $38.75 ($p = 0.397$). Under loss framing, offers rose from $35.61 to $39.75 ($p = 0.035$). Although the treatment effects differ in magnitude across gain and loss framing, the difference is statistically insignificant ($p = 0.347$).

[40] A caveat is that although the World Values Survey item suggests competition reduces zero-sum thinking, this conclusion may not generalize. An alternative measure based on the immigrant–local job tradeoff, as described in Section 3.1, shows no significant treatment effects. The corresponding results are presented in Appendix Figure B.11, with regression estimates in Appendix Table B.9.

Figure 16: Effects of Competition on Altruism



Notes: This figure shows the effect of competition on altruism, measured using a dictator game in which participants allocated $100 between themselves and another participant. The outcome is the amount offered to the partner. The figure illustrates mean offers across the four treatment groups (gain framing vs. loss framing; control vs. competition) with 95% confidence intervals. Panel A shows results for the pooled sample, and Panel B shows results separately by gain and loss framing. Corresponding regression estimates are provided in Appendix Table B.8.

This increase in altruism may arise from the same underlying mechanisms discussed in Section A.. An enjoyable competitive experience may induce a more positive affective state and thereby promote other-regarding behavior. Alternatively, the positive and interactive nature of competition may enhance social connectedness, prompting participants to treat others more generously and with greater kindness. I also examined prosocial behavior in a public goods game, in which individuals decided whether to contribute their endowment to a common pool and then reported the percentage of others they believed chose not to contribute, as described in Section 3.1. The experimental results indicate that competition has no statistically significant effect on either contribution decisions or beliefs about the share of others who do not contribute.

RESULT 6. *Enjoyable competitive experience reduces zero-sum thinking and fosters altruism.*

7 Conclusion

Economists often treat competition as an instrument for incentivizing effort, improving efficiency, and ultimately enhancing welfare (Smith, 1937; Stigler, 1957; Dhingra and Morrow, 2019; Englmaier et al., 2024). However, this perspective overlooks an important dimension: competition itself can be a direct source of welfare. This paper develops a simple conceptual framework and conducts a series of carefully designed experiments to examine this idea. By evaluating the utility costs and benefits of competition per se, it demonstrates that the intrinsic welfare value of competition warrants greater attention.

The experimental evidence indicates that competition generates positive utility. This finding, however, comes with an important caveat: the laboratory setting involves relatively low-stakes rewards, leaving open the question of whether competition might instead generate disutility in high-stakes environments. Prior research suggests that individuals' performance can differ substantially between low- and high-stakes contexts (Apesteguia and Palacios-Huerta, 2010). Competition may be enjoyable and engaging in low-stakes, game-like settings, yet it can become stressful and welfare-reducing in high-pressure situations such as college entrance exams or competitive workplaces. Although the experiments in this paper cannot fully resolve this question, they offer valuable insights into the specific channels through which competition affects utility.

First, there is a belief channel: competition can lower individuals' perceived probability of success, which in turn reduces their utility. Second, there is a preference channel, which captures the intrinsic utility derived from competition itself. In the experiment, positive emotions such as excitement and motivation outweighed negative emotions like pressure and stress, resulting in net positive intrinsic utility. Finally, the effort channel was well-controlled in the experiment. An interesting observation is that when rewards are gain-framed, performance in the non-competitive setting, where individuals work independently to surpass a threshold, is better than in the competitive setting. This is opposite to what people usually expect, namely that competition motivates greater effort.

These findings about how competition affects immediate utility also have important implications for individuals' future choices and social attitudes. The nature of the competitive experience, whether enjoyable or stressful, shapes subsequent behavior through multiple pathways. A positive competitive experience can increase individuals' intrinsic interest in the underlying task and their willingness to engage in it again. In practical terms, someone who finds competition enjoyable may be more inclined to participate in similar activities in the future. Conversely, if students experience distress under intense academic competition, they may develop an aversion to studying itself, potentially hindering their

long-term human capital accumulation. The character of competition also influences social interactions. A pleasant competitive experience appears to reduce zero-sum thinking and foster greater altruism toward others. While it is plausible that an unpleasant competitive experience might have the opposite effect, this hypothesis requires further empirical investigation and is left for future work.

In today's economic and social systems, competition is pervasive. A comprehensive evaluation of its welfare effects must therefore consider not only the indirect benefits of competition as an incentive mechanism, but also the direct utility costs and benefits of the competitive experience itself. Competition should not be viewed solely as a tool for achieving other objectives; the welfare it generates directly is equally important. This distinction is crucial for both welfare analysis and policy design. Moreover, understanding how these direct utility effects shape individuals' preferences, beliefs, and social behavior represents a promising direction for future research.

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APPENDIX

A Theoretical Appendix

A.1 Optimal Effort

This subsection derives the optimal effort $e_{i,s}^{*,f}$ for any incentive structure $s \in \{C, NC\}$ and frame $f \in \{G, L\}$. For brevity, suppress the subscript i. Under (s, f), the utility $U^{s,f}(e)$ is,

$$P^s(e) \cdot v\big(w^{win,f}\big) + \big(1 - P^s(e)\big) \cdot v\big(w^{lose,f}\big) - c(e) \; + \; u(P^s(e)) \; + \; \psi^f \, \mathbf{1}_{\{s=T\}} \tag{A.1}$$

Collect the two terms that are linear in $P^s(e)$ and rearrange the equation,

$$P^s(e) \cdot (v\big(w^{win,f}\big) - v\big(w^{lose,f}\big)) - c(e) \; + \; u(P^s(e)) \; + \; \psi^f \, \mathbf{1}_{\{s=T\}} + v\big(w^{lose,f}\big) \tag{A.2}$$

The last two terms do not depend on e. Assume P^s is continuously differentiable and strictly increasing (i.e., $P^{s\prime}(e) > 0$), u is continuously differentiable, and c is continuously differentiable, strictly increasing, and convex, with $c(0) = 0$, $c'(\cdot) > 0$ and $c''(\cdot) \geq 0$. The first order condition for an optimal effort level e^* is

$$c'(e^*) = P^{s\prime}(e^*)\Big(v\big(w^{win,f}\big) - v\big(w^{lose,f}\big) + u'\big(P^s(e^*)\big)\Big) \tag{A.3}$$

Optimal effort equalizes marginal cost with marginal improvement in success probability multiplied by the sum of the monetary payoff spread and the marginal belief utility. Consider the reference-dependent value function

$$v(x) = \begin{cases} x, & x \geq 0, \\ \lambda x, & x < 0, \end{cases} \qquad (\lambda > 1)$$

and the payoff structure $(w^{win,G}, w^{lose,G}) = (w^{win}, 0)$, $(w^{win,L}, w^{lose,L}) = (0, -w^{win})$, the optimal effort under a gain frame satisfies

$$c'(e^*) = P^{s\prime}(e^*)\Big(w^{win} + u'\big(P^s(e^*)\big)\Big) \tag{A.4}$$

and the optimal effort under a loss frame satisfies

$$c'(e^*) = P^{s\prime}(e^*)\Big(\lambda w^{win} + u'\big(P^s(e^*)\big)\Big) \tag{A.5}$$

A.2 Belief Channel

This subsection proves Prediction 1. Fix $f \in \{G, L\}$. Under Assumption 1, I show that, when evaluated at the respective optima, the competitive setting yields (weakly) lower expected utility from monetary payoffs and belief utility, as stated in Section 2.

Proposition 1. *Fix a frame $f \in \{G, L\}$. Under Assumptions 1, the expected utility from monetary payoffs is (weakly) lower in the competitive setting than in the non-competitive setting when evaluated at the respective optima:*

$$U_{i,pec}^{C,f}\big(e_C^{*,f}\big) \;\le\; U_{i,pec}^{NC,f}\big(e_{NC}^{*,f}\big).$$

Proof. Fix $f \in \{G, L\}$ and define, for $s \in \{C, NC\}$,

$$U_{\text{pec}}^{s,f}(e) = \Delta v^{\,f}\, P^s(e) - c(e) + v\big(w^{lose,f}\big),$$

$$\Delta v^{\,f} := v\big(w^{win,f}\big) - v\big(w^{lose,f}\big) > 0.$$

By Assumption 1, for every effort level $e \ge 0$, $P^C(e) \le P^{NC}(e)$. Hence, for the *same* e,

$$U_{\text{pec}}^{C,f}(e) - U_{\text{pec}}^{NC,f}(e) = \Delta v^{\,f}\big(P^C(e) - P^{NC}(e)\big) \le 0,$$

because the cost term $c(e)$ and the constant $v(w^{lose,f})$ cancel. Therefore $U_{\text{pec}}^{C,f}(e) \le U_{\text{pec}}^{NC,f}(e)$ for all $e \ge 0$. Moreover, evaluating at $e = e_C^{*,f}$, and using the optimality of $e_{NC}^{*,f}$ for the non-competitive setting gives

$$U_{\text{pec}}^{NC,f}\big(e_{NC}^{*,f}\big) \ge U_{\text{pec}}^{NC,f}\big(e_C^{*,f}\big) \ge U_{\text{pec}}^{C,f}\big(e_C^{*,f}\big),$$

where the first inequality is by optimality of $e_{NC}^{*,f}$ and the second by the pointwise dominance $U_{\text{pec}}^{C,f}(e) \le U_{\text{pec}}^{NC,f}(e)$ at $e = e_C^{*,f}$. Hence,

$$U_{\text{pec}}^{C,f}\big(e_C^{*,f}\big) \;\le\; U_{\text{pec}}^{NC,f}\big(e_{NC}^{*,f}\big).$$

A.3 preference channel

This subsection proves Prediction 2. The non-pecuniary component differs across settings only through ψ_i^f: it enters additively in the competitive setting and is zero otherwise. Holding the belief channel fixed, I show that under Assumption 2, this yields a positive intrinsic premium in the gain frame and a negative one in the loss frame, as stated in Section 2.

Proposition 3. *Fix $f \in \{G, L\}$ and hold the belief channel fixed. Under Assumption 2, the competitive setting, relative to the non-competitive benchmark, yields higher intrinsic utility in the gain frame,*

$$U_{i,nonpec}^{C,G} \geq U_{i,nonpec}^{NC,G},$$

and lower nonpec utility in the loss frame,

$$U_{i,nonpec}^{C,L} \leq U_{i,nonpec}^{NC,L}.$$

Proof. Fix a frame $f \in \{G, L\}$ and hold the belief channel fixed. By construction, the non-pecuniary term enters additively in both settings, with potentially different levels:

$$U_{i,\text{nonpec}}^{C,f} = \psi_i^{C,f} \qquad \text{and} \qquad U_{i,\text{nonpec}}^{NC,f} = \psi_i^{NC,f}.$$

The comparison reduces to a setting-specific constant. Under Assumption 2, we have

$$\psi_i^{C,G} \geq \psi_i^{NC,G} \quad \text{and} \quad \psi_i^{C,L} \leq \psi_i^{NC,L}.$$

These inequalities imply

$$U_{i,\text{nonpec}}^{C,G} \geq U_{i,\text{nonpec}}^{NC,G} \quad \text{and} \quad U_{i,\text{nonpec}}^{C,L} \leq U_{i,\text{nonpec}}^{NC,L}.$$

A.4 Supplemental Proofs

This subsection analyzes optimal effort under the competitive and non-competitive settings. A further assumption is introduced to deliver a directional prediction.

Assumption 3 *Fix a frame $f \in \{G, L\}$. At the optimal effort in each setting, perceived success is (weakly) less sensitive to effort in the competitive setting than in the non-competitive setting:*

$$P^{T\,\prime}\big(e_C^{*,G}\big) \leq P^{C\,\prime}\big(e_{NC}^{*,G}\big)$$

Complementing Assumption 1's level effect, the competitive setting makes the success benchmark endogenous and moving. This strategic uncertainty reduces how effectively a marginal increase in own effort translates into perceived success,, making the belief–effort map locally flatter at the competitive optimum than at the non-competitive optimum. Intuitively, when the target can shit with opponents' actions, marginal effort "buys" less perceived progress.

Proposition 4. *Fix a frame $f \in \{G, L\}$. The optimal effort is (weakly) lower in the competitive setting than in the non-competitive setting:*

$$e_C^{f,*} \;\leq\; e_{NC}^{f,*}.$$

Proof. Consider first the gain frame ($f = G$). The optimal effort in setting $s \in \{C, NC\}$ solves

$$c'(e_s^{*,G}) = P^{s\,\prime}(e_s^{*,G})\Big(w^{win} + u'\big(P^s(e_s^{*,G})\big)\Big). \tag{A.6}$$

Define the marginal–benefit for any effort level e by

$$MB_s(e) \;:=\; P^{s\,\prime}(e)\Big(w^{win} + u'\big(P^s(e)\big)\Big). \tag{A.7}$$

By Assumption 1, $P^C(e) \leq P^{NC}(e)$ at all effort e. Since $u''(\cdot) \geq 0$, we have

$$u'\big(P^C(e)\big) \;\leq\; u'\big(P^{NC}(e)\big) \tag{A.8}$$

Moreover, Assumption 3 yields

$$P^{C\,\prime}\big(e_C^{*,G}\big) \leq P^{NC\,\prime}\big(e_{NC}^{*,G}\big)$$

Combining these inequalities with (A.8), we obtain

$$\begin{aligned} MB_C\big(e_C^{*,G}\big) &= P^{C\prime}\big(e_C^{*,G}\big)\Big(w^{win} + u'\big(P^C(e_C^{*,G})\big)\Big) \\ &\leq P^{C\prime}\big(e_C^{*,G}\big)\Big(w^{win} + u'\big(P^{NC}(e_{NC}^{*,G})\big)\Big) \\ &\leq P^{NC\prime}\big(e_C^{*,G}\big)\Big(w^{win} + u'\big(P^{NC}(e_{NC}^{*,G})\big)\Big) = MB_{NC}\big(e_{NC}^{*,G}\big). \end{aligned} \tag{A.11}$$

From (A.6), optimal effort satisfies $c'(e_s^{*,G}) = MB_s(e_s^{*,G})$. Since $c(\cdot)$ is strictly increasing and convex, $c'(\cdot)$ is strictly increasing; and with P and u differentiable, $MB_{NC}(\cdot)$ is continuous. Hence,

$$c'\big(e_C^{*,G}\big) = MB_C\big(e_C^{*,G}\big) \leq MB_{NC}\big(e_{NC}^{*,G}\big) = c'\big(e_{NC}^{*,G}\big). \tag{A.12}$$

This implies

$$c'\big(e_C^{*,G}\big) \leq c'\big(e_{NC}^{*,G}\big). \tag{A.13}$$

Therefore,

$$e_C^{*,G} \;\leq\; e_{NC}^{*,G}.$$

The loss frame ($f = L$) is analogous: replace w^{win} by $\lambda\, w^{win}$ in (A.6)–(A.7); the remainder of the argument is unchanged. Hence, for either frame $f \in \{G, L\}$,

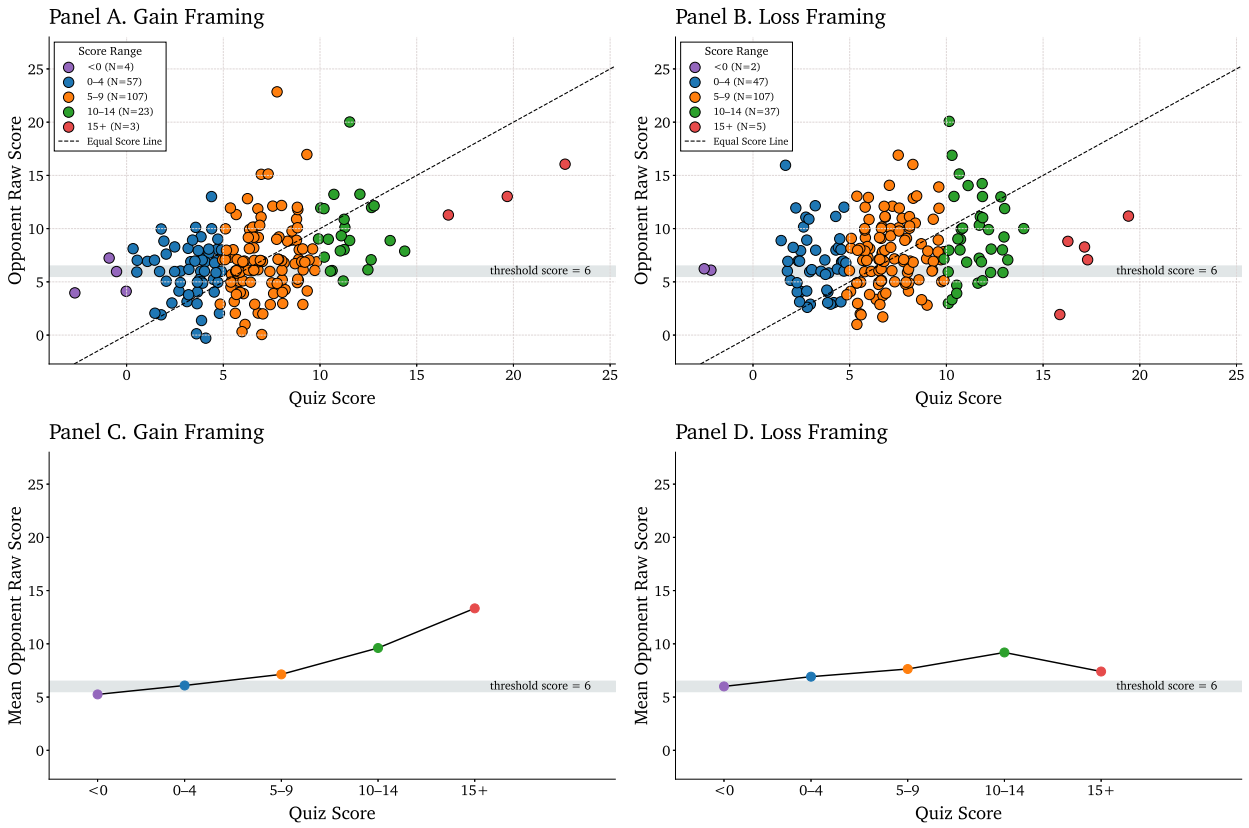
$$e_C^{*,f} \;\leq\; e_{NC}^{*,f}$$

as claimed.

B Additional Figures and Tables

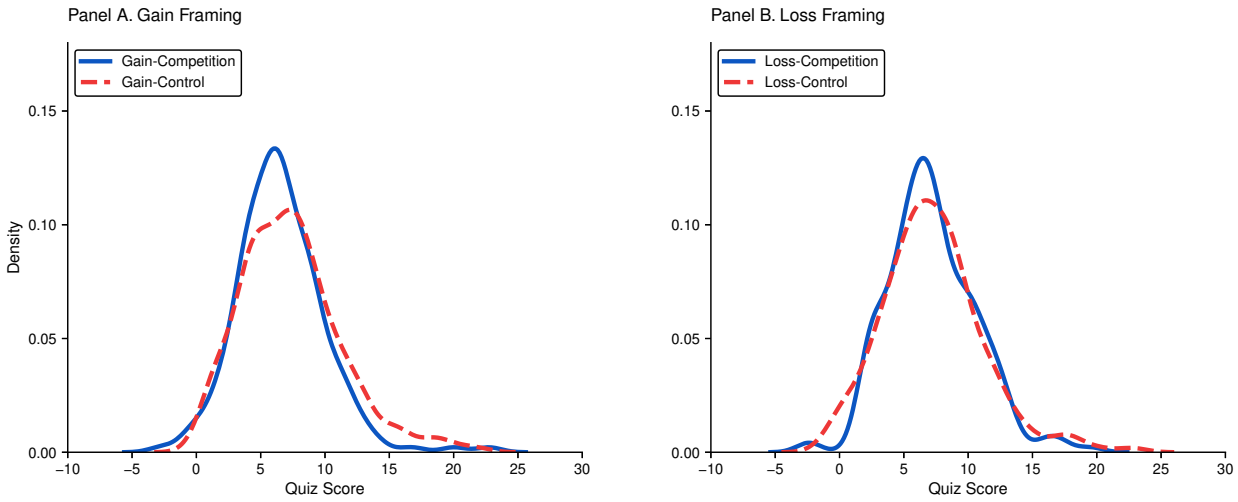
B.1 Additional Figures

Appendix Figure B.1: Own Scores and Opponent Raw Scores



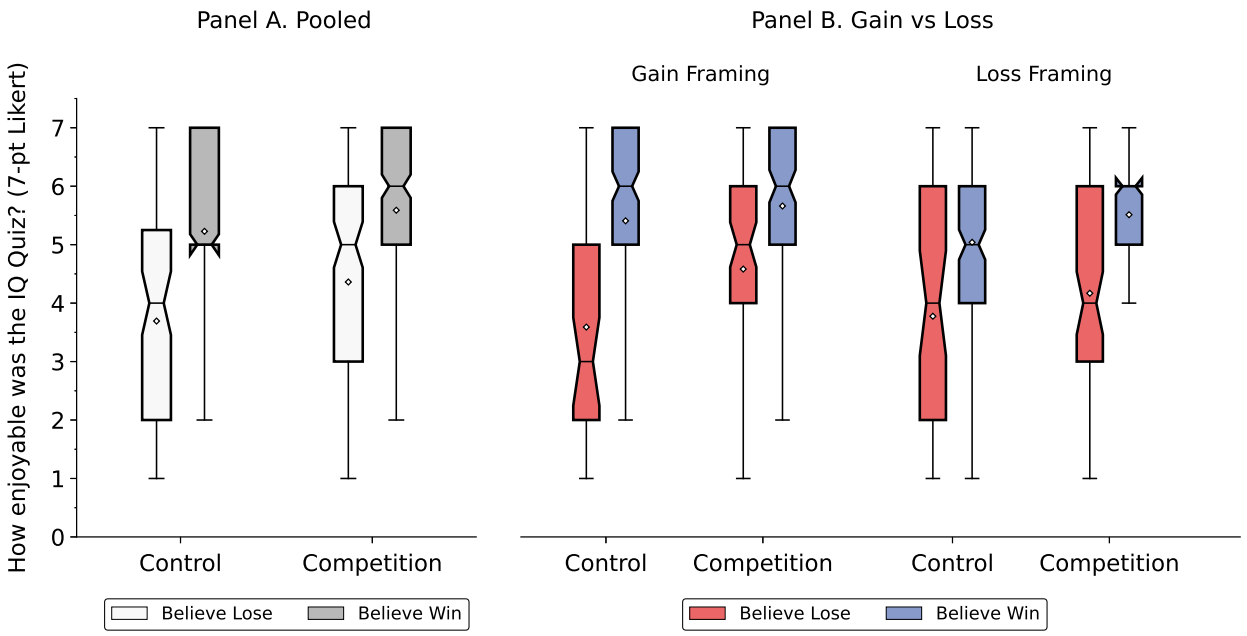
Notes: This figure shows the relationship between participants' quiz scores and their opponents' *raw* scores in the competition treatments. Panels A and B present individual-level scatter plots of participants' quiz scores (horizontal axis) against their matched opponents' raw scores (vertical axis) under gain and loss framings. The dashed 45° line denotes equal scores, and the shaded band at six marks the threshold score used in the non-competitive reference condition. Panels C and D display bin means by quiz-score range (< 0, 0–4, 5–9, 10–14, 15+), with lines connecting means for readability. In both framings, the mean opponent raw score stays close to six, indicating similar average difficulty across treatments. Matching patterns appear broadly comparable between gain and loss framings.

Appendix Figure B.2: Distribution of Quiz Scores



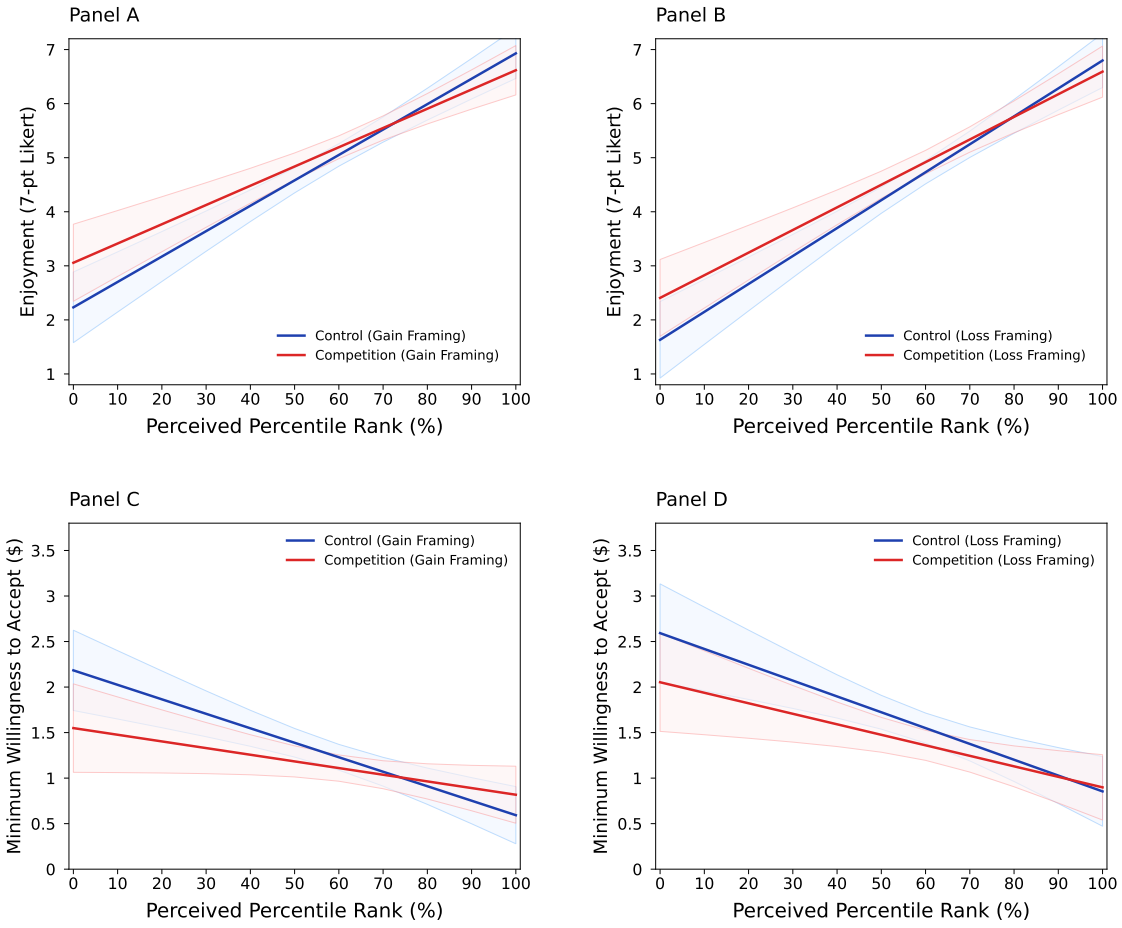
Notes: This figure displays the distribution of participants' quiz scores across framing and competition conditions. Panel A compares Gain–Competition (solid blue) with Gain–Control (dashed red); Panel B compares Loss–Competition (solid blue) with Loss–Control (dashed red). Scores are measured on the –10 to 30 scale, and densities are normalized to integrate to one within each panel. The distributions are closely aligned across treatments, indicating comparable task difficulty and performance dispersion between competition and control conditions.

Appendix Figure B.3: Belief in Winning and Utility



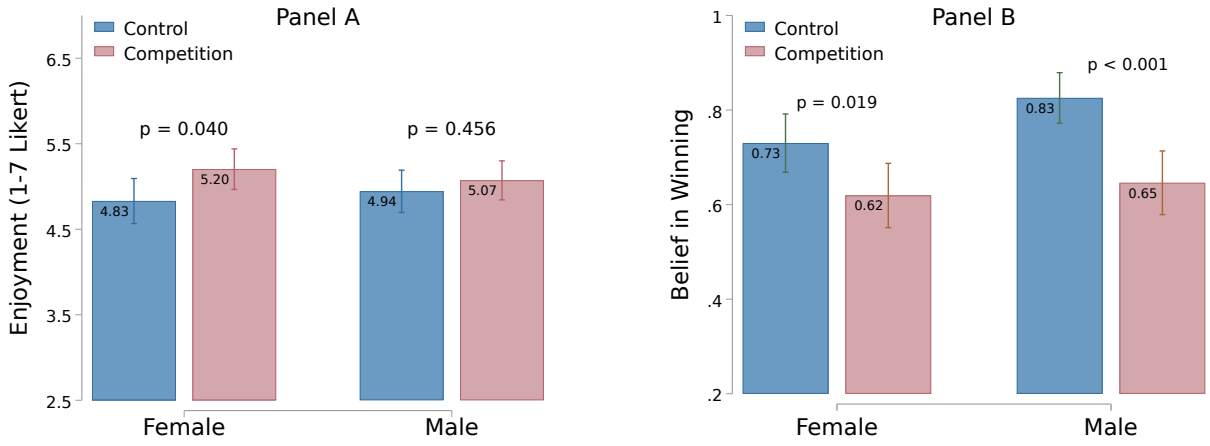
Notes: This figure plots self-reported enjoyment by winning beliefs ("believe lose" vs. "believe win") across experimental conditions (competition vs. control). Enjoyment was measured on a 7-point Likert scale in response to the question: "On a scale of 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ Quiz Competition (or IQ Quiz)?" Winning belief is defined as an indicator equal to 1 if the participant expects to win and 0 otherwise. Panel A pools observations across gain and loss frames, while Panel B reports them separately. Diamonds indicate mean values.

Appendix Figure B.4: Heterogeneity by Framing Condition and Perceived Ability



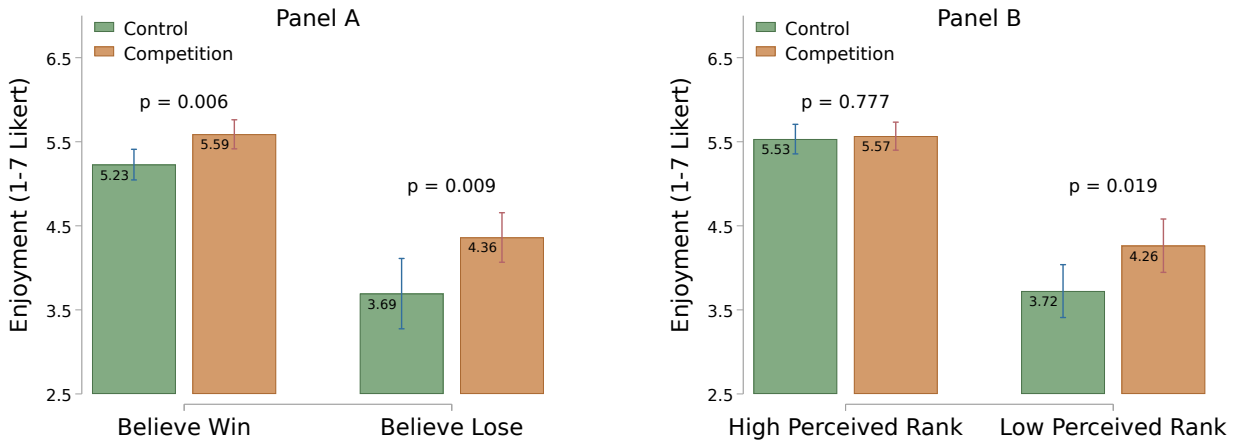
Notes: This figure shows the heterogeneous effects of competition by framing condition and perceived performance rank. Panels A and B plot predicted enjoyment (measured on a 7-point Likert scale) against perceived percentile rank for the gain- and loss-framing conditions, respectively. Panels C and D report predicted minimum willingness to accept (WTA) to perform the task again, also by perceived percentile rank, for the gain- and loss-framing conditions. Blue lines represent the control group and red lines represent the competition group, with shaded areas denoting 95% confidence intervals.

Appendix Figure B.5: Effects of Competition by Gender: Utility and Confidence



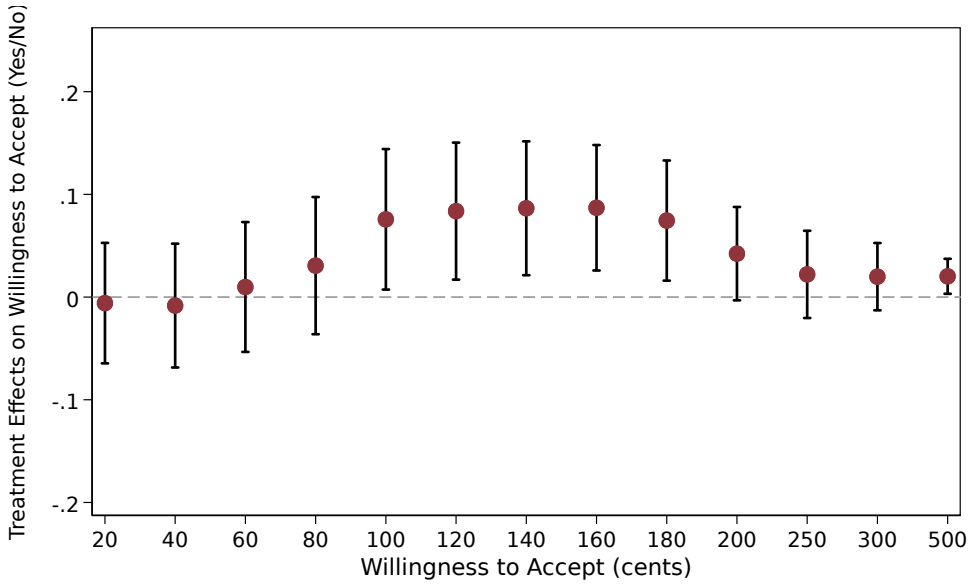
Notes: This figure illustrates the effects of competition by gender on enjoyment and belief in winning. Enjoyment is measured using a 7-point Likert scale question, where a larger number indicates greater enjoyment. Belief in winning is a binary indicator; the bar height represents the percentage of participants who believe they will win. Error bars denote 95% confidence intervals. p-values correspond to two-sample t-tests comparing the Competition and Control treatments within each gender.

Appendix Figure B.6: Effects on Utility by Winning Beliefs and Perceived Rank



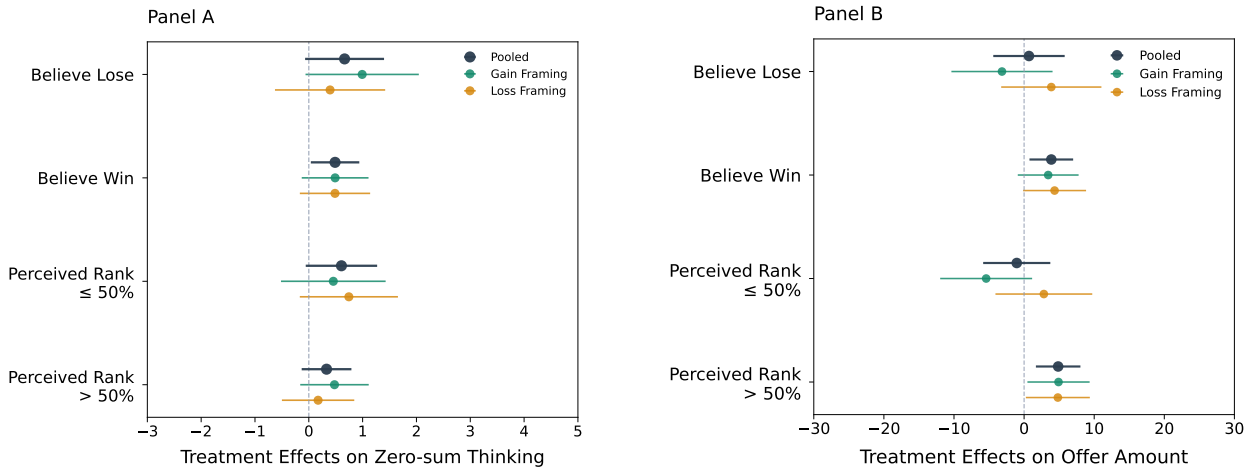
Notes: This figure illustrates the effects of competition on enjoyment by participants' winning beliefs and perceived rank. Enjoyment is measured on a 7-point Likert scale, with higher values indicating greater enjoyment. Bars represent mean enjoyment within each subgroup. "Believe Win" denotes participants who expected to win, while "Believe Lose" refers to those who expected to lose. "High Perceived Rank" refers to participants who believed their performance was above the median performance of all participants in the study, while "Low Perceived Rank" corresponds to those who believed their performance was at or below that median. Error bars indicate 95 percent confidence intervals. p-values are based on two-sample t-tests comparing the Competition and Control treatments within each subgroup.

Appendix Figure B.7: Effects on Task Preference through Attribution Bias



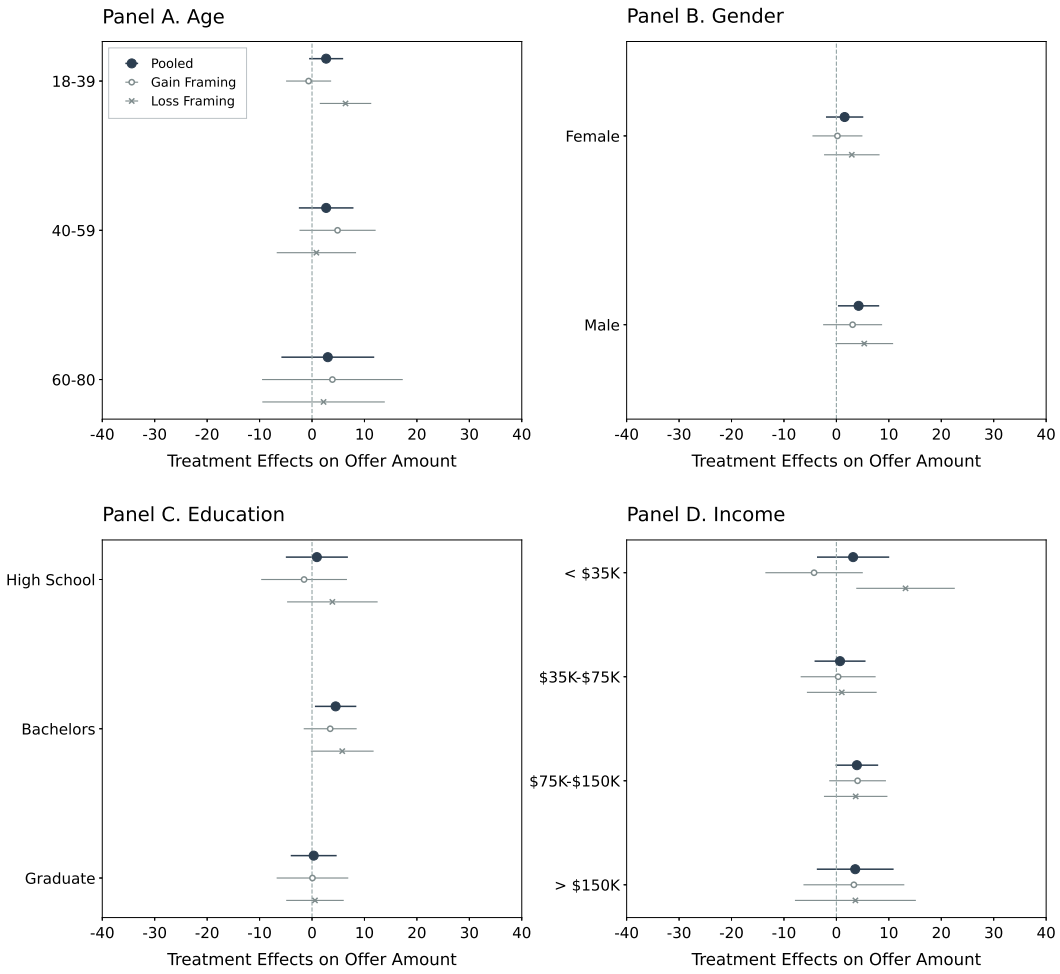
Notes: This figure shows the effect of competition on willingness to perform the experimental task again at different monetary amounts. For each listed amount, the outcome is a binary indicator equal to one if participants stated that they would accept performing the task again for that payment and zero otherwise. The offered amounts are \$0.20, \$0.40, \$0.60, \$0.80, \$1.00, \$1.20, \$1.40, \$1.60, \$1.80, \$2.00, \$2.50, \$3.00, and \$5.00. The figure reports results for the pooled sample.

Appendix Figure B.8: Heterogeneous Effects on Zero-sum Thinking and Altruism



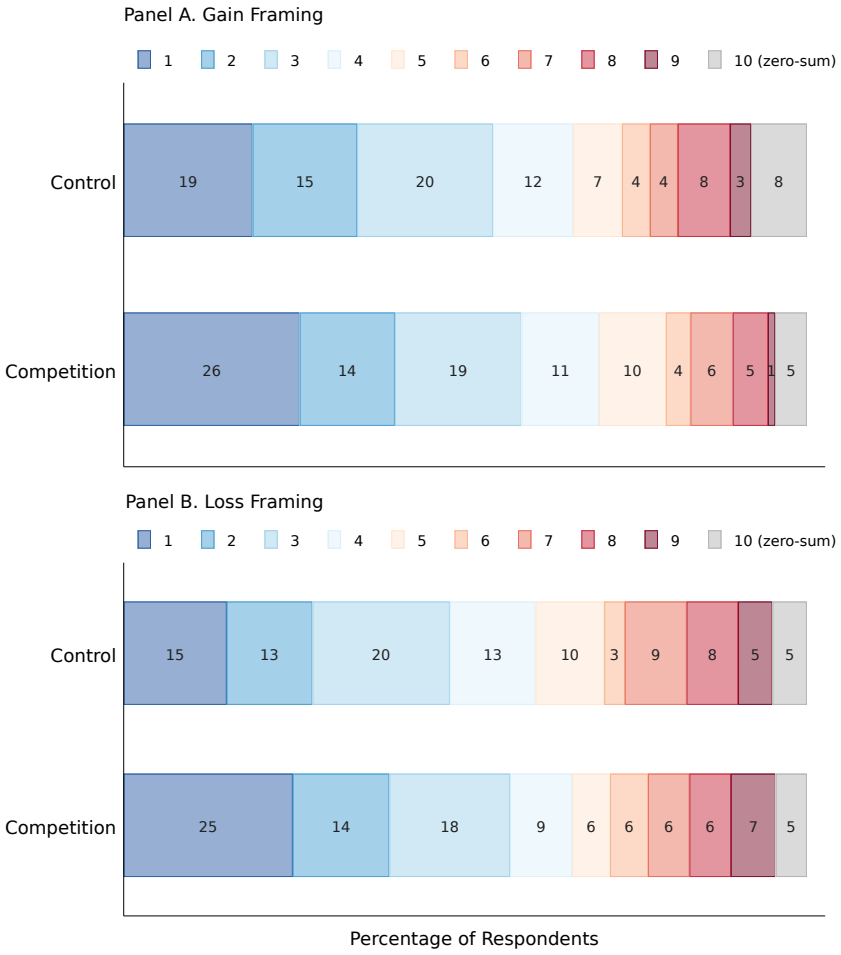
Notes: This figure shows heterogeneous treatment effects of competition on zero-sum thinking and altruism. Panel A shows effects on zero-sum thinking, and Panel B shows effects on offer amounts. Each point represents the estimated treatment effect, and the horizontal lines indicate 95% confidence intervals. Results are presented separately for the pooled sample, the gain framing condition, and the loss framing condition, as well as across subgroups based on participants' perceived rank (above or below the median) and beliefs about winning or losing.

Appendix Figure B.9: Effects of Competition on Altruism across Demographic Groups



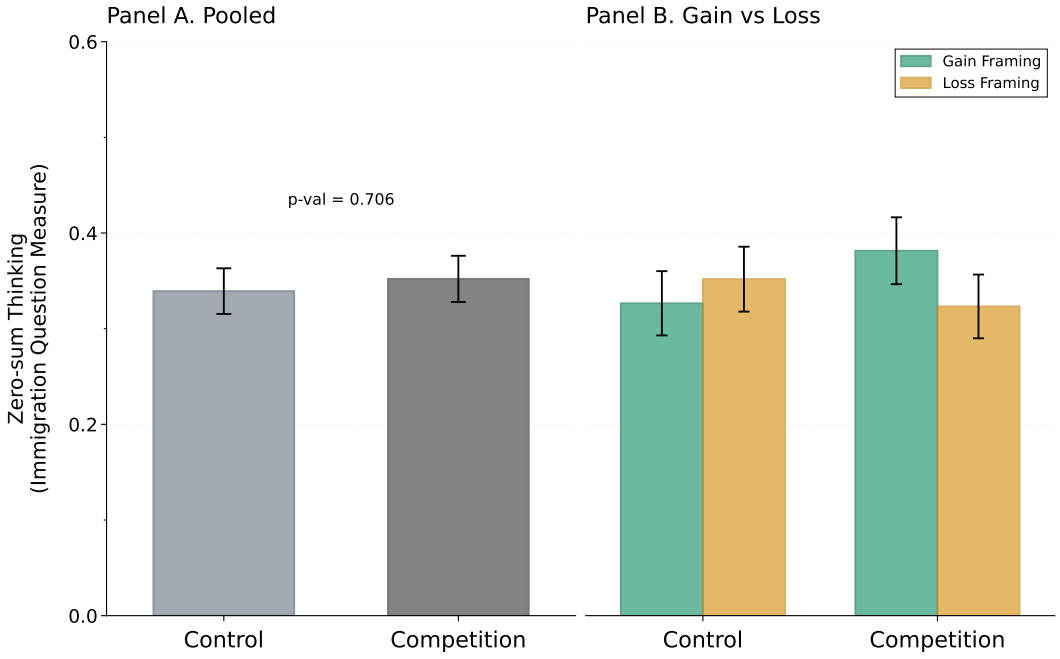
Notes: This figure shows the heterogeneous effects of competition on altruism by participants' beliefs about winning and their perceived performance rank under gain and loss framing. Panel A displays results for the control and competition groups under gain framing, and Panel B displays the corresponding results under loss framing. The figure plots predicted altruism, measured by the offer amount in the dictator game, as a function of perceived percentile rank (0–100, in increments of 10). Shaded areas indicate 95% confidence intervals.

Appendix Figure B.10: Zero-Sum Thinking Distribution by Treatment



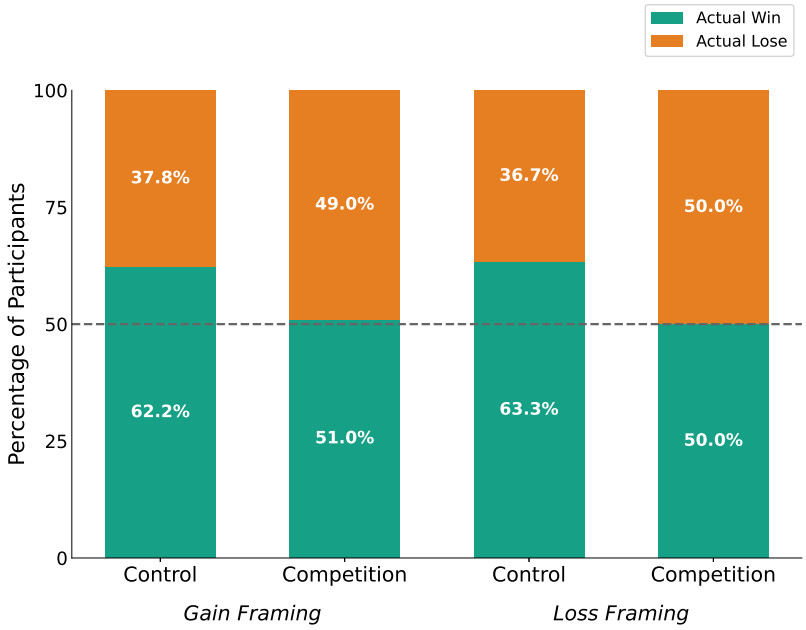
Notes: The figure displays the distribution of responses on the zero-sum scale under gain framing (Panel A) and loss framing (Panel B). Zero-sum beliefs are measured using a World Values Survey item (Inglehart et al., 2014), where respondents rate their agreement on a 1–10 scale between the statements: "Wealth can grow so there's enough for everyone" (1, indicating minimal zero-sum thinking) and "People can only become wealthy at the expense of others" (10, indicating strong zero-sum thinking). Higher values correspond to stronger endorsement of zero-sum beliefs. Percentages indicate the share of respondents selecting each scale point within the control and competition groups.

Appendix Figure B.11: Treatment Effects on Zero-sum Thinking



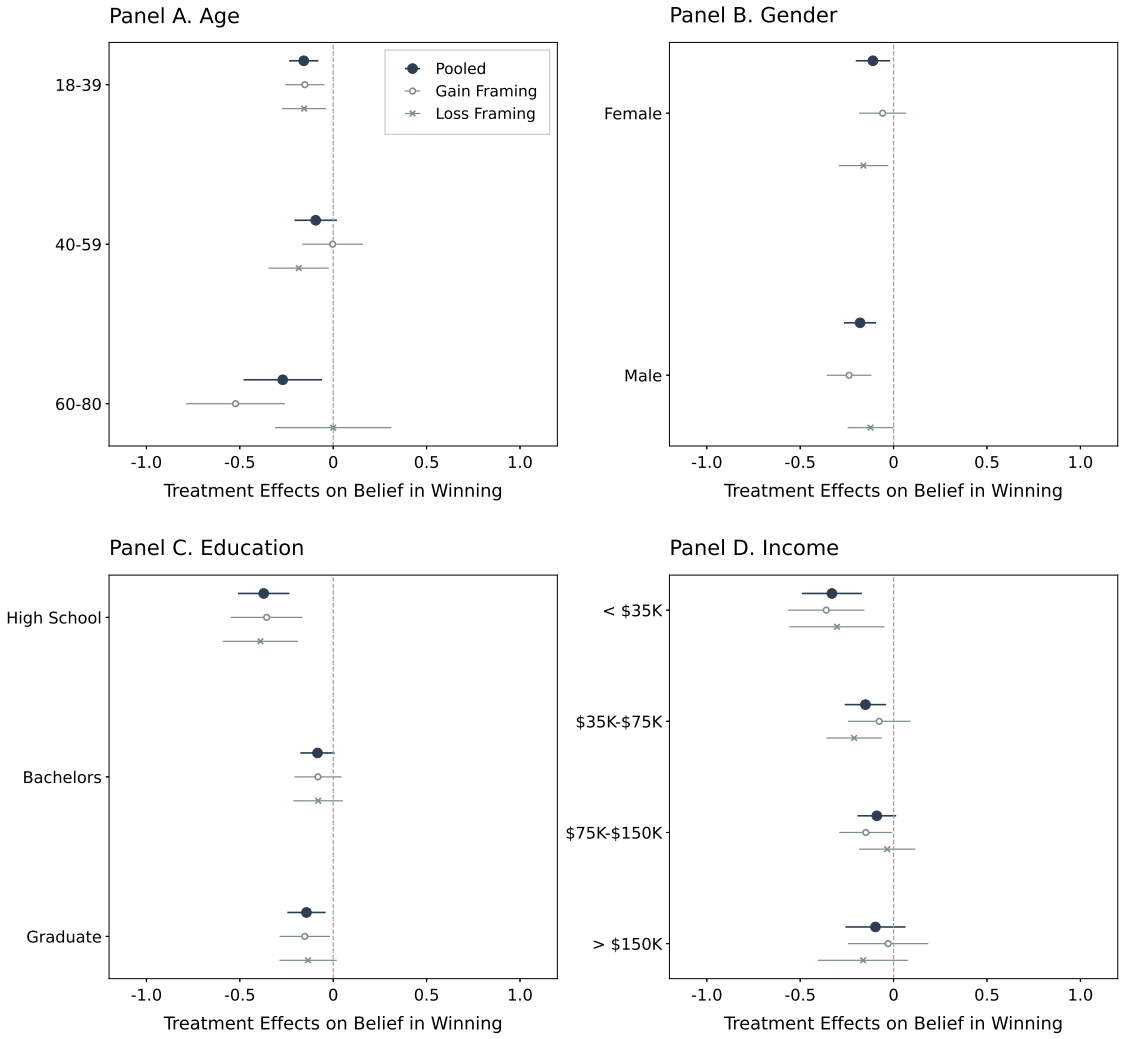
Notes: This figure illustrates the estimated treatment effects of competition on zero-sum thinking using the immigration measure. Zero-sum thinking is measured with a scenario-choice question in which both immigrants and locals work as day laborers. On Day 1, immigrant workers find 20 jobs and local workers 40 jobs. On Day 2, immigrant workers again find 40 jobs, and respondents then choose whether local workers find 20 or 80 jobs. Choosing 20 reflects zero-sum thinking (coded as 1), while choosing 80 reflects non–zero-sum thinking (coded as 0). Panel A presents results for the pooled sample, and Panel B shows results separately for gain- and loss-framing conditions. Bars indicate mean values with error bars representing robust standard errors.

Appendix Figure B.12: Actual Win–Loss Outcomes by Framing and Treatment Condition



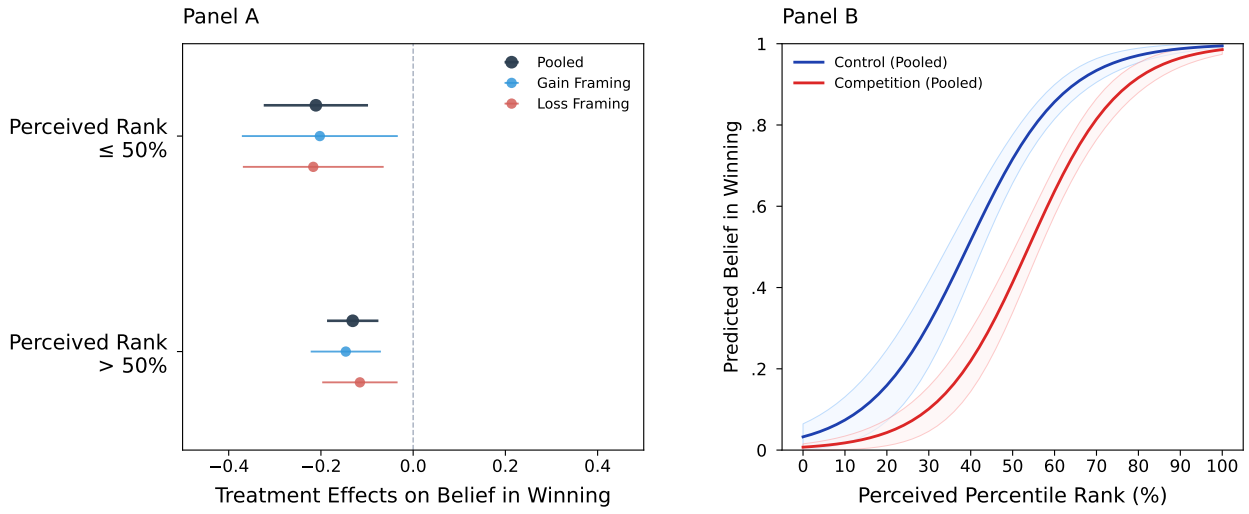
Notes: This figure shows the distribution of actual win–loss outcomes across control and competition conditions under gain and loss framing. In the control condition, a "win" is defined as achieving a score on the IQ quiz above the threshold score, while a "loss" indicates performance below the threshold. In the competition condition, a "win" denotes that a participant outperformed their paired opponent on the IQ quiz, while a "loss" indicates the opposite. Under gain framing, participants were endowed with $2; winners earned an additional $2 (totaling $4), while losers received no additional reward. Under loss framing, participants were endowed with $6; winners retained the full endowment, while losers forfeited $4 from the initial amount. The distribution of beliefs about winning and losing across conditions is displayed in the Panel A of Figure **??**.

Appendix Figure B.13: Effect of Competition on Belief in Winning by Demographic Group



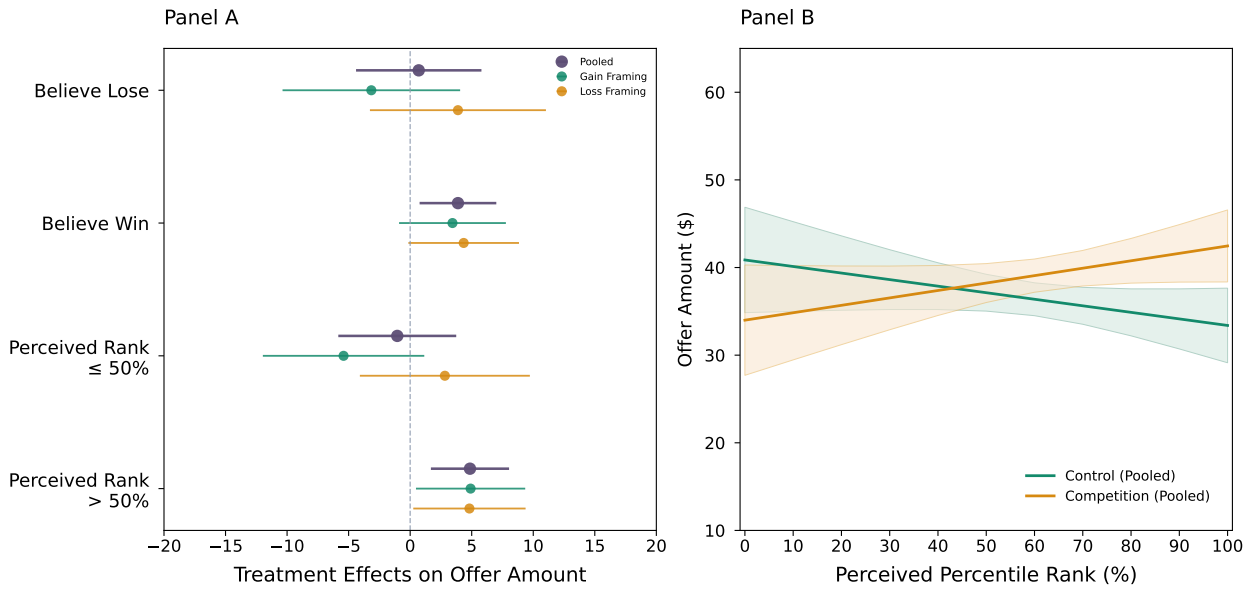
Notes: This figure presents the heterogeneous effects of competition on the belief in winning across demographic groups. Belief in winning is a binary variable equal to 1 if participants report expecting to beat their paired opponent in the competition treatment, or to surpass the threshold score in the control group, and 0 otherwise. The filled circle represents the treatment effect for the pooled sample, the hollow circle for the gain-framing condition, and the star for the loss-framing condition. All estimates are shown with 95% confidence intervals. Panel A reports results by age group (18–39, 40–59, and 60–80), Panel B by gender, Panel C by educational attainment (high school, bachelor's, and graduate), and Panel D by income categories ($<$\$35K, \$35K–\$75K, \$75K–\$150K, and $>$\$150K).

Appendix Figure B.14: Heterogeneity in Belief in Winning by Perceived Ability



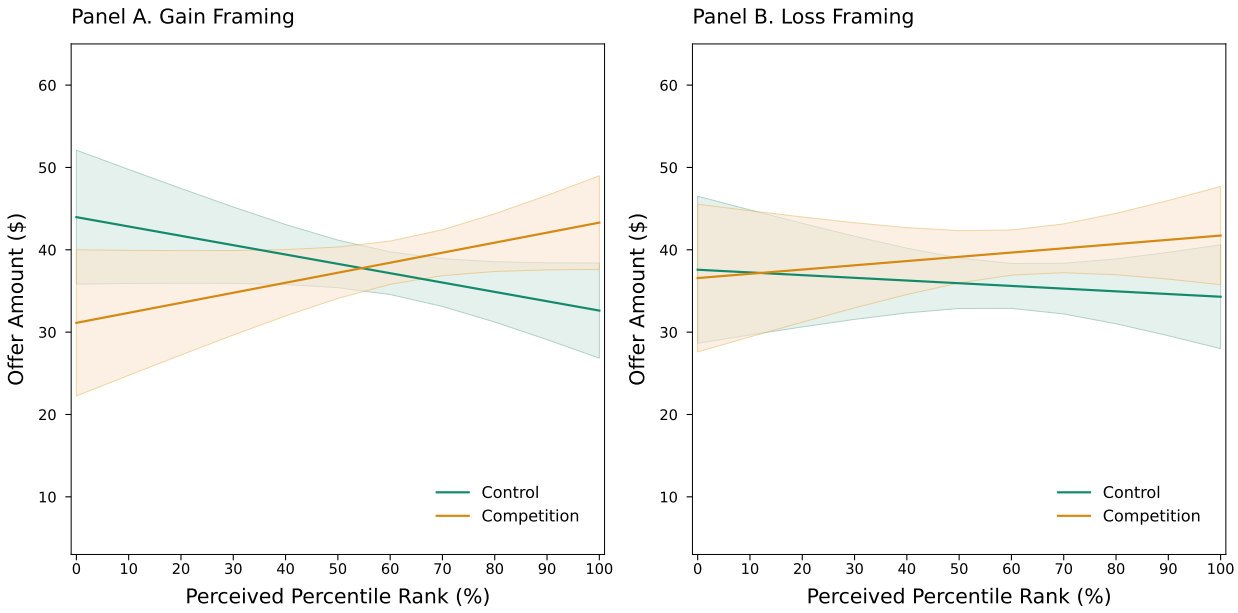
Notes: This figure presents the effect of competition on belief in winning by perceived ability. Panel A shows estimated mean treatment effects with 95% confidence intervals for the pooled sample, the gain-framing condition, and the loss-framing condition. Results are reported separately for individuals who perceived their performance rank to be below or above the median. Belief in winning is a binary variable equal to one if participants believed they would win the IQ quiz competition in the treatment group or pass the threshold score in the control group. Perceived rank is elicited by asking participants to estimate the rank of their performance relative to others. Panel B plots predicted probabilities of belief in winning against perceived percentile rank for the pooled sample, based on estimates from a logit model.

Appendix Figure B.15: Heterogeneous Effects on Altruism



Notes: This figure shows the heterogeneous effects of competition on altruism by participants' beliefs about winning and their perceived performance rank. Panel A presents treatment effects for the pooled sample, the gain-framing condition, and the loss-framing condition. Black markers indicate pooled estimates, green markers indicate gain framing, and orange markers indicate loss framing. Each marker shows the estimated mean, with horizontal bars denoting 95 percent confidence intervals. Panel B plots predicted altruism, measured by the offer amount in the dictator game, as a function of perceived percentile rank (0–100, in increments of 10). Shaded areas indicate 95% confidence intervals. Results for the gain- and loss-framing conditions are reported in Appendix Figure B.16.

Appendix Figure B.16: Effects of Competition on Altruism by Perceived Ability



Notes: This figure shows the heterogeneous effects of competition on altruism by participants' beliefs about winning and their perceived performance rank under gain and loss framing. Panel A displays results for the control and competition groups under gain framing, and Panel B displays the corresponding results under loss framing. The figure plots predicted altruism, measured by the offer amount in the dictator game, as a function of perceived percentile rank (0–100, in increments of 10). Shaded areas indicate 95% confidence intervals.

B.2 Additional Tables

Appendix Table B.1: Robustness Using Alternative Effort Proxies

	Dependent Variable: Enjoyment								
	Pooled			Gain Framing			Loss Framing		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Competition	0.43***	0.44***	0.46***	0.42**	0.42**	0.43***	0.45***	0.46***	0.50***
	(0.12)	(0.12)	(0.12)	(0.16)	(0.17)	(0.16)	(0.17)	(0.17)	(0.17)
Belief in Winning	1.40***	1.39***	1.37***	1.40***	1.40***	1.37***	1.37***	1.36***	1.33***
	(0.14)	(0.14)	(0.14)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Effort (score)	✓			✓			✓		
Effort (correct answers)		✓			✓			✓	
Effort (time per question)			✓			✓			✓
Control mean	4.89	4.89	4.89	5.05	5.05	5.05	4.73	4.73	4.73
Observations	787	787	787	390	390	390	397	397	397
R^2	0.14	0.14	0.13	0.14	0.14	0.14	0.13	0.13	0.13

Notes: This table reports OLS estimates of the effect of competition on utility, both overall and net of the belief-updating channel, with alternative effort proxies as controls. The check mark (✓) indicates which effort proxy is included in each specification. "Score" denotes the total number of points achieved on the IQ quiz; "Correct answers" is the number of questions answered correctly; and "Time per question" measures the average time spent on each question. Control means refer to average enjoyment in the control group. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.2: Heterogeneity by Beliefs and Perceived Ability

	Dependent Variable: Enjoyment		
	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)
Panel A: Belief in Winning			
Competition	0.67**	0.99***	0.39
	(0.26)	(0.37)	(0.36)
Believe Win	1.53***	1.82***	1.26***
	(0.23)	(0.33)	(0.32)
Competition × Believe Win	-0.31	-0.74*	0.08
	(0.29)	(0.41)	(0.41)
Control mean	3.69	3.59	3.78
Observations	787	390	397
R^2	0.13	0.14	0.12
Panel B: Perceived Rank			
Competition	0.54**	0.70**	0.40
	(0.23)	(0.32)	(0.33)
Perceived High Rank	1.81***	2.07***	1.55***
	(0.18)	(0.25)	(0.27)
Competition × Perceived High Rank	-0.51*	-0.77**	-0.26
	(0.26)	(0.36)	(0.37)
Control mean	3.72	3.69	3.76
Observations	787	390	397
R^2	0.19	0.24	0.15

Notes: This table shows heterogeneous treatment effects of competition on utility. The dependent variable is enjoyment, measured on a 7-point Likert scale, with higher values indicating greater enjoyment. Competition is an indicator equal to one if the participant was assigned to the competition condition. In Panel A, heterogeneity is examined by whether participants believed they would win (Believe Win = 1 if the participant expected to win, 0 otherwise). In Panel B, heterogeneity is based on perceived relative rank (Perceived High Rank = 1 if the participant perceived their performance to be above the median, 0 otherwise). Interaction terms capture differential treatment effects by beliefs and perceived ability. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.3: Correlation between Belief in Winning and Utility

	Dependent Variable: Enjoyment					
	Pooled		Gain Framing		Loss Framing	
	Control	Competition	Control	Competition	Control	Competition
	(1)	(2)	(3)	(4)	(5)	(6)
Belief in Winning	1.53***	1.23***	1.82***	1.08***	1.26***	1.34***
	(0.23)	(0.17)	(0.33)	(0.24)	(0.32)	(0.25)
Control mean	4.89	5.14	5.05	5.29	4.73	4.99
Observations	395	392	196	194	199	198
R^2	0.12	0.13	0.16	0.11	0.09	0.14

Notes: This table summarizes OLS estimates of the relationship between belief in winning and enjoyment. The dependent variable is participants' responses to the question: "On a scale of 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ Quiz Competition (or IQ Quiz)?" Belief in Winning is an indicator based on post-treatment responses to "Do you think you were the top performer in the IQ Quiz competition?" (or "Do you think you scored 6 or higher on the IQ Quiz?"). Columns (1)–(2) pool all framing conditions, while columns (3)–(4) and (5)–(6) report results separately for the gain and loss framing treatments. Within each framing condition, the first column corresponds to the Control group and the second to the Treatment (Competition) group. Reported coefficients are based on robust standard errors shown in parentheses. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.4: Effects on Task Preference through Attribution Bias

	Competition	Control	Difference	p-value
	(1)	(2)	[(1)-(2)]	(4)
Minimum Willingness to Accept ($)	1.22	1.39	-0.17**	0.03
	(0.05)	(0.06)	(0.08)	
Willing to Accept for 20 cents	0.22	0.23	-0.01	0.84
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 40 cents	0.24	0.25	-0.01	0.79
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 60 cents	0.29	0.28	0.01	0.76
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 80 cents	0.37	0.34	0.03	0.37
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 100 cents	0.64	0.56	0.08**	0.03
	(0.02)	(0.03)	(0.03)	
Willing to Accept for 120 cents	0.69	0.60	0.09**	0.01
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 140 cents	0.72	0.63	0.09**	0.01
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 160 cents	0.78	0.70	0.08**	0.01
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 180 cents	0.81	0.73	0.08**	0.01
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 200 cents	0.90	0.86	0.04*	0.07
	(0.02)	(0.02)	(0.02)	
Willing to Accept for 250 cents	0.91	0.89	0.02	0.31
	(0.01)	(0.02)	(0.02)	
Willing to Accept for 300 cents	0.95	0.93	0.02	0.23
	(0.01)	(0.01)	(0.02)	
Willing to Accept for 500 cents	0.99	0.97	0.02**	0.02
	(0.00)	(0.01)	(0.01)	

Notes: This table reports the effects of competition on willingness to perform the experimental task again at different monetary amounts for the pooled sample. Columns (1) and (2) present mean acceptance rates in the competition and control groups, respectively. Column (3) reports the difference between the two groups, and column (4) provides the associated p-values. Standard errors are shown in parentheses. The outcome variable is a binary indicator equal to one if participants accepted performing the task again at the specified payment amount and zero otherwise. The first row reports the estimated minimum willingness to accept (WTA) in dollars. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.5: Treatment Effects on Task Preference (Gain Framing)

Sample: Gain Framing	Competition	Control	Difference	p-value
	(1)	(2)	[(1)-(2)]	(4)
Minimum Willingness to Accept ($)	1.09	1.23	-0.14	0.18
	(0.07)	(0.08)	(0.11)	
Willing to Accept for 20 cents	0.26	0.27	-0.01	0.78
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 40 cents	0.28	0.29	-0.01	0.87
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 60 cents	0.34	0.32	0.02	0.78
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 80 cents	0.41	0.38	0.03	0.62
	(0.04)	(0.03)	(0.05)	
Willing to Accept for 100 cents	0.69	0.60	0.09*	0.09
	(0.03)	(0.04)	(0.05)	
Willing to Accept for 120 cents	0.73	0.66	0.07	0.11
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 140 cents	0.76	0.68	0.08*	0.06
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 160 cents	0.82	0.74	0.08*	0.06
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 180 cents	0.85	0.78	0.07*	0.08
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 200 cents	0.94	0.90	0.04	0.20
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 250 cents	0.93	0.93	0.00	0.86
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 300 cents	0.96	0.95	0.01	0.65
	(0.01)	(0.02)	(0.02)	
Willing to Accept for 500 cents	0.99	0.98	0.01	0.42
	(0.01)	(0.01)	(0.01)	

Notes: This table reports the effects of competition on willingness to accept (WTA) performing the experimental task again, restricted to the gain-framing condition. Column (1) shows mean acceptance rates in the competition group, and column (2) shows mean acceptance rates in the control group. Column (3) reports the difference between the two groups, and column (4) provides the associated p-values. Standard errors are reported in parentheses. The outcome variable is a binary indicator equal to one if participants accepted performing the task again at the specified payment amount and zero otherwise. The first row reports the estimated minimum WTA in dollars. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.6: Treatment Effects on Task Preference (Loss Framing)

Sample: Loss Framing	Competition	Control	Difference	p-value
	(1)	(2)	[(1)-(2)]	(4)
Minimum Willingness to Accept ($)	1.34	1.55	-0.21*	0.08
	(0.08)	(0.09)	(0.12)	
Willing to Accept for 20 cents	0.19	0.19	0.00	0.98
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 40 cents	0.21	0.22	-0.01	0.83
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 60 cents	0.25	0.24	0.01	0.88
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 80 cents	0.33	0.29	0.04	0.43
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 100 cents	0.59	0.52	0.07	0.17
	(0.04)	(0.04)	(0.05)	
Willing to Accept for 120 cents	0.64	0.55	0.09*	0.06
	(0.03)	(0.04)	(0.05)	
Willing to Accept for 140 cents	0.68	0.59	0.09*	0.07
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 160 cents	0.74	0.65	0.09**	0.04
	(0.03)	(0.03)	(0.05)	
Willing to Accept for 180 cents	0.77	0.69	0.08*	0.08
	(0.03)	(0.03)	(0.04)	
Willing to Accept for 200 cents	0.86	0.81	0.05	0.18
	(0.02)	(0.03)	(0.04)	
Willing to Accept for 250 cents	0.88	0.84	0.04	0.25
	(0.02)	(0.03)	(0.03)	
Willing to Accept for 300 cents	0.94	0.91	0.03	0.25
	(0.02)	(0.02)	(0.03)	
Willing to Accept for 500 cents	1.00	0.97	0.03**	0.01
	(0.00)	(0.01)	(0.01)	

Notes: This table reports the effects of competition on willingness to accept (WTA) performing the experimental task again, restricted to the loss-framing condition. Column (1) shows mean acceptance rates in the competition group, and column (2) shows mean acceptance rates in the control group. Column (3) reports the difference between the two groups, and column (4) provides the associated p-values. Standard errors are reported in parentheses. The outcome variable is a binary indicator equal to one if participants accepted performing the task again at the specified payment amount and zero otherwise. The first row reports the estimated minimum WTA in dollars. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.7: Treatment Effects on Task Preference (Alternative Measure)

	Dependent Variable: Another 10 questions without reward		
	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)
Competition	0.26	0.12	0.39*
	(0.16)	(0.22)	(0.23)
Control mean	4.36	4.74	3.98
Observations	787	390	397
R^2	0.00	0.00	0.01

Notes: This table shows the effect of competition on task preference, measured by an unincentivized question asking participants, on a scale from 1 to 7, how likely they were to take another 10 IQ questions, similar to the ones in the IQ quiz, but without monetary rewards. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.8: Treatment Effects on Zero-sum Thinking

	Dependent Variable: Zero-sum Thinking (World Values Survey Measure)		
	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)
Competition	-0.44**	-0.50*	-0.39
	(0.20)	(0.27)	(0.28)
Control mean	4.27	4.15	4.38
Observations	787	390	397
R^2	0.01	0.01	0.01

Notes: This table reports the estimated treatment effects of competition on zero-sum thinking. Zero-sum thinking is measured using a World Values Survey question (Inglehart et al., 2014) in which respondents rate their agreement, on a 1–10 scale, between two statements: "Wealth can grow so there's enough for everyone" (1, indicating minimal zero-sum thinking) and "People can only become wealthy at the expense of others" (10, indicating strong zero-sum thinking). Higher values on the y-axis therefore represent stronger zero-sum thinking. Each column presents results from an OLS regression of zero-sum thinking on a treatment indicator for competition. Column (1) pools all observations, while Columns (2) and (3) report results separately for gain framing and loss framing. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.9: Treatment Effects on Zero-sum Thinking (Alternative Measure)

	Dependent Variable: Zero-sum Thinking (Immigration Measure)		
	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)
Competition	0.01	0.05	-0.03
	(0.03)	(0.05)	(0.05)
Control mean	0.34	0.33	0.35
Observations	787	390	397
R^2	0.00	0.00	0.00

Notes: This table shows the estimated treatment effects of competition on zero-sum thinking. Zero-sum thinking is measured with a scenario-choice question in which both immigrants and locals work as day laborers. On Day 1, immigrant workers find 20 jobs and local workers 40 jobs. On Day 2, immigrant workers find 40 jobs. Respondents then choose whether local workers find 20 or 80 jobs on Day 2. Choosing 20 reflects zero-sum thinking (coded as 1), while choosing 80 reflects non-zero-sum thinking (coded as 0). Column (1) presents results for the pooled sample, while Columns (2) and (3) present results for gain and loss framing, respectively. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.10: Effects on Altruism by Belief in Winning

	Dependent Variable: Altruism					
	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	2.88**	0.70	1.59	-3.15	4.14**	3.88
	(1.36)	(2.59)	(1.88)	(3.66)	(1.96)	(3.64)
Belief in Winning		-1.13		-2.93		0.19
		(2.25)		(3.20)		(3.17)
Competition × Belief in Winning		3.19		6.59		0.47
		(3.04)		(4.28)		(4.30)
Control mean	36.38	37.26	37.17	39.51	35.61	35.47
Observations	787	787	390	390	397	397
R^2	0.01	0.01	0.00	0.01	0.01	0.01

Notes: The table shows the effect of competition on altruism, measured by the amount offered to a randomly matched partner in the dictator game. It also presents heterogeneous effects by Belief in Winning, a binary variable equal to 1 if the participant expected to win and 0 otherwise. Columns (1)–(2) presents results for the pooled sample, while Columns (3)–(4) for gain framing and Columns (5)–(6) for loss framing. Perceived Rank is the self-assessed percentile rank in the IQ quiz. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.11: Treatment Effects on Altruism by Perceived Percentile Rank

	Dependent Variable: Altruism					
	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	2.88**	-1.05	1.59	-5.41	4.14**	2.82
	(1.36)	(2.44)	(1.88)	(3.34)	(1.96)	(3.52)
Perceived Rank		-1.45		-4.82*		1.64
		(2.02)		(2.61)		(3.03)
Competition × Perceived Rank		5.91**		10.32**		2.00
		(2.93)		(4.03)		(4.22)
Control mean	36.38	37.32	37.17	40.34	35.61	34.58
Observations	787	787	390	390	397	397
R^2	0.01	0.01	0.00	0.02	0.01	0.02

Notes: The table shows the effect of competition on altruism, measured by the amount offered to a randomly matched partner in the dictator game. It also shows heterogeneous effects by perceived percentile rank. Columns (1)–(2) presents results for the pooled sample, while Columns (3)–(4) for gain framing and Columns (5)–(6) for loss framing. Perceived Rank is the self-assessed percentile rank in the IQ quiz. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.12: Effects on Contribution Decisions and Beliefs in a Public Goods Game

	Contribution to Public Pool			*Belief: Others Not Contributing (%)*		
	Pooled	Gain Framing	Loss Framing	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	-0.05	-0.05	-0.05	0.23	0.37*	0.09
	(0.04)	(0.05)	(0.05)	(0.15)	(0.21)	(0.22)
Control mean	0.60	0.57	0.63	6.17	6.25	6.09
Observations	787	390	397	787	390	397
R^2	0.00	0.00	0.00	0.00	0.01	0.00

Notes: This table reports the effect of competition on contribution decisions and beliefs in a public goods game. Competition is a binary indicator equal to 1 for participants in the competition group and 0 for those in the control group. The dependent variable in Columns (1)–(3) is a binary indicator for contributing to the public pool, while the dependent variable in Columns (4)–(6) is the participant's belief (in percent) about the share of others not contributing (i.e., keeping the money for themselves). Columns (1) and (4) pool all treatments, whereas Columns (2)–(3) and (5)–(6) report results separately for the gain- and loss-framing conditions. Robust standard errors are reported in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.13: Treatment Effects on Positive Emotions

Panel A. Dependent Variable: Excitement

	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	0.24*	0.42***	0.23	0.41**	0.26	0.42**
	(0.13)	(0.12)	(0.18)	(0.17)	(0.19)	(0.18)
Believe Win		1.21***		1.24***		1.14***
		(0.15)		(0.22)		(0.20)
Control mean	4.65	4.65	4.83	4.83	4.47	4.47
Observations	787	787	390	390	397	397
R^2	0.00	0.09	0.00	0.10	0.00	0.08

Panel B. Dependent Variable: Satisfaction

	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	0.21	0.41***	0.24	0.45***	0.18	0.37**
	(0.13)	(0.12)	(0.18)	(0.17)	(0.19)	(0.18)
Believe Win		1.37***		1.41***		1.30***
		(0.14)		(0.21)		(0.20)
Control mean	4.33	4.33	4.48	4.48	4.19	4.19
Observations	787	787	390	390	397	397
R^2	0.00	0.12	0.00	0.13	0.00	0.11

Notes: This table reports the treatment effects of competition on positive emotions. Panel A presents results for excitement, and Panel B presents results for satisfaction. Each panel shows estimates for the pooled sample (columns 1–2), the gain-framing condition (columns 3–4), and the loss-framing condition (columns 5–6). Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.14: Treatment Effects of Competition on Negative Emotions

	Panel A. Dependent Variable: Stress					
	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	-0.23	-0.32**	-0.43**	-0.53***	-0.02	-0.11
	(0.14)	(0.14)	(0.19)	(0.20)	(0.20)	(0.20)
Believe Win		-0.65***		-0.67***		-0.60***
		(0.16)		(0.22)		(0.22)
Control mean	3.90	3.90	3.84	3.84	3.96	3.96
Observations	787	787	390	390	397	397
R^2	0.00	0.03	0.01	0.04	0.00	0.02
	Panel B. Dependent Variable: Anxiety					
	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	-0.02	-0.09	-0.26	-0.32	0.22	0.13
	(0.14)	(0.14)	(0.20)	(0.20)	(0.20)	(0.20)
Believe Win		-0.53***		-0.40*		-0.62***
		(0.16)		(0.23)		(0.21)
Control mean	3.95	3.95	3.94	3.94	3.96	3.96
Observations	787	787	390	390	397	397
R^2	0.00	0.01	0.00	0.01	0.00	0.02
	Panel C. Dependent Variable: Embarrassment					
	Pooled		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)
Competition	-0.04	-0.15	-0.24	-0.35**	0.15	0.05
	(0.12)	(0.12)	(0.16)	(0.16)	(0.18)	(0.18)
Believe Win		-0.75***		-0.74***		-0.74***
		(0.14)		(0.19)		(0.21)
Control mean	2.50	2.50	2.47	2.47	2.53	2.53
Observations	787	787	390	390	397	397
R^2	0.00	0.04	0.01	0.05	0.00	0.04

Notes: This table reports the treatment effects of competition on negative emotions. Panel A presents results for stress, Panel B presents results for anxiety, and Panel C for embarrassment. Each panel shows estimates for the pooled sample (columns 1–2), the gain-framing condition (columns 3–4), and the loss-framing condition (columns 5–6). Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.15: Treatment Effects of Competition on Positive and Negative Emotions

	Positive Emotion Index				*Negative Emotion Index*			
	Gain Framing		Loss Framing		Gain Framing		Loss Framing	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Competition	0.18	0.33***	0.17	0.31**	-0.29**	-0.37***	0.11	0.02
	(0.13)	(0.12)	(0.14)	(0.13)	(0.14)	(0.14)	(0.15)	(0.15)
Belief in Winning		1.03***		0.95***		-0.56***		-0.60***
		(0.15)		(0.14)		(0.17)		(0.17)
Control mean	0.04	0.04	-0.21	-0.21	0.04	0.04	-0.21	-0.21
Observations	390	390	397	397	390	390	397	397
R^2	0.01	0.13	0.00	0.11	0.01	0.04	0.00	0.04

Notes: This table reports the treatment effects of competition on the emotion index. The positive emotion index (columns 1–6) is constructed from measures of excitement and satisfaction, while the negative emotion index (columns 7–10) is constructed from measures of stress, anxiety, and embarrassment, using principal component analysis (PCA). Estimates are reported separately for the gain-framing and loss-framing conditions. "Competition" is an indicator for assignment to the competition treatment. "Believe Win" captures participants' belief that they would win the competition. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.16: Heterogeneity in Intrinsic Enjoyment by Perceived Ability

	Dependent Variable: Enjoyment		
	Pooled	Gain Framing	Loss Framing
	(1)	(2)	(3)
Competition	0.69***	0.84***	0.56*
	(0.23)	(0.31)	(0.33)
Perceived Rank	1.49***	1.77***	1.21***
	(0.19)	(0.26)	(0.28)
Competition × Perceived Rank	-0.56**	-0.81**	-0.33
	(0.26)	(0.35)	(0.37)
Belief in Winning	0.70***	0.66***	0.73***
	(0.15)	(0.20)	(0.23)
Observations	787	390	397
R^2	0.21	0.26	0.18

Notes: This table reports OLS regressions of enjoyment on competition, perceived performance rank, their interaction, and belief in winning. The dependent variable is enjoyment, measured on a 7-point Likert scale, with larger values indicating greater utility. Competition is a treatment indicator equal to one for participants assigned to the competition group and zero for those in the control group. Perceived Rank denotes participants' self-assessed percentile rank of performance. Columns (1), (2), and (3) present results for the pooled sample, the gain-framing condition, and the loss-framing condition, respectively. Heterogeneity is captured by the interaction between competition and perceived rank. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.17: Heterogeneity in Intrinsic Enjoyment Across Demographic Groups

	Dependent Variable: Enjoyment			
	(1)	(2)	(3)	(4)
Competition	0.28*	0.37**	0.70***	0.72**
	(0.15)	(0.17)	(0.26)	(0.29)
Competition × Age (40-59)	0.34			
	(0.26)			
Competition × Age ($\geq$60)	0.34			
	(0.41)			
Competition × Female		0.15		
		(0.23)		
Competition × Bachelor Degree			-0.24	
			(0.31)	
Competition × Graduate Degree			-0.69**	
			(0.32)	
Competition × Income ($35K-$75K)				-0.51
				(0.36)
Competition × Income ($75K-$150K)				-0.10
				(0.34)
Competition × Income ($>$$150K)				-0.69
				(0.44)
Observations	787	787	787	787
R^2	0.13	0.13	0.15	0.14

Notes: This table reports heterogeneous treatment effects of competition on utility using the pooled sample. Results by gain and loss framing are presented in the Appendix Tables B.18 and B.19. The dependent variable is enjoyment, measured on a 7-point scale where higher values indicate greater enjoyment. Competition is a treatment indicator equal to one for participants assigned to the competition group and zero otherwise. Each column corresponds to a separate regression where competition is interacted with the indicated subgroup characteristic. All specifications include belief in winning as a control. The omitted categories are age 18–39, male, high school or less, and income below $35K, which are coded as zero within their respective groups. For example, age is coded as 0 for ages 18–39, 1 for ages 40–59, and 2 for ages 60 and above; other subgroup variables follow a similar coding scheme. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.18: Heterogeneity in Intrinsic Enjoyment Across Demographic Groups

Sample: Gain Framing	*Dependent Variable: Enjoyment*			
	(1)	(2)	(3)	(4)
Competition	0.36*	0.32	0.71**	0.50
	(0.22)	(0.24)	(0.34)	(0.38)
Competition × Age (40-59)	0.15			
	(0.34)			
Competition × Age ($\geq$60)	0.29			
	(0.57)			
Competition × Female		0.25		
		(0.33)		
Competition × Bachelor Degree			-0.17	
			(0.41)	
Competition × Graduate Degree			-0.91**	
			(0.42)	
Competition × Income ($35K-$75K)				-0.06
				(0.47)
Competition × Income ($75K-$150K)				0.04
				(0.46)
Competition × Income (>$150K)				-0.59
				(0.56)
Observations	390	390	390	390
R^2	0.15	0.14	0.18	0.15

Notes: This table reports heterogeneous treatment effects of competition on utility using the gain framing sample. The dependent variable is enjoyment, measured on a 7-point scale where higher values indicate greater enjoyment. Competition is a treatment indicator equal to one for participants assigned to the competition group and zero otherwise. Each column corresponds to a separate regression where competition is interacted with the indicated subgroup characteristic. The omitted categories are age 18–39, male, high school or less, and income below $35K, which are coded as zero within their respective groups. For example, age is coded as 0 for ages 18–39, 1 for ages 40–59, and 2 for ages 60 and above; other subgroup variables follow a similar coding scheme. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table B.19: Heterogeneity in Intrinsic Enjoyment Across Demographic Groups

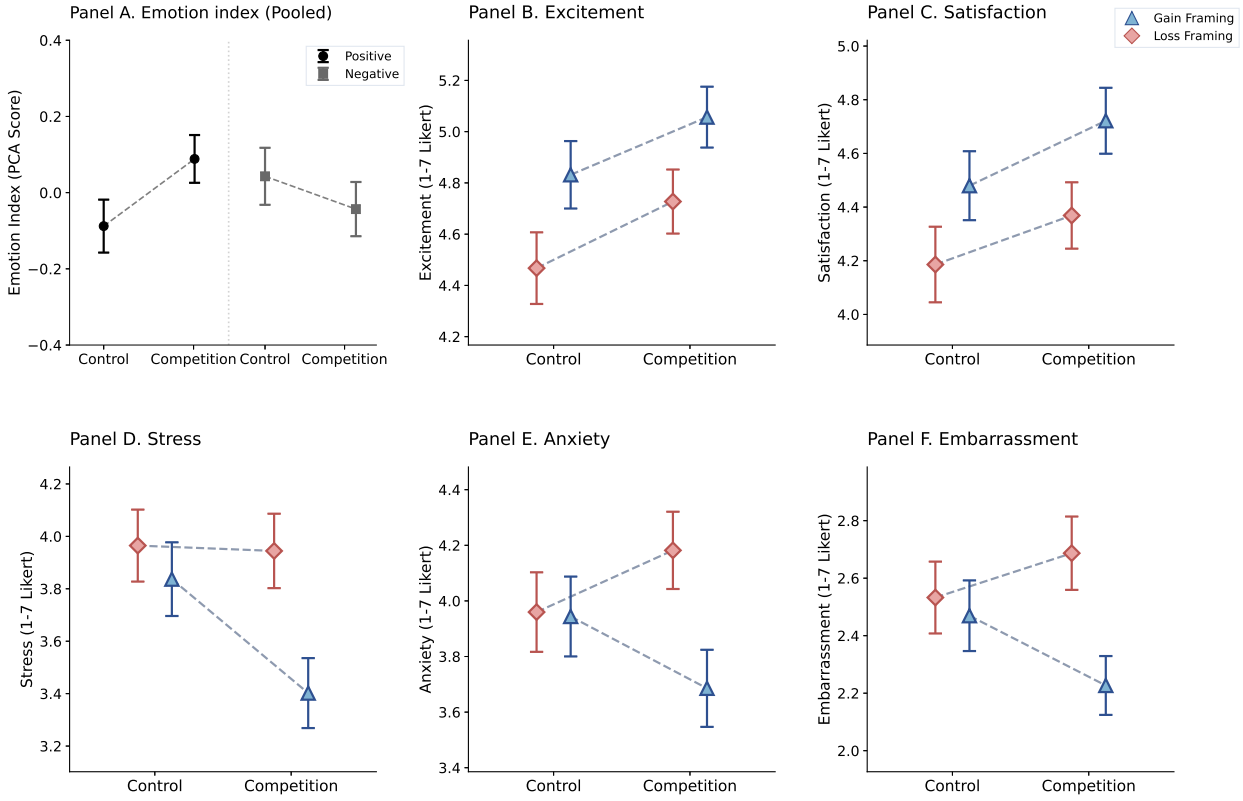
Sample: Loss Framing	*Dependent Variable: Enjoyment*			
	(1)	(2)	(3)	(4)
Competition	0.24	0.42*	0.67*	1.02**
	(0.22)	(0.23)	(0.41)	(0.46)
Competition × Age (40-59)	0.45			
	(0.38)			
Competition × Age (≥60)	0.35			
	(0.59)			
Competition × Female		0.05		
		(0.34)		
Competition × Bachelor Degree			-0.27	
			(0.48)	
Competition × Graduate Degree			-0.48	
			(0.49)	
Competition × Income ($35K-$75K)				-1.00*
				(0.55)
Competition × Income ($75K-$150K)				-0.32
				(0.53)
Competition × Income (>$150K)				-0.82
				(0.71)
Observations	397	397	397	397
R^2	0.12	0.12	0.13	0.13

Notes: This table reports heterogeneous treatment effects of competition on utility using the loss framing sample. The dependent variable is enjoyment, measured on a 7-point scale where higher values indicate greater enjoyment. Competition is a treatment indicator equal to one for participants assigned to the competition group and zero otherwise. Each column corresponds to a separate regression where competition is interacted with the indicated subgroup characteristic. The omitted categories are age 18–39, male, high school or less, and income below $35K, which are coded as zero within their respective groups. For example, age is coded as 0 for ages 18–39, 1 for ages 40–59, and 2 for ages 60 and above; other subgroup variables follow a similar coding scheme. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C Supplemental Analyses

Decomposing Utility into Emotional Components. To better understand the mechanisms underlying utility changes, I decompose subjective well-being into specific emotional components. Appendix Figure C.17 shows how competition affects excitement, satisfaction, stress, anxiety, and embarrassment. I classify the first two as positive emotions and the latter three as negative. All emotions were measured on a 7-point Likert scale, with higher values indicating stronger intensities.

Appendix Figure C.17: Effects of Competition on Emotional Components of Utility



Notes: This figure shows the treatment effects of competition on the emotional components of utility, including positive emotions (excitement, satisfaction) and negative emotions (stress, anxiety, embarrassment). These emotions are measured using 7-point Likert scale questions administered after the experimental task. Higher values indicate stronger experiences of the respective emotion. Panels B–F display mean values of participants' responses to each emotion question across the four experimental treatments (control vs. competition, under gain vs. loss framing), with 95% confidence intervals. Panel A summarizes these measures into an overall emotion index constructed using principal component analysis (PCA). Detailed regression estimates of the effects of competition on each emotional component of utility are provided in Appendix Table B.15, and Appendix Table B.13 and B.14.

Panel A of Appendix Figure C.17 documents the general pattern that competition increases positive emotions while reducing negative ones. Panels B and C show that compe-

tition raises excitement and satisfaction in the IQ quiz, regardless of whether the payoff is framed as a gain or a loss. Panels D, E, and F indicate that competition reduces stress, anxiety, and embarrassment under gain framing, while potentially increasing them under loss framing. Individuals are generally more excited and satisfied, and less stressed, anxious, and embarrassed when payoffs are framed as gains rather than losses. While these findings provide valuable insights into the emotional consequences of competition, it should be noted that some effects are estimated with limited statistical power.

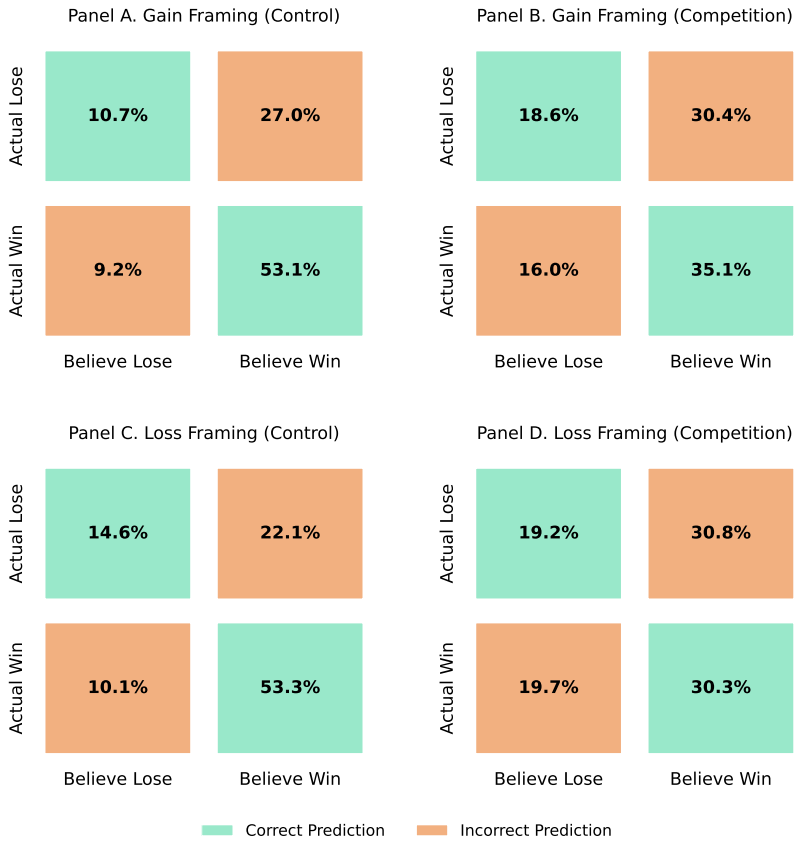
Appendix Table B.15 present the treatment effects of competition on positive and negative emotions under gain and loss framing, respectively. Introducing the "belief in winning" variable shuts down the belief channel and isolates the intrinsic emotional effect of competition on specific emotional components. The change in the competition coefficients after controlling for belief in winning suggests that competition, through the belief channel, lowers expectations of winning, which reduces positive emotions and increases negative emotions. The intrinsic utility channel, however, indicates that competition itself generates positive emotions under both gain and loss framing and mitigates negative emotions under gain framing, but has a weaker mitigating effect under loss framing.

These results reveal a dual mechanism through which competition affects emotional components of utility. Through the belief channel, competition reduces positive emotions and increases negative ones by lowering individuals' expectations of winning. Conversely, through the preference channel, competition does the opposite: it generates positive emotions and reduces negative ones, particularly under gain framing. This distinction highlights the importance of separating the psychological impact of competitive environments from the effects of winning expectations when evaluating the overall emotional consequences of competition.

Expected versus Actual Outcomes. Welfare assessments should account not only for the utility derived from actual outcomes, but also for the utility generated by the act of competing itself. The utility participants derive from the competitive process may differ substantially from the utility they obtain from actual outcomes. Understanding this distinction is crucial for evaluating the overall welfare implications of competition. If people hold biased expectations about competitive outcomes or their emotional responses to these outcomes, their ex-ante willingness to compete may diverge from their ex-post experienced utility. Appendix Figure C.18 illustrates this distinction by comparing anticipated versus actual outcomes: believing one would win vs. actually winning, and believing one would lose vs. actually losing. In the competition group, a correct prediction means participants believed they would beat their opponent and indeed did so; in the control group, it means

they expected their score to exceed the threshold and it did. Incorrect predictions capture the opposite cases. Green cells denote accurate predictions, while orange cells denote inaccurate ones.

Appendix Figure C.18: Anticipated versus Actual Outcomes



Notes: This figure presents confusion matrices of participants' anticipated versus actual outcomes across the four experimental conditions (control vs. competition; gain vs. loss framing). Each cell shows the percentage of participants in that category. Green cells denote correct predictions (believing one would win and actually winning; believing one would lose and actually losing), while orange cells denote incorrect predictions (believing one would win but actually losing; believing one would lose but actually winning).

Overall, participants' predictive accuracy was relatively low, with accuracy rates in the competition groups even lower than in the control groups. As shown in the figure, approximately 65% of participants in the control conditions (both gain and loss framing) predicted correctly, whereas only about 50% of those in the competition conditions did so. This suggests that participants form more accurate expectations when evaluated against a fixed threshold than when competing against an uncertain opponent.

A noteworthy pattern is that around 60% of participants in the competition conditions (gain and loss framing) believed they would win, whereas roughly 80% of participants in the control groups believed they would exceed the threshold. In reality, however, only half

of participants in competition could win by design, and as Appendix Figure B.12 shows, nearly 40% of control participants failed to reach the threshold. These findings point to a general tendency toward overconfidence, consistent with prior literature (Niederle and Vesterlund, 2007; Deaves et al., 2010; Bhatt and Smith, 2025). Interestingly, competition appears to attenuate this bias: although participants remained overly optimistic, the gap between expected and actual outcomes was smaller under competition than under non-competition. This attenuation likely reflects the additional perceived uncertainty introduced by competing against an opponent rather than facing a fixed benchmark.

Heterogeneity in Winning Expectations. Participants with lower perceived ability experience greater enjoyment from competition than those who consider themselves higher ranked. As discussed in Section 5.2, competition influence utility through a belief channel by shaping individuals' expectations of winning. A natural question, therefore, is whether the observed heterogeneity across ability groups arises because competition differentially affects their winning expectations. Appendix Figure B.14 suggests this is not the case.

Panel A of Appendix Figure B.14 shows that competition significantly reduces winning expectations for both high- and low-ability participants ($p < 0.001$ for both groups, pooled sample), and the difference between them is not statistically significant ($p = 0.166$, pooled sample). This suggests that the heterogeneity in utility is more likely to come through the intrinsic utility channel, whereby individuals with lower perceived relative ability derive greater enjoyment from competition than their higher-ranked counterparts. This inference is confirmed by the intrinsic-channel heterogeneity evidence presented later in this subsection. Panel B provides a more detailed view of the relationship between perceived rank and winning expectations across competition and control groups. Consistent with Panel A, participants in the competition condition hold systematically lower beliefs in winning, regardless of whether they view themselves as high or low ability.[41]

Appendix Figure B.13 explores heterogeneity in the effect of competition on winning expectations across demographic subgroups. By age, competition substantially lowers winning expectations among younger participants aged 18–39 ($p < 0.001$, pooled sample)[42] and among older participants aged 60–80 ($p = 0.014$), while the effect for those aged 40–59 is smaller and statistically insignificant ($p = 0.106$). By gender, both women ($p = 0.018$) and men ($p < 0.001$) show declines in winning expectations, with no statistically significant difference between the two groups ($p = 0.284$). In terms of education,

[41] Panel B plots predicted probabilities of winning as a function of perceived rank for the pooled sample, based on estimates from a logit model, since belief in winning is a binary variable.

[42] All p-values reported in this paragraph are for the pooled sample.

the reduction is strongest among participants with a high school degree or less ($p < 0.001$) and among those with graduate training ($p = 0.008$), whereas the effect is smaller and only marginally significant among those with a bachelor's degree ($p = 0.075$). Finally, the income gradient is clear: participants in the lower income groups, earning below $35,000 ($p < 0.001$) or between $35,000 and $75,000 ($p = 0.007$) , exhibit pronounced declines in winning expectations. In contrast, the effect is weaker and statistically insignificant among participants with higher incomes ($75,000–$150,000: $p = 0.100$; above $150,000: $p = 0.245$).

Heterogeneity in Intrinsic Enjoyment. The preceding results indicate that heterogeneity in enjoyment across ability groups cannot be explained by differences in winning expectations (belief channel), pointing instead to the intrinsic utility channel as the underlying source. Appendix Table B.16 provides direct evidence supporting this interpretation. The regression specifications include winning beliefs as controls, effectively shutting down the belief channel and allowing the competition coefficient to be cleanly interpreted as capturing intrinsic enjoyment. The interaction terms are statistically significant, confirming that individuals who perceive themselves as lower ability derive greater intrinsic enjoyment from competition than those who view themselves as higher ability. This pattern holds in the pooled sample and under gain framing. Under loss framing, the interaction coefficient is not statistically significant, though its magnitude points in the same direction.

Appendix Table B.17 explores the heterogeneity in intrinsic enjoyment across demographic groups using the pooled sample. Results for the gain and loss framing samples are presented in Appendix Tables B.18 and B.19, which show broadly similar patterns. Among age groups, younger participants (under 40) experience positive enjoyment from competition, with no significant differences relative to those aged 40–59 or 60 and above. For gender, both men and women derive intrinsic enjoyment from competition, and the difference between them is not statistically significant. By education, individuals with a high school degree or less obtain substantial enjoyment, while those with a bachelor's or graduate degree experience lower levels. The reduction relative to bachelor's degree holders is not statistically significant, but the lower enjoyment among graduate degree holders is significant. In terms of income, participants with incomes below $35,000 experience strong and significant enjoyment from competition, while higher-income groups gain somewhat lower enjoyment, though the differences are not statistically significant.

Heterogeneity in Altruism. Appendix Figure B.15 illustrates the heterogeneous effects of competition on altruism by participants' beliefs about winning and by their perceived ability. Panel A of Appendix Figure B.15 indicates that participants who believed they would win, or who rated their ability above the median, offered significantly more amounts in the competition condition than in the control group. In contrast, participants who expected to lose or who rated their ability below the median showed no significant differences. One interpretation for this pattern is that enjoyable competing experience motivates more altruistic behavior when individuals expect monetary payoff. Detailed regression results are shown in the Appendix Table B.10 and B.11. Panel B of Appendix Figure B.15 provides a more detailed view of altruism in the control and competition groups across the distribution of perceived ability. The same pattern emerges: among participants who rated their ability above the median, those in the competition group gave substantially more than those in the control group. The results are similar under both gain- and loss-framing, as shown in Appendix Figure B.16. By contrast, little heterogeneity is observed across age, gender, education, or income (Appendix Figure B.9).

D Experimental Materials

D.1 Recruitment

Participants were recruited via the Prolific platform for a study titled 'A short quiz and a set of survey questions (15–25 minutes).' The study description varied slightly depending on the contextual framing. Participants were randomly assigned to one of four experimental groups.

GAIN FRAMING: COMPETITION AND CONTROL GROUPS

In this study, you will complete a short quiz followed by a set of survey questions. The base payment for participating in the study is $2.00. You can earn a bonus of up to $4.00 in the first section, and additional bonuses in later sections, depending on your performance and decisions. The entire study will take approximately 15-25 minutes.

LOSS FRAMING: COMPETITION AND CONTROL GROUPS

In this study, you will complete a short quiz followed by a set of survey questions. The base payment for participating in the study is $6.00. You may lose up to $4.00 of this amount in the first section. Bonuses are available in later sections. Your final payment will depend on your performance and decisions. The entire study will take approximately 15-25 minutes.

To qualify for the study, participants had to be at least 18 years old, reside in the United States, have a task approval rate above 95%, and have completed at least 100 tasks on Prolific. Each participant could only take part in one experimental group.

D.2 Welcome and Consent

Welcome! Thank you for participating in our study! We are academic researchers from Boston University. This study will take approximately 15–25 minutes to complete. Your participation contributes to valuable academic research. After completing the study, you will receive a completion code for payment.

Important Guidelines. (1) Engagement: Your careful attention is essential for the success of this research. Please read all instructions carefully, engage thoroughly in the tasks, and

answer questions truthfully. The study includes multiple checks to ensure participants are engaging properly. Responses that show signs of inattention may be flagged as low quality and excluded from our analysis. (2) Commitment: We kindly ask that you complete the entire study once you begin, as some sections involve interactions with other participants. Your participation is entirely voluntary, and you may withdraw at any point without penalty. However, please note that if you leave the study before finishing, your session will end, and you may not be able to resume later. (3) Anonymity: This study is completely anonymous. Your Prolific ID will be used only to process your payment. No one will know your decisions or performance, and you will never be personally identified.

GAIN FRAMING: COMPETITION AND CONTROL GROUPS

Compensation. The base payment for participating in the study is $2.00. You can earn a bonus of up to $4.00 in the first section, and additional bonuses in later sections, depending on your performance and decisions.

LOSS FRAMING: COMPETITION AND CONTROL GROUPS

Compensation. The base payment for participating in the study is $6.00. You may lose up to $4.00 of this amount in the first section. Bonuses are available in later sections. Your final payment will depend on your performance and decisions.

Contact. If you have any questions, you may contact us at jiaruiw@bu.edu. After the welcome page, participants are presented with an informed consent form. To proceed, they must agree to the following statement by checking a box: "I consent to participate in this study. By checking this box, I confirm that I have read and understood the information provided about the purpose, risks, and benefits of this study. I understand that my participation is voluntary and I agree to the use of my data as described in the study information." Once consent is given, participants are asked to enter their Prolific ID and complete a reCAPTCHA verification to confirm they are not automated bots. They can then begin the study.

D.3 Instructions

A. Gain Framing

This study consists of Competition and Survey Sections. You will receive a base payment of $2.00 for participating. You can earn a bonus of up to $4 in the Competition Section (or Quiz Section for the control group), and additional bonuses in the Survey Section. The exact amount will depend on your performance and decisions. The entire study will take approximately 15 to 25 minutes to complete.

GAIN FRAMING: COMPETITION GROUP

Competition section. You will be randomly paired with another participant for an IQ Quiz Competition (Intelligence Quotient Quiz Competition). Only one of you will earn a $4 reward. The participant with the higher score will be the top performer and receive the $4. The one with the lower score will be the bottom performer and receive $0. If both participants have the same score, one will be randomly selected to receive the $4 reward. In the IQ Quiz Competition, you will earn 1 point for each correct answer, lose 0.25 points for each incorrect answer, and neither earn nor lose any points for skipped questions. Once you submit an answer or skip a question, you cannot go back to it. The quiz consists of fifty questions, and you will have 4 minutes to answer as many as possible. Throughout the competition, you will see your opponent's raw score in real time, which shows only the number of questions they have answered correctly (without any deductions for wrong answers). You will not see your own score during the competition. Your final score and competition results will be revealed at the end of the study. Before the competition begins, you will have the opportunity to answer a practice question to get familiar with the quiz format.

GAIN FRAMING: CONTROL GROUP

Quiz section. You will take an IQ Quiz (Intelligence Quotient Quiz). If you score 6 points or higher, you will receive a $4 reward. In a previous session of the experiment, about half of the participants scored 6 points or higher. If you score below 6 points, you will receive $0. In the IQ Quiz, you will earn 1 point for each correct answer, lose 0.25 points for each incorrect answer, and neither earn nor lose any points for skipped questions. Once you submit an answer or skip a question, you cannot go back to it. The quiz consists of fifty questions, and you will have 4 minutes to answer as many as possible. At the end of the study, you will see your score and the quiz results. Before the quiz begins, you will have the opportunity to answer a practice question to get familiar with the format.

Survey section. You will answer six survey questions and complete a decision-making task, followed by a few final survey questions. Some questions offer bonuses and will be clearly marked.

Comprehension question. Before we proceed, let's ensure you understand the instructions clearly. Please answer the following question correctly to continue.

GAIN FRAMING: COMPETITION GROUP

In the 4-minute IQ Quiz competition, Emily answers 20 questions (14 correct, 6 incorrect) while Lucy answers 12 questions (8 correct, 4 incorrect). Who receives the $4 reward? A. Lucy B. Emily C. It's a tie. One of them will be randomly selected to receive the reward.

GAIN FRAMING: CONTROL GROUP

In the 4-minute IQ Quiz, Lucy answers 18 questions (14 correct, 4 incorrect). Does she receive the $4 reward? A. No B. Yes C. Not enough information.

B. Loss Framing

This study consists of Competition and Survey Sections. You will receive a base payment of $6.00 for participating. You may lose up to $4 of this amount in the Competition Section (or Quiz Section for the control group). Bonuses are available in the Survey Section. Your final payment will depend on your performance and decisions. The entire study will take

approximately 15 to 25 minutes to complete.

LOSS FRAMING: CONTROL GROUP

Quiz section. You will take an IQ Quiz (Intelligence Quotient Quiz). If you score 6 points or higher, you will keep the initial payment of $6. In a previous session of the experiment, about half of the participants scored 6 points or higher. If you score below 6 points, you will lose $4 from the initial payment. In the IQ Quiz, you will earn 1 point for each correct answer, lose 0.25 points for each incorrect answer, and neither earn nor lose any points for skipped questions. Once you submit an answer or skip a question, you cannot go back to it. The quiz consists of fifty questions, and you will have 4 minutes to answer as many as possible. At the end of the study, you will see your score and the quiz results. Before the quiz begins, you will have the opportunity to answer a practice question to get familiar with the format.

LOSS FRAMING: COMPETITION GROUP

Competition section. You will be randomly paired with another participant for an IQ Quiz Competition (Intelligence Quotient Quiz Competition). Only one of you will keep the initial payment of $6. The participant with the higher score will be the top performer and keep the $6. The one with the lower score will be the bottom performer and lose $4 from their initial payment. If both participants have the same score, one will be randomly selected to lose $4. In the IQ Quiz Competition, you will earn 1 point for each correct answer, lose 0.25 points for each incorrect answer, and neither earn nor lose any points for skipped questions. Once you submit an answer or skip a question, you cannot go back to it. The quiz consists of fifty questions, and you will have 4 minutes to answer as many as possible. Throughout the competition, you will see your opponent's raw score in real time, which shows only the number of questions they have answered correctly (without any deductions for wrong answers). You will not see your own score during the competition. Your final score and competition results will be revealed at the end of the study. Before the competition begins, you will have the opportunity to answer a practice question to get familiar with the quiz format.

Survey section. You will answer six survey questions and complete a decision-making task, followed by a few final survey questions. Some questions offer bonuses and will be clearly marked.

Comprehension question. Before we proceed, let's ensure you understand the instructions clearly. Please answer the following question correctly to continue.

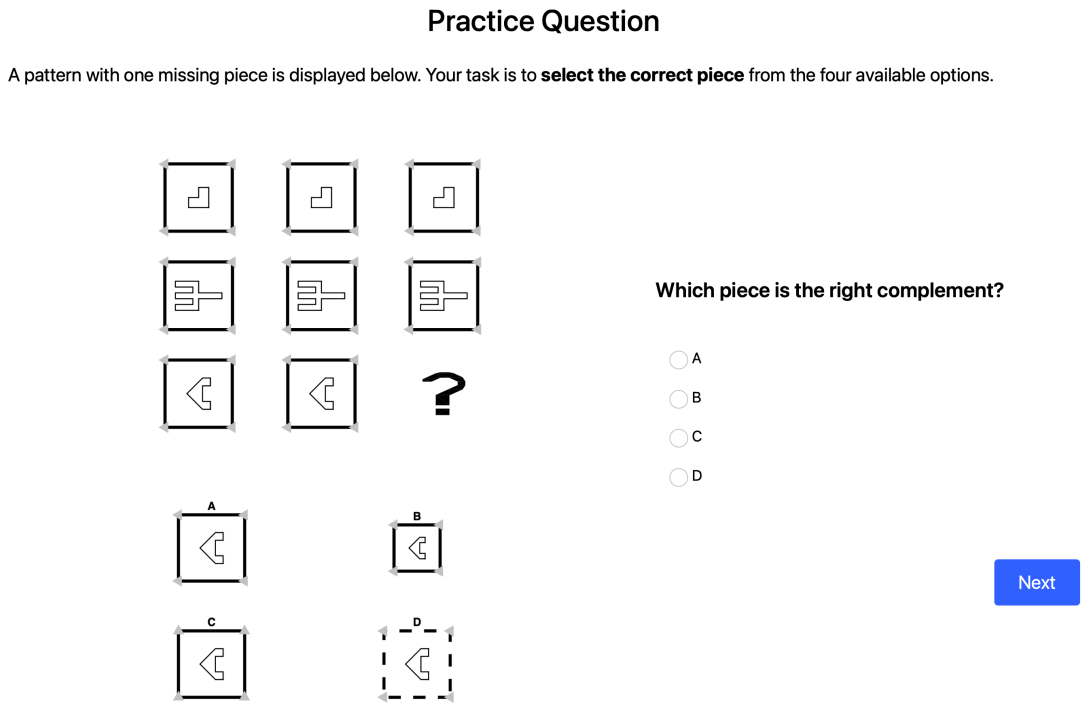
Loss Framing: Control Group

In the 4-minute IQ Quiz, Emily answers 10 questions (6 correct, 4 incorrect). Does she lose $4 from the initial payment of $6? A. No B. Yes C. Not enough information.

Loss Framing: Competition Group

In the 4-minute IQ Quiz competition, Lucy answers 20 questions (14 correct, 6 incorrect) while Emily answers 12 questions (8 correct, 4 incorrect). Who loses $4 from the initial payment of $6? A. Lucy B. Emily C. It's a tie. One of them will be randomly selected to lose $4.

D.4 Practice Question



Appendix Figure D.1: Practice Question Interface

D.5 IQ Quiz

A. A Few Reminders

Before the IQ quiz begins, participants are presented with a reminder page that lists the following points: (1) This study is completely anonymous. Neither the organizers nor other participants will know your identity, and no one will know your performance or decisions. (2) To ensure high-quality research, please take the quiz in a quiet environment without distractions. Turn off notifications or other potential interruptions before starting.

GAIN FRAMING: COMPETITION GROUP

During the competition, you will see your opponent's real-time raw score (number of correct answers) and a 4-minute timer. You will not see your own score. Competition results will be revealed at the end of the study. Only the top performer receives the $4 reward, while the bottom performer receives nothing. Once you submit an answer or skip a question, you cannot go back to it. When you are ready, click 'Next' to begin matching and start the competition.

GAIN FRAMING: CONTROL GROUP

During the quiz, you will see a 4-minute timer. Quiz results will be revealed at the end of the study. If you score 6 points or higher, you will receive a $4 reward. If not, you will receive nothing. Once you submit an answer or skip a question, you cannot go back to it. When you are ready, click 'Next' to start the quiz.

LOSS FRAMING: COMPETITION GROUP

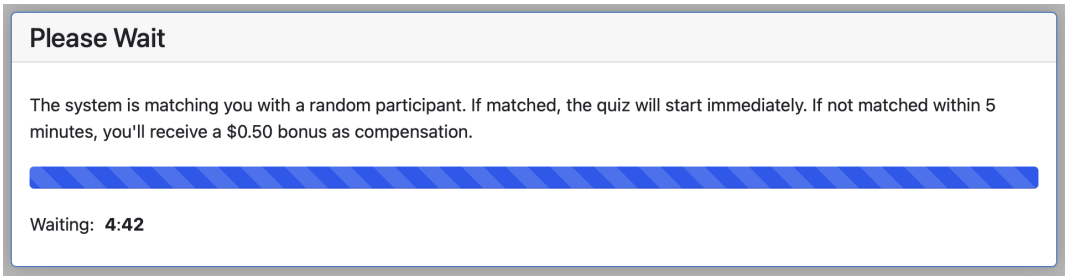
During the competition, you will see your opponent's real-time raw score (number of correct answers) and a 4-minute timer. You will not see your own score. Competition results will be revealed at the end of the study. Only the top performer keeps the full initial payment of $6, while the bottom performer loses $4. Once you submit an answer or skip a question, you cannot go back to it. When you are ready, click 'Next' to begin matching and start the competition.

LOSS FRAMING: CONTROL GROUP

During the quiz, you will see a 4-minute timer. Quiz results will be revealed at the end of the study. If you score 6 points or higher, you will keep the full initial payment of $6. If not, you will lose $4. Once you submit an answer or skip a question, you cannot go back to it. When you are ready, click 'Next' to start the quiz.

B. Matching

Following the reminder page, participants in the competition groups proceed to the matching page, where they wait to be paired in real time with another online participant.

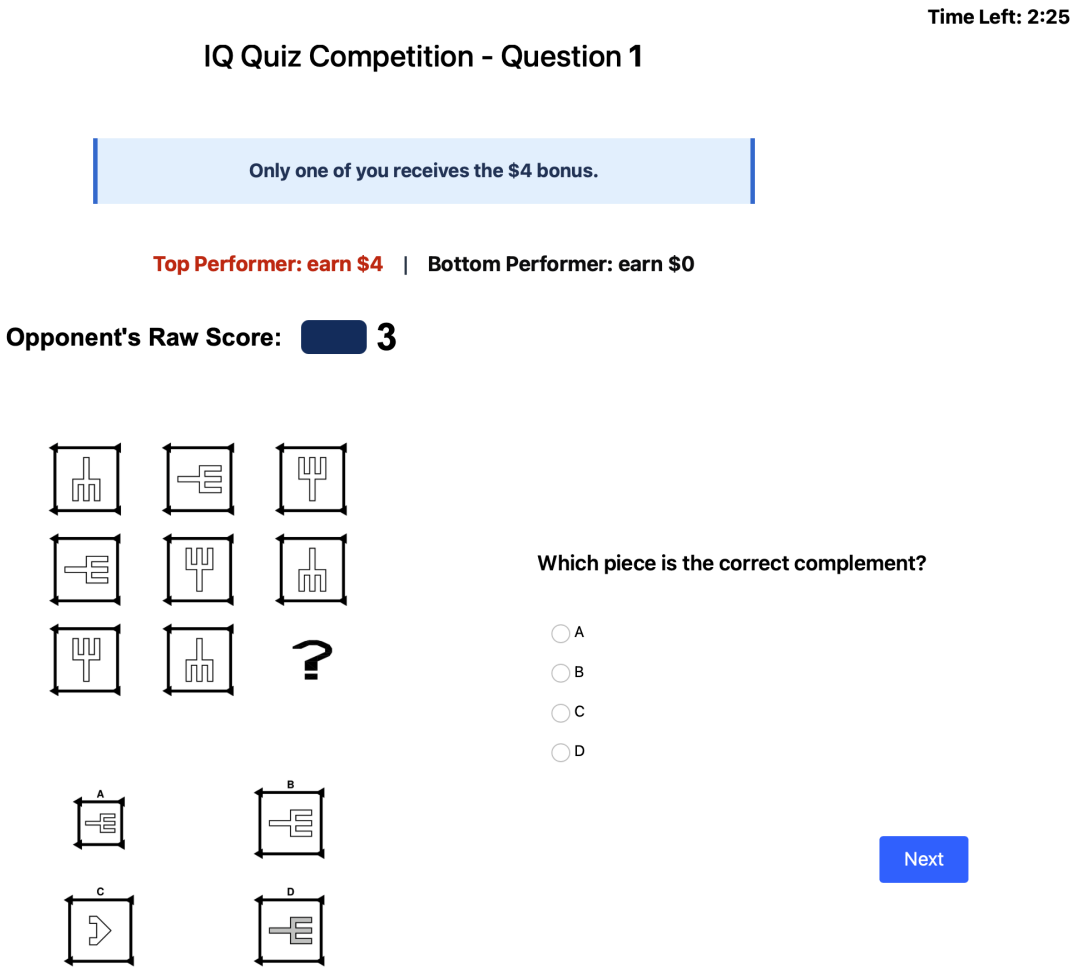


Appendix Figure D.2: Matching Page Interface

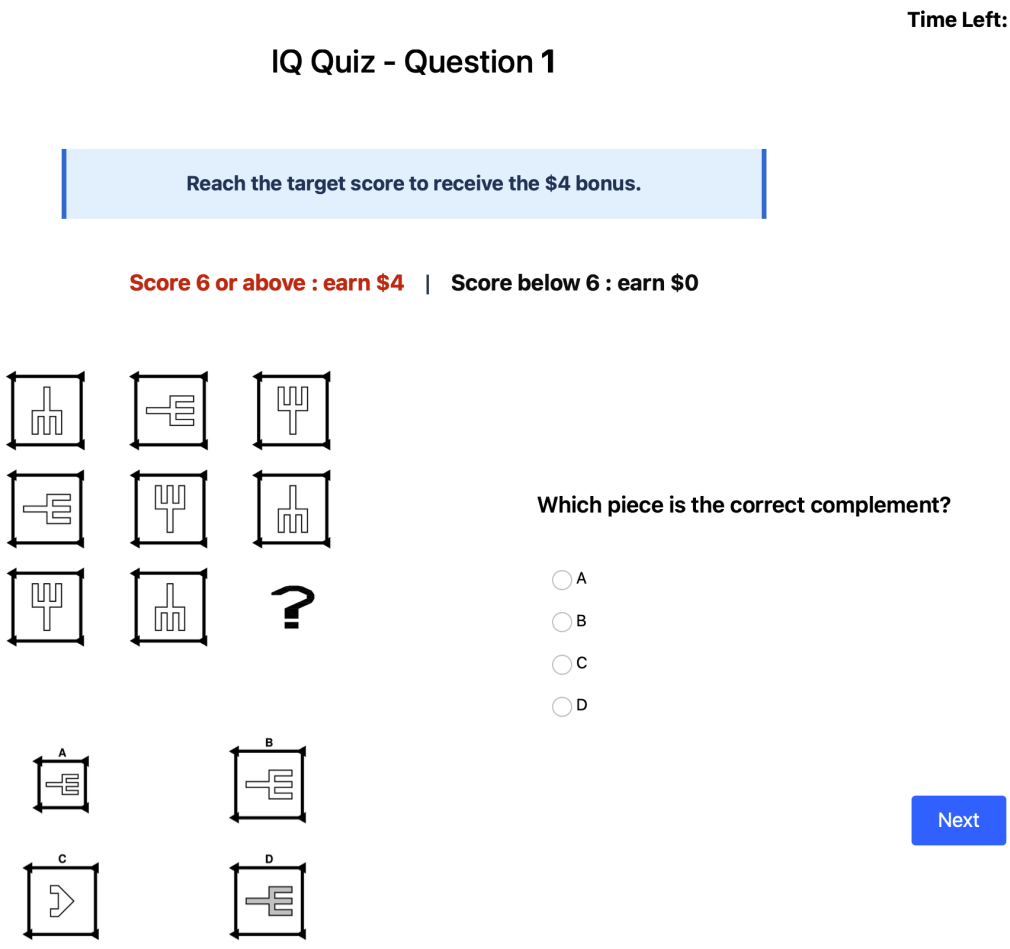
C. IQ Quiz Question

Below are screenshots of IQ quiz questions from each of the four experimental groups: Gain Framing–Competition, Gain Framing–Control, Loss Framing–Competition, and Loss Framing–Control.

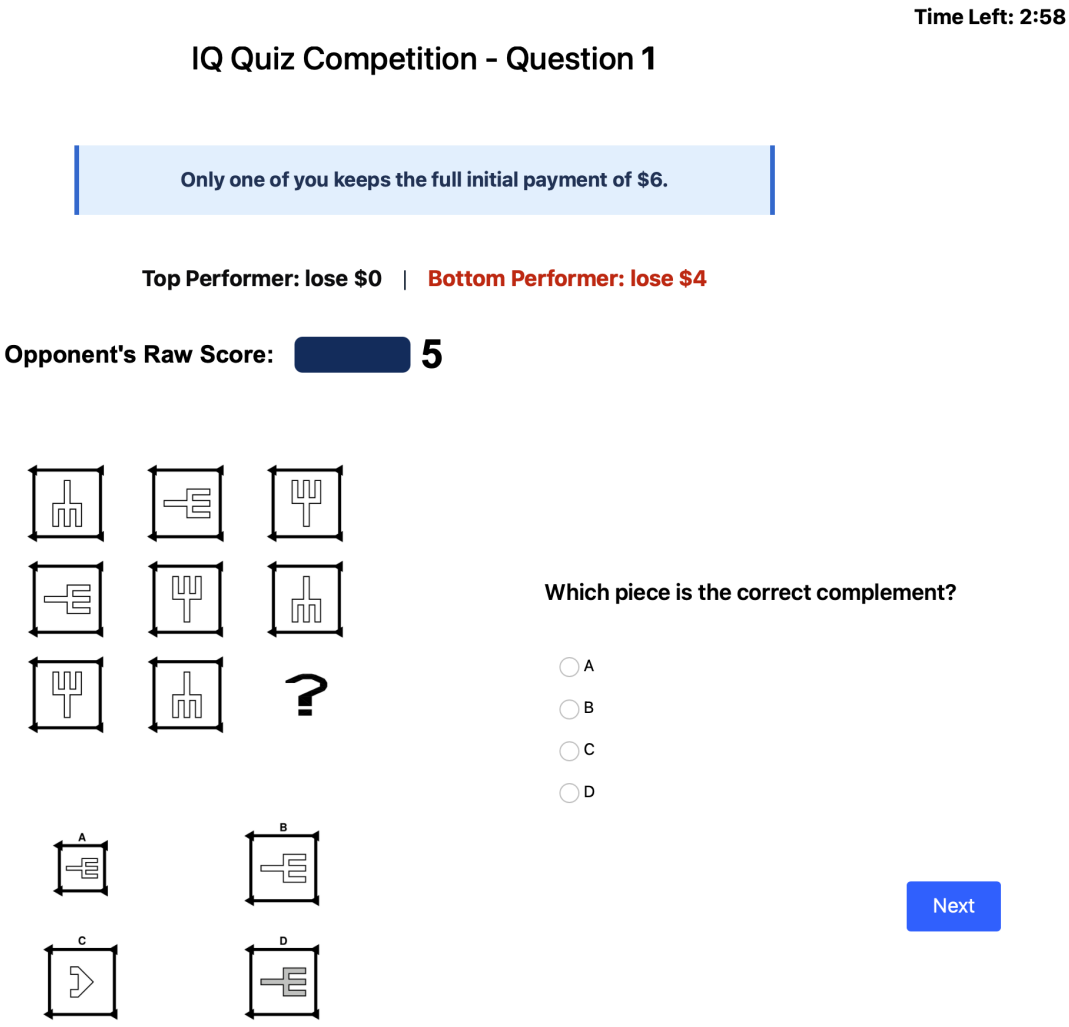
Appendix Figure D.3: Sample IQ Quiz Question – Gain Framing (Competition Group)



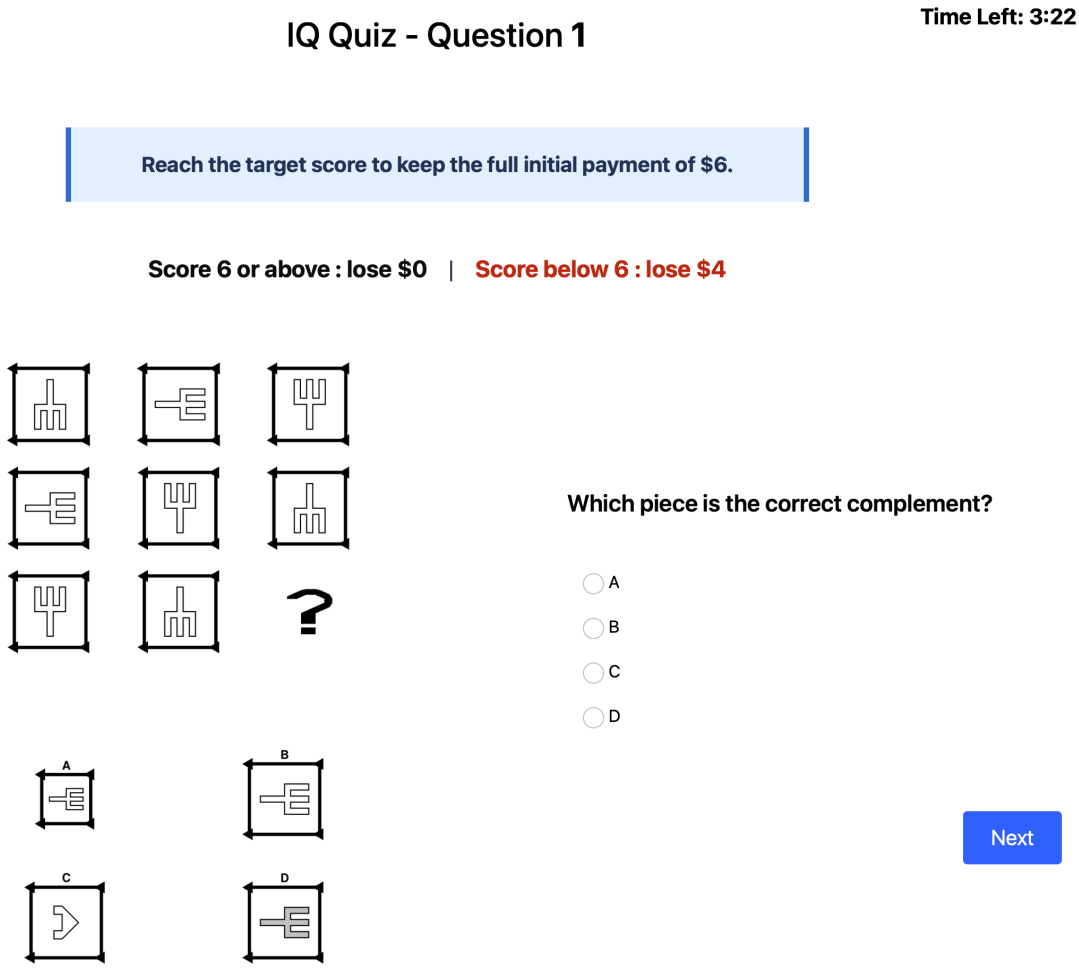
Appendix Figure D.4: Sample IQ Quiz Question – Gain Framing (Control Group)



Appendix Figure D.5: Sample IQ Quiz Question – Loss Framing (Competition Group)



Appendix Figure D.6: Sample IQ Quiz Question – Loss Framing (Control Group)



D.6 Main Survey

GAIN FRAMING: COMPETITION GROUP

Survey Introduction. The IQ Quiz Competition is complete. You will see the results at the end of the study. As a reminder, only the top performer will receive a $4 bonus, while the bottom performer will receive nothing.

GAIN FRAMING: CONTROL GROUP

Survey Introduction. The IQ Quiz is complete. You will see the results at the end of the study. As a reminder, if you score 6 points or higher, you will earn a $4 bonus. Otherwise, you will receive nothing.

LOSS FRAMING: COMPETITION GROUP

Survey Introduction. The IQ Quiz Competition is complete. You will see the results at the end of the study. As a reminder, only the top performer will keep the full initial payment of $6, while the bottom performer will lose $4.

LOSS FRAMING: CONTROL GROUP

Survey Introduction. The IQ Quiz is complete. You will see the results at the end of the study. As a reminder, if you score 6 points or higher, you will keep the full initial payment of $6. Otherwise, you will lose $4.

Next, you will answer six survey questions and complete a decision-making task, followed by a few final survey questions. You can earn a bonus of up to $1.30 in this section, depending on your performance and decisions. Bonus-eligible questions will be clearly marked.

Please note that your responses will remain anonymous. Your honest responses are greatly appreciated. To ensure high-quality research, attention checks are included throughout the survey. Responses indicating inattention may be excluded from the analysis.

A. Utility

Question1. On a scale from 1 (not at all enjoyable) to 7 (extremely enjoyable), how enjoyable was the IQ Quiz Competition (or *IQ Quiz* for the control group)? [Options: 1 (not at all enjoyable), 2, 3, 4, 5, 6, 7 (extremely enjoyable)]

Question2. Thinking back to how you felt during the IQ Quiz Competition (or *IQ Quiz* for the control group), please indicate to what extent you were experiencing the following, on a scale from 1 (not at all) to 7 (extremely) [Stress, Excitement, Satisfaction, Embarrassment, Anxiety. Options: 1 (not at all), 2, 3, 4, 5, 6, 7 (extremely)]

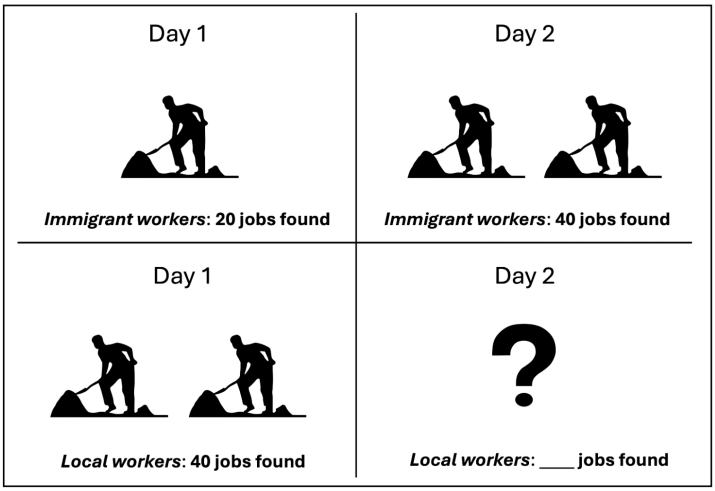
B. Task Preference

Question1. On a scale from 1 (not at all likely) to 7 (extremely likely), how likely would you be to voluntarily take another 10 IQ questions, similar to the ones you just saw in the IQ quiz, with no monetary rewards? [Options: 1 (not at all likely), 2, 3, 4, 5, 6, 7 (extremely likely)]

Question2. Imagine you have another IQ quiz in front of you right now, similar to the one you just completed, but with a different set of fifty questions. You again have 4 minutes to answer as many as possible. If you get at least 6 questions correct within the 4 minutes, you will receive a payment. Below is a list of payment amounts. For each amount, please indicate 'Yes' if you would be willing to take the quiz for that payment, or 'No' if you would not. [$0.20, $0.40, $0.60, $0.80, $1.00, $1.20, $1.40, $1.60, $1.80, $2.00, $2.50, $3.00, $5.00. Options: Yes, I would take; No, I would not take.]

C. Zero-sum Thinking

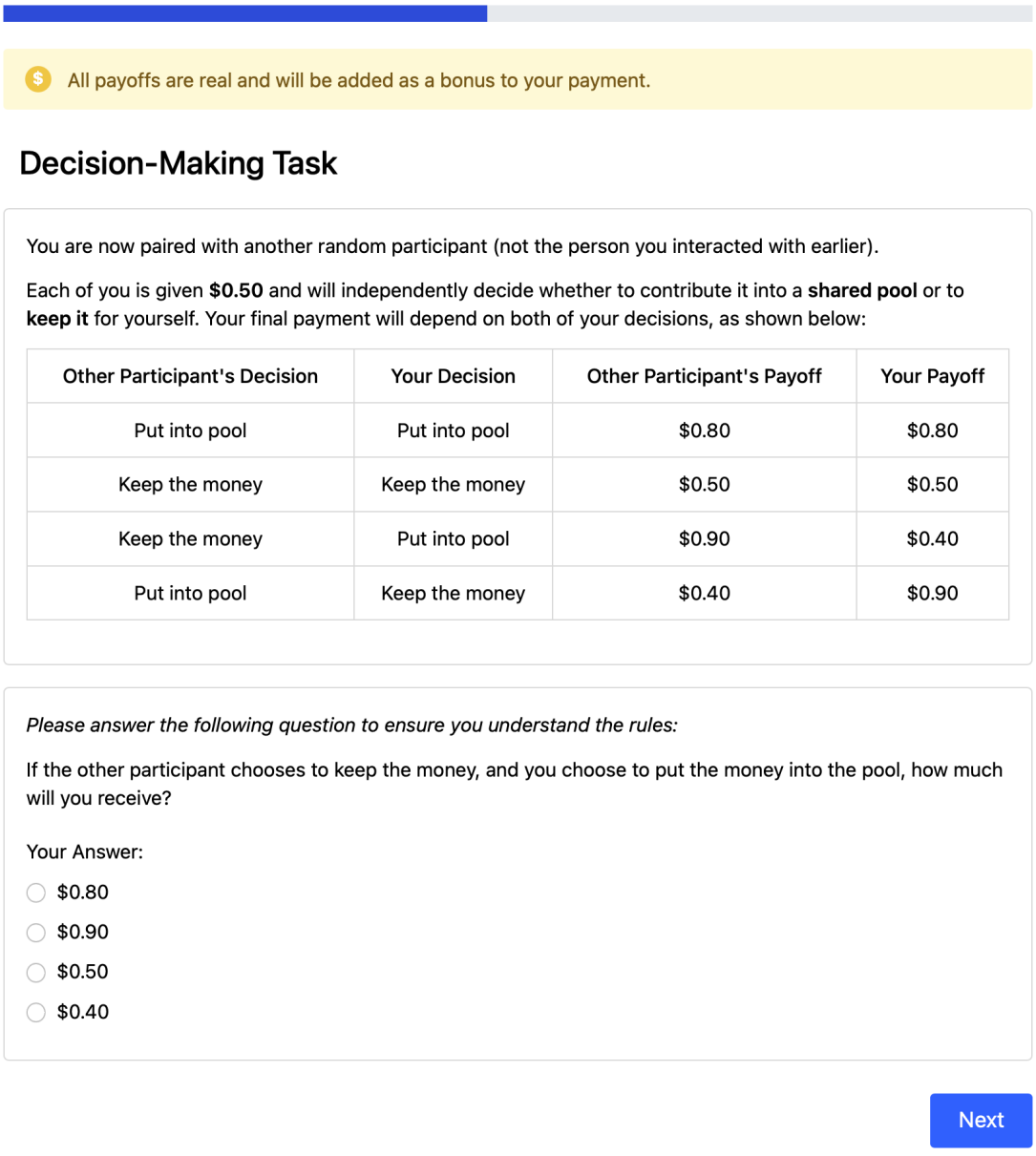
Question1. Consider a local job market where both immigrants and locals work as day laborers. On Day 1, immigrant workers found 20 jobs, while local workers found 40 jobs. On Day 2, immigrant workers found 40 jobs. Which of the following estimates is more likely to be accurate regarding the number of jobs local workers found on Day 2? [Options: 20 jobs, 80 jobs]



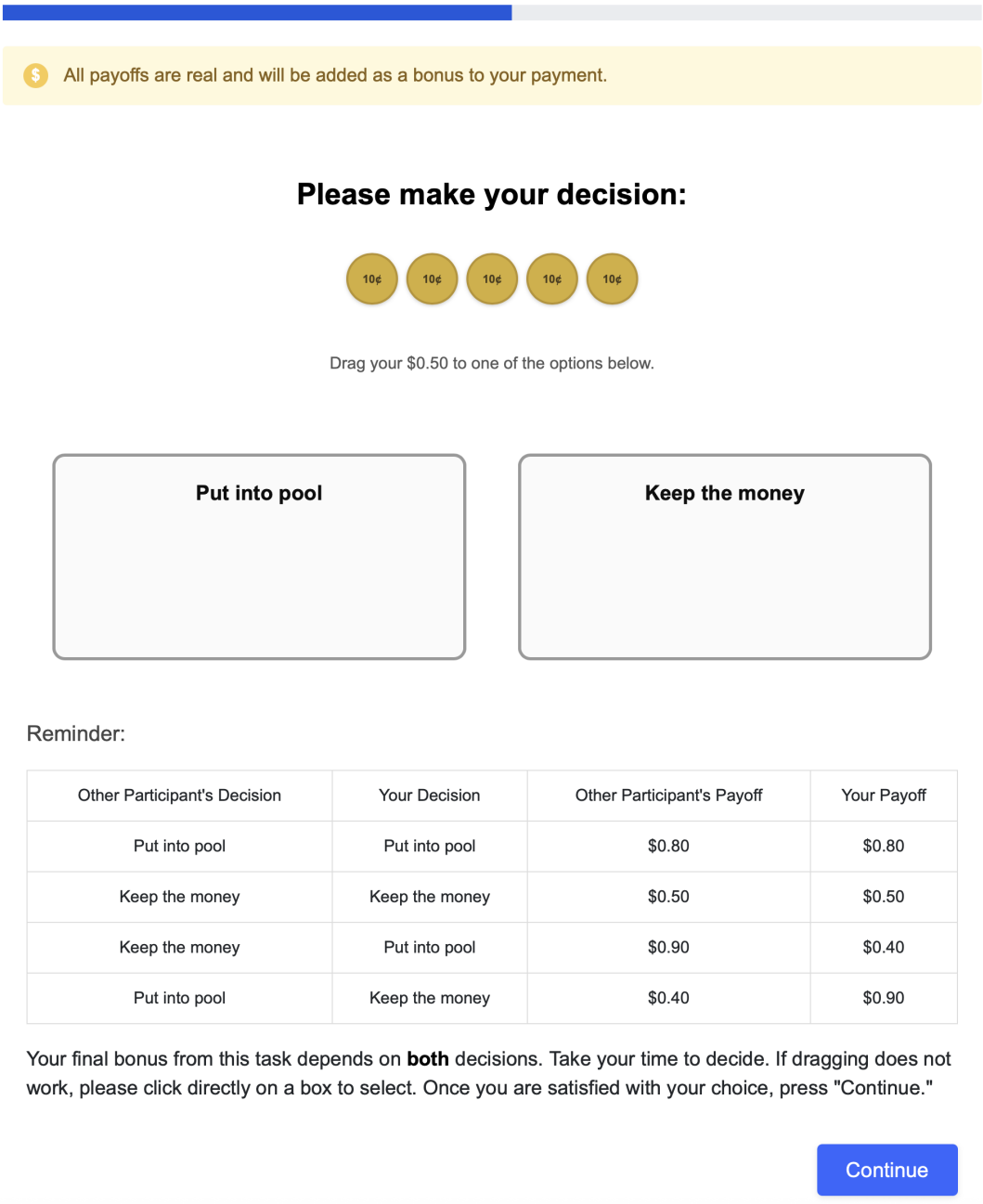
Question2. Below are two statements. Where do your views fall on a scale from 1 to 10? 1 means you agree completely with the statement 1; 10 means you agree completely with the statement 2. *Statement 1*: People can only become wealthy at the expense of others. *Statement 2*: Wealth can grow so there's enough for everyone. If your views fall somewhere in between, you can choose any number in between. [Options: 1 (statement1), 2, 3, 4, 5, 6, 7, 8, 9, 10 (statement2)]

D. Public Goods Game

Appendix Figure D.7: Public Goods Game Instructions



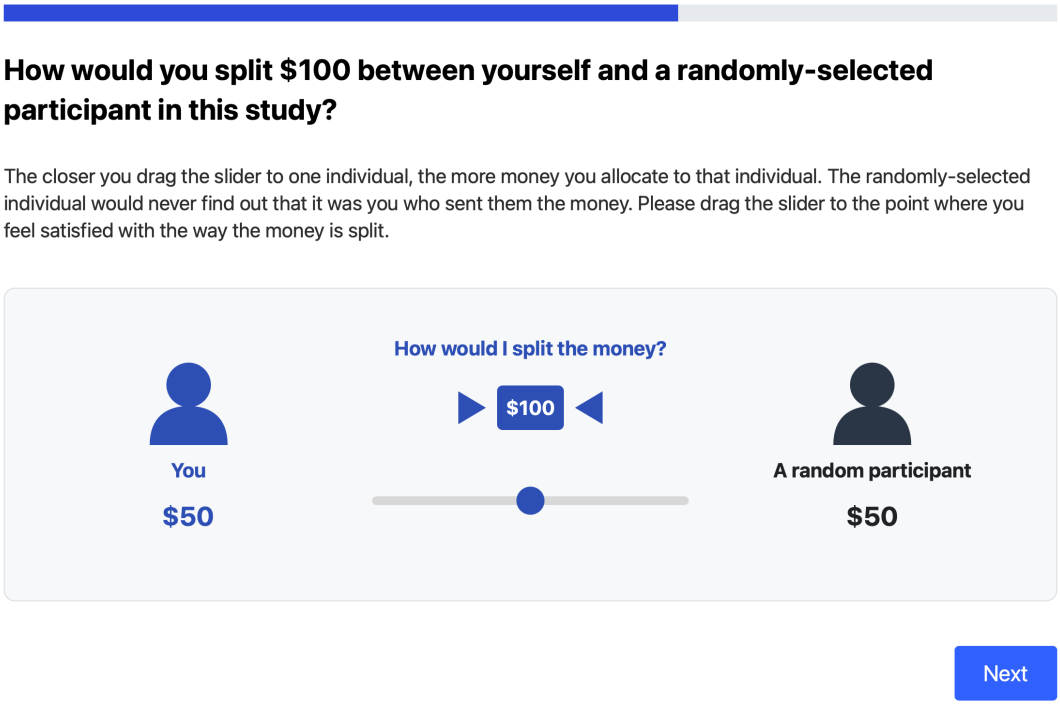
Appendix Figure D.8: Public Goods Game-Decision Page



Question. Approximately 800 participants are taking part in this study today. What percentage of them do you think choose to keep the money? If your answer is correct, you will receive a $0.20 bonus. [Options: 0–10%, 11–20%, 21–30%, 31–40%, 41–50%, 51–60%, 61–70%, 71–80%, 81–90%, 91–100%.]

E. Dictator Game

Appendix Figure D.9: Interface of the Dictator Game



F. Attention Check

Question. This is not a question that needs to be answered. Instead, the goal of this question is to check whether you are reading all instructions carefully. To indicate this, please click the next button without selecting any of the options below. You must click next without making any selections in order to have your response approved. [Options: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

D.7 Supplemental Survey

A. Belief in Winning

COMPETITION GROUPS
Do you think you were the top performer in the IQ Quiz Competition? [Options: Yes, No.]

CONTROL GROUPS
Do you think you scored 6 or higher on the IQ Quiz? [Options: Yes, No.]

B. Perceived Percentile Rank

Question. Based on your experience in the IQ Quiz, how well do you think you performed compared to all other participants in this study, on a scale from 0 to 10? The lowest value (0) indicates that you believe you performed worse than almost everyone else, and the highest value (10) indicates that you believe you performed better than nearly all other participants. For example, if you think you performed better than approximately 70% of all other participants, you should select 7. Please make your choice. [Options: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

C. Competition Preferences

Question1. On a scale from 1 (not at all like me) to 7 (exactly like me), please indicate the extent to which the following statement describes you: "Competition brings the best out of me." [Options: 1 (not at all like me), 2, 3, 4, 5, 6, 7 (exactly like me)]

Question2. On a scale from 1 (not at all like me) to 7 (exactly like me), please indicate the extent to which the following statement describes you: "I enjoy competing against others." [Options: 1 (not at all like me), 2, 3, 4, 5, 6, 7 (exactly like me)]

D. Understanding of Instructions

Question. Did you understand the instructions throughout the study? [Options: I fully understood them, I understood them almost fully, I only partly understood them, I did not understand them]

E. Demographics

Question1. Which year were you born? [Options: 1920 to 2010]
Question2. What's your gender? [Options: Male, Female, Other]
Question3. How would you describe your race or ethnicity? [Options: White, African-American, Hispanic, American Indian or Alaska Native, Asian, Other]
Question4. How would you describe your educational attainment? [Options: No high school graduation, High school graduate, Bachelor's degree, Graduate or professional degree]
Question5. What's your approximate annual household income before taxes? [Options: Below $10,000, $10,000–$14,999, $15,000–$24,999, $25,000–$34,999, $35,000–$49,999, $50,000–$74,999, $75,000–$99,999, $100,000–$149,999, $150,000–$199,999, $200,000 or more]
Question6. Are you employed full-time? [Options: Yes, No]
Question7. On economic policy matters, where do you see yourself on the left–right spectrum? [Options: Extreme Left, Leaning Left, Center, Leaning Right, Extreme Right]

F. Comments

Thank you for participating in our study! We would appreciate any comments or feedback about your experience. If any part of the instructions was unclear or if you ran into any issues during the study, please let us know. Your valuable feedback will help us improve our research." After this page, participants are shown their IQ Quiz results and informed whether they were the top performer in the competition (or scored 6 or higher).