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

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Abstract

Economists often view competition as a positive force that incentivizes effort and improves efficiency. Yet a full accounting of the welfare effects of competition requires consideration of the direct utility costs and benefits of competition itself. This paper investigates how competition affects utility derived purely from the act of competing, independent of realized outcomes. I conduct a series of experiments which show that competition shapes utility through two opposing channels: a belief channel, whereby competition lowers expectations of success and reduces utility; and an intrinsic-utility channel, whereby individuals derive enjoyment directly from competing. The overall effect depends on the relative strength of these channels. I also show that these utility effects can impact future choices: attribution bias in competitive settings, as it leads individuals to misattribute the enjoyment of competition to the underlying task and become more willing to engage in the task again. This influence also extends 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 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 dimension of welfare: the direct utility consequences of how people experience competition. Buyers may feel excitement when bidding for a desired good, while job seekers experience anxiety when competing in the labor market. Such experienced utility[1] arising directly from the act of competing can potentially 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 purely from the act of competing, independent of realized outcomes. I ask whether this impact is context dependent, specifically when competition generates positive utility and when it yields disutility. I further explore the implications of these direct welfare effects: I conjecture that they may shape individuals' beliefs about the enjoyment of certain tasks and influence their attitudes toward social and strategic interaction.

To address these questions, I conduct a series of pre-registered randomized controlled experiments on Prolific[2] with two treatment dimentions: (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-framing 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, in most cases the lowest-ranked participant earns no reward (Harbring and Irlenbusch, 2011; Cason et al., 2020). I introduce a loss-framing design in which competition imposes explicit losses on the losers. This design captures a salient feature of many real-world competitive environments, where losing a competition entails outcomes worse than the status quo rather than merely the absence of gains. For example, in the workplace, "winning" may mean keeping one's job, while losing means being laid off, a situation that is worse than the status quo. I hypothesize that competition has a positive impact

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

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

on utility under gain framing but a negative impact under loss framing, as individuals are more sensitive to potential losses than to equivalent gains (Tversky and Kahneman, 1979). Taken together, this design creates four experimental treatments: gain-framing competition, gain-framing control, loss-framing competition, and loss-framing control.

To implement the treatments, participants recruited from Prolific were randomly assigned to one of four experimental conditions and asked to complete a timed quiz. The quiz consists of 50 puzzles similar to the Raven Progressive Matrices, a widely used measure of cognitive ability (Drobner and Goerg, 2024; Willadsen et al., 2024). Participants have four minutes to complete the quiz. Each correct answer earns 1 point, each incorrect answer deducts 0.25 points, and skipped questions receive zero points.[3]

In the competition treatments, participants were randomly paired online in *real time* to compete for a monetary prize. Under the gain frame, each participant receives a $2 show-up fee. The participant with the higher score on the quiz earns a $4 reward, while the other receives nothing. Under loss frame, each participant receives a $6 show-up fee. The participant with the higher score keeps the full $6, while the other loses $4 of it. During the competition, participants can observe their opponent's real-time raw score, which shows the accumulated number of correct answers without deductions for incorrect ones. This design feature serves two purposes. First, it heightens the sense of competition. Online experiments limit competitive engagement because participants cannot physically observe rivals; the score bar mitigates this limitation. Second, it provides information about the opponent's performance while preventing participants from inferring competition outcomes.

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

After completing the quiz, participants filled out a survey evaluating their enjoyment of

[3]This scoring rule was designed to encourage participants to engage actively in the quiz rather than simply skip questions.

[4]I depart from the standard piece-rate design (Niederle and Vesterlund, 2007; Möbius et al., 2022) for non-competition treatments because adopting a linear payment scheme would confound the effect of competition with differences in payoff structure (linear versus binary). Utility may differ when facing a binary reward relative to a fixed piece-rate scheme.

the task and their willingness to take part in a similar quiz again in the future. 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, participants were asked whether they believed they had won the competition or, in the non-competition treatments, whether they had exceeded the threshold score.

The experiment shows that competition increases experienced utility, not only under gain framing, as expected, but also under loss framing. Although utility is generally higher in the gain frame, the difference in treatment effects across the two framing conditions is not statistically significant. To understand this pattern, I decompose the effect into two components. Through a belief-based channel, competition lowers individuals' beliefs about their chances of winning, thereby reducing utility. Through an intrinsic-utility channel, individuals derive direct enjoyment from the act of competing itself. The positive intrinsic-utility channel dominates the negative belief-based channel, producing the overall positive effect of competition on utility observed in the experiment. Interestingly, competition increases utility regardless of whether individuals expect to win or lose, and those who believe they rank lower in performance experience greater enjoyment from competition than those who believe they rank higher. Moreover, the effect does not vary systematically across demographic characteristics such as gender, age, education, or income.

Regarding the implications of these direct welfare effects, the experimental evidence shows that an enjoyable competitive experience can enhance individuals' perceived enjoyment of a task and increase their willingness to participate in similar activities in the future. Those who find competition pleasurable are more likely to view the quiz task favorably and intend to repeat it. This pattern suggests the presence of attribution bias in competitive settings[5]: individuals may mistakenly attribute the enjoyment of competition to the inherent qualities of the task itself. These welfare effects also extend to social attitudes. Participants exposed to competition display weaker zero-sum mindsets and allocate more money to their partner in a dictator game, indicating stronger altruistic preferences. This finding contrasts with the pre-registered hypothesis, which predicted that competition would foster more zero-sum thinking. One possible explanation for this discrepancy is that when competition is enjoyable, it can promote more positive views toward interpersonal interaction, resulting in friendlier and more prosocial behavior.

This paper contributes to several strands of literature. First, it connects to studies on experienced and procedural utility, which emphasize that well-being depends not only on

[5]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)

outcomes but also on the process that generates them. (Kahneman et al., 1997, 1999; Frey et al., 2004; Frey and Stutzer, 2005; Kahneman and Krueger, 2006; Kahneman and Deaton, 2010; Benjamin et al., 2014; Benz and Frey, 2008). Closely related is the literature on behavioral welfare economics. Bartling et al. (2014) and Bernheim et al. (2024) highlight the intrinsic value individuals attach to their decisions, thereby extending the traditional revealed-preference framework of welfare analysis to account for the emotional and psychological dimensions of choice. I add to this literature by showing that competition, one of the central features of economic interaction, generates its own experienced utility, distinct from material payoffs. Accounting for this dimension is essential for a more comprehensive welfare assessment of competitive environments.

Second, the study contributes to the literature on attribution bias. Prior work shows that individuals misattribute temporary states such as thirst, weather, fatigue to persistent features of goods or activities (Haggag et al., 2019, 2021; Bushong and Gagnon-Bartsch, 2023). I provide complementary evidence that attribution also arises in a strategic setting: enjoyment induced by competition is partly misattributed to the underlying task.

Third, this paper relates 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 schemes (Gneezy et al., 2003; Niederle and Vesterlund, 2007, 2011; Möbius et al., 2022; Hauge et al., 2023; Englmaier et al., 2024). I introduce a novel noncompetitive benchmark: a threshold-based payment scheme that preserves the binary payoff structure of tournaments. This design eliminates potential confounds arising from differences between linear and binary payoffs, thus generating a cleaner estimate of the causal effect of competition. 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 add 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 develops a conceptual framework that formalizes the idea of experienced utility from competition. Section 3 describes the experimental design and data. Section 4 presents the competitive dynamics in the treatment. Section 5 shows main results on how competition affects utility, decomposing the total impact into a belief-based channel and an intrinsic-utility channel. Section 6 discusses the implications of these direct welfare effects of competition. Section 7 concludes.

2 Conceptual Framework

This section develops a conceptual framework comparing individual utility in competitive settings with a noncompetitive benchmark where individuals face a fixed performance threshold rather than real opponents. The framework builds on the classical winner-take-all structure introduced by Lazear and Rosen (1981) and incorporates reference-dependent preferences from Kőszegi and Rabin (2006) to allow utility to vary across contexts. Its primary objective is to isolate the distinct sources of experienced utility from competition, disentangling them from material payoffs. The framework also clarifies how the effect of competition on utility may depend on the context. Section 2.1 presents the model setup, and Section 2.2 derives testable predictions for the experiment.

2.1 Setup

Consider a competition with $N \geq 2$ risk-neutral 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 $e_i \geq 0$; let $\mathbf{e}_{-i}$ denote the effort profile of the opponents. 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 competition follows a winner-take-all structure: a single competitor is the winner and all others are losers. Monetary payoffs are given by $(w^{win}, w^{lose}) \in \mathbb{R}^2$.

Competitor i has reference-dependent utility with an exogenously fixed reference point $r \in \mathbb{R}$, which is a monetary endowment. Two reference frames are considered. In the *gain frame*, each competitor i receives an initial endowment b (so $r = b$). The winner receives a reward w^{win}, leading to a final payment of $b + w^{win}$, while the losers receive no monetary reward and end with b. In contrast, under the *loss frame*, each competitor is initially endowed with $b + w^{win}$ (so $r = b + w^{win}$). The winner retains the full endowment $b + w^{win}$, while the losers forfeit w^{win} from their endowment, ending with b.[6] In theory, with everything else equal, the final expected payoffs are identical under the two frames.

Prior to the realization of outcomes, the utility of competitor i consists of the expected utility of monetary payoff and a nonpecuniary component, denoted by ψ_i. The term ψ_i captures all behavioral sources of utility that are distinct from expected payoffs. It may include several elements. First, it reflects the intrinsic utility from the act of competing itself, the affective experience of competition, such as excitement, engagement, or stress,

[6] In the gain frame, $(w^{win}, w^{lose}) = (w^{win}, 0)$, so with initial endowment b, the final payoffs are $(b + w^{win}, b)$. In the loss frame, $(w^{win}, w^{lose}) = (0, -w^{win})$, and with endowment $b + w^{win}$, the final payoffs are again $(b + w^{win}, b)$.

independent of material outcomes or beliefs. Second, ψ_i can incorporate utility derived from beliefs about winning. A large body of literature has documented that individuals may derive utility directly from their beliefs (Caplin and Leahy, 2001; Kőszegi, 2006; Bénabou and Tirole, 2011). In the context of competition, the intuition is straightforward: the higher the subjective probability that competitor i expects to win, the greater the utility they derive. This belief-based utility may reflect the anticipation of monetary gains as well as the satisfaction associated with superiority or status. Formally, it can be represented by a belief–utility function $u : [0,1] \to \mathbb{R}$ of the perceived probability of winning p, which is twice continuously differentiable, nondecreasing $\big(u'(p) \geq 0\big)$, and convex $\big(u''(p) \geq 0$ for all $p \in [0,1]\big)$. Convexity implies that the marginal affective gain rises with perceived success: the nearer one is to winning, the larger the utility gain from from an incremental increase in p. Taken together, the utility can be expressed as

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

The first three terms account for the expected utility of monetary payoff, and the fourth term ψ_i represents the nonpecuniary utility from competition. In the gain frame, $(w^{win}, w^{lose}) = (w^{win}, 0)$, while in the loss frame, $(w^{win}, w^{lose}) = (0, -w^{win})$. 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 is perceived to win if their performance exceeds that of all others; in the event of a tie, the winner is selected uniformly at random, with probability $\frac{1}{N}$. The function $v(x)$ 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 components of the model remaining unchanged. An individual succeeds if performance exceeds θ^*, so payoffs depend solely on their own actions. 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 the performance distribution, ensuring a 50 percent success probability. When

$N = 10$, it is set at the 90th percentile of the performance distribution, so that the probability of surpassing the threshold coincides with the 10 percent winning probability in a winner-take-all tournament.

More generally, let $s \in \{C, NC\}$ denote the incentive structure, with C representing the competitive setting and NC the non-competitive setting. Let $f \in \{G, L\}$ denote the framing of monetary outcomes, where G corresponds to the gain frame and L to the loss frame. Then, prior to the realization of outcomes, the utility of competitor i in setting (s, f), denoted $U_i^{s,f}(e_i)$, can be written as

$$P_i^s(e_i) \cdot v\Big(w_i^{win,f}\Big) + \big(1 - P_i^s(e_i)\big) \cdot v\Big(w_i^{lose,f}\Big) - c(e_i) \;+\; \psi_i^f \, \mathbf{1}_{\{s=C\}}$$

The first three terms capture the expected utility from monetary payoffs, denoted $U_{i,\text{money}}^{s,f}(e_i)$. The fourth term, $\psi_i \mathbf{1}_{\{s=C\}}$, represents the nonpecuniary utility from competition, denoted $U_{i,\text{nonpec}}^{s,f}$. Specifically, $P_i^s(e_i)$ is competitor i's perceived probability of winning in setting s; $w_i^{win,f}$ and $w_i^{lose,f}$ denote the monetary outcomes under frame f; and r^f is the corresponding reference point. The term ψ_i^f represents the nonmonetary utility under frame f, and the indicator $\mathbf{1}_{\{s=C\}}$ ensures that this utility of competition enters only in the competitive setting. To derive directional predictions from the model, I introduce two empirically testable assumptions. These assumptions are not imposed as axioms but serve as analytical devices, whose validity will be evaluated later against experimental evidence.

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

$$P_i^C(e) \;\leq\; P_i^{NC}(e) \quad \textit{for all } e \geq 0.$$

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, the strategic uncertainty (Bruttel et al., 2023; Balafoutas and Sutter, 2019) in tournaments may depress individuals' beliefs about their prospects,[7] lowering perceived chances of success relative to fixed standards. Formally, for optimal effort $e_i^{f,*}$, $P_i^C\big(e_i^{f,*}\big) \leq P_i^{NC}\big(e_i^{f,*}\big)$.

[7] 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 nonpecuniary utility of competition is positive in the gain frame ($\psi^G > 0$) and negative in the loss frame ($\psi^L < 0$).*

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 $\psi^G > 0$. 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 $\psi^L < 0$.

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:*

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

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 pay-

offs 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. *(intrinsic-utility 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.,*

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

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

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

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 primarily to investigate whether competition itself carries utility or disutility, independent of realized outcomes, and whether this utility varies across different contexts. Beyond this central question, it also considers whether competition impacts individuals' beliefs and preferences. To provide clean and credible causal evidence, I conduct an online experiment that explores the effects of competition on utility, zero-sum thinking, and altruistic behavior. Section 3.1 introduces the experimental design, while Section 3.2 and Section 3.3 describe its implementation and the experimental data.

3.1 Experimental Design

A. Treatments

Participants were randomly assigned to one of four experimental conditions: Gain Framing with Competition, Gain Framing without Competition, Loss Framing with Competition, and Loss Framing without Competition. All participants completed a timed IQ quiz under their assigned condition, followed by a post-task survey (see Figure 1).

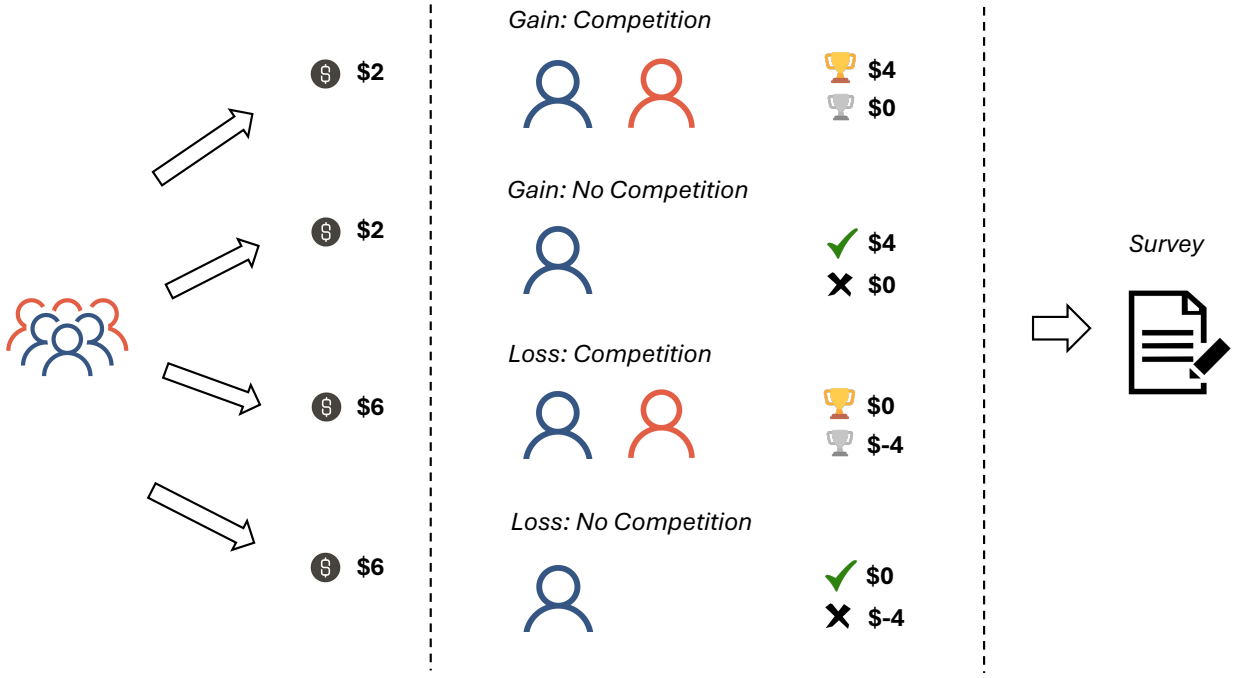


Figure 1: Visual Representation of Experimental Design

Incentives. In the gain-framing competition group, participants are randomly paired to compete in an IQ quiz. Each participant receives an initial endowment of $2. Within

each pair, the higher-scoring participant is designated the "top performer" and earns an additional $4, while the lower-scoring participant receives no extra payment. In the gain-framing control group, participants complete the quiz individually. Those scoring above a predetermined threshold receive a $4 bonus, while those falling below the threshold keep only their initial endowment. The threshold is set at the median score observed in the gain-framing competition group, and participants are informed that, in a previous session, approximately half of individuals have surpassed this benchmark.

This design ensures equivalence in both the reward structure and expected payoffs across the competitive and non-competitive treatments. While piece-rate schemes are often used as non-competitive benchmarks (Niederle and Vesterlund, 2007; Möbius et al., 2022), they are less suitable here because their linear payoff structure differs from the binary outcomes of competition, potentially confounding competition effects with factors such as risk preferences or inequality aversion. By contrast, the threshold design preserves a binary reward structure in both conditions. Setting the threshold at the median score equalizes expected monetary returns: in the competitive treatment, participants receive a $2 endowment and face a 50 percent chance of winning an additional $4 (and a 50 percent chance of earning nothing), yielding expected earnings of $4. The same holds in the non-competitive treatment, where participants have a 50 percent probability of surpassing the threshold and earning the $4 bonus. By construction, expected monetary payoffs are held constant across treatments, isolating the competition effects from monetary incentives.

The loss-framing competition condition parallels the gain frame but shifts the reference point from $2 to $6. Each participant receives an initial endowment of $6 and is paired with a competitor. The higher-scoring individual retains the full $6, while the lower-scoring participant loses $4 of it. In the loss-framing control condition, participants again completes the quiz individually. Those scoring above the predetermined threshold keeps the full endowment, whereas those falling short forfeit $4. As in the gain frame, the threshold is set at the median score observed in the corresponding competition condition and is disclosed to participants. Expected payoffs are again identical across treatments: in both loss-framed conditions, participants face a 50 percent chance of keeping $6 and a 50 percent chance of ending with $2, yielding an expected payoff of $4. Across all four treatments, therefore, expected monetary payoffs are all held constant at $4.

The four groups face identical monetary incentives while differing only in the presence of competition and the framing of outcomes as gains or losses. This design enables a clean identification of the treatment effects of competition across distinct framing contexts.

IQ Quiz. The IQ quiz is identical across all experimental conditions. It consists of 50 puzzles from Civelli and Deck (2017), similar to the Raven Progressive Matrices, which is commonly used an IQ test (Drobner and Goerg, 2024); Willadsen et al. (2024). An example puzzle is shown in Figure 2. Each puzzle has four answer choices, and participants are required to select the correct one to earn points. They have four minutes to solve as many puzzles as possible. The scoring rule awards 1 point for each correct answer, deducts 0.25 points for each incorrect answer, and give zero points for skipped questions. Participants can not return to a question once they have submitted an answer or chosen to skip it. This scoring structure is designed to encourage thoughtful participation: the expected payoff of answering a question exceeds that of skipping, and the penalty for incorrect responses discourages random guessing. Additionally, the quiz is deliberately set as time-constrained so that participants across all experimental conditions spend the same amount of time on the treatment task, thereby eliminating potential confounds related to variation in task duration.

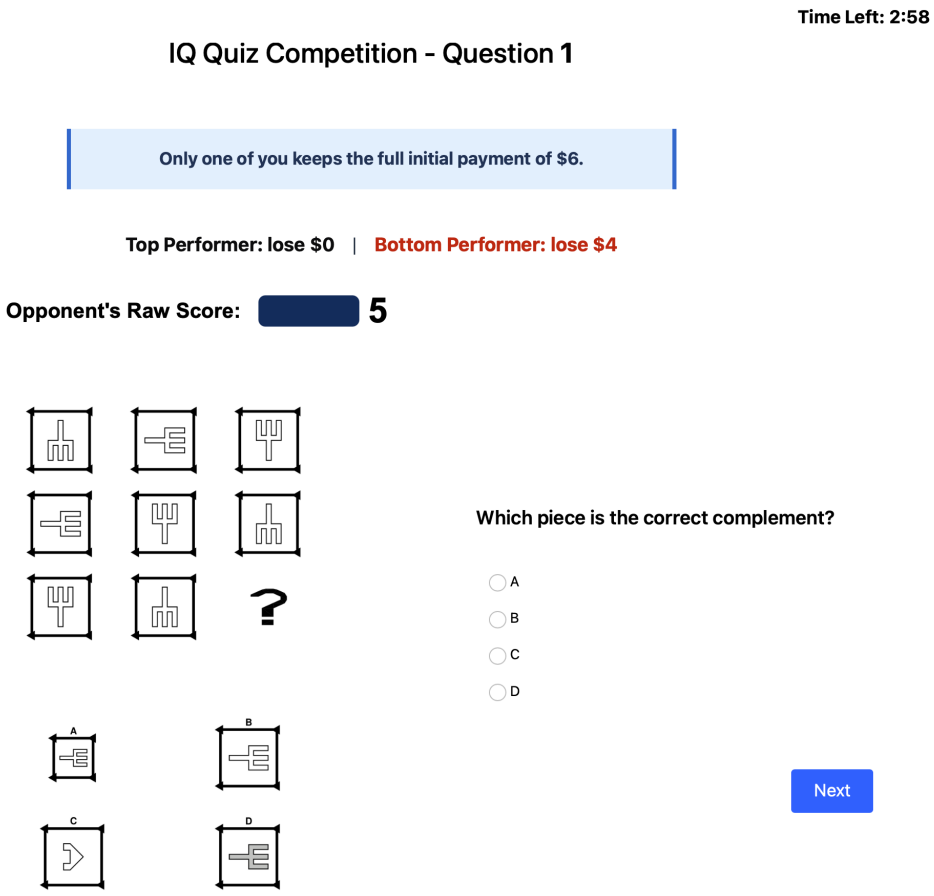


Figure 2: IQ Quiz Interface

The choice of the IQ quiz as the treatment task is also deliberate. The study's primary objective is to isolate the effect of competition itself. An appropriately chosen task can facilitate this goal. The IQ quiz is well-suited in this respect: it is ego-relevant and naturally induces utility responses, since performance conveys information about intelligence, shapes self-evaluations, and potentially affect perceived utility. Moreover, the quiz resembles tasks commonly encountered in real-life contexts such as academic and workplace settings, in terms of both seriousness and cognitive demands. This resemblance enhances the external validity of a laboratory-style experiment. While the use of an IQ quiz carries potential drawbacks—such as the possibility that participants avoid IQ competition, leading to differential attrition across groups—this concern did not materialize in practice.

Online Matching. In the competition treatments, participants in both gain-framing and loss-framing conditions are randomly matched in real time with another participant as their opponent. The maximum waiting time is set to five minutes. In practice the average waiting time was 19 seconds. Figure 3 displays the matching screen shown to participants during this stage. Once matched, participants begin the IQ quiz simultaneously. In the non-competitive treatments, participants proceed directly to the IQ quiz after the instruction phase without matching.[8]

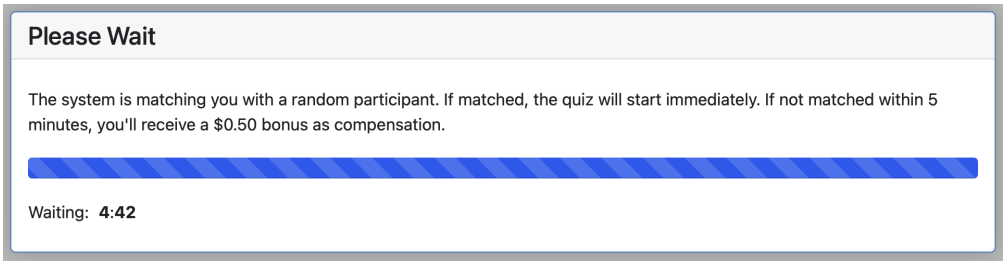


Figure 3: Participant Matching Screen

Interface. Figure 2 shows the IQ quiz interface for the loss-framing competition group. The interfaces for the loss-framing control, gain-framing competition, and gain-framing control groups are presented in Section C. Two design features of the task screen are worth noting. The first is the *real-time opponent score bar* . In both gain-framing and loss-framing competitive treatments, participants observe their opponent's *raw* score in real time. The raw score represents the cumulative number of correct answers up to that point, without deductions for incorrect answers. This score bar design serves two purposes. On one hand,

[8]Since the actual waiting time was very short, the matching stage is highly unlikely to introduce systematic differences between treatment and control groups.

its dynamic nature heightens the salience of competition and may evoke emotions such as excitement, nervousness, or stress, thereby enabling us to detect whether participants derive utility from the act of competing. Online experiments often limit engagement because participants cannot physically observe rivals; the score bar mitigates this limitation by making competition more tangible. On the other hand, because only raw scores are shown, participants learn about their opponents' performance only partially and cannot infer the final outcome. This feature is crucial, as the aim of the experiment is to isolate the effect of competition itself. The score bar is displayed only in the competitive treatments. Second, the interface wording is tailored to each experimental group to reinforce treatment salience. In the competitive conditions, it 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, by contrast, the wording stresses the individual dimension: "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 following the IQ quiz, as shown in Figure 1. Utility, task preferences, and zero-sum thinking are elicited in 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[9] 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

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

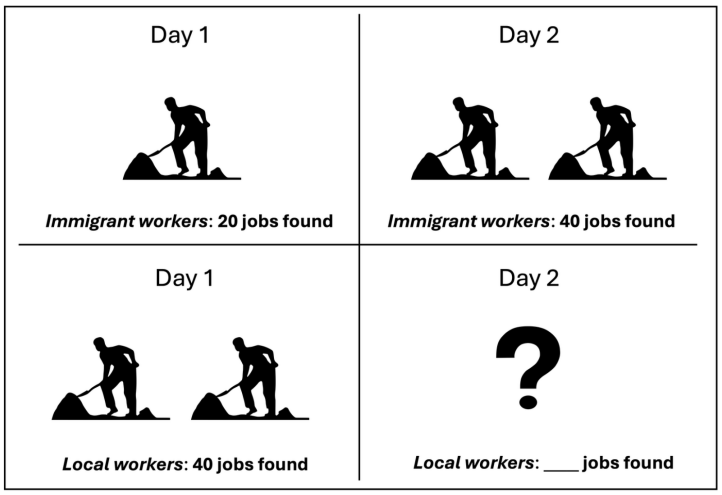


Figure 4: Measure of Zero-Sum Thinking

number 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 (high zero-sum thinking), and intermediate values represent 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 4). 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: the reasoning is that the total number of jobs is fixed, so if immigrants take more, fewer remain for locals. Choosing 80 reflects non-zero-sum thinking: the reasoning is that a common demand shock doubled the number of jobs for immigrants, and thus 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 5). 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 6. 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.

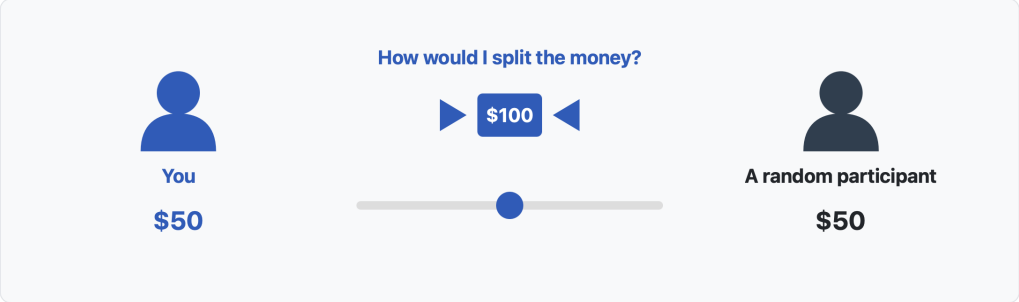


Figure 5: Dictator Game

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 treatment 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 a correct answer. 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.

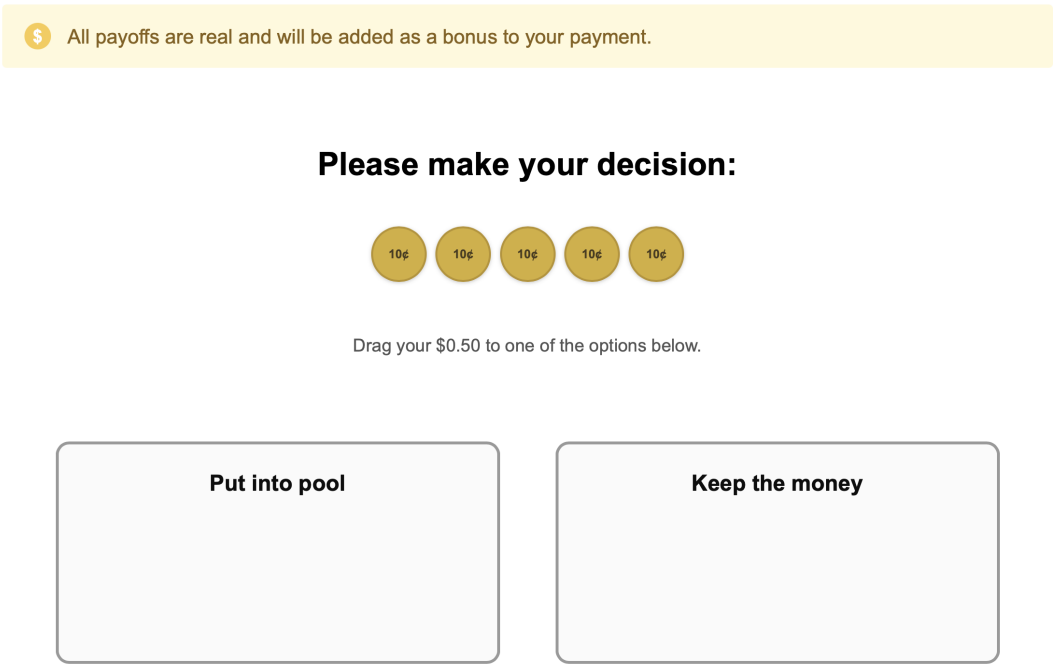


Figure 6: Public Goods Game

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 prior to 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 for later data analysis. To prevent automated participation, a 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, in one survey item embedded among the main questions, participants are instructed 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.[10] Fourth, each participant could access only one recruitment posting and participate in a single experimental condition.[11] Finally, to ensure smooth implementation, only desktop or laptop devices were permitted; responses from mobile phones and tablets were disallowed.

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.[12]

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 of the experiment, 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-No Competition 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. In the Loss-No Competition condition, avoiding the deduction required

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

[11] 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. Based on the data, no participant took part in more than one condition.

[12] 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."

meeting a prespecified threshold.[13]

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 IQ 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 (minimum: 1.8 seconds).[14] Once matched (or directly proceed 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). [15]

Pre-registration. The experiment was preregistered on the AEA RCT Registry[16]. The preregistration specified the experimental design, interventions, planned sample sizes by treatment arm, and the primary hypotheses concerning competition and the main outcomes.

[13]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.

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

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

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

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.

3.3 Data Description

A total of 798 participants enrolled in the study: 198 in the Gain Framing–Competition group and 200 in each of the other three groups (Gain Framing–Control, Loss Framing–Competition, and Loss Framing–Control).[17] Of these, 8 participants failed the attention check and 3 submitted incomplete responses. Excluding these 11 yields a final sample of 787.[18] Attrition was minimal. The median completion time was 18 minutes.[19]

Demographic characteristics and balance tests are presented in Table 1. The sample is well balanced across most demographics, including age, gender, and race. In the loss-framing treatments, the proportions of respondents with a high school education and with incomes between $10,000 and $34,999 differ slightly between the competition and control groups. These differences are not concerning: joint tests of balance show no evidence of systematic imbalance (*F-test* (p-val = 0.61) for Gain Framing competition vs. control; *F-test* (p-val = 0.17) for Loss Framing competition vs. control).

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 others' performance or, more generally, on their relative ranking (Niederle and Vesterlund, 2007; Bartling et al., 2012; Gill and Prowse, 2012; Delfgaauw et al., 2013). In the experiment, besides this payoff structure, competition is introduced through two design features.[20] The first feature is the presence of another participant. 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 control groups 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 bar provides real-time information about the opponent's raw score, serving as a noisy signal of their actual performance, since the raw score reflects only the number of correct answers without accounting for penalties from incorrect ones. Moreover, it intensifies the sense of competition, potentially eliciting

[17] The target sample was 800, with 200 per group. A shortfall of two resulted from minor technical issues on the Prolific platform.

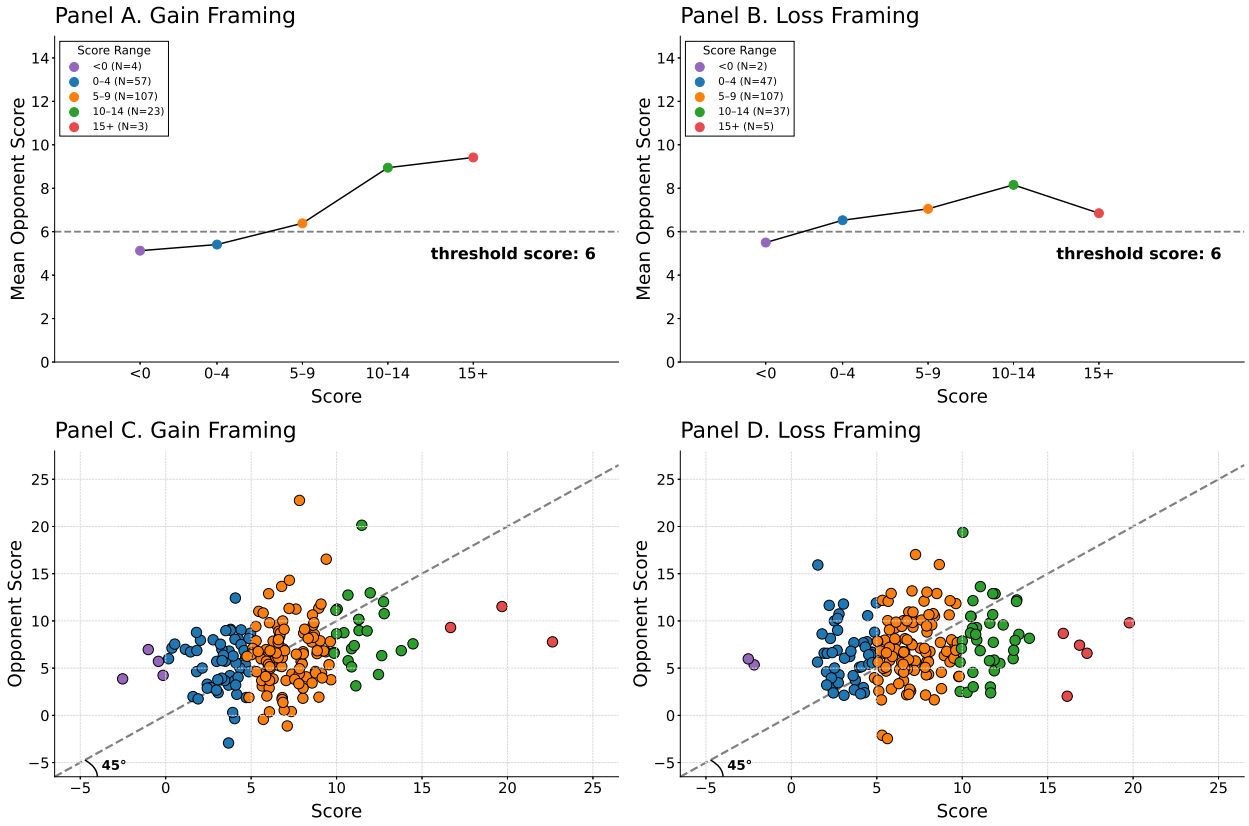
[18] Exclusions: 3 from Gain Framing with Competition, 4 from Gain Framing without Competition, 1 from Loss Framing with Competition, and 3 from Loss Framing without Competition.

[19] 18 minutes in Gain Framing–Competition, 17 in Gain Framing–Control, 19 in Loss Framing–Competition, and 17 in Loss Framing–Control.

[20] 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*.

emotions 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 7 shows the detailed matching patterns, and Figure 8 illustrates the dynamic evolution of the opponent's raw score in the actual experiment.

Figure 7: Matching Patterns

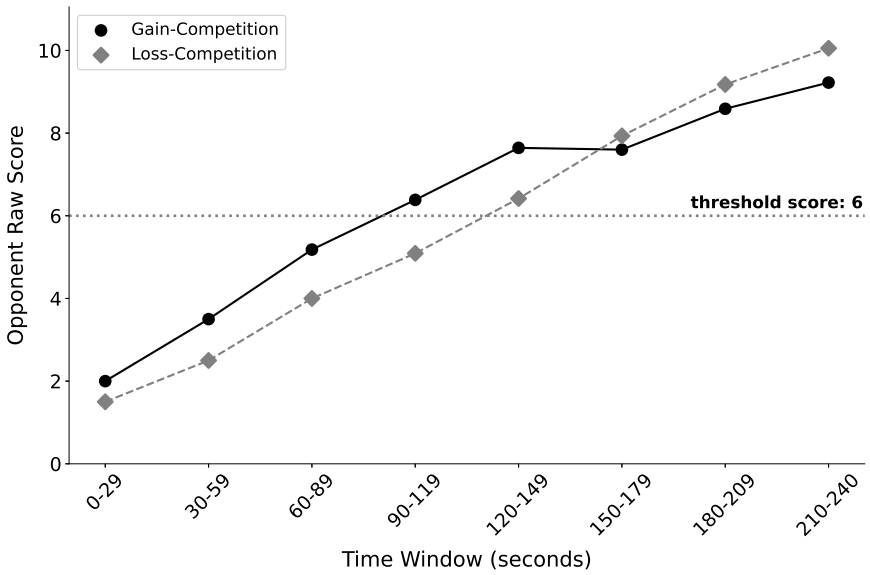


Notes: This figure plots opponent scores versus participants' quiz scores under Gain (A,C) and Loss (B,D) framings. Panels A–B show scatterplots; points are colored by quiz-score bins (< 0, 0–4, 5–9, 10–14, 15+) with bin counts in the legend. The dashed 45° line indicates equal scores; the shaded band at 6 marks the fixed threshold from the non-competitive reference. Panels C–D display bin means by quiz-score bin; lines connect means for readability. Patterns are comparable across framings.

Panels A and B of Figure 7 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.[21] 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.

Figure 8: Opponent Raw Score over Time



Notes: The figure plots the change in opponent raw scores across successive 30-second time windows (0–240 seconds) for two conditions: Gain-Competition (solid black line with circles) and Loss-Competition (dashed gray line with diamonds). Overall, opponent scores increase steadily over time in both conditions. The dotted line indicates the non-competitive comparison group's fixed threshold score of 6 points.

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.

[21] 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 8 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 intrinsic-utility 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.

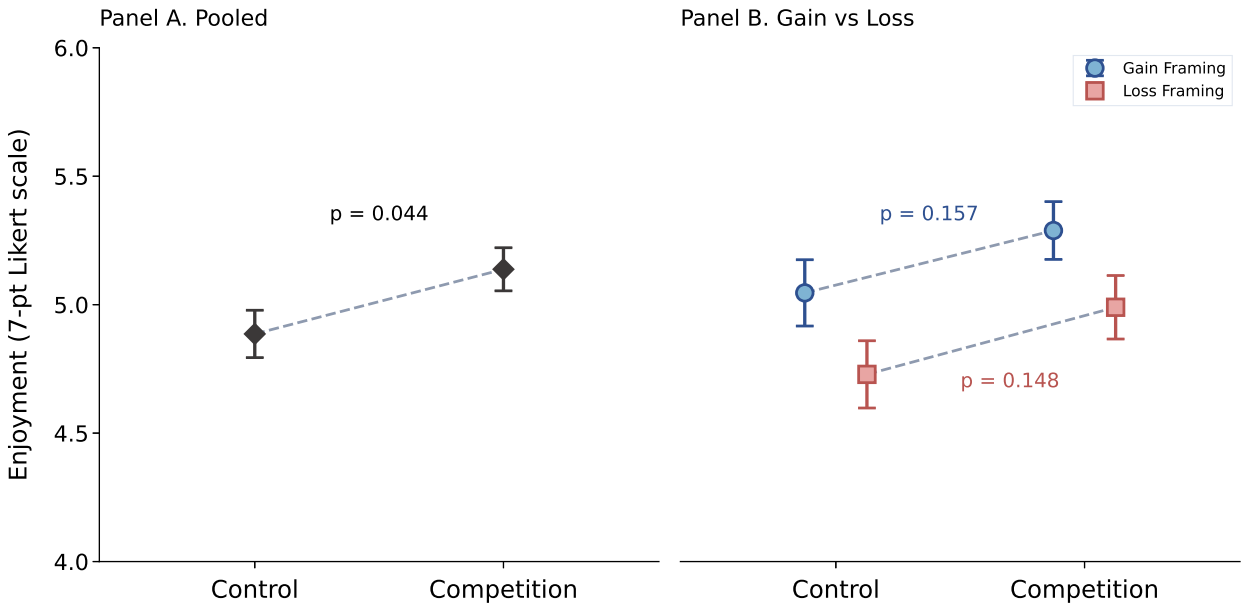
5.1 Effects of Competition on Utility

Figure 9 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.[22]

Panel B of Figure 9 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

[22]Appendix **??** shows the distribution of utility by treatment and framing condition.

Figure 9: 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.

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.*

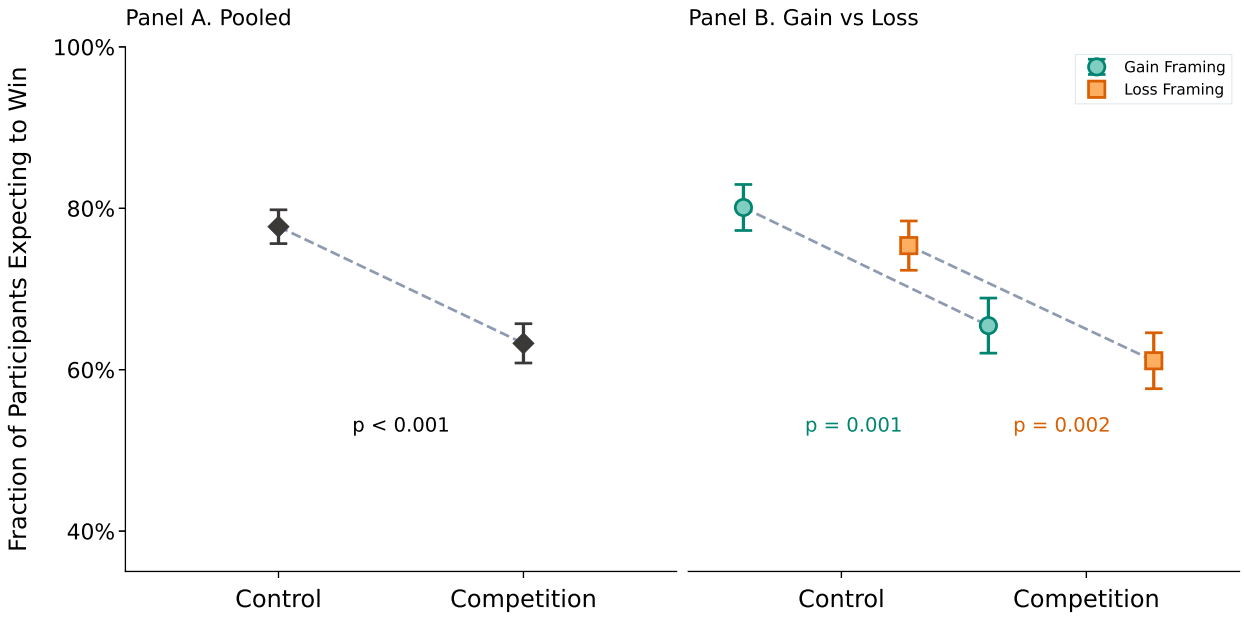
5.2 Belief Channel

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 10. The relationship between beliefs about winning and reported enjoyment is shown in Figure 11.

Figure 10: 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.

Panel B of Figure 10 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% of participants in the competition condition believe they outperformed their opponent, a decline of 20 percentage points ($p = 0.001$). Under loss framing, 75% of participants 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 con-

trol group, 78% of participants believe they reached the threshold, while only 63% in the competition group believe they outperformed their opponent—a decline of 15 percentage points ($p < 0.001$). Taken together, these results indicate that competition reduces 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.

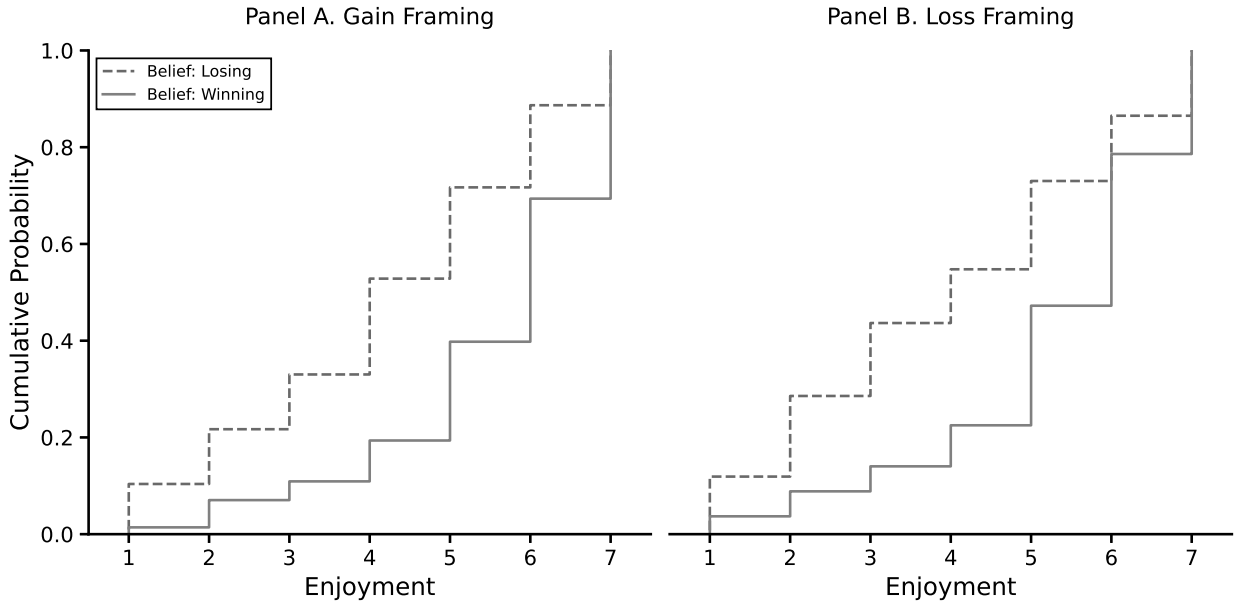
Figure 11 shows the cumulative distributions of reported enjoyment for participants who believe they won[23] and those who believe they lost.[24] Panel A presents results under gain framing, and Panel B presents results under loss framing. In both framing conditions, the distribution for participants 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 psychological satisfaction of winning, such as a sense of superiority when outperforming

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

[24]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.

Figure 11: 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.

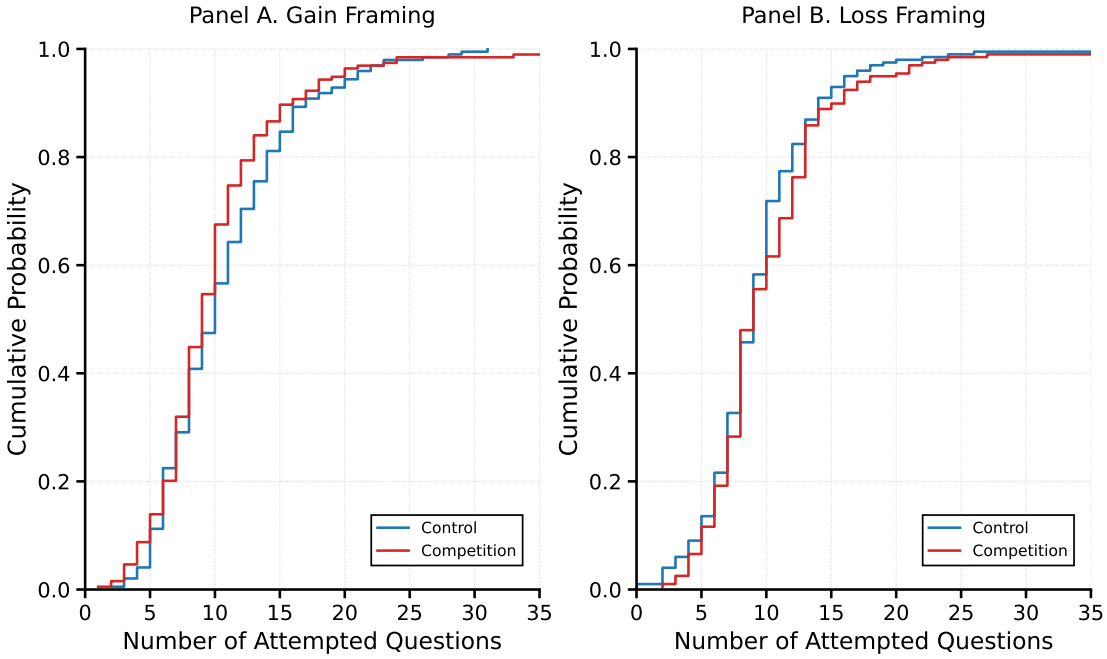
others in the competition condition or a feeling of achievement when meeting a performance threshold in the control condition.

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

5.3 Intrinsic Utility Channel

Competition affects utility through an intrinsic-utility 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 intrinsic-utility channels described in the conceptual framework in Section 2. Figure 12 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 (Kol-

Figure 12: Cumulative Distribution of Effort Proxy: Attempted Questions



Notes: This figure plots the cumulative distribution functions (CDFs) of the number of attempted questions across treatment conditions, separately for gain and loss framing conditions. Panel A displays results for the Gain Framing treatment, while Panel B presents results for the Loss Framing treatment. In both panels, the blue line represents participants in the Control condition, and the red line represents those in the Competition condition.

mogorov–Smirnov test, $p = 0.198$ under gain framing; $p = 0.249$ under loss framing).[25] These results indicate that competition does not significantly affect effort, implying that the overall effect of competition on utility primarily reflects the intrinsic-utility 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.[26] The intrinsic-utility is robust across both gain and loss framings, with no statistically significant difference in magnitude between the two.

RESULT 3. *Competition affects utility through an intrinsic-utility channel: individuals derive enjoyment from the act of competing itself.*

[25]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.

[26]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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

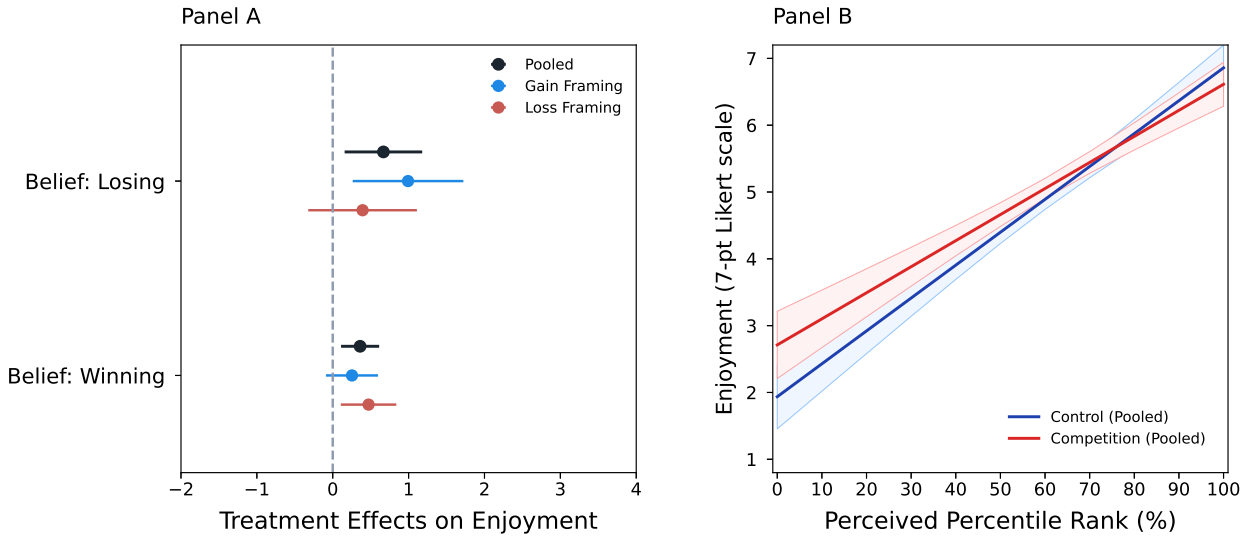
5.4 Discussion

A. Heterogeneity

Figure 13 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.

Panel B shows that enjoyment increases monotonically with perceived rank, indicating

Figure 13: Heterogeneity in Utility by Beliefs in Winning and Perceived Ability

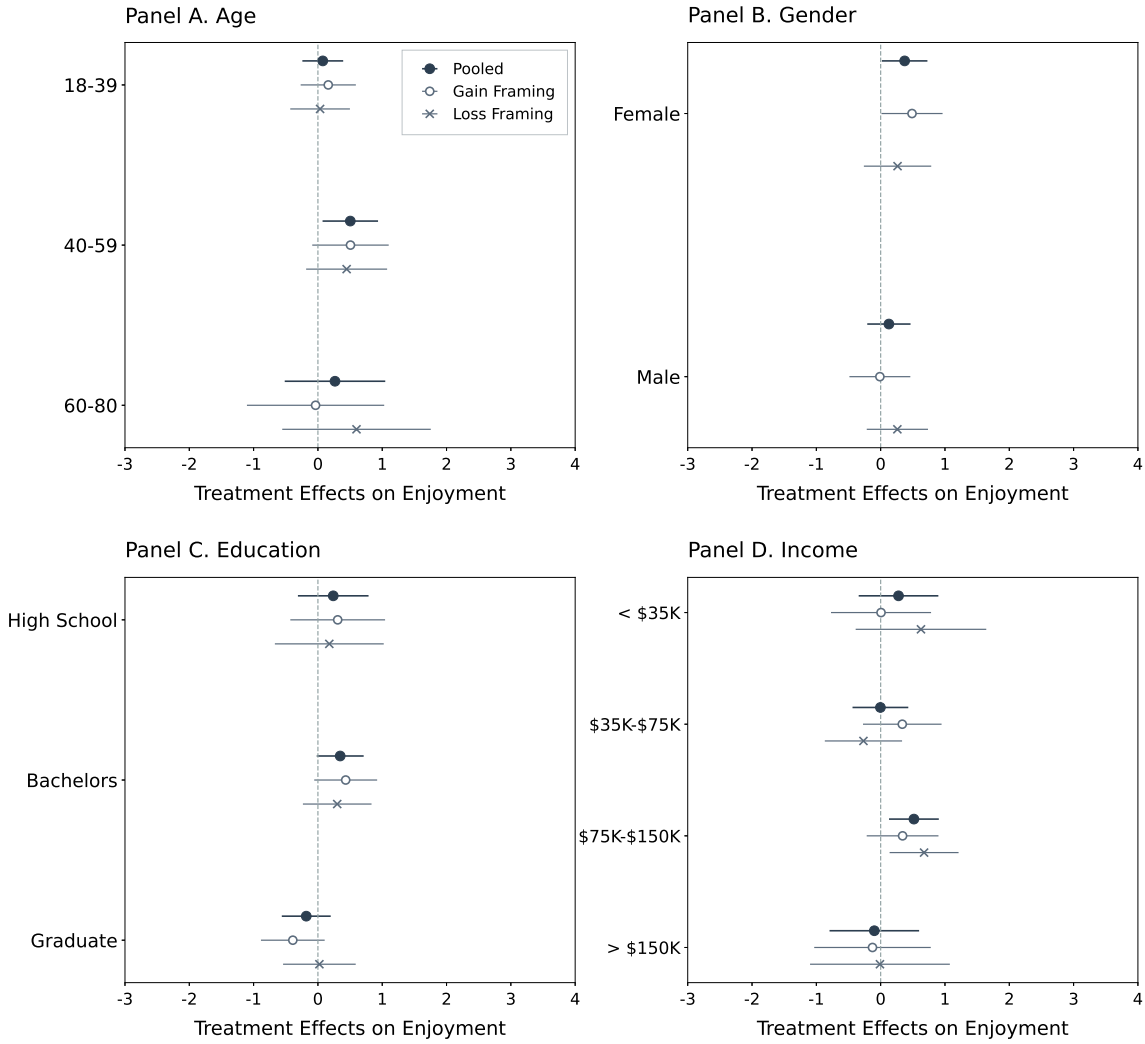


Notes: This figure shows the heterogeneous effects of competition on enjoyment by participants' beliefs about winning and their perceived performance rank. Panel A presents the estimated treatment effects of competition on reported enjoyment, conditional on participants' beliefs about whether they expect 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.

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. Beyond that point, 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 14 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 insignificant. 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

Figure 14: 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).

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 utility derived from final outcomes but also for the direct utility costs and benefits generated by the act of competing itself. Since competition can directly affect utility, omitting this component would bias welfare assessment, underestimating welfare when competition brings enjoyment and overestimating it when competition induces stress.[27]

The utility derived from competition depends on the relative strength of three channels: effort, belief, and intrinsic utility. 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 intrinsic channel[28] 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?

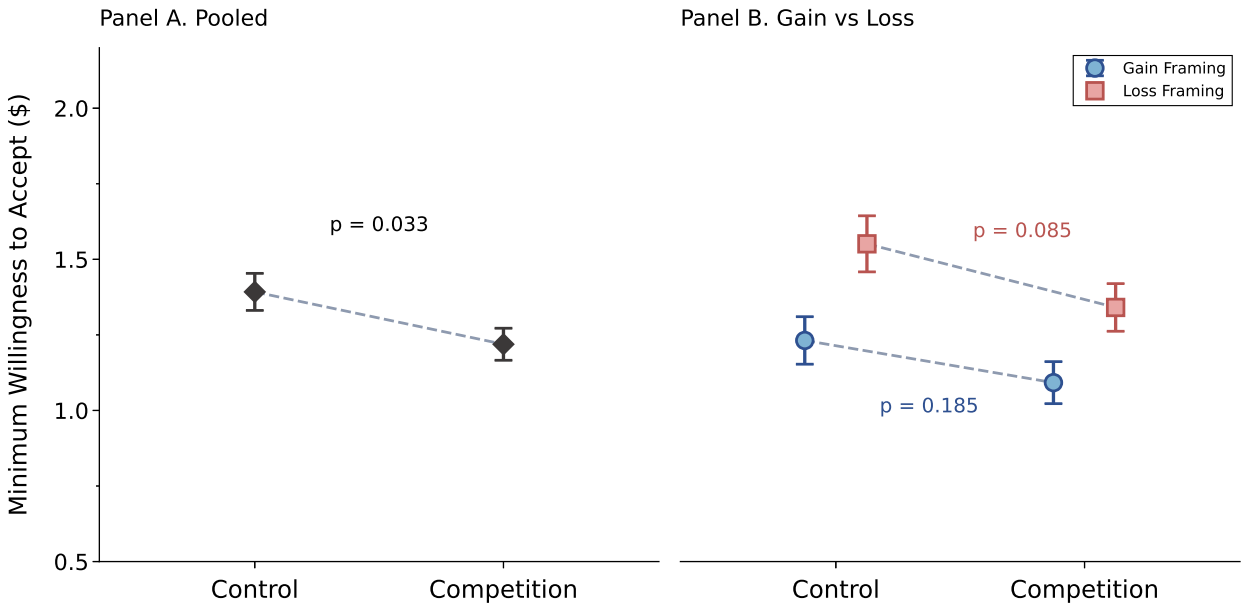
The experiment demonstrates that competition enhances individuals' enjoyment at work. I now investigate whether this increase in utility shapes their subsequent decisions, specifically whether it affects their willingness to perform the same task again in the future. According to the concept of attribution bias,[29] 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.

[27] A detailed analysis of the emotional components associated with competition is in Appendix C.1.

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

[29] 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).

Figure 15: Effects on Task Preference through Attribution Bias



Notes: This figure shows the effect of competition on task preference. Panel A presents pooled results, and Panel B reports results separately for the gain- and loss-framing conditions. The horizontal axis indicates the treatment groups (Control vs. Competition), and the vertical axis reports the minimum willingness to accept (WTA), measured as the minimum amount of money required to perform the task again. The exact survey wording is provided in Appendix Section D.6. Each point represents the mean minimum WTA for the corresponding group, with 95% confidence intervals. The pooled comparison is statistically significant ($p = 0.033$). The differences in Panel B are not statistically significant ($p = 0.185$ for gain framing and $p = 0.085$ for loss framing).

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 15 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 15 presents results by framing condition. Under the gain framing, participants in the control group require 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.

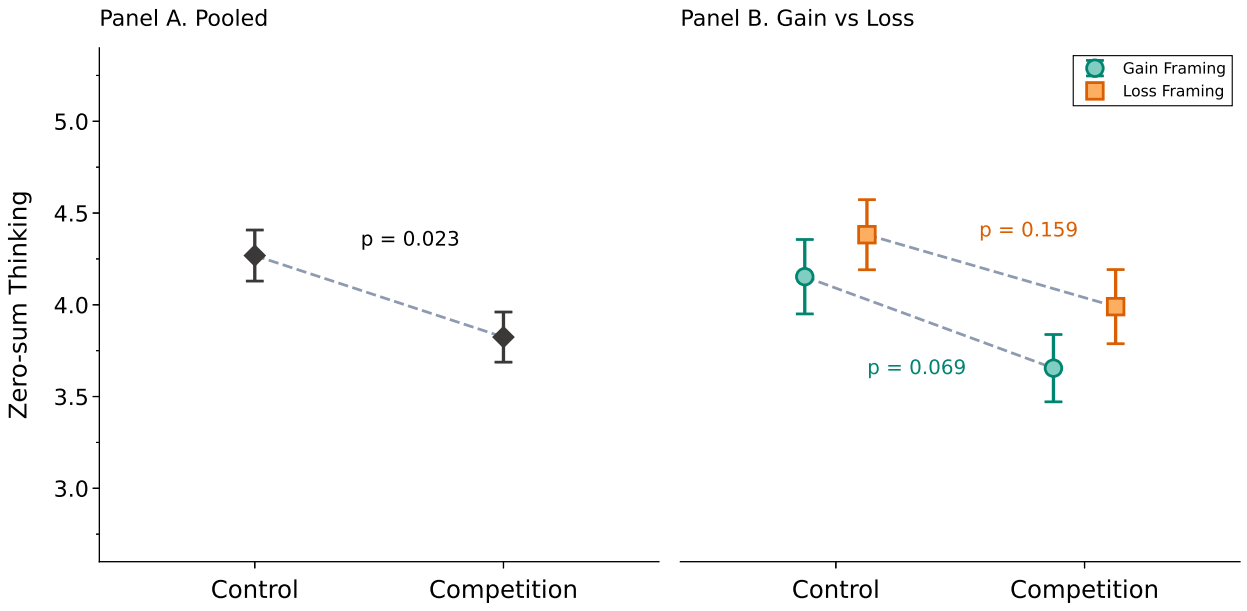
RESULT 4. *Enjoyable competitive experience increases participants' preference for the underlying task and their willingness to undertake it again in the future. This pattern indicates the presence of attribution bias in the strategic context of competition.*

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 16: 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.

Figure 16 shows that competition unexpectedly reduces individuals' zero-sum mindsets. Panel B of Figure 16 reports the mean value of zero-sum thinking for the control and

competition groups under both gain and loss framing conditions. 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.[30] 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 ($p = 0.159$). Panel A of Figure 16 presents the pooled results, combining both 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.

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.

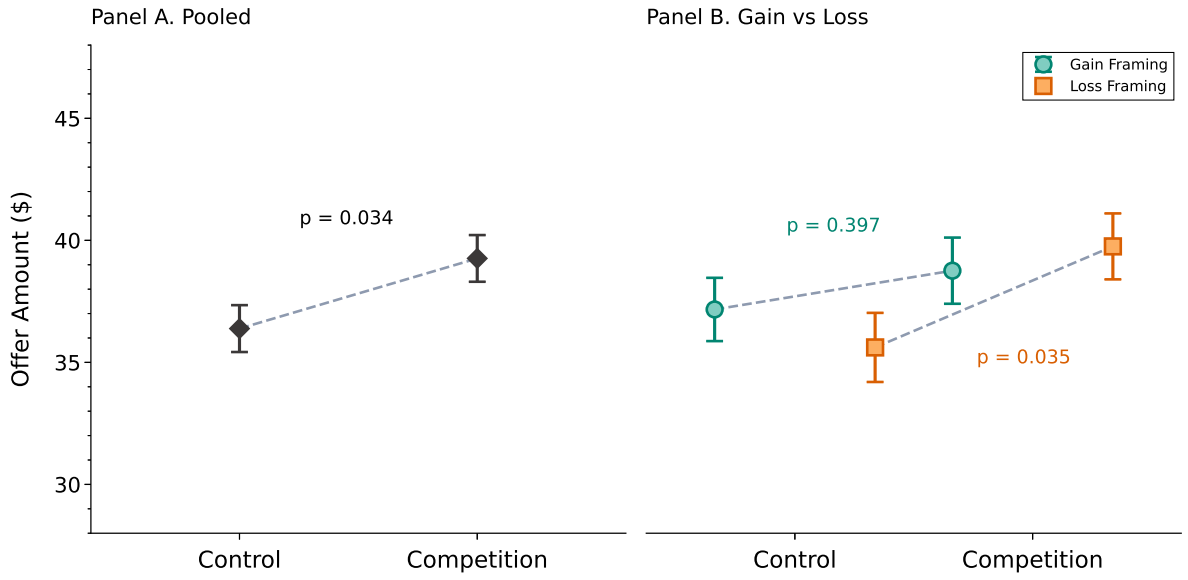
B. Altruism

Competition also affects people's altruistic tendencies. Figure 17 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 17 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 17 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

[30] 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.

statistically insignificant ($p = 0.347$).

Figure 17: 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 argues that the intrinsic welfare value of competition warrants greater attention.

Experimental evidence indicates that competition generates positive utility. This finding, however, comes with an important caveat: the laboratory setting involves relatively low-stakes rewards. It remains an open question 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 stimulating in low-stakes, game-like settings, yet it can become stressful and welfare-reducing in situations such as college entrance exam or high-pressure workplaces. Although the experiments in this paper cannot resolve this question, they offer valuable insights into the multiple channels through which competition directly affects utility.

First, there is a belief channel. Competition can lower individuals' perceived probability of success, which in turn reduces their happiness. Second, there is intrinsic utility from competition itself. In the experiment, positive emotions such as excitement and motivation outweigh negative emotions like pressure and stress, resulting in a net positive intrinsic utility. Finally, there is an effort channel. Although the utility difference attributed to effort is not pronounced in the experiment, an interesting observation is that performance in the non-competitive setting, where individuals work independently to surpass a threshold, is better than in the competitive setting, at least in the gain-framing competition.

Beyond the immediate welfare effects, the nature of the competitive experience, whether enjoyable or stressful, has important implications for individuals' future choices and social attitudes. A positive competitive experience can make people like the underlying task more and increase their willingness to engage in it again. In real-world terms, someone may wish to play the same game again if competition previously added enjoyment. Conversely, if students suffer under intense academic competition, they may develop an aversion to studying itself, negatively affecting their long-term human capital accumulation. The character of competition also shapes social interactions. A pleasant competitive experience appears to reduce zero-sum thinking and foster greater altruism toward others. It is

plausible that a miserable competitive experience might have the opposite effect, although this hypothesis requires further empirical investigation and is left for future work.

In today's economic and social systems, competition is pervasive, and people are deeply immersed in it. A comprehensive evaluation of its welfare effects requires considering the direct utility costs and benefits of competition itself, which is crucial for achieving true welfare maximization as well. Competition should not be viewed solely as a tool for achieving some future goal; the welfare it generates directly is also worth recognizing. Moreover, exploring how such direct utility effects from competition influence individuals' preferences, beliefs, and social behavior is also a valuable 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:*

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

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

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

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

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

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

because the cost term $c(e)$ and the constant $v(w^{lose,f})$ cancel. Therefore $U_{\text{money}}^{C,f}(e) \le U_{\text{money}}^{NC,f}(e)$ 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

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

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

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

A.3 intrinsic-utility channel

This subsection proves Prediction 2. The intrinsic 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,*

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

and lower intrinsic utility in the loss frame,

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

Proof. Fix a frame $f \in \{G, L\}$ and hold the belief channel fixed. By construction, the intrinsic term enters additively only in the competitive setting:

$$U_{i,\text{intrinsic}}^{C,f} = \psi_i^f \qquad \text{and} \qquad U_{i,\text{intrinsic}}^{NC,f} = 0.$$

This difference is effort-invariant. Under Assumption 2, $\psi^G > 0$ and $\psi^L < 0$, which implies

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

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 $f \in \{G, L\}$,

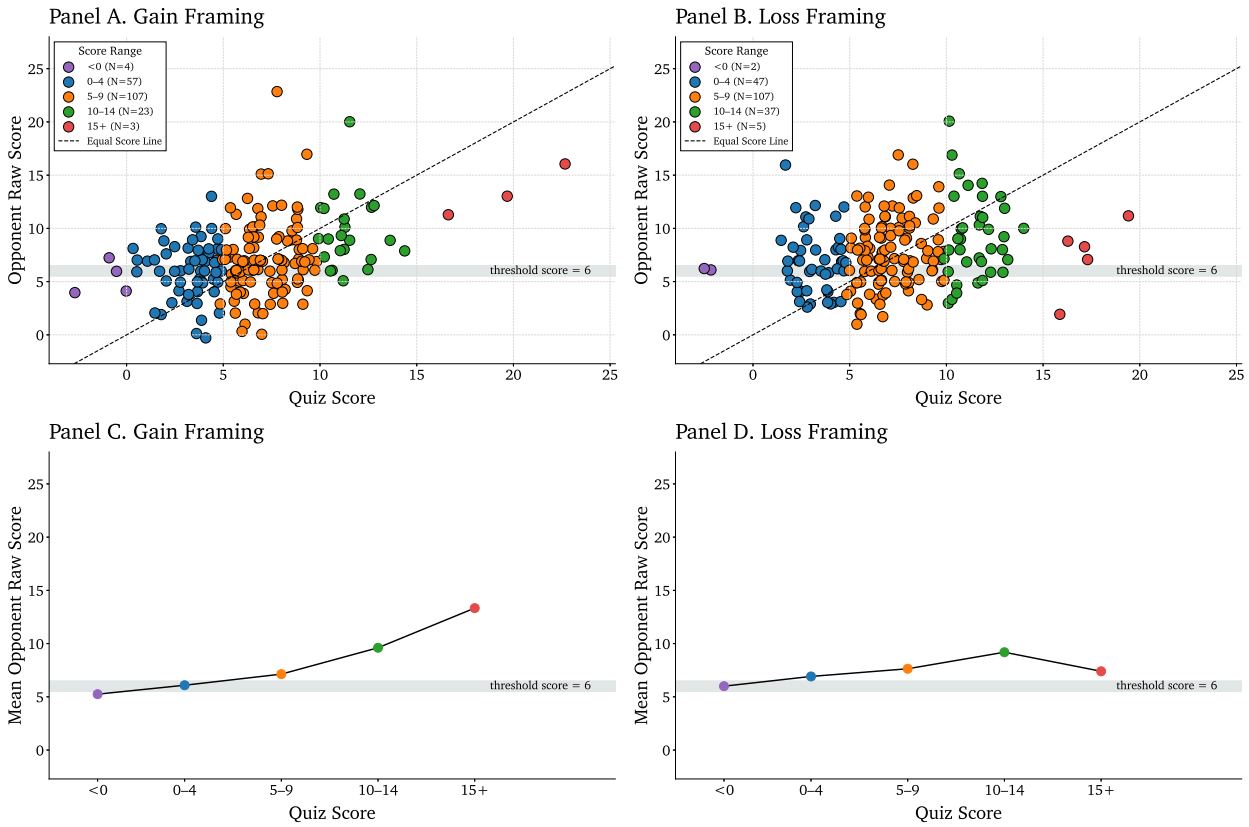
$$e_C^{*,f} \;\leq\; e_{NC}^{*,f}$$

as claimed.

B Additional Figures and Tables

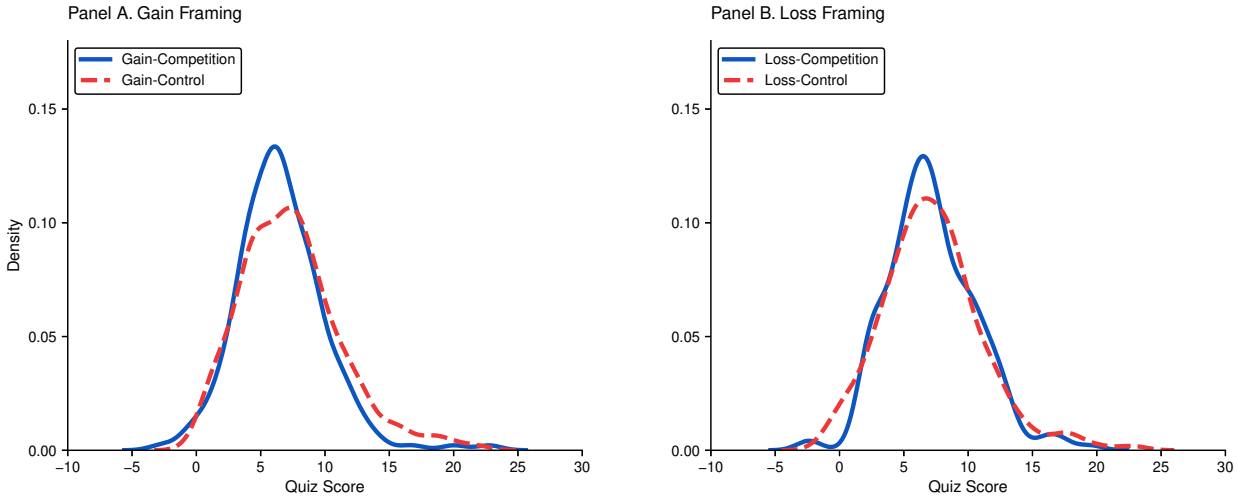
B.1 Additional Figures

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



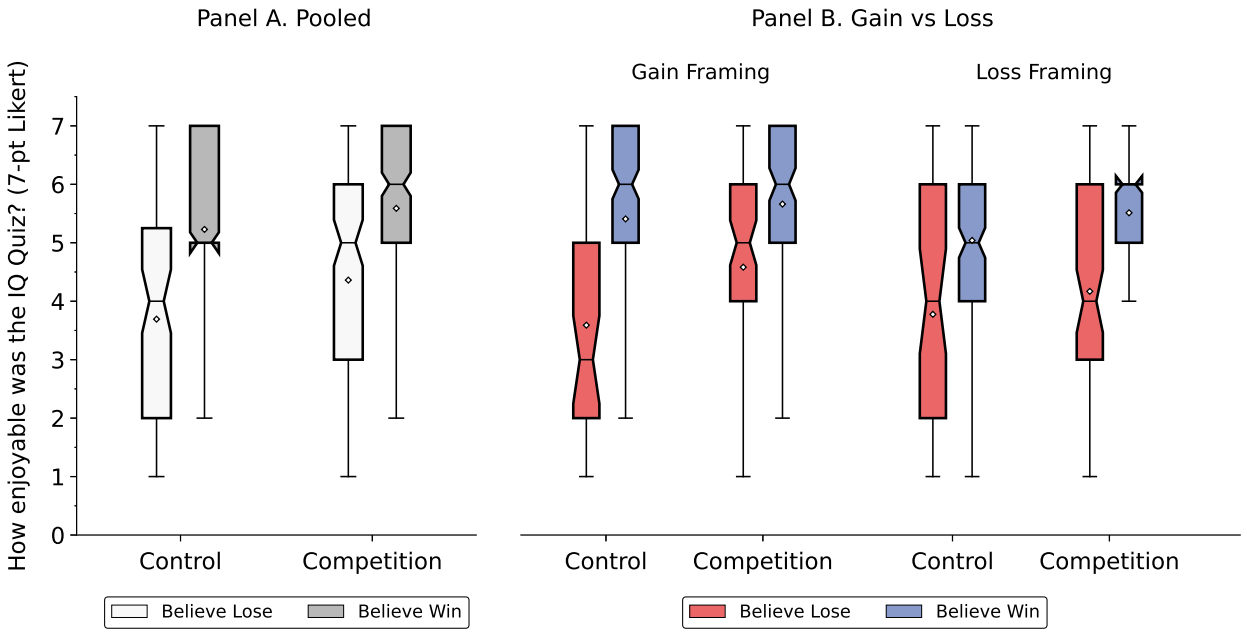
Notes: This figure plots *raw opponent scores* versus participants' quiz scores under *Gain* (A, C) and *Loss* (B, D) framings. Panels A–B show scatterplots; points are colored by quiz-score bins (< 0, 0–4, 5–9, 10–14, $15+$) with bin counts in the legend. The dashed $45°$ line indicates equal scores. The shaded band at 6 marks the fixed threshold from the non-competitive reference. Panels C–D display bin means by quiz-score bin; lines connect means for readability. Patterns are comparable across framings; values on the y-axis are unadjusted (raw) opponent scores.

Appendix Figure B.2: Distribution of Quiz Score



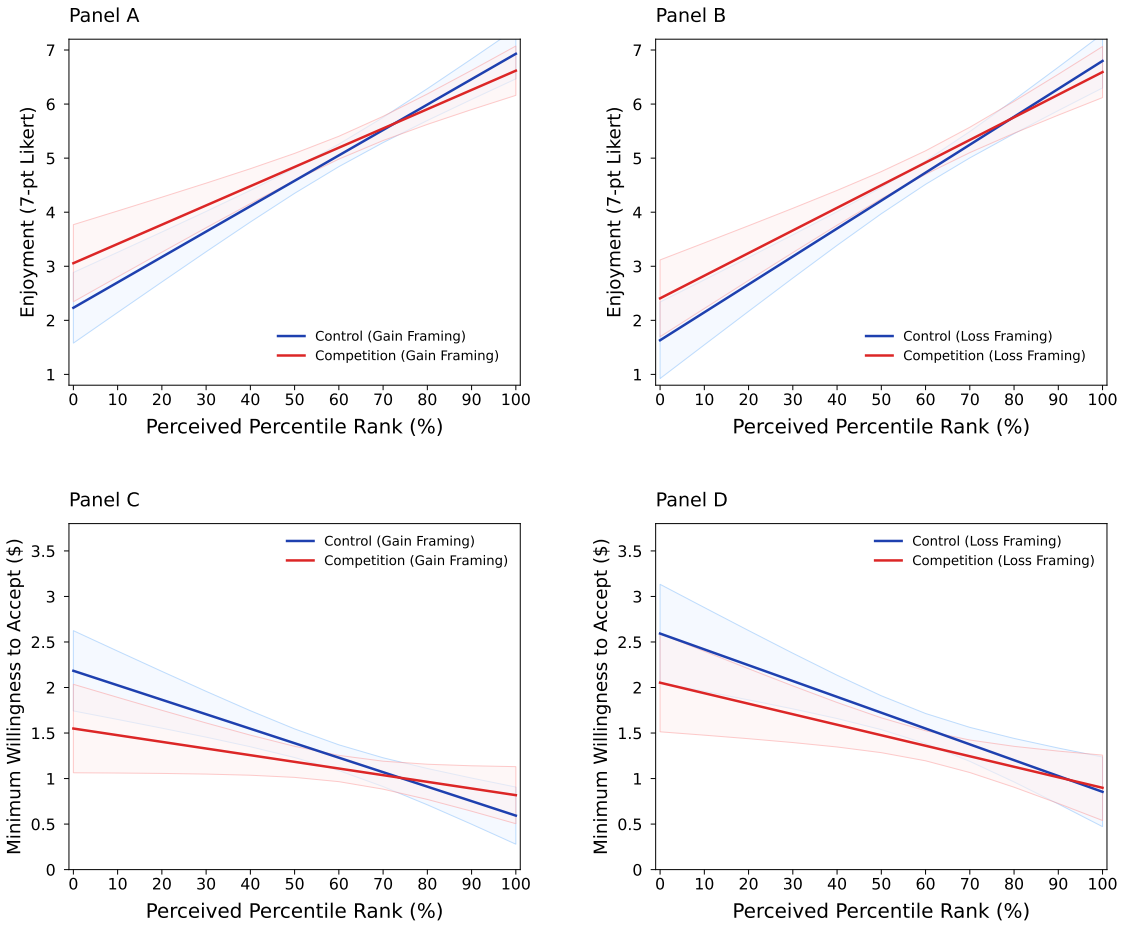
Notes: This figure plots the distribution of quiz scores by framing and treatment. Panel A (Gain) contrasts Competition (solid blue) with Control (dashed red); Panel B (Loss) contrasts Competition (solid blue) with Control (dashed red). Scores are on the -10 to 30 scale; densities integrate to one within each panel.

Appendix Figure B.3: Belief in Winning and Utility



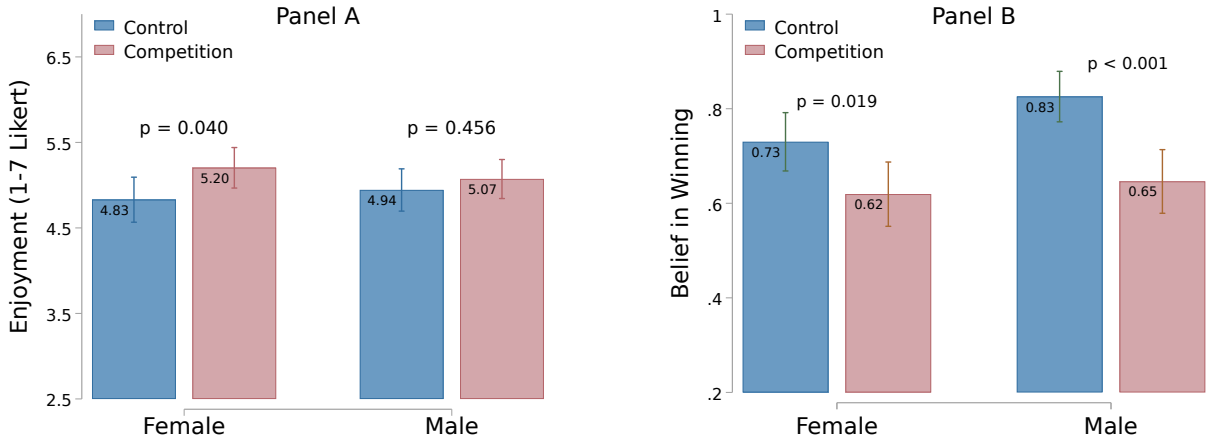
Notes: This figure plots self-reported enjoyment by winning beliefs ("believe lose" vs. "believe win") across experimental conditions (competition vs. control). Enjoyment was measured on a 7-point Likert scale in response to the question: "On a scale of 1 (not at all enjoyable) to 7 (extremely enjoyable), 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



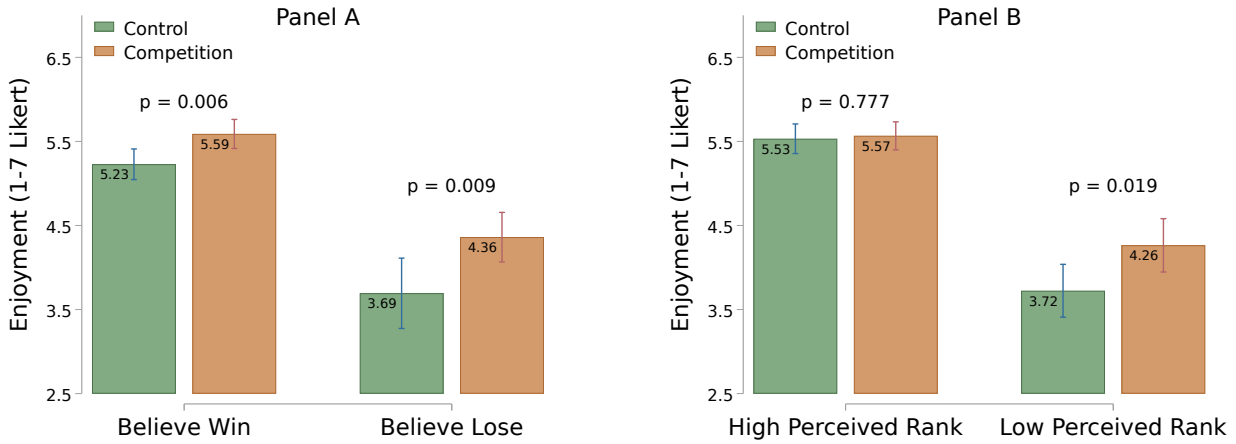
Notes: This figure shows the heterogeneous effects of competition by framing condition and perceived performance rank. Panels A and B plot predicted enjoyment (measured on a 7-point Likert scale) against perceived percentile rank for the gain- and loss-framing conditions, respectively. Panels C and D 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



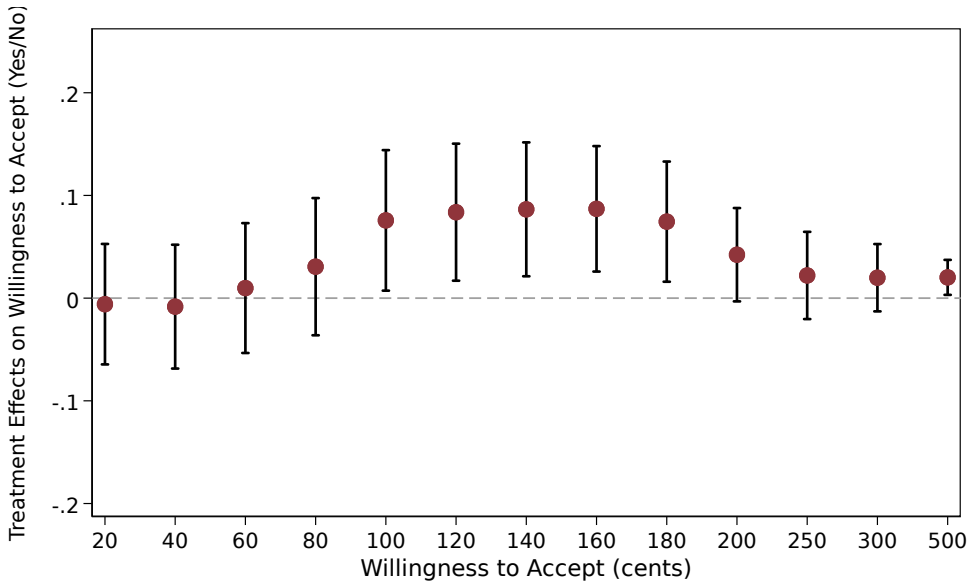
Notes: This figure illustrates the effects of competition by gender on enjoyment and belief in winning. Enjoyment is measured using a 7-point Likert scale question, where a larger number indicates greater enjoyment. Belief in winning is a binary indicator; the bar height represents the percentage of 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



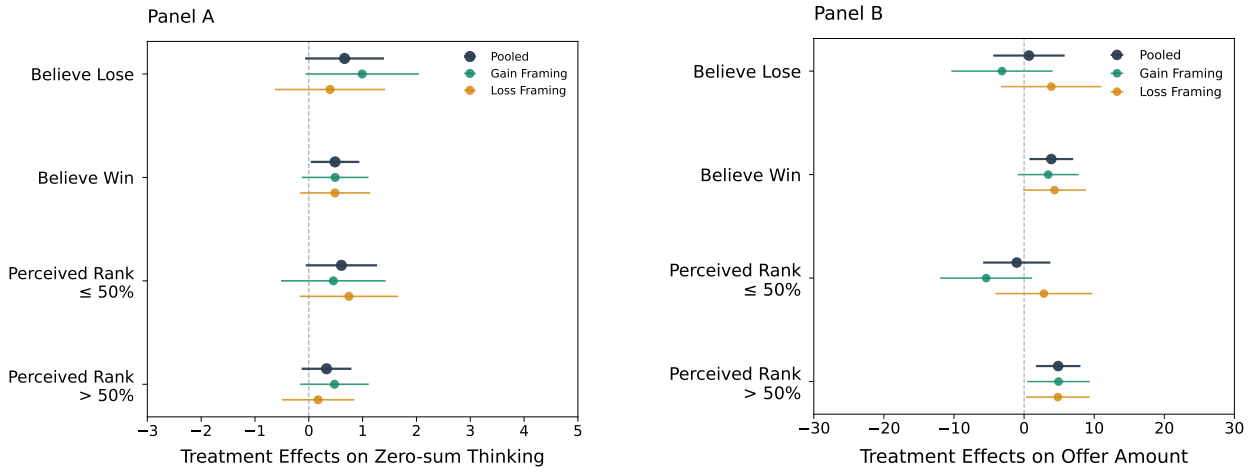
Notes: This figure illustrates the effects of competition on enjoyment by participants' winning beliefs and perceived rank. Enjoyment is measured on a 7-point Likert scale, with higher values indicating greater enjoyment. Bars represent mean enjoyment within each subgroup. "Believe Win" denotes participants 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



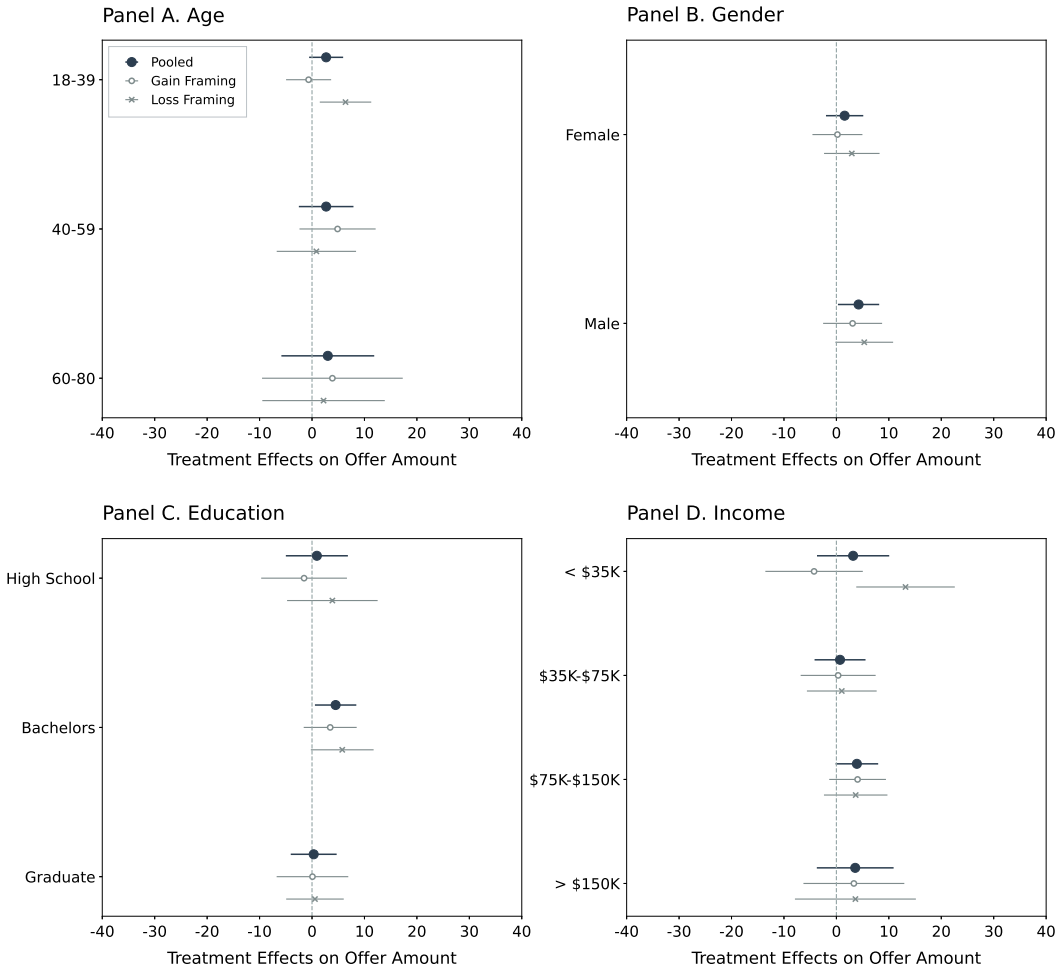
Notes: This figure shows the effect of competition on willingness to perform the experimental task again at different monetary amounts. For each listed amount, the outcome is a binary indicator equal to one if participants stated that they would accept performing the task again for that payment and zero 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. Results for the gain- and loss-framing conditions are provided in Appendix Figure **??**.

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



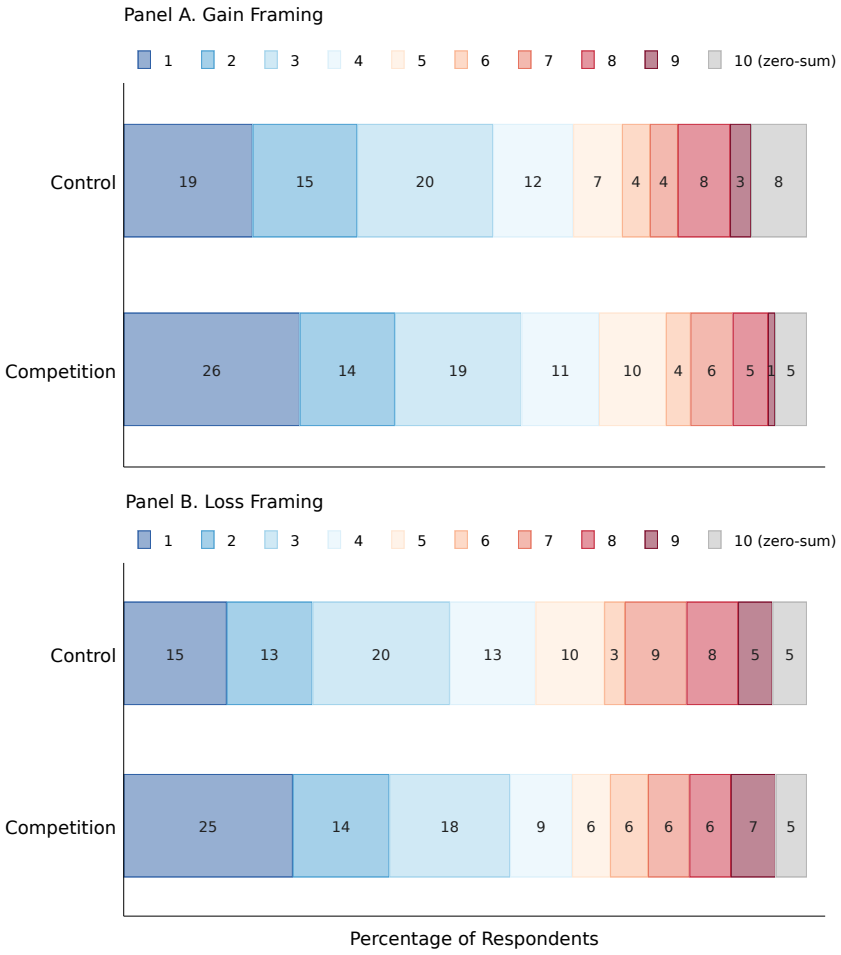
Notes: This figure shows heterogeneous treatment effects of competition on zero-sum thinking and altruism. Panel A shows effects on zero-sum thinking, and Panel B shows effects on offer amounts. Each point represents the estimated treatment effect, and the horizontal lines indicate 95% confidence intervals. 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



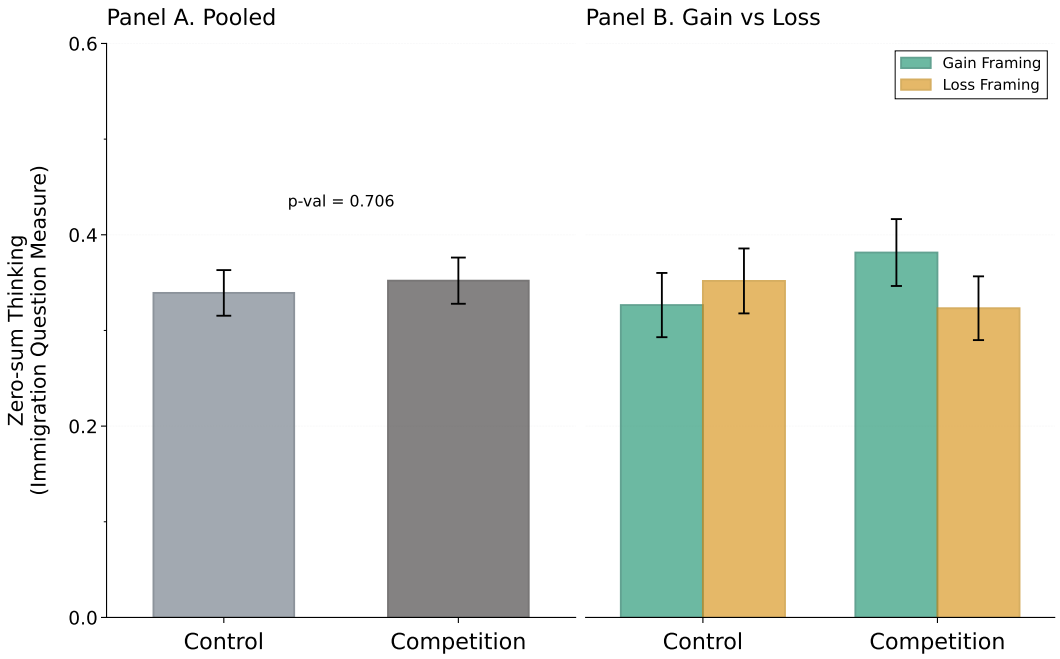
Notes: This figure shows the heterogeneous effects of competition on altruism by participants' beliefs about winning and their perceived performance rank under gain and loss framing. Panel A displays results for the control and competition groups under gain framing, and Panel B displays the corresponding 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



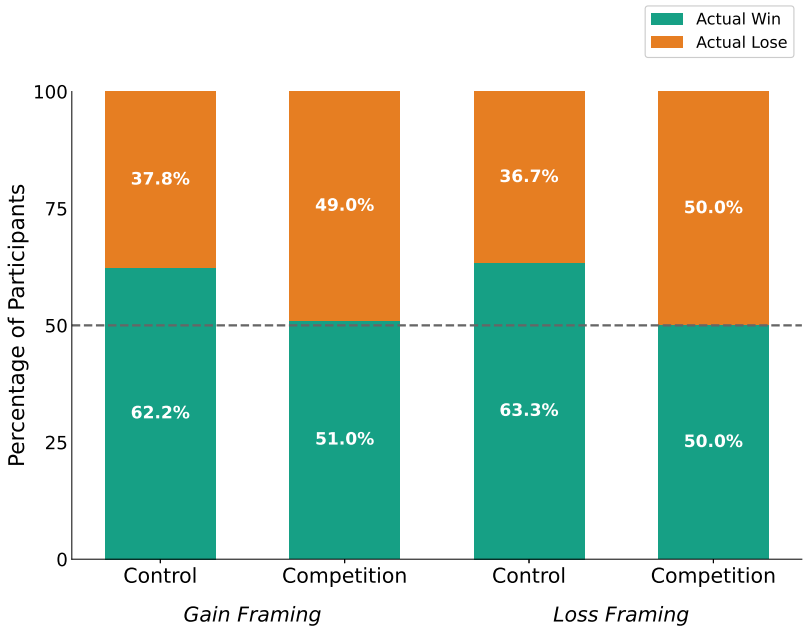
Notes: The figure displays the distribution of responses on the zero-sum scale under gain framing (Panel A) and loss framing (Panel B). Zero-sum beliefs are measured using a World Values Survey item (Inglehart et al., 2014), where respondents rate their agreement on a 1–10 scale between the statements: "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 (Alternative Measure)



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 **??**.

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

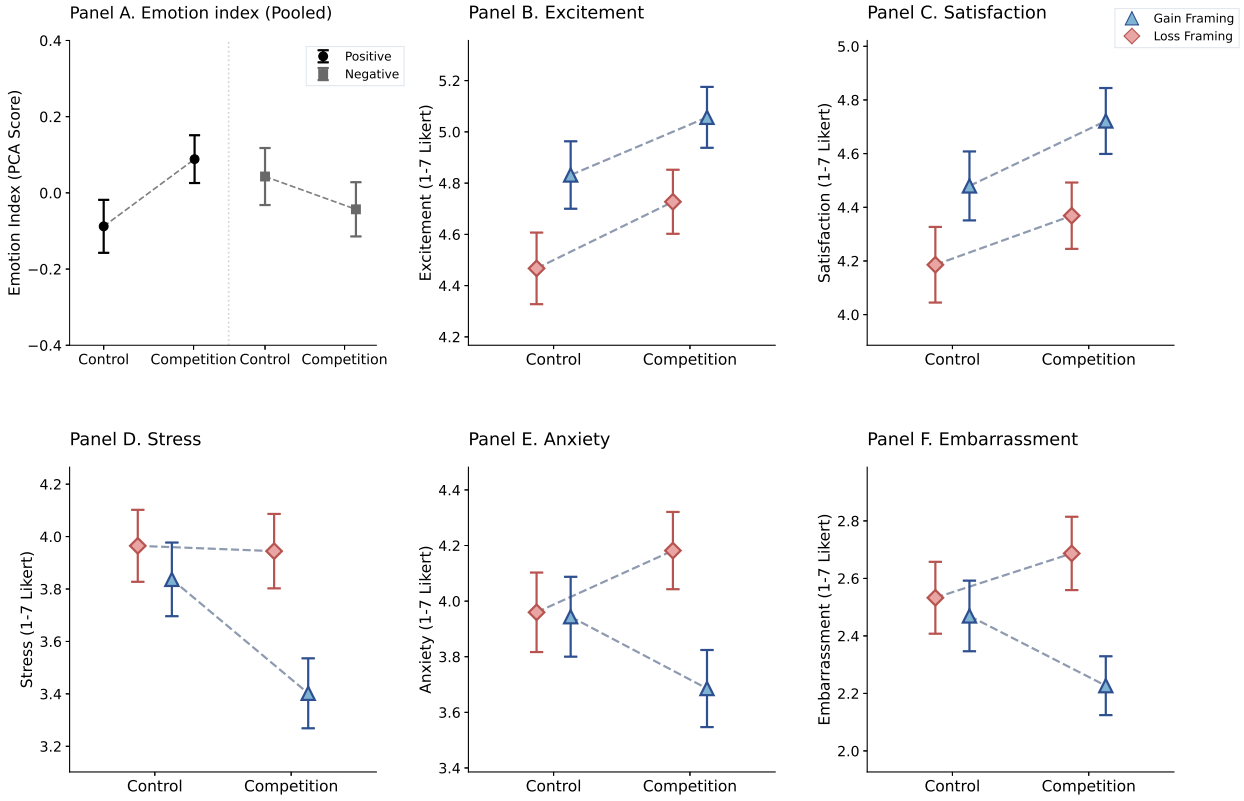
Notes: This table reports the treatment effects of competition on the emotion index. The positive emotion index (columns 1–6) is constructed from measures of excitement and satisfaction, while the negative emotion index (columns 7–10) is constructed from measures of stress, anxiety, and embarrassment, 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C Supplemental Analyses

C.1 Effects of Competition on Emotional Components of Utility

Utility, as a measure of overall happiness, can be decomposed into specific emotional components. Appendix Figure C.13 illustrates how competition affects excitement, satisfaction, stress, anxiety, and embarrassment. Excitement and satisfaction are classified as positive emotions, whereas stress, anxiety, and embarrassment are classified as negative. All emotions were measured on a 7-point Likert scale, with higher values indicating stronger intensities.

Appendix Figure C.13: 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.13 documents the general pattern that competition increases positive emotions while reducing negative ones using the pooled sample. Panels B and C show that competition raises excitement and satisfaction in the IQ quiz, irrespective 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. The specific regression estimates are in Appendix Tables B.13 and B.14.[31]

Columns 1, 3, 5, and 7 of Appendix Table B.15 shows 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, though less so under loss framing.

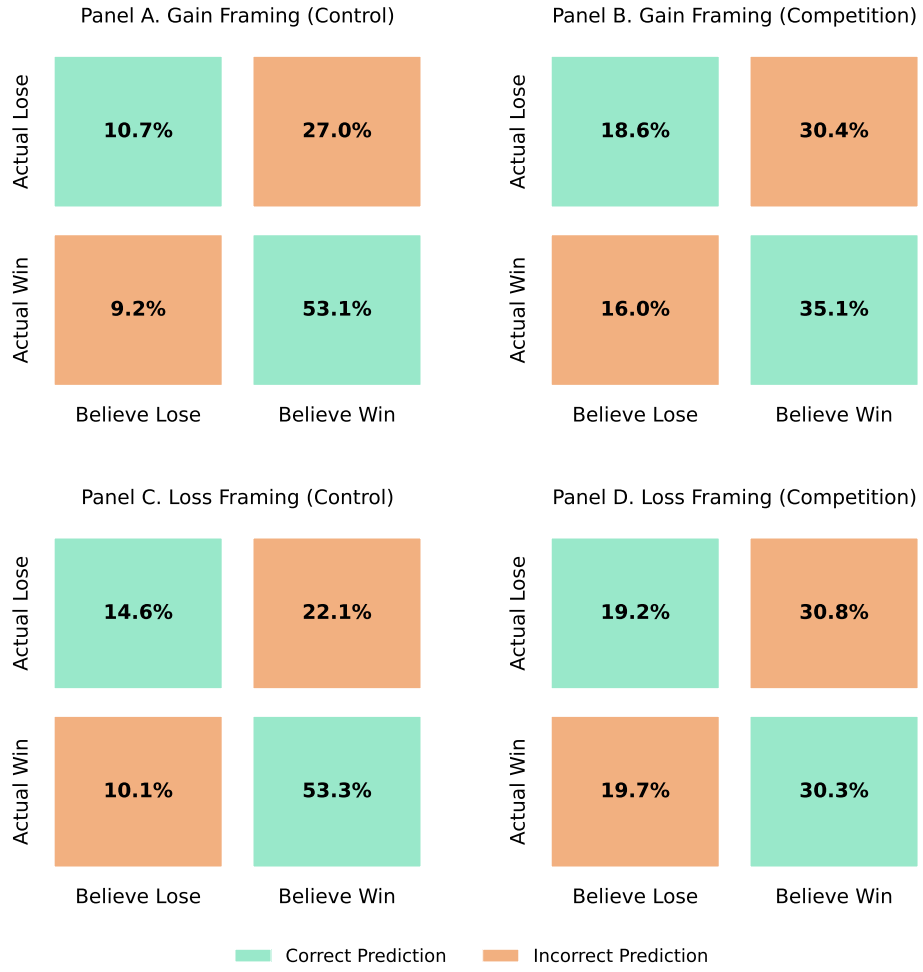
RESULT 7. *Through the belief channel, competition reduces positive emotions and increases negative ones, whereas through the intrinsic utility channel, it does the opposite: it generates positive emotions and reduces negative ones.*

[31] Appendix Figure **??** shows bar graphs for each emotional component using the pooled sample. Appendix Figures **??** and **??** present the distribution of emotional components under gain and loss framing, respectively.

C.2 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.

Appendix Figure C.14: 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).

Appendix Figure C.14 illustrates this distinction by comparing anticipated versus actual outcomes: believing one would win vs. actually winning, and believing one would lose

vs. actually losing.[32] 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.

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.

[32] A comparison of expected and actual performance rank in the IQ quiz is in Appendix Figure **??**.

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 par-

ticipants 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.

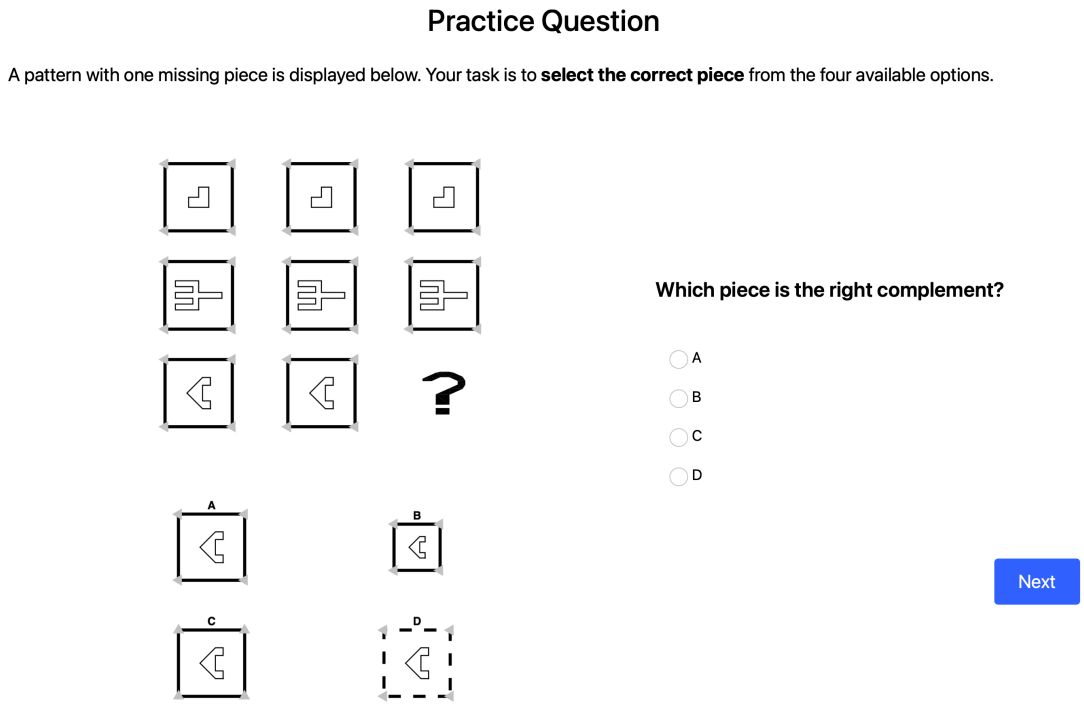
LOSS FRAMING: CONTROL GROUP

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.

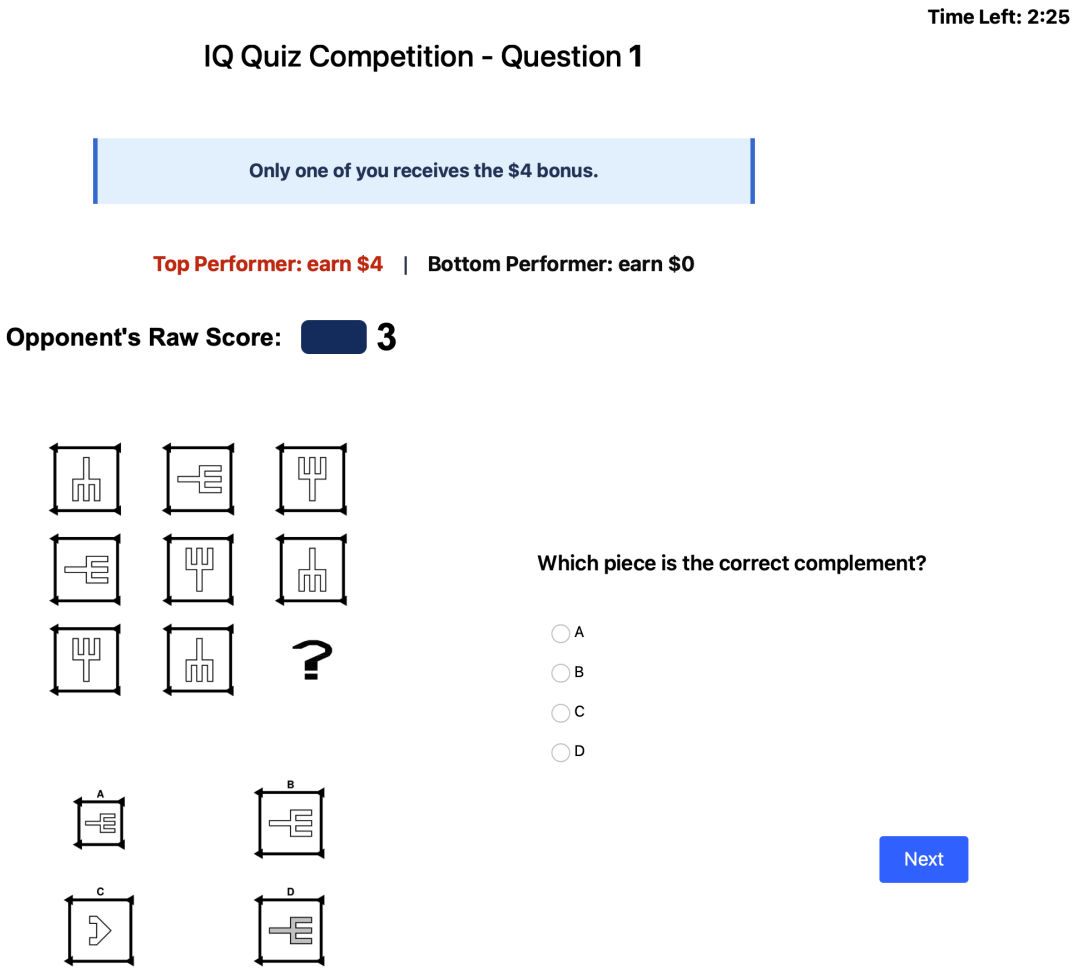
B. Matching

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.

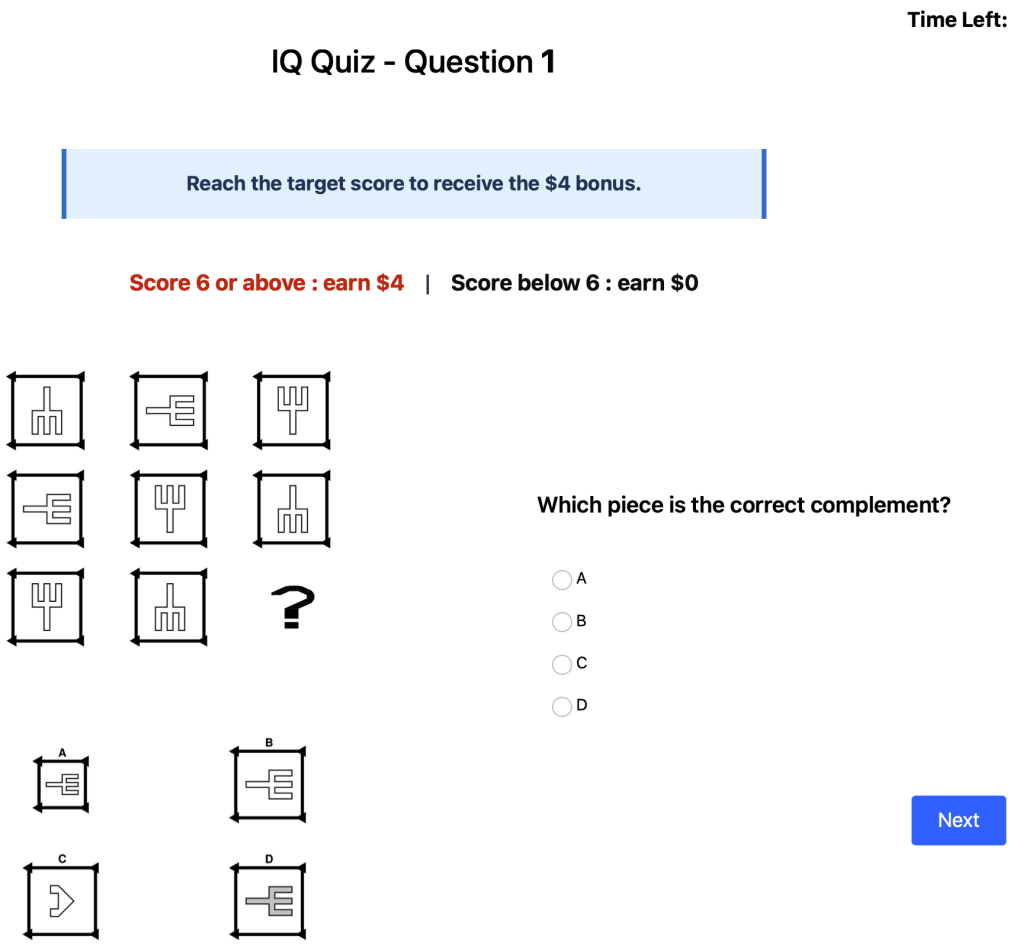
C. *IQ Quiz Question*

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.

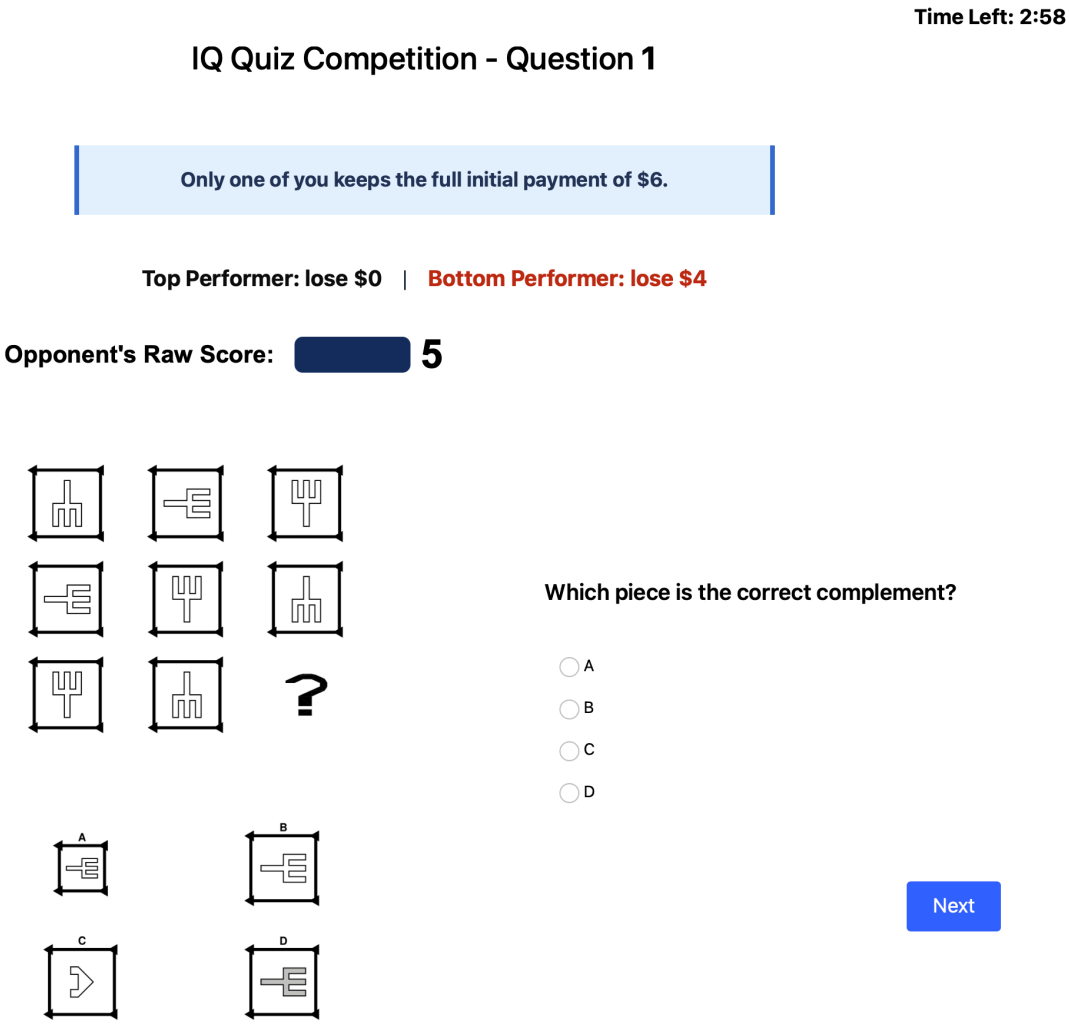
Appendix Figure D.2: Sample IQ Quiz Question – Gain Framing (Competition Group)



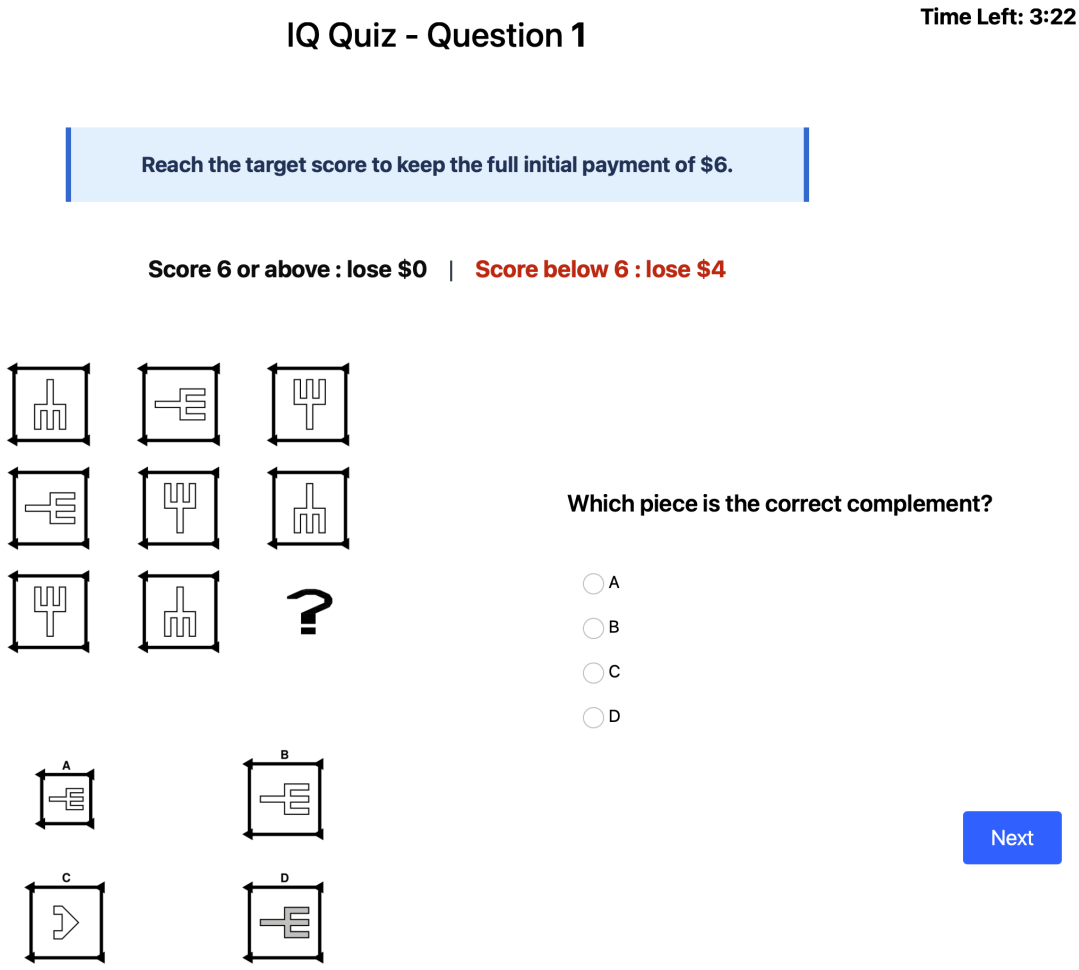
Appendix Figure D.3: Sample IQ Quiz Question – Gain Framing (Control Group)



Appendix Figure D.4: Sample IQ Quiz Question – Loss Framing (Competition Group)



Appendix Figure D.5: 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)]

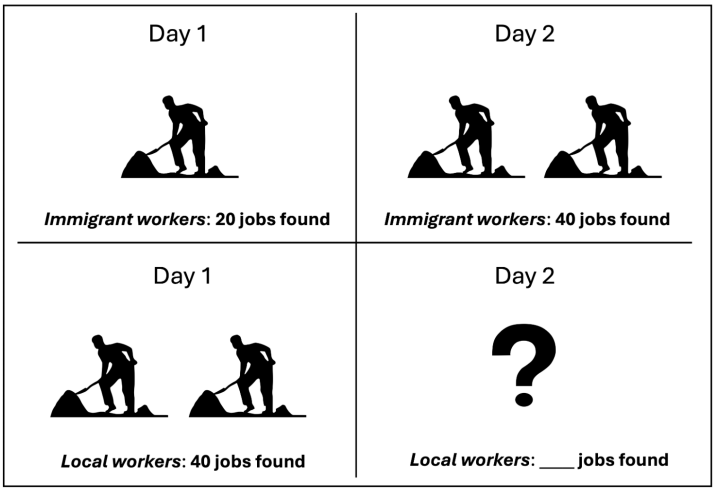
B. Task Preference

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

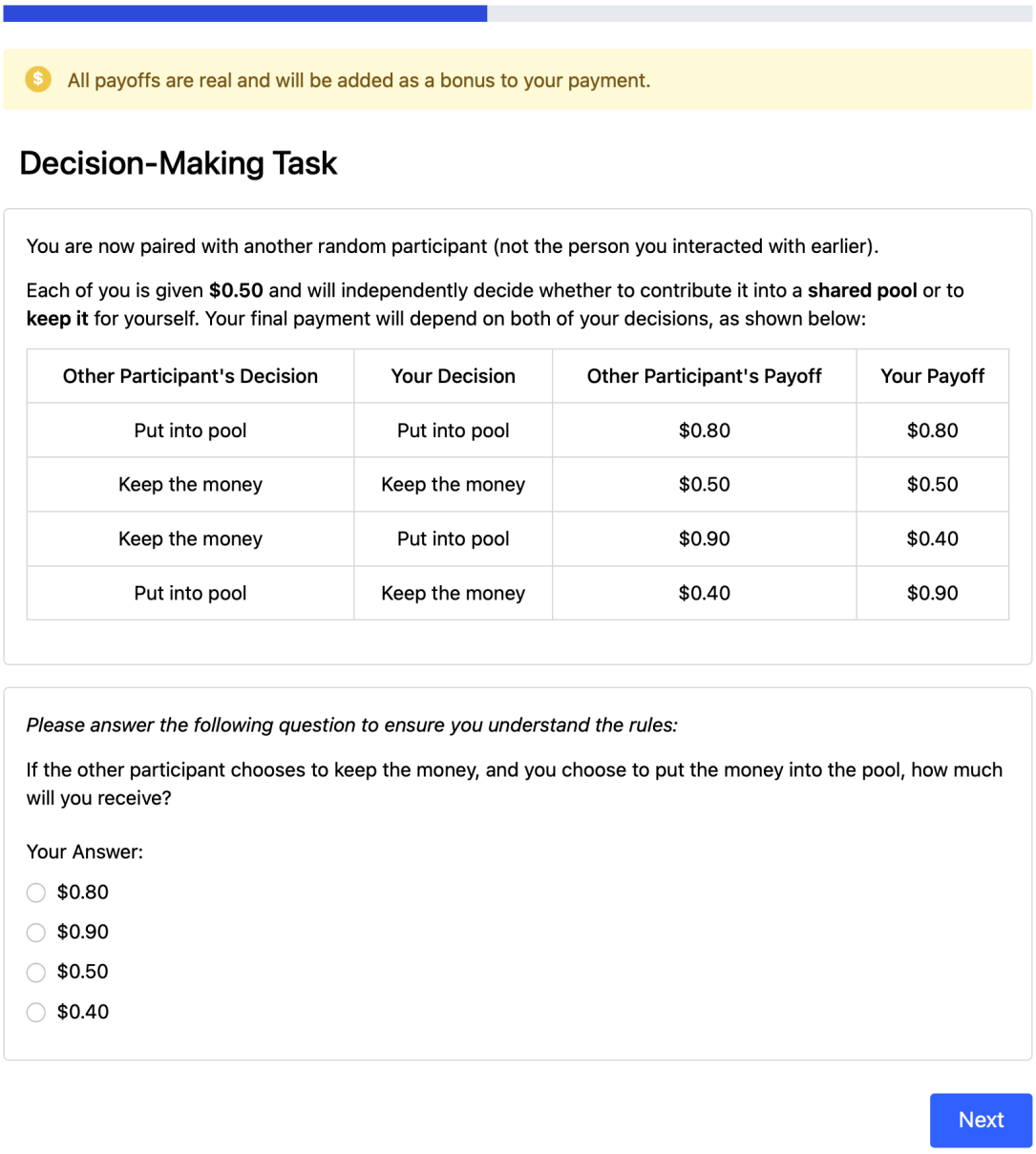
Question1. Consider a local job market where both immigrants and locals work as day laborers. On Day 1, immigrant workers found 20 jobs, while local workers found 40 jobs. On Day 2, immigrant workers found 40 jobs. Which of the following estimates is more likely to be accurate regarding the number of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



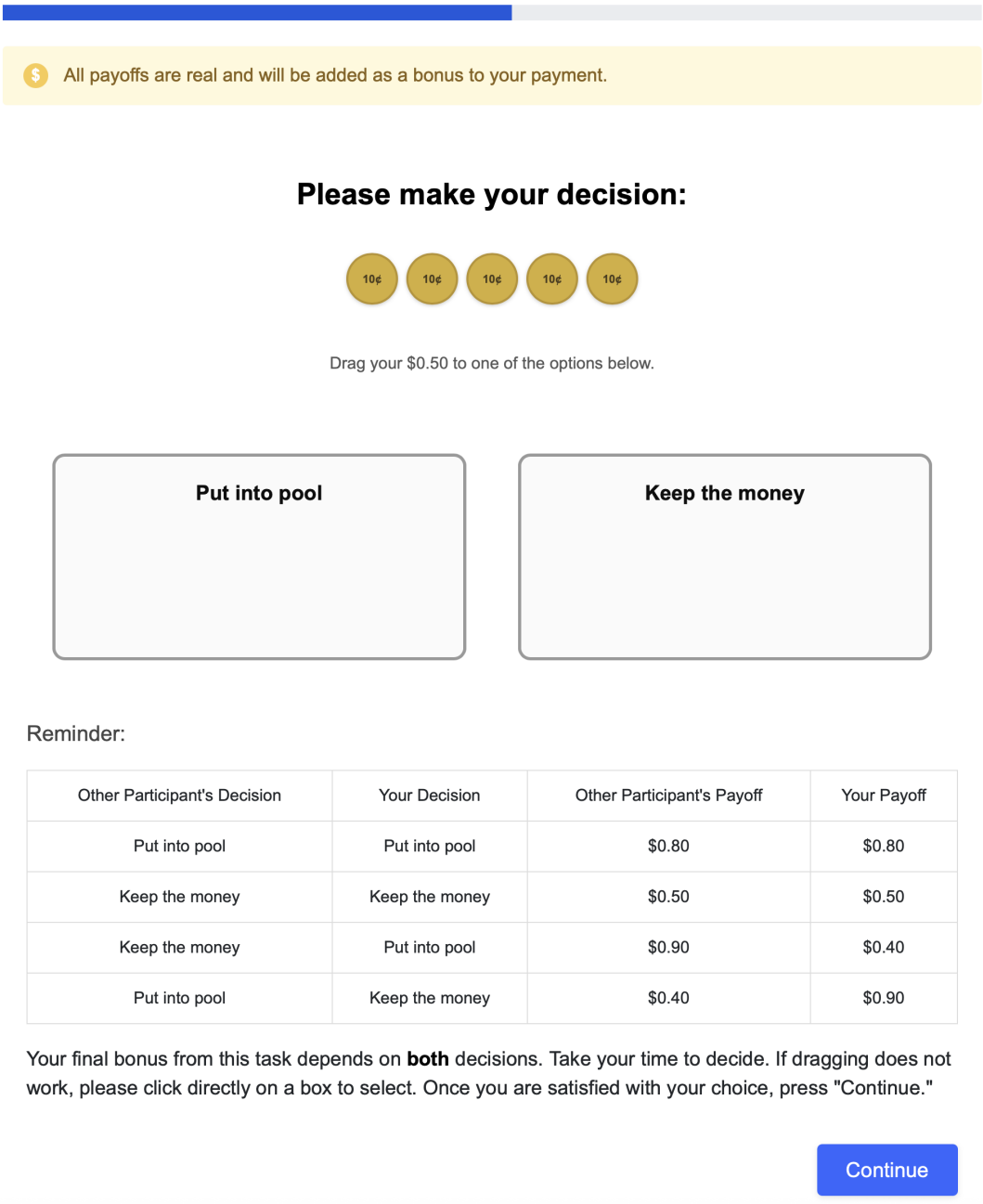
Question2. Below are two statements. Where do your views fall on a scale from 1 to 10? 1 means you agree completely with the statement 1; 10 means you agree completely with the statement 2. *Statement 1*: People can only become wealthy at the expense of others. *Statement 2*: Wealth can grow so there's 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.6: Public Goods Game Instructions



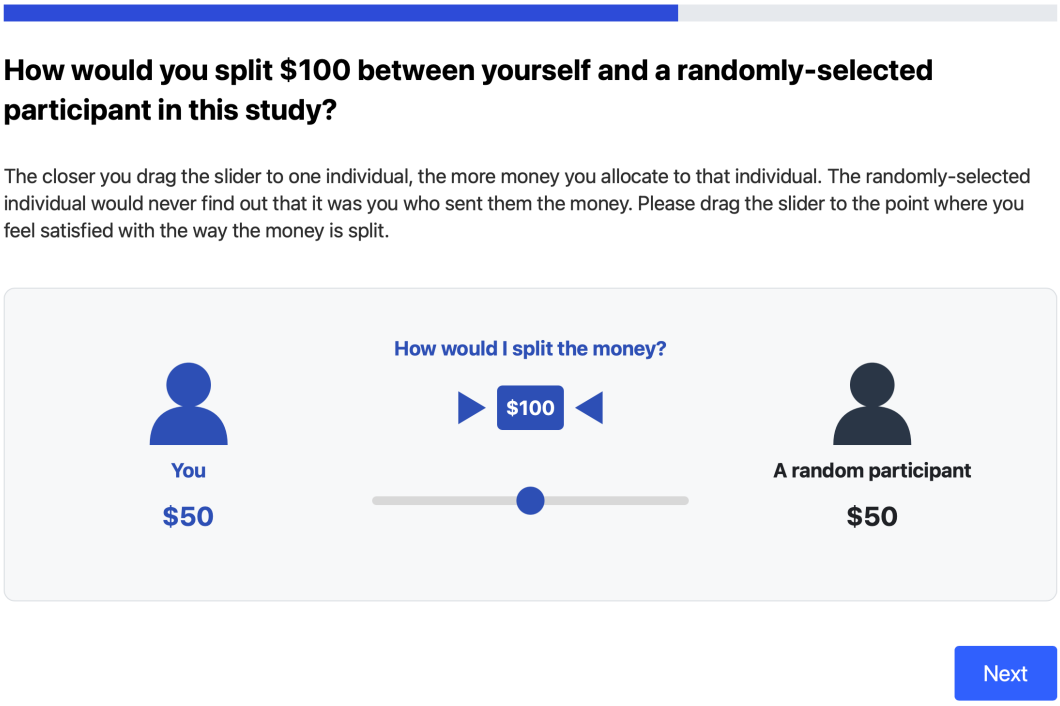
Appendix Figure D.7: Public Goods Game-Decision Page



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.8: 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).