Freedom, Power and Interference*

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Abstract

We propose a behavioral theory of preference for decision rights, driven by preference for freedom, power, or non-interference, which can lead subjects to value decision rights intrinsically, i.e., beyond the expected utility associated with them. We conduct a novel laboratory experiment in which the effect of each preference is distinguished. We find that the intrinsic value of decision rights is driven more strongly by preference for non-interference than by preference for freedom or power. This result suggests that individuals value decision rights neither because they enjoy the freedom of making a choice, nor because they enjoy having power over other individuals, but rather because they dislike letting other individuals interfere in their outcomes. Our theoretical framework and experimental findings lead to a fundamental change in perspective on preference for decision rights.

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1 Introduction

Freedom and power are pervasive components in any social, political, and economic interaction in our lives. In any organization, from clubs to corporations and government bodies, individuals interact by making decisions, affecting themselves to the extent that they have the freedom to do so, and affecting others to the extent that they have the power to do so. Thus, freedom and power are fundamentally related to the exercise of decision rights. Economics, which has traditionally considered decision rights solely for their instrumental value in achieving outcomes, has recently moved to consider decision rights also for their intrinsic value, i.e., the value beyond the expected utility associated with them. In doing so, economics has built on previous literature in philosophy and sociology that has highlighted the intrinsic value of freedom and power.[1]

In this paper, we propose a behavioral theory of preference for decision rights, driven by preference for freedom, power, and non-interference, and we conduct a novel laboratory experiment in which the effect of each preference is distinguished. We employ the following terminology. An individual experiences *freedom* when his preferences over the possible outcomes influence the outcomes he achieves. An individual experiences *power* when his preferences influence another individual's outcomes. An individual does not experience *interference* (in other words, he experiences *non-interference*) when his outcomes are not influenced by another individual's preferences. Each concept captures the causal dependence of an individuals' preferences on an individuals' outcomes. The causal dependence is measured via the mutual information between preferences and outcomes. In our behavioral theory, individuals have not only preferences over outcomes, which lead them to value decision rights instrumentally, but also preference for freedom, power, and non-interference, which lead them to value decision rights intrinsically.

Consider the following situation as an example. Suppose a group of individuals can be organized in various institutions to decide some outcome. Ex ante no individual knows his preferences over the possible outcomes. If the group is organized as a dictatorship, the dictator has obviously freedom: his

[1] In philosophy, the view that "liberty" and wellbeing are strongly connected originates from Mill (1963). In sociology, McClelland (1975) views "power" as an intrinsic human need.

outcomes will completely depend on his preferences. Since the other individuals' outcomes will depend on his preferences, the dictator has also power. He also experiences non-interference since his outcomes will not depend on the other individuals' preferences. All other individuals do not have either freedom or power: their outcomes and preferences are uncorrelated. However, there is a perfect correlation between the preferences of another player (the dictator) and their outcomes. Therefore, they experience a high degree of interference, i.e. a low degree of non-interference. Compare the dictatorship with the institution of majority voting. Under majority voting, each individual will enjoy some freedom, some power, and some non-interference, since the preferences of all influence the outcomes of all, but the preferences of no single one of them fully determine the outcome of any of them.

Contributions. We present a general theoretical model of decision-rights allocation and choice, which we formulate in the context of extensive form games. Within a Bayesian game, the model can represent a player who may change his behavior at an earlier stage of the game in anticipation of greater freedom, power, and non-interference at a later stage. Specifically, in a setting where a player can bid for a decision right via an auction mechanism, his bid may be influenced by the freedom, power, and non-interference conveyed by the decision right. The model has several key features.

First, we employ a Bayesian game with players of different types to generate for each player a variation in preferences. Freedom, power, and non-interference require a variation in preferences, which in a Bayesian game is given by the uncertainty about types.[2] Second, outcome functions associating each terminal node with an outcome are player-specific. This allows to distinguish freedom, which involves influencing one's own outcomes, from power, which involves influencing other players' outcomes. Third, the causal influence of preference profiles on outcomes is measured by how far the joint distribution of outcomes and preference profiles is from the independent case.

We implement a simplified version of the model in a laboratory experiment. Pairs of participants (Player 1 and Player 2) play a game that involves the allocation and the exercise of a decision right. First, Player 1 bids for the

[2]Instead, the same framework can be used with 'reasonable' preferences (Jones and Sugden 1982) instead of uncertainty about preferences. For details, see Rommeswinkel (2014).

decision right. Second, if Player 1 receives the decision right, he exercises it; otherwise Player 2 exercises it. The exercise of the decision right consists of making a final choice, which generates payoff consequences for both players. Uncertainty regarding the payoff consequences is resolved before the final choice is made, but only after the bid for the decision right is submitted by Player 1. Across treatments and rounds, we vary the freedom, power, and non-interference associated with the decision right. We estimate how Player 1's preference for freedom, power, and non-interference affects his valuation of the decision right, as revealed by his bid. A higher bid has two effects. First, it increases the probability that Player 1 will hold the decision right. Second, it decreases the payoff uncertainty for Player 1. Therefore, it is crucial to distinguish between two different motivations for a high bid: intrinsic valuation of the decision right and risk aversion. By eliciting individual risk preferences in an additional game, we compare the actual bids with the bids implied by the elicited risk preferences.

Results and implications. Evidence from our experiment confirms the existence of an intrinsic value of decision rights, as previously reported in Fehr et al. (2013) and Bartling et al. (2014) within a delegation setting, and extends it to a willingness-to-pay/auction setting. Most importantly, our theoretical framework and experimental design allow to disentangle the factors generating the intrinsic value of decision rights.

We highlight two main findings. First, we find no evidence of preference for power. This result suggests that preference for power, as casually observed in politics or other institutional settings, may simply be instrumental to other components of well-being, such as status recognition. Second, we find stronger evidence of preference for non-interference than of preference for freedom. This result suggests that individuals value decision rights neither because they enjoy the freedom of making a choice, nor because they enjoy having power over other individuals, but rather because they dislike letting other individuals interfere in their outcomes. Our theoretical framework and experimental findings lead to a fundamental change in perspective on preference for decision rights. Individuals like to have decision rights in virtue of the absence of the decision rights of other individuals. An individual's evaluation of risks then depends on whether risks are generated by an objective process or by the behavior of other individuals.

Our findings contribute to the corporate governance (Dyck and Zingales 2004) and entrepreneurship literature (Hamilton 2000; Moskowitz and Vissing-Jørgensen 2002) on the private benefits of control. The evidence that a preference for non-interference is the source of the intrinsic value of decision rights suggests that managers in control and self-employed entrepreneurs enjoy their roles not because they lead the actual decision-making process (*freedom*), not because they exercise control over other individuals (*power*), but because other individuals cannot exercise control over them (*non-interference*). Moreover, our findings are also related to the literature on the delegation of decision rights (Fehr et al. 2013, Bartling et al. 2014), suggesting that the reluctance of a principal to delegate a decision right to an agent is driven by his reluctance to allow an agent to interfere with his outcomes and not by his reluctance to give up power over the agent. Finally, our findings contribute to the human resource literature on high-performance work systems (Bartling et al. 2012), suggesting that individuals with a strong preference for non-interference are likely to appreciate jobs with high task discretion and to self-select into high-performance work systems.

Related literature. This paper lies at the intersection of several literatures, both experimental and theoretical. The paper builds on previous experimental work documenting the intrinsic value of decision rights. In a principal-agent experiment, Fehr et al. (2013) find that principals often decide not to delegate a decision right to an agent even when delegation would provide large expected utility gains. Bartling et al. (2014) report that two game-specific characteristics affect the intrinsic value of decision rights. The intrinsic value of decision rights is higher when the stake size and the alignment of interests between the principal and the agent are higher. They find that the intrinsic value of decision rights cannot be explained by risk preferences, social preferences, ambiguity aversion, loss aversion, illusion of control, preference reversal, reciprocity, or bounded rationality. Instead, they conclude that the intrinsic value of decision rights originates from an intrinsic preference for decision rights. Our paper tackles the unanswered question of what the ultimate drivers of a preference for decision rights are.[3]

[3]Bartling et al. (2014) state "The finding that individuals intrinsically value decision rights naturally leads to the question of the ultimate reason why people value decision

Our paper builds on concepts and measures originally developed in the literature on freedom of choice (Barberà et al. 2004, Baujard 2007, Dowding and van Hees 2009), diversity (Nehring and Puppe 2009) and power indices (Penrose 1946, Shapley and Shubik 1954, Banzhaf 1965, Diskin and Koppel 2010). The measures we propose for freedom and non-interference are closely related to the concepts of positive and negative freedom, originally introduced in philosophy by Berlin (1958), though not in the context of strategic interaction.

The main difference from the freedom of choice literature is that in our experiment players face uncertainty over their future preferences, which are induced by moves of Nature. In the freedom of choice literature preferences are formed internally and may be known at the time of decision making. Freedom is then derived from hypothetical preferences, as for example in Jones and Sugden (1982). We believe that our experimental setup is conservative: if we observe any effect of preference for freedom, power, or non-interference with preferences induced by moves of Nature, it is likely that such effects persist if preferences are formed internally.

We highlight two concepts that are related to our main result (i.e., the intrinsic value of decision rights) but not to our framework: preference for flexibility (Kreps 1979) and betrayal aversion (Bohnet and Zeckhauser 2004). First, preference for flexibility does not apply to our framework, nor to Fehr et al. (2013) and Bartling et al. (2014), since preference for flexibility is already captured in the behavior predicted by the Nash equilibrium. In our experimental design, players are informed about their preferences over outcomes after the decision right is assigned. In the Nash equilibrium, individuals anticipate at an earlier stage the value of being able at a later stage to make a final choice instead of receiving the outcome of a lottery. In other words, the value of flexibility is fully captured by Nash equilibrium behavior. Thus, the deviations from Nash equilibrium, which we observe, cannot be explained by preference for flexibility.[4]

rights beyond their instrumental benefits. One potential source stems directly from having or not having decision rights. [...] Alternatively, decision rights could be intrinsically valuable because the utility received from specific outcomes depends on whether the outcome is a consequence of one's own actions, the actions of someone else, or not the consequence of a choice at all. Further exploring these potential sources of the intrinsic value of decision rights provides exciting avenues for future research." With a behavioral model of preference for freedom, power, and non-interference, we formalize these sources.

[4]Preference for freedom is the procedural rather than the consequentialist value of one's

Second, Bohnet and Zeckhauser (2004) report experimental evidence suggesting that the decision not to trust another individual is driven by betrayal aversion. In their experimental design, the decision to trust someone (letting another individual make a final choice that has payoff consequences for both individuals) entails an additional risk premium compared to the decision to let a random-device lottery determine the final choice and payoff consequences. They argue that the additional risk premium is required to balance the costs of trust betrayal. However, as they acknowledge, their design cannot establish whether differences in behavior are due to different assessments of the outcomes. Therefore, they cannot rule out that their results may be driven not by an aversion to betrayal but by an aversion to relinquishing control to another individual ('interference' in our framework). Our results suggest that aversion to interference may be a driver of behavior in their experiment.

Plan of the paper. The paper proceeds as follows. In Section 2, we outline a behavioral model of preference for freedom, power, and non-interference. Section 3 describes the experimental design. We present the theoretical predictions of the model in Section 4 and the empirical strategy in Section 5. The results are given in Section 6. Section 7 concludes.

2 Theoretical framework

In this section, we describe a model of decision-rights allocation and choice. To provide a general theoretical framework, we formulate the model in the context of extensive form games. We then implement a simplified version of the model in a laboratory experiment.

2.1 Notation

Consider a Bayesian game $\Im = (N, A, \psi, \mathcal{P}, \mathcal{I}, \mathcal{C}, O, \mathcal{U}, p)$. $N = \{1, \ldots, n\}$ is a finite set of players, and A is a finite set of nodes. $\psi : A \backslash a_0 \to A$ is a predecessor function such that, for node a, $\psi(a)$ is the immediate predecessor of a. $\mathcal{P}$ is the player partitioning of the nodes. $\mathcal{I} = \{I_0, \ldots, I_n\}$ is the information partitioning, with I_i being the set of information sets of Player i, and $A(I) = \{a \in A : \psi(a) \in I\}$ is the set of nodes following information

own preferences determining the outcomes.

set I. $\mathcal{C}$ is the set of choice sets C_I for each information set I, and $\Delta(C_I)$ is the set of probability distributions over the choice set at I. For $b \in I$ and $b = \psi(a)$, let $c(a|b) \in C_I$ be the choice that leads from node b to node a.

Our notation diverges from the standard notation of Bayesian games by allowing for player-specific outcome functions. First, $O = \{o_1, ..., o_n\}$ is the set of outcome functions, where $o_i : A_\omega \to O_i$ maps the terminal nodes $A_\omega = A \backslash \psi(A)$ (with $\psi(A)$ being the image of ψ) into the finite set of possible outcomes for Player i, O_i. We require player-specific outcome functions to distinguish power from freedom. Having power means being able to influence another player's outcomes. Having freedom means being able to influence one's own outcomes. Outcome functions that are not player-specific would conflate power and freedom. However, if for all players i and j, $o_i = o_j$, we are back to the standard case with a single outcome function.

Finally, the set of types in the Bayesian game is given as follows. $\mathcal{U} = \{U_1, \ldots, U_n\}$ is the set of sets of utility functions $U_i = \{u_i^1, \ldots, u_i^J\}$ for each Player i, where $u_i^j : O_i \to \mathbb{R}$. Since our model of preference for freedom, power, and non-interference requires the possibility to act in one way or another, individuals need to potentially have more than one preference profile. Since individuals may at a particular point in time not yet know their preferences, information sets contain both nodes and utility functions: $I \subseteq A \cup \cup_{i \in N} U_i$ such that $I \cap A \neq \emptyset$ and $\forall i : I \cap U_i \neq \emptyset$. For example, at an information set $I \in I_1 = \{a_1, a_2, u_1^1, u_1^2, u_2^1\}$, Player 1 does not know whether he is at node a_1 or a_2 and whether he has preferences u_1^1 or u_1^2, but he knows that Player 2 has preferences u_2^1.

A local strategy $s_I \in \Delta(C_I)$ is a probability distribution over the elements of the choice set at information set I. A strategy profile S is a tuple of local strategies specifying behavior at each information set $S = (s_I|_{I \in I_i}|_{i \in N})$. p is the probability distribution of moves of Nature at information sets in I_0 and over utility functions for each player. Finally, θ^S denotes the joint probability distribution over nodes, outcomes, and preference profiles resulting from strategy profile S and moves of Nature according to p. The subgame function $subg(\supset, a)$ returns for any game $\supset$ the subgame starting at node a. Let θ_i be a joint probability distribution over nodes, outcomes, and preference profiles representing the beliefs of Player i. Let $\theta_{i|I}$ ($\theta_{i|a}$) denote the beliefs of Player i given that play has reached information set I (node a), derived from Bayesian updating on θ_i. We can construct the

belief of node a following the current information set given strategy s_I as $\tilde{\theta}_{i|s_I}(a) = \theta_{i|I}(\psi(a)) \cdot s_I(c(a|\psi(a)))$.

2.2 Equilibrium Concept

We define an equilibrium of game $\supset$ as a strategy profile $S^* = (s^*(I, \theta_i)|_{I \in I_i}|_{i \in N})$ and beliefs such that $\forall i : \theta_i = \theta^{S^*}$ with:

$$s^*(I, \theta_i) \in \arg \max_{s \in \Delta(C_I)} \sum_{a \in A(I)} \tilde{\theta}_{i|s}(a) V_i(subg(\supset, a), \theta_{i|a}). \tag{1}$$

V_i represents the procedural preferences over games. In our setting, individuals care not only about their utility from material outcomes $u \in U_i$, but also about the game by which these outcomes are reached. A similar distinction is made in Battigalli and Dufwenberg (2009) where the valuation function may depend not only on the utility over outcomes but also on all other players' strategies. In our model only strategies in subgames of the current node may influence the valuation function. Since the maximization is performed at each information set (both off and on the equilibrium path), this definition corresponds to a perfect Bayesian Nash equilibrium if $V_i(\supset, \theta)$ coincides with expected utility $EU_i(\supset, \theta)$:

$$EU_i(\supset, \theta) = \sum_{u \in U_i} \theta(u) \sum_{o \in O_i} \theta(o|u) u(o). \tag{2}$$

Instead, we define V_i to include also the utility from freedom, power, and non-interference for each subgame. Thus, individuals may change their behavior at earlier stages of the game in anticipation of greater freedom, power, and non-interference at later stages. In order not to confuse the two distinct notions of preferences, the non-procedural preferences $u \in U_i$ and the procedural preferences V_i, we refer to the former in the plural ('preferences') and to the latter in the singular ('preference'). We use the following terminology.

Freedom. Player i has *freedom* if he causally influences his own outcomes. Thus, freedom is measured by the degree to which Player i's own preferences determine his own outcomes, as

$$\Phi_i^f(\supset, \theta) = \sum_{u \in U_i} \theta(u) \sum_{o \in O_i} g(o,u)\theta(o|u) \log_2 \frac{\theta(o|u)}{\theta(o)}, \tag{3}$$

where $\log_2 \frac{\theta(o|u)}{\theta(o)}$ is the causal influence measure capturing how far the joint probability of outcome o and preference profile u is from the independent case. The measure computes the expectation of these terms across all preference-outcome combinations. For example, take two outcomes A and B and an individual who prefers either A or B; i.e., he has preference profile u^A or u^B. If $\theta(A|u^A) = \theta(A) = 1 - \theta(B)$, the fact that an individual prefers A or B makes no difference on whether the outcome is A or B. This is captured by the causal influence measure via $\log_2 \frac{\theta(o|u)}{\theta(o)} = 0$ for all $o \in \{A, B\}$ and $u \in \{u^A, u^B\}$. However, if the individual has some influence, then $\theta(A|u^A) > \theta(A)$, and this will result in a positive causal influence measure. This measure captures Berlin's definition of positive freedom as "[t]he freedom which consists in being one's own master" (1958, p.8) and other concepts from the literature on freedom of choice.[5]

The function $g(o,u)$ is included to capture the value of the causal influence. For example, if two outcomes are qualitatively very similar, the value of having the freedom to choose between the two may be very low. The causal influence measure $\log_2 \frac{\theta(o|u)}{\theta(o)}$ between outcome o and preferences u is therefore weighted by $g(o,u)$. Two specifications of $g(o,u)$ will be discussed in Section 4.

Non-Interference. Player i has *non-interference* if other players do not causally influence his outcomes. Interference is measured by the degree to which other players' preferences determine Player i's own outcomes. Thus, non-interference is measured by

$$\Phi_i^{ni}(\supset, \theta) = -\sum_{j \in N \setminus i} \sum_{v \in U_j} \theta(v) \sum_{u \in U_i} \theta(u|v) \sum_{o \in O_i} g(o,u)\theta(o|v) \log_2 \frac{\theta(o|v)}{\theta(o)}. \tag{4}$$

The concept of non-interference is analogous to that of freedom. The difference is that non-interference captures not the causal influence that a player

[5]For details, see Rommeswinkel (2014).

has on his own outcomes but the causal influence that other players have on his outcome. This measure is closely related to Berlin's definition of negative freedom as "not being interfered with by others. The wider the area of non-interference, the wider my freedom"(1958, p.3). Again, $g(o,u)$ can be used to determine the value of not being interfered with. Reducing the interference of another player may be less valuable when its qualitative impact on the outcome is small compared to the case in which it is large.

Power. Player i has *power* if he causally influences the outcomes of other players. Power is measured as

$$\Phi_i^p(\partial,\theta) = \sum_{u\in U_i}\theta(u)\sum_{j\in N/i}\sum_{o\in O_j} g(o,u)\theta(o|u)\log_2\frac{\theta(o|u)}{\theta(o)}. \tag{5}$$

This measure differs from the voting power measure by Diskin and Koppel (2010) in that we introduced player-specific outcomes and a weighting function $g(o,u)$, and generalized the measure to extensive form games. The weighting function $g(o,u)$ measures the qualitative impact on the outcomes of those players over whom Player i has power.

The valuation function $V_i(\partial,\theta)$ of a Player i with preference for freedom, non-interference, and power includes all the above components, as

$$V_i(\partial,\theta) = \alpha_i\Phi_i^f(\partial,\theta) + \beta_i\Phi_i^{ni}(\partial,\theta) + \gamma_i\Phi_i^p(\partial,\theta) + \delta_i EU_i(\partial,\theta), \tag{6}$$

where coefficients α, β, γ, and δ determine the intensity of each component.[6] An individual with preference for freedom/non-interference/power evaluates the choices not only by the expected utility of the subgame following the choice but also by the expected freedom/non-interference/power offered by the subgame. In Appendix B, as an illustration, we apply our theoretical framework to the authority-delegation game of Fehr et al. (2013).

2.3 Discussion

Measuring freedom, non-interference, and power requires determining not only what individuals can causally influence (i.e., their own or others' out-

[6]While for simplicity we consider an additively separable valuation function, future research may include a more general functional form.

comes) but also what enables individuals to exercise such a causal influence (i.e., the source of agency). Agency is what allows an individual to behave in one way or another and to achieve one outcome or another by doing so. Outside of an experimental setting, the source of agency lies in an individual's preferences over the alternative outcomes. In an experimental setting, it is standard practice to induce the value of each alternative via monetary payments.[7] Thus, the source of agency is introduced by the game structure by means of a payment structure. This is unproblematic in experiments that investigate how behavior changes if the values of the alternatives change: manipulating the monetary payments is sufficient. However, an experiment such as ours, which investigates how behavior changes if freedom/non-interference/power change, requires making the formation of preferences part of the game since manipulating freedom/non-interference/power requires manipulation of the relationship between preferences over outcomes and outcomes. We achieve this by having preferences over outcomes randomly determined by moves of Nature at the beginning of a subgame.

While we are aware that freedom in real-world situations may be qualitatively different from freedom induced by the game structure, we also believe that our framework makes preference for freedom more unlikely to be observed in the experiment. Therefore, evidence of preference for freedom in the experiment suggests that such preference for freedom is even more likely to arise in real-world settings, where preferences are not induced but formed internally. Analogous arguments can be made for preference for non-interference and power.

Finally, it should be noted that, in the context of a Bayesian game, $\theta(v)$ is nontrivial only if individuals are uncertain about preferences. If an individual is certain about his own preferences in all future subgames, he does not experience freedom or power. Similarly, if the individual is certain about other individuals' preferences, he does not experience non-interference. To avoid this limitation, the theory can be generalized by changing $\theta(v)$ to a distribution of 'reasonable' preferences (Jones and Sugden 1982). In our experiment however, this generalization would not change the explanatory power of freedom, power, or non-interference.

[7] For an introduction to induced-value theory, see Smith (1976).

3 Experimental design

The experiment implements a simplified version of the theoretical framework presented in Section 2. Two players, Player 1 and Player 2, play a card game involving the selection of a card from one of two boxes, Box L and Box R. Box L and Box R each contain two cards, Card A and Card B. Each card has two sides, Side 1 and Side 2.

The game consists of two stages: a bidding stage and a choice stage. The bidding stage serves to determine which player has the decision right in the choice stage. In the choice stage, the player with the decision right makes the card selection. The decision right is allocated via a Becker-DeGroot-Marschak (BDM) mechanism (Becker et al. 1964). Player 1 is required to bid for the decision right by choosing an integer between 0 and 100, $y \in \{0, \ldots, 100\}$. The computer then randomly determines an integer between 1 and 100 with uniform probability, $r \in \{1, \ldots, 100\}$. If $y \geq r$, Player 1 has the decision right: he will select a card from Box L in the choice stage and pay a fee equal to r. Otherwise, Player 2 has the decision right: he will select a card from Box R in the choice stage, and no fee is paid by either player.

In each box independently, the colors of the sides of the cards are determined via a random draw from the four cases represented in Figure 1. Each case has a priori equal probability. The color of Side 1 is payoff-relevant for Player 1, and the color of Side 2 is payoff-relevant for Player 2. Green is associated with a higher payoff; i.e., $\pi_i^{high,K} \geq \pi_i^{low,K}$, where $\pi_i^{high,K}$ denotes Player i's payoff if Side i of the card selected from box K is green, and $\pi_i^{low,K}$ denotes Player i's payoff if Side i of the card selected from box K is red, and $K \in \{L, R\}$. Each side of each card can be green or red with equal probability. Moreover, Side i of Card A and Side i of Card B are always a different color, which guarantees that Player i prefers either Card A to be selected or Card B to be selected. If Side 1 and Side 2 of a given card are the same color, then the players prefer the same card. Otherwise, the players prefer different cards.[8] We can interpret the random draw from the four cases in Figure 1 as a move by Nature, which randomly determines players' preferences over outcomes, $U_1 \in \{u_1^A, u_1^B\}$ and $U_2 \in \{u_2^A, u_2^B\}$, as

[8] As shown in Figure 1, in case 1, both players prefer Card B; in case 2, Player 1 prefers Card B and Player 2 prefers Card A; in case 3, Player 1 prefers Card A and Player 2 prefers Card B; in case 4, both players prefer Card A.

discussed in Section 2.

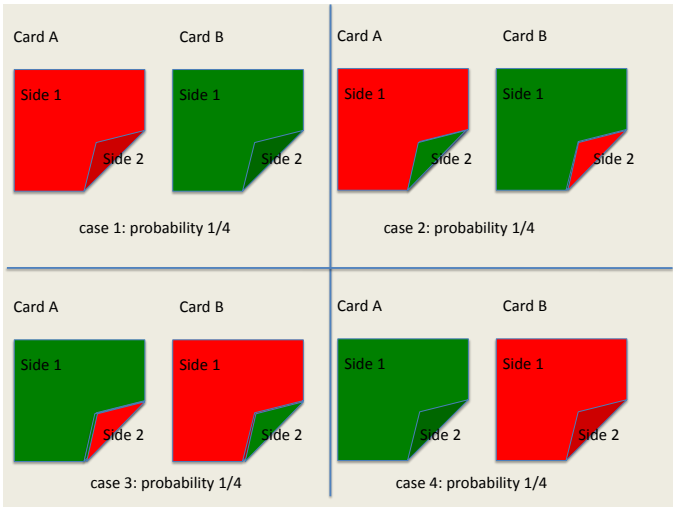

Figure 1: Card colors in Box $K = L, R$

The order of events is shown in Figure 2. As the bidding stage starts, players are informed about the values of $\pi_i^{high,K}$ and $\pi_i^{low,K}$ for $i = 1, 2$ and $K \in \{L, R\}$. Thus, they observe, for each player and for each box, what the payoff associated with green and the payoff associated with red are. At this moment, neither player knows, for either box, whether he prefers Card A or B, or whether the other player prefers Card A or B. As the choice stage starts, players receive additional information. The box from which the card selection will occur is opened, and each player observes the colors on his side of the two cards: Player 1 observes Side 1 of Card A and Side 1 of Card B, and Player 2 observes Side 2 of Card A and Side 2 of Card B. Therefore, each player observes which card gives him the high payoff, i.e., which card he prefers. However, no player observes the colors on the other side of the two cards. Therefore, no player is informed about which card the other player prefers.

To represent preference for freedom, non-interference, and power we must define the set of outcomes. For Player 1, let $O_1 = \{0, \ldots, 100\} \times \{1, 2\} \times \{A, B\}$, with $o_1(r, i, c)$ denoting the outcome where the randomly drawn number is r and Player i has the decision right and chooses card c. For Player 2, the number r is never relevant, so let $O_2 = \{1, 2\} \times \{A, B\}$, with $o_2(i, c)$ denoting the outcome where Player i has the decision right and

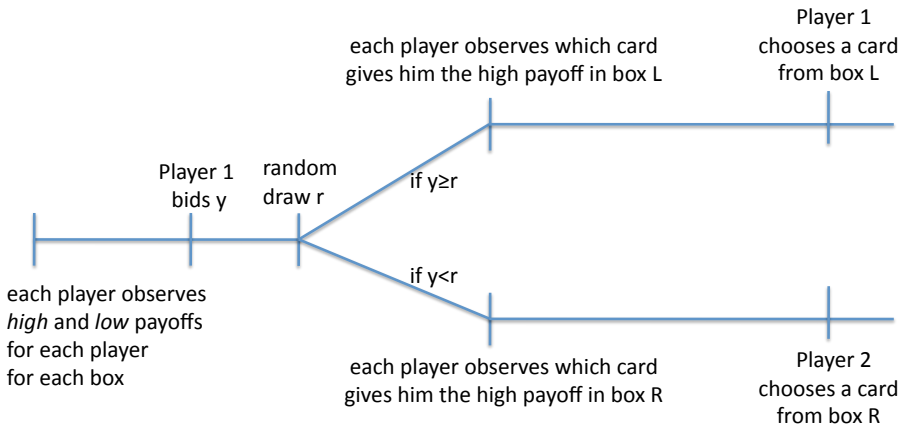

Figure 2: Order of events

chooses card c.[9]

The payoff structure of the game is always common knowledge. Payoffs vary across rounds and treatments, as described in detail in Sections 3.1-3.2. Table 1 provides the general payoff structure. Player 1's payoff is $\pi_1(o_1(r,i,c),u_1^A)$ if he prefers Card A and $\pi_1(o_1(r,i,c),u_1^B)$ if he prefers Card B. Analogously, Player 2's payoff is $\pi_2(o_2(i,c),u_2^A)$ if he prefers Card A and $\pi_2(o_2(i,c),u_2^B)$ if he prefers Card B. Moreover, Player 1 and Player 2 start the game holding endowments w_1 and w_2, respectively.

	$i=1$		$i=2$	
	$c=A$	$c=B$	$c=A$	$c=B$
$\pi_1(o_1(r,i,c),u_1^A)$	$w_1+\pi_1^{high,L}-r$	$w_1+\pi_1^{low,L}-r$	$w_1+\pi_1^{high,R}$	$w_1+\pi_1^{low,R}$
$\pi_1(o_1(r,i,c),u_1^B)$	$w_1+\pi_1^{low,L}-r$	$w_1+\pi_1^{high,L}-r$	$w_1+\pi_1^{low,R}$	$w_1+\pi_1^{high,R}$
$\pi_2(o_1(i,c),u_2^A)$	$w_2+\pi_2^{high,L}$	$w_2+\pi_2^{low,L}$	$w_2+\pi_2^{high,R}$	$w_2+\pi_2^{low,R}$
$\pi_2(o_1(i,c),u_2^B)$	$w_2+\pi_2^{low,L}$	$w_2+\pi_2^{high,L}$	$w_2+\pi_2^{low,R}$	$w_2+\pi_2^{high,R}$

Table 1: Payoff structure

[9]The outcomes of Player 2 are a coarsening of the outcomes of Player 1. Since Player 2 has never control over the finer distinctions made in O_1, the following analysis could be presented without assuming player-specific outcomes. However, the theory must also be able to accommodate for more complicated differences between player-specific outcomes, e.g. Gaertner et al. (1992).

3.1 Rounds

The card game is played repeatedly for 20 rounds. Across rounds, we vary the values for Player 2's payoffs $\pi_2^{high,L}$ and $\pi_2^{low,L}$ to account for situations in which the decision right gives Player 1 power or does not. $\eth^{np}$ are games where $\pi_2^{high,L} = \pi_2^{low,L}$. Therefore, when Player 1 has the decision right and selects a card from Box L, he does not have power since he cannot influence Player 2's outcomes: Player 2 is indifferent between the cards since $\pi_2^{high,L} = \pi_2^{low,L}$. $\eth^{p}$ are games where $\pi_2^{high,L} > \pi_2^{low,L}$, so the decision right gives Player 1 power. Across the 20 rounds, participants play 10 $\eth^{np}$ games and 10 $\eth^{p}$ games. Within $\eth^{np}$ and $\eth^{p}$, the rounds differ in the expected payoff and the stake size for each player, as shown in Table 2. The order in which the rounds are played is randomized. Note that, in both $\eth^{np}$ and $\eth^{p}$, we have $\pi_2^{high,R} > \pi_2^{low,R}$: Player 2 is never indifferent between the cards when he has the decision right. Finally, Player 1's payoffs are $\pi_1^{high,L} = \pi_1^{high,R} = \pi_1^{high}$ and $\pi_1^{low,L} = \pi_1^{low,R} = \pi_1^{low}$.

		Box L		Box R	
		Player 1	Player 2	Player 1	Player 2
game	round	Green/Red π_1^{high}/π_1^{low}	Green/Red $\pi_2^{high,L}/\pi_2^{low,L}$	Green/Red π_1^{high}/π_1^{low}	Green/Red $\pi_2^{high,R}/\pi_2^{low,R}$
$\eth^{np}$	1	100/30	70/70	100/30	100/30
$\eth^{np}$	2	90/40	70/70	90/40	90/40
$\eth^{np}$	3	80/50	70/70	80/50	80/50
$\eth^{np}$	4	85/15	70/70	85/15	85/15
$\eth^{np}$	5	75/25	70/70	75/25	75/25
$\eth^{np}$	6	65/35	70/70	65/35	65/35
$\eth^{np}$	7	70/0	70/70	70/0	70/0
$\eth^{np}$	8	60/10	70/70	60/10	60/10
$\eth^{np}$	9	50/20	70/70	50/20	50/20
$\eth^{np}$	10	100/0	70/70	100/0	100/0
$\eth^{p}$	11	75/25	85/15	75/25	85/15
$\eth^{p}$	12	75/25	75/25	75/25	75/25
$\eth^{p}$	13	75/25	65/35	75/25	65/35
$\eth^{p}$	14	75/25	90/40	75/25	90/40
$\eth^{p}$	15	75/25	60/10	75/25	60/10
$\eth^{p}$	16	85/15	75/25	85/15	75/25
$\eth^{p}$	17	65/35	75/25	65/35	75/25
$\eth^{p}$	18	90/40	75/25	90/40	75/25
$\eth^{p}$	19	60/10	75/25	60/10	75/25
$\eth^{p}$	20	100/0	100/0	100/0	100/0

Table 2: Payoffs in each round

Treatment	Endowments w_1, w_2	Cards in Box L	Games	decision right gives Player 1 freedom	non-interference	power
1	100,100	A, B	$\eth_1^{np}$	*yes*	*yes*	*no*
			$\eth_1^{p}$	*yes*	*yes*	*yes*
2	100,0	A, B	$\eth_2^{np}$	*yes*	*yes*	*no*
			$\eth_2^{p}$	*yes*	*yes*	*yes*
3	100,0	C	$\eth_3$	*no*	*yes*	*no*

Table 3: Treatments

3.2 Treatments

We conducted the experiment under three treatments, in which we modified key features of the game. Games are denoted $\eth_1$, $\eth_2$, and $\eth_3$ in Treatment 1, 2, and 3, respectively. In the benchmark Treatment 1, both players receive an endowment ($w_1 = w_2 = 100$). In Treatment 2, only Player 1 receives an endowment ($w_1 = 100$, $w_2 = 0$). The variation in endowments allows to verify whether social preferences play a role. Specifically, Player 1 may prefer to bid higher or lower due to advantageous or disadvantageous inequality aversion. We explore the role of inequality aversion in Appendix D.

In Treatment 3, $w_1 = 100$ and $w_2 = 0$, as in Treatment 2, but Box L contains only one card (Card C), which is green on Side 1 and is either red or green on Side 2. Under this modified design, the decision right provides Player 1 non-interference but neither freedom nor power. Similarly to the other treatments, if Player 1 has the decision right, he enjoys non-interference since Player 2 cannot influence Player 1's outcomes. However, Player 1 does not have freedom since he cannot influence his own outcomes: there is no choice for him to make, since Box L contains only Card C. Moreover, Player 1 has no power since he cannot influence Player 2's outcomes. Treatment 3 allows to distinguish non-interference from freedom, which are not distinguishable in Treatment 1 and 2.

Table 3 summarizes the characteristics of each treatment. Note that the distinction between games $\eth^{np}$ and games $\eth^{p}$ is relevant for Treatment 1 and 2, but not for Treatment 3, which never involves power.

3.3 Procedures

We conducted eight sessions: three sessions of Treatment 1, three sessions of Treatment 2, and two sessions of Treatment 3. The sessions took place over two consecutive days in October 2013 at the Cologne Laboratory for

Economic Research (CLER).[10] Each session lasted approximately 1.5 hours. In total, 244 subjects participated: 86 in Treatment 1, 96 in Treatment 2, and 62 in Treatment 3.[11] Participants were recruited via ORSEE (Greiner 2004) and consisted mostly of students at the University of Cologne. The experiment was implemented in zTree (Fischbacher 1999). Each session was divided into three parts. Participants received instructions for each part only after completing the previous part. The instructions are reported in Appendix E.

In Part 1, subjects play the card game described above.[12] At the start, half of the subjects are randomly assigned the role of Player 1 and the other half of the subjects the role of Player 2. Each Player 1 is randomly matched with a Player 2. The roles and the matches are then fixed for the entire duration of Part 1. Subjects play a trial round of game $\eth^{np}$ (which does not count for their earnings) and then play 20 rounds (10 games $\eth^{np}$ and 10 games $\eth^{p}$). Rounds are played in random order, and feedback regarding each round is given only at the end of the session (i.e., end of Part 3). At the end of the session, one round of the card game is randomly selected, and each subject is paid according to the payoff earned in that round only.

Part 2 and Part 3 involve individual decisions, with no interaction among subjects. In Part 2, subjects answer a lottery-choice questionnaire similar to that of Holt and Laury (2002). The lottery-choice questionnaire allows the elicitation of participants' risk attitudes. Each question involves the choice

[10]The experiment was conducted at a German University, where institutional review boards or committees are not mandatory (see guidelines of the German Psychological Society: http://www.bdp-verband.org/bdp/verband/ethic.shtml; particularly section C.II.4). Treatment of participants was in agreement with the ethical guidelines of the German Research Foundation (Deutsche Forschungsgemeinschaft) and the German Psychological Society (DGP).

[11]One session had 22 participants, one session 30 participants, and six sessions 32 participants.

[12]As Part 1 starts, subjects receive written instructions. To have participants focus on the key features of the game, we present them with four comprehension questions. The questions are reported in Appendix E. When participants submit an incorrect answer, they are provided with a correction and a short explanation. In general, subjects understood the experiment well. Questions 1, 2, and 3 were answered correctly by 96, 98, and 97 percent of the subjects, respectively. Question 4 is presented to highlight the fact that, if Player 1's bid is successful, Player 1 has to pay not his own bid but the number randomly drawn by the computer. Question 4, which is clearly the most difficult question, was answered correctly by 58 percent of the subjects. Individuals were thereby reminded, in a non-technical way, of the second-price nature of the bidding mechanism. Despite the lower fraction of initial correct answers, we believe that the provided correction and explanation were instrumental in achieving subjects' understanding.

between a safe lottery (Option A) that yields prize π^A with certainty and a risky lottery (Option B) yielding a high prize $\pi^{B,high}$ with probability 0.5 and a low prize $\pi^{B,low}$ with probability 0.5. The lotteries of Part 2 are designed to resemble the implicit lotteries faced by the players in the card games of Part 1. Prize π^A resembles the certain payoff that a player receives when he has the decision right, while prizes $\pi^{B,high}$ and $\pi^{B,low}$ resemble the payoffs that a player may receive when the other player has the decision right. As discussed later in Section 4, an expected-utility-maximizer Player 1 who chooses bid y^* in a card game of Part 1 should choose the safe Option A in the corresponding lottery-choice question of Part 2 (with $\pi^{B,high} = \pi_1^{high}$, $\pi^{B,low} = \pi_1^{low}$) if and only if $\pi^A \geq \pi^{B,high} - y^*$. The questionnaire consists of 3 sets of 11 questions each. π^A is varied within each set, taking values from 30 to 80 in steps of 5 points. $(\pi^{B,high}, \pi^{B,low})$ are varied across sets. In the first set $(\pi^{B,high}, \pi^{B,low}) = (85, 15)$, in the second set $(\pi^{B,high}, \pi^{B,low}) = (75, 25)$, and in the third set $(\pi^{B,high}, \pi^{B,low}) = (65, 35)$. At the end of the session, one lottery-choice question is randomly selected. Each subject has his chosen option played out and is paid accordingly.

Finally, in Part 3, subjects complete a Locus of Control Test (Rotter 1966, Levenson 1981, Krampen 1981).[13] In personality psychology, locus of control refers to the extent to which an individual believes that he can control events that affect him. A person's locus is either internal (if he believes that events in his life derive primarily from his own actions) or external (if he believes that events in his life derive primarily from external factors, such as chance and other people's actions, which he cannot influence). There may be several reasons why attitudes toward locus of control may be related to attitudes toward freedom and non-interference. For example, subjects who believe that other individuals control their lives may have a greater preference for freedom and non-interference. However, as reported in Appendix C, we do not find strong evidence that attitudes toward locus of control are correlated with preference for freedom or non-interference.

At the end of the session, participants answer a socio-demographic questionnaire. All payoffs in the experiment are expressed in points. The conversion rate is €1 = 12 points. Participants earned, on average, €10.97 in Part 1 and €4.90 in Part 2. In addition, they received €2.50 for participation. Part 3 does not involve any payment.

[13] The questionnaire is reported in Appendix C.

4 Theoretical Predictions

The Bayesian Nash equilibrium predictions, assuming $V_i(\ni, \theta) = EU_i(\ni, \theta)$ and a utility function u linear in payoffs, are straightforward. In the choice stage, Player i with the decision right chooses $c^{*RNNE} = A \Leftrightarrow U_i = u_i^A$ and $c^{*RNNE} = B \Leftrightarrow U_i = u_i^B$. In the bidding stage, it is optimal for Player 1 to bid his true valuation of the decision right. The continuation payoff from the subgame where Player 1 has the decision right is π_1^{high}, and the continuation payoff from the subgame where he does not have the decision right is $(\pi_1^{high} + \pi_1^{low})/2$. Therefore, the optimal bid of a risk-neutral Player 1 is $y^{*RNNE} = (\pi_1^{high} - \pi_1^{low})/2$.

Allowing for risk aversion, while keeping $V_i(\ni, \theta) = EU_i(\ni, \theta)$, does not affect behavior in the choice stage: Player i with the decision right chooses $c^{*NE} = A \Leftrightarrow U_i = u_i^A$ and $c^{*NE} = B \Leftrightarrow U_i = u_i^B$. However, in the bidding stage, Player 1 is influenced by the fact that Box R involves the risky lottery $(\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low})$ while Box L involves the safe lottery $(1, \pi_1^{high})$.[14] Therefore, the optimal bid y^{*NE} satisfies the following condition:

$$u(w_1 - y^{*NE} + \pi_1^{high}) = \frac{1}{2}u(w_1 + \pi_1^{high}) + \frac{1}{2}u(w_1 + \pi_1^{low}). \tag{7}$$

Defining the certainty equivalent CE of the risky lottery as

$$CE\left(\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low}\right) = c : u(c) = \frac{1}{2}u(\pi_1^{high}) + \frac{1}{2}u(\pi_1^{low}), \tag{8}$$

we can rewrite Equation 7 in terms of certainty equivalent as

$$w_1 - y^{*NE} + \pi_1^{high} = CE\left(\frac{1}{2}, w_1 + \pi_1^{high}; \frac{1}{2}, w_1 + \pi_1^{low}\right). \tag{9}$$

To predict the behavior of a participant with preference for freedom, non-interference, and power, we need to determine freedom, non-interference, and power at each subgame following the bid of Player 1: the measures Φ_1^f, Φ_1^{ni}, and Φ_1^p introduced in Section 2. Before doing so, we must determine the functional form of $g(o, u)$ in Equations 3-5.

We consider two specifications. First and most simply, we set $g(o, u) = 1$, assuming that the value of freedom, non-interference, or power is independent of the outcome and the utility of the outcome. According to this

[14] $(\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low})$ is the lottery yielding π_1^{high} with probability 0.5 and π_1^{low} with probability 0.5. $(1, \pi_1^{high})$ is the lottery yielding π_1^{high} with probability 1.

specification, we index the measures as $\Phi_1^{f,c}$, $\Phi_1^{ni,c}$, and $\Phi_1^{p,c}$. Second, we set $g(o,u) = \Delta\pi_i = |\pi_i^{high} - \pi_i^{low}|$. While the logarithmic terms in Equations 3-5 account for the probabilistic causal influence of preferences on outcomes, the distance in payoffs $\Delta\pi_i$ measures the qualitative effect on utility of such causal influence (Nehring and Puppe 2002).[15] For example, the decision between two outcomes yielding very similar payoffs may be seen as having a smaller qualitative effect than a decision between two outcomes yielding very different payoffs. Thus, freedom, non-interference, and power may become more important, as the alternative outcomes differ more in terms of the payoffs they yield. We must use $\Delta\pi_1$, the qualitative impact on Player 1's payoffs, for freedom and non-interference, and $\Delta\pi_2$, the qualitative impact on Player 2's payoffs, for power. According to this specification, we index the measures as $\Phi_1^{f,d}$, $\Phi_1^{ni,d}$, and $\Phi_1^{p,d}$.

Decisions in the choice stage are unaffected by preference for freedom, non-interference, and power. Since the subgame following each choice is a terminal node a_ω, we have $\theta(o(a_\omega)) = 1$, so the causal influence measures $\log_2 \frac{\theta(o|u)}{\theta(o)}$ are equal to zero. This is intuitive: while the individual has control over the outcome at the moment of making the decision, he loses the control by exercising it. Since the terminal nodes do not offer any freedom, non-interference, or power, the choice over terminal nodes is therefore unaffected by preference for them. Thus, an individual i with $\delta_i > 0$ in Equation 6 chooses $c^* = A \Leftrightarrow U_i = u_i^A$ and $c^* = B \Leftrightarrow U_i = u_i^B$, just as in the Bayesian Nash equilibrium. In the bidding stage, instead, the bid of Player 1 is affected by preference for freedom, non-interference, and power. Derivations of all measures ($\Phi_1^{f,c}$, $\Phi_1^{f,d}$, $\Phi_1^{ni,c}$, $\Phi_1^{ni,d}$, $\Phi_1^{p,d}$) for Treatments 1, 2, and 3 are given in Appendix A, and a summary is presented in Table 4.[16] With a slight abuse of notation, let $subg(\Game, y)$ refer to the subgame following a bid y by Player 1.

As an example, let us analyze the decision problem in Treatment 1 of a Player 1 with preference for freedom under the $\Phi^{f,c}$ specification. Intuitively, freedom under this specification is equal to the probability of having the

[15] It can be shown that, if an individual has full control over his outcomes, the freedom measure is equal to the qualitative and quantitative diversity over which the individual has control, as measured in Nehring and Puppe (2009). Similar convergence results hold for the power and non-interference measures.

[16] Since games $\Game^p$ differ from games $\Game^{np}$ uniquely because of a positive payoff difference for Player 2, $\Delta\pi_2 = \pi_2^{high,L} - \pi_2^{low,L}$, we consider only the specification $\Phi^{p,d}$ for power.

Game	Specification	Measure
$\eth_1$, $\eth_2$	$\Phi^{f,c}$	$\frac{y}{100}$
$\eth_3$	$\Phi^{f,c}$	0
$\eth_1$, $\eth_2$	$\Phi^{f,d}$	$\frac{y}{100}\left(\pi_1^{high} - \pi_1^{low}\right)$
$\eth_3$	$\Phi^{f,d}$	0
$\eth_1$, $\eth_2$, $\eth_3$	$\Phi^{ni,c}$	$-\frac{100-y}{100}$
$\eth_1$, $\eth_2$, $\eth_3$	$\Phi^{ni,d}$	$-\frac{100-y}{100}\left(\pi_1^{high} - \pi_1^{low}\right)$
$\eth_1^p$, $\eth_2^p$	$\Phi^{p,d}$	$\frac{y}{100}\left(\pi_2^{high} - \pi_2^{low}\right)$
$\eth_1^{np}$, $\eth_2^{np}$, $\eth_3$	$\Phi^{p,d}$	0

Table 4: Freedom, power, and non-interference measures

decision right. This is because, if Player 1 has the decision right, then $g(A, u_1^A)\log_2\frac{\theta(A|u_1^A)}{\theta(A)} = g(B, u_1^B)\log_2\frac{\theta(B|u_1^B)}{\theta(B)} = \log_2\frac{1}{1/2} = 1$. If Player 1 does not have the decision right, then $g(o,u)\log_2\frac{\theta(o|u)}{\theta(u)} = 0\ \forall o, u$. Thus, a Player 1 with preference for freedom chooses his bid to solve

$$\max_y V_1 = \max_y \alpha_1 \frac{y}{100} + \delta_1 EU_1(subg(\eth_1, \theta_{1|y})). \tag{10}$$

The optimal bid condition corresponding to Equation 7 then becomes

$$\alpha_1 + u(w_1 - y^{*F} + \pi_1^{high}) = \frac{1}{2}u(w_1 + \pi_1^{high}) + \frac{1}{2}u(w_1 + \pi_1^{low}). \tag{11}$$

This means that the utility from having the decision right is increased by a constant α_1. In Treatment 3, instead, in which by design Card C is the outcome of the game if Player 1 has the decision right, it would be $g(C, u_1^C)\log_2\frac{\theta(C|u_1^C)}{\theta(C)} = g(C, u_1^C)\log_2\frac{1}{1} = 0$, so freedom would be zero.

5 Empirical Strategy

Equation 11 gives an especially simple way of measuring Player 1's preference for freedom in a game of Treatment 1. The parameter α_1 can be inferred from a regression of the difference in estimated utilities from Box L and Box R, $\Delta EU_1 = u(w_1 - y + \pi_1^{high}) - \frac{1}{2}u(w_1 + \pi_1^{high}) - \frac{1}{2}u(w_1 + \pi_1^{low})$, on a constant.[17] A similar approach can be also applied to measure Player

[17] The estimated utility from Box L in ΔEU_1 is computed setting $r = y$.

1's preference for non-interference and preference for power. For simplicity, since we consider only Player 1's behavior, we drop the subscript 1. For each subject k playing as Player 1, we consider the following estimation equation:

$$\Delta EU_{k,t} = \alpha_k V^f_{k,t} + \beta_k V^{ni}_{k,t} + \gamma_k V^p_{k,t} + \epsilon_{k,t} \tag{12}$$

where k stands for the subject, t for the round of play, and V^f, V^{ni}, V^p for the freedom, non-interference, and power variables, respectively, and where we normalized $\delta_k = 1$ of Equation 6 to achieve identification of α_k, β_k, and γ_k. Table 5 gives an overview of the measures and their empirical implementation.

Measure	Variable	Value
$\Phi^{f,c}$	$V^{f,c}$	$-1_{[\eth_1,\eth_2]}$
$\Phi^{f,d}$	$V^{f,d}$	$-1_{[\eth_1,\eth_2]}\Delta\pi_1$
$\Phi^{ni,c}$	$V^{ni,c}$	-1
$\Phi^{ni,d}$	$V^{ni,d}$	$-\Delta\pi_1$
$\Phi^{p,d}$	$V^{p,d}$	$-1_{[\eth^p_1,\eth^p_2]}\Delta\pi_2$

Table 5: Empirical implementation of measures
$1_{[\eth,\eth']} = 1$ if game is $\eth$ or $\eth'$ and $= 0$ otherwise.

As discussed above, in Treatment 1, the freedom measure $\Phi^{f,c}$ corresponds to a constant. The same holds in Treatment 2. In Treatment 3, instead, freedom is excluded by design.[18] Therefore, estimating preference for freedom under the specification $\Phi^{f,c}$ corresponds to running a regression on a dummy variable that equals 1 in Treatments 1 and 2 and 0 in Treatment 3, denoted $1_{[\eth_1,\eth_2]}$. Under the specification $\Phi^{f,d}$, the dummy is interacted with the payoff distance $\Delta\pi_1 = \pi_1^{high} - \pi_1^{low}$.

Unlike freedom, non-interference is present in all treatments.[19] Therefore, estimating preference for non-interference under the specification $\Phi^{ni,c}$ corresponds to running a regression on a constant. The specification $\Phi^{ni,d}$ takes into account the payoff distance $\Delta\pi_1$.

Power is present only in games $\eth^p$ in Treatments 1 and 2, denoted $\eth^p_1$ and $\eth^p_2$.[20] We focus on the specification $\Phi^{p,d}$ since games $\eth^p$ differ from games $\eth^{np}$

[18] In Treatment 3, Box L contains only 1 card, so even if his bid is successful, Player 1 does not select a card and thus has no freedom.

[19] In Treatment 3, Player 2 affects the outcomes of Player 1 if the bid is not successful; therefore, a successful bid yields non-interference for Player 1.

[20] In Treatment 3, Box L contains only 1 card, so even if his bid is successful, Player 1

uniquely because of a positive payoff distance for Player 2, $\Delta\pi_2 = \pi_2^{high,L} - \pi_2^{low,L}$. Thus, estimating preference for power under the specification $\Phi^{p,d}$ corresponds to running a regression on $\Delta\pi_2$ times a dummy variable that equals 1 in games $\supset^p$ in Treatments 1 and 2 and zero otherwise.

6 Results

6.1 Allocation and exercise of decision rights

Before turning to the results obtained via the empirical strategy described in the previous section, we briefly present descriptive results on how Player 1 bids for the decision right, and on how the player with the decision right (Player 1 or 2) makes the card selection.

First, we inspect whether bids differ across treatments. Table 6 reports the median bids submitted by Players 1 for each treatment and each round. For most rounds, bids in Treatment 3, in which the decision right gives Player 1 only non-interference, are significantly higher than in Treatment 1, in which the decision right additionally gives freedom ($\supset^{np}$) or power and freedom ($\supset^p$). At first sight, this finding may suggest a negative value of freedom or power in specific rounds. However, when aggregating across all rounds, as done in Section 6.4, the negative value of freedom and power is found to be statistically insignificant while the value of non-interference is found to be positive and statistically significant.

Second, we inspect whether bids in games that do not involve power ($\supset^{np}$) differ from those in games that involve power ($\supset^p$). We make pairwise comparisons across rounds in which Player 1 faces the same stake size and the same expected payoff. We compare round 5 to round 12 and round 10 to round 20.[21] We find no significant differences between $\supset^{np}$ and $\supset^p$ in either pair of comparisons.[22] This evidence suggests that considerations

does not select a card and thus has no power over Player 2. In games $\supset^{np}$ in Treatments 1 and 2, Player 2's payoffs in box L are equal, $\pi_2^{high,L} = \pi_2^{low,L}$, so Player 1 has no power over Player 2. In games $\supset^p$ in Treatments 1 and 2, in contrast, Player 2's payoffs in box L differ, $\pi_2^{high,L} > \pi_2^{low,L}$, so Player 1 has power over Player 2.

[21] Player 1 faces a stake size of 25 and an expected payoff of 50 in rounds 5 and 12, and a stake size of 50 and an expected payoff of 50 in rounds 10 and 20.

[22] We perform a Wilcoxon signed rank sum test on observations paired at the participant level. For round 5 versus round 12, we have $z = 0.658$ ($p = 0.5102$) in Treatment 1 and $z = 1.339$ ($p = 0.1806$) in Treatment 2. For round 10 versus round 20, we have $z = -1.143$ ($p = 0.2531$) in Treatment 1 and $z = -1.356$ ($p = 0.1750$) in Treatment 2. In Treatment 3, as highlighted in Section 3.2, all rounds involve non-interference but do not involve

regarding power may be less relevant than considerations regarding freedom and non-interference. We further investigate this aspect in Section 6.4.

Once the decision right is allocated, the player with the decision right makes the card selection. Recall from Section 3 that, if Player 1 has the decision right, he chooses a card from Box L, knowing which card gives him the highest payoff. Similarly, if Player 2 has the decision right, he chooses a card from Box R, knowing which card gives him the highest payoff. Do individuals with the decision right use it in their favor, selecting the card that gives them the highest payoff? Pooling all data together, we find that, as Table 7 shows, in more than 98 percent of the observations, the decision right is exercised by selecting the card that gives the decision-maker his highest payoff.

Round	Treatment						
	1	2	3	all	1 vs 2	2 vs 3	1 vs 3
1	50	52	69	60			-2.492 (0.0127)
2	48	40	45	44		-2.357 (0.0184)	
3	28	30	30	30			-1.709 (0.0874)
4	45	40	60	50		-3.073 (0.0021)	-2.884 (0.0039)
5	40	40	45	40			-1.831 (0.0671)
6	30	30	30	30			-1.781 (0.0749)
7	50	40	70	50		-2.968 (0.0030)	-3.000 (0.0027)
8	30	36	45	35			-2.198 (0.0280)
9	20	30	30	30	-2.489 (0.0128)		-2.893 (0.003)
10	66	68	80	70		-1.945 (0.0518)	
11	40	40	45	40			-2.043 (0.0411)
12	35	36	45	40		-1.703 (0.0886)	-1.977 (0.0481)
13	35	40	50	40		-2.296 (0.0217)	-2.430 (0.0151)
14	33	35	43	40		-1.719 (0.0856)	-1.909 (0.0562)
15	30	30	45	40		-1.706 (0.0880)	-1.941 (0.0523)
16	50	40	65	50		-2.586 (0.0097)	-2.916 (0.0035)
17	25	30	30	30			-2.411 (0.0159)
18	40	47	50	48		-1.860 (0.0628)	-2.614 (0.0089)
19	30	31	35	33			
20	80	70	70	72			
all	40	40	50	40			

Table 6: Median bids. Results of a Mann-Whitney-Wilcoxon rank-sum test (p-values in parentheses) are reported only for statistically significant cases.

6.2 Certainty equivalents

As a first step, we analyze whether individuals exhibit any preference for control, i.e., whether their bids are higher than expected utility maximizing

either freedom or power. Therefore, distinguishing between $\ni^{np}$ and $\ni^{p}$ in Treatment 3 is not meaningful.

Treatment	Player 1		Player 2	
	has decision right	chooses card with highest payoff	has decision right	chooses card with highest payoff
1	0.41	1	0.59	0.98
2	0.4	0.99	0.6	0.99
3	0.55	1	0.45	0.94
all	0.44	1	0.56	0.98

Table 7: Decision rights and choice behavior conditional on having the decision right. Fraction of observations.

bids. Ex ante, it is not clear whether such behavior would occur, since the game structure is simpler than in Fehr et al. (2013) and Bartling et al. (2014) and expected utility maximizing strategies are thus easier to find.

To verify whether subjects playing as Player 1 behave according to expected utility maximization, we compare the certainty equivalent in each lottery-choice in Part 2, $CE_{lottery}(L)$ with $L = (\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low})$, to the certainty equivalent implied in the bidding choice in the corresponding card game in Part 1 (i.e., involving the same π_1^{high} and π_1^{low}):

$$\pi_1^{high} - y = CE\left(\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low}\right). \tag{13}$$

Denote ΔCE as

$$\Delta CE = \pi_1^{high} - y - CE_{lottery}\left(\frac{1}{2}, \pi_1^{high}; \frac{1}{2}, \pi_1^{low}\right). \tag{14}$$

Overbidding occurs if ΔCE is negative: the subject exhibits more risk aversion in the bidding choice than in the lottery choice. Underbidding occurs if ΔCE is positive: the subject exhibits more risk aversion in the lottery choice than in the bidding choice.[23]

If the only error in ΔCE is due to the imprecise measurement of the certainty equivalent (which is measured at intervals of 5 payoff units), we should expect ΔCE to be distributed uniformly with mean 0 and standard deviation $(25/12)^{1/2} \approx 1.44$. We find instead that the mean is too low (-14.11) and the standard deviation is too high (25.41).[24] Both deviations are

[23]We are aware of a caveat. When subjects answered the lottery-choice questionnaire in Part 2, they already knew their endowment in Part 1 (w_1), but they did not know their earnings in Part 1 yet. Therefore, if there are significant income effects on risk aversion, we cannot expect Equation 9 to be identical to Equation 13.

[24]The empirical distribution of ΔCE over 1132 observations has mean -14.11, median -12.50, 25% percentile -27.5, 75% percentile 2.5, and standard deviation 25.41.

significant at the 1% level. We therefore reject the hypothesis of expected-utility-maximizing behavior.

6.3 Risk preferences

Among the variables defined in Section 5, ΔEU requires knowledge of an individual's utility function over payoffs, $u(\pi)$. We approximate $u(\pi)$ by a CRRA utility function $u(\pi) = \frac{\pi^{1-\rho}}{1-\rho}$. For each subject, we estimate his risk aversion coefficient via maximum likelihood estimation from his responses in the lottery-choice questionnaire in Part 2 using a random utility model with

$$u_k\left(\frac{1}{2}, \pi^{high,q}; \frac{1}{2}, \pi^{low,q}\right) = \frac{(\pi^{high,q})^{1-\rho_k}}{2(1-\rho_k)} + \frac{(\pi^{low,q})^{1-\rho_k}}{2(1-\rho_k)} + \epsilon_{q,k} \tag{15}$$

where $\epsilon_{q,k} \sim_{iid} N(0, \sigma_k^2)$ and k indicates the subject and q indicates the lottery.

We are able to estimate the risk aversion coefficients for 235 out of 244 subjects: nine subjects exhibit such extreme risk preferences that we are unable to fit a CRRA model. In general, risk preferences range from slightly risk loving to strongly risk averse.[25] Based on the risk aversion coefficients, we calculate the expected utility values of the payoffs from Box L and Box R.

6.4 Preference for freedom, non-interference, and power

As a preliminary analysis, we perform a linear regression on the whole dataset for different combinations and specifications of V^f, V^{ni}, and V^p. We assume that, for each individual k, $\alpha_k = \alpha$, $\beta_k = \beta$, and $\gamma_k = \gamma$; i.e., preferences for freedom, non-interference, and power are homogeneous across individuals. Thus, Equation 12 simplifies to the population regression

$$\Delta EU_{k,t} = \alpha V^f_{k,t} + \beta V^{ni}_{k,t} + \gamma V^p_{k,t} + \epsilon_{k,t} \tag{16}$$

Results are reported in columns 1-4 of Table 8.[26] We find no conclusive

[25] The empirical distribution of $\hat{\rho}$ over 235 observations has mean 0.59, median 0.37, 25% percentile 0.28, 75% percentile 0.46, and standard deviation 2.58.

[26] Note that measurement error in the risk preferences does not bias the results, since it is measurement error of the dependent variable and is captured by $\epsilon_{k,t}$.

evidence of preference for freedom. Preference for power is neither statistically nor economically significant. Instead, we find that preference for non-interference is both economically and statistically significant. The best fit is provided by the model in column 1, where both the freedom variable and the non-interference variable are specified as constants. Given the estimated non-interference parameter, Player 1 experiences a utility loss of 6.711 when the decision right is given to Player 2. Interpreting such utility loss is not straightforward since a utility unit has different meanings for different subjects depending on their risk aversion. To provide an interpretation, we consider a Player 1 with median risk aversion ($\rho = 0.37$), and we look at what reduction in his endowment would generate a utility loss equivalent to that generated by not having the decision right. As an example, let us consider round 10 of Treatment 1, in which Player 1 has an endowment $w_1 = 100$ and potential payoffs $\pi_1^{high} = 100$ and $\pi_1^{low} = 0$. For this Player 1, a reduction in the endowment from 100 to 65 would generate a utility loss equivalent to that generated by not having the decision right.

A limitation of the population regression from Equation 16 is that it estimates a single vector of parameters (α, β, γ) for all individuals even though their ΔEU differ in scale and standard deviation after the estimation of each individual's risk aversion coefficient.

We therefore estimate a more general model that allows for heterogeneous preference across individuals. Since power is not a statistically significant explanatory variable in the estimation of the homogeneous-preference model, we exclude it from the estimation of the heterogeneous-preference model and consider

$$\Delta EU_{k,t} = \alpha_k V_{k,t}^f + \beta_k V_{k,t}^{ni} + \epsilon_{k,t}, \tag{17}$$

which we interpret as a random coefficient model with $\alpha_k = \alpha + \epsilon_{\alpha,k}$ and $\beta_k = \beta + \epsilon_{\beta,k}$. We estimate the random coefficient model using the following moment conditions:

	Homogeneous Preferences Equation 16				Heterogeneous Preferences Equations 17-22	
	1	2	3	4	I	II
$V^{f,c}$	-1.748		0.565		0.1895	
	(1.935)		(1.427)		(0.7423)	
$V^{f,d}$		-0.029		-0.059		-0.0077
		(0.053)		(0.065)		(0.0192)
$V^{ni,c}$	6.711***	6.082***				5.6507***
	(1.520)	(1.163)				(0.4032)
$V^{ni,d}$			0.171***	0.218***	0.2081***	
			(0.039)	(0.049)	(0.0291)	
$V^{p,d}$	0.004	-0.0004	-0.007	0.008		
	(0.005)	(0.005)	(0.005)	(0.005)		
obs	2360	2360	2360	2360	2360	2360
subjects	118	118	118	118	117	117
F-test	12.7	12.71	11.11	11.65		
R-squared	0.1556	0.1539	0.1405	0.1425		
J test $\chi^2(1)$					0.0319	0.0591

Table 8: Columns 1-4 report the estimation results of the model from Equation 16. Standard errors are clustered at the individual level and are shown in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Columns I and II report the estimation results of the model from Equations 17-22. In I and II we used simulated annealing with 1000 search points and the estimation of parameters and weighting matrix was iterated five times to achieve better finite-sample properties. To avoid misspecification, we excluded one individual who perfectly maximized expected payoffs. This does not affect the statistical or economic significance of the results. Standard errors are shown in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. J test $\chi^2(1)$ is the Hansen test of over-identifying restrictions. Since $\chi^2(1)_{.05} = 3.841$, we do not reject the null hypothesis of a correctly specified model in either column I or II.

$$E[\epsilon_{k,t} V_{k,t}^{f}] = 0 \tag{18}$$

$$E[\epsilon_{k,t} V_{k,t}^{ni}] = 0 \tag{19}$$

$$E[\epsilon_{\alpha,k} - \alpha] = 0 \tag{20}$$

$$E[\epsilon_{\beta,k} - \beta] = 0 \tag{21}$$

$$E[\epsilon_{\beta,k} 1_{k,[\supset_3]}] = 0 \tag{22}$$

Conditions 18-19 state that errors $\epsilon_{k,t}$ are independent of the regressors, the freedom variable $V_{k,t}^{f}$ and the non-interference variable $V_{k,t}^{ni}$, respectively. Conditions 20-21 identify the population parameters α and β. Condition 22 states that the mean of individual non-interference parameters in Treatment 3 is equal to that of the other treatments. Since treatment assignment is random, individuals' preference for freedom or non-interference should be independent across treatments. This allows identification of the freedom parameters α_k for individuals in Treatments 1 and 2. Without condition 22 we cannot distinguish whether their bidding behavior is motivated by preference for freedom or preference for non-interference. However, assuming that the mean preference parameters are identical across treatments, we can identify the mean α via the difference in behavior between Treatment 3 and the other treatments.

Results of the heterogeneous-preference model from Equations 17-22 are reported in columns I-II of Table 8. The previous results are confirmed. Preference for non-interference is the driving force for preference for decision rights. Therefore, the economic significance of the coefficient of preference for non-interference in the homogeneous-preference model is not simply driven by a few individuals with high risk aversion. The median coefficients of preference for non-interference in columns I and II are 0.04 and 1.70, respectively. To provide an interpretation, we compute, as done above for the homogeneous-preference model, the reduction in endowment that would generate for a Player 1 with median risk aversion ($\rho = 0.37$) in round 10 of Treatment 1 a utility loss equivalent to that generated by not having the decision right. The endowment would need to be reduced by 10.37 and 12.38 points in column I and II, respectively.

Additionally, in Appendix C, we use the estimates obtained for individual-level α_k and β_k to examine whether preference for freedom and non-interference

can be explained by locus of control, which is measured in Part 3 of the experiment. We find that one of the scales used to measure locus of control, the P-scale, which measures the degree to which individuals believe that other persons control their lives, explains preference for freedom and non-interference in model I, but not in model II. Thus, the evidence suggests that preference for freedom and non-interference cannot be fully explained by locus of control.

We are aware of several limitations in our results. First, non-interference is present in all treatments. Therefore, it is only identified via the difference in behavior between the card game (Part 1) and the lottery-choice questionnaire (Part 2). Possibly, the coefficient for non-interference captures not only the effect of non-interference itself but also the effects of all other factors which differ between the card game and the lottery-choice questionnaire. The same limitation is also present in Fehr et al. (2013) and Bartling et al. (2014), which investigate intrinsic preference for decision rights in delegation games. However, given that we observe preference for non-interference both in games with delegation of the decision right and in games with bidding for the decision right, it seems implausible that the observed effect is an artifact of the game structure.

Second, the weak evidence of preference for power may be driven partly by the experimental setting, in which each player is informed about his own preferences over the final outcomes but is never informed about the preferences of the other player. Therefore, a Player 1 with preference for power may not find the exercise of power over Player 2 particularly satisfying because he does not know Player 2's preferences and thus does not know how he can influence him. However, the size of the effect of non-interference in our setting is similarly large as the size of the combined effect in Fehr et al. (2013), where Player 1 knows the payoff impact of his choice on Player 2. Therefore, it seems unlikely that relaxing this information constraint would strongly affect the bidding behavior in our setting. We consider experimental settings that relax such information constraint an interesting direction for further research.

Third, some readers may perceive preference for non-interference as driven by ambiguity aversion. If a subject believes that other individuals, when they have the decision right, will not necessarily choose the option in their best interest, then he will perceive strategic uncertainty with respect

to the types of individuals he is facing. However, evidence from our experiment seems not to support this conjecture. Almost all participants in our experiment chose the option in their best interest. Having chosen the option in his best interest when having the decision right, it is unlikely for Player 1 to believe that Player 2 will behave differently when she has the decision right.[27] Thus, to fully explain the extent of preference for non-interference, we would need to posit either very strong ambiguity aversion or beliefs about other players that are too far from the actual behavior to be plausible.

7 Conclusions

In this paper, we present theoretical foundations for preference for decision rights, driven by preference for freedom, power, and non-interference. We conduct a laboratory experiment in which the role of each preference is distinguished.

Our results confirm the existence of an intrinsic value of decision rights and extend it from a delegation setting to a willingness to pay/auction setting. Evidence from our experiment highlights two main results. First, we find no evidence of preference for power. Thus, preference for power, as casually observed in politics or other institutional settings, may simply be instrumental to other components of well-being, such as status recognition.

Second, we find stronger evidence of preference for non-interference than for freedom. This result suggests that individuals value decision rights neither because they enjoy the freedom of making a choice, nor because they enjoy having power over other individuals, but rather because they dislike letting other individuals interfere in their outcomes. Our theoretical framework and experimental findings lead to a fundamental change in perspective

[27] Experimental evidence from previous works suggests that participants in our experiment not only choose the option in their best interest but also believe that other participants do the same. Iriberri and Rey-Biel (2013) use data from modified dictator games to study the relationship between individuals' interdependent preferences and their beliefs about others' distributive choices. They find that selfish individuals, i.e. individuals who always choose the self-payoff maximizing choice, 'systematically state that they believe other individuals take selfish actions, while other preferences types are more aware of the existent heterogeneity in actions'. Huck and Weizsäcker (2002), Costa-Gomes and Weizsäcker (2008) and Manski and Neri (2013) find that subjects are on average able to correctly predict the option chosen with higher frequency. Rubinstein and Salant (2015) find that 'reported beliefs are influenced by self-similarity considerations, whereby a player tends to think that other players behave similarly to him, and thus reports beliefs that gravitate toward his own action'.

on preference for decision rights. Individuals like to have decision rights in virtue of the absence of the decision rights of other individuals. An individual's evaluation of risks then depends on whether risks are generated by an objective process or by the behavior of other individuals.

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A Derivations of valuation functions

In this appendix we present the derivation of the measures of freedom Φ_1^f, non-interference Φ_1^{ni}, and power Φ_1^p under each specification of function $g(o,u)$ ($g=1$ and $g=|\pi^{high}-\pi^{low}|$) and for each treatment (1, 2 and 3).

The freedom measure Φ_1^f under Treatment 1 for a general function g is:

$$\begin{aligned}&\Phi_1^f(subg(\supset_1,y),\theta_{1|y})=\\&\sum_{r\leq y}\sum_{u\in U_1}\theta_{1|y}(u)\sum_{c\in\{A,B\}}g(o(r,1,c),u)\theta_{1|y}(o(r,1,c)|u)\log_2\frac{\theta_{1|y}(o(r,1,c)|u)}{\theta_{1|y}(o(r,1,c))}+\\&+\sum_{r>y}\sum_{u\in U_1}\theta_{1|y}(u)\sum_{c\in\{A,B\}}g(o(r,2,c),u)\theta_{1|y}(o(r,2,c)|u)\log_2\frac{\theta_{1|y}(o(r,2,c)|u)}{\theta_{1|y}(o(r,2,c))},\end{aligned}\tag{23}$$

where we use the fact that $\sum_{o\in O_i}f(o)=\sum_{r=1}^{100}\sum_{i\in\{1,2\}}\sum_{c\in\{A,B\}}f(o(r,i,c))$ for any function $f(o)$ and that $y\geq r$ implies $\theta_{1|y}(o(r,2,c))=0$. Moreover, $\theta_{1|y}(o(r,2,c)|u)=\theta_{1|y}(o(r,2,c))$ since if Player 2 has the decision right, the outcome is independent of Player 1's preferences. Since $\log_2 1=0$, the measure simplifies to:

$$\begin{aligned}&\Phi_1^f(subg(\supset_1,y),\theta_{1|y})=\\&\sum_{r\leq y}\sum_{u\in U_1}\theta_{1|y}(u)\sum_{c\in\{A,B\}}g(o(r,1,c),u)\theta_{1|y}(o(r,1,c)|u)\log_2\frac{\theta_{1|y}(o(r,1,c)|u)}{\theta_{1|y}(o(r,1,c))}\end{aligned}\tag{24}$$

The remaining probabilities are as follows:

$$\begin{aligned}\forall u\in U_1:\quad&\theta_{1|y}(u)=1/2\\\forall u\in U_1:\forall r\leq y:\quad&\theta_{1|y}(o(r,1,A)|u)=\begin{cases}\frac{1}{100}, & u=u_1^A\\0, & \text{else}\end{cases}\\\forall u\in U_1:\forall r\leq y:\quad&\theta_{1|y}(o(r,1,B)|u)=\begin{cases}\frac{1}{100}, & u=u_1^B\\0, & \text{else}\end{cases}\\\forall r\leq y:\quad&\theta_{1|y}(o(r,1,A))=1/200\\\forall r\leq y:\quad&\theta_{1|y}(o(r,1,B))=1/200\end{aligned}\tag{25}$$

The freedom measure therefore simplifies to:

$$\Phi_1^f(subg(\supset_1,y),\theta_{1|y})=\frac{1}{200}\sum_{r\leq y}(g(o(r,1,A),u_1^A)+g(o(r,1,B),u_1^B))\tag{26}$$

Since Treatment 2 differs from Treatment 1 only in that Player 2's endowment w_2 equals 0 instead of 100, it follows that $\Phi_1^f(subg(\supset_1,y),\theta_{1|y})=\Phi_1^f(subg(\supset_2,y),\theta_{1|y})$. For Treatment

3, instead:

$$\Phi_1^f(subg(\supset_3, y), \theta_{1|y}) =$$
$$\sum_{r\leq y}\sum_{u\in U_1}\theta_{1|y}(u)\sum_{c\in\{C\}} g(o(r,1,c),u)\theta_{1|y}(o(r,1,c)|u)\log_2\frac{\theta_{1|y}(o(r,1,c)|u)}{\theta_{1|y}(o(r,1,c))}$$
$$+\sum_{r>y}\sum_{u\in U_1}\theta_{1|y}(u)\sum_{c\in\{A,B\}} g(o(r,2,c),u)\theta_{1|y}(o(r,2,c)|u)\log_2\frac{\theta_{1|y}(o(r,2,c)|u)}{\theta_{1|y}(o(r,2,c))}, \tag{27}$$

As in (23), $\theta_{1|y}(o(r,2,c)|u) = \theta_{1|y}(o(r,2,c))$: if Player 2 has the decision right, the outcome is independent of Player 1's preferences. In addition, $\theta_{1|y}(o(r,1,C)|u) = \theta_{1|y}(o(r,1,C))$: if Player 1 has the decision right, then only Card C is available, so the outcome is independent of Player 1's preferences. Since $\ln_2 1 = 0$, the measure equals $\Phi_1^f(subg(\supset_3, y), \theta_{1|y}) = 0$. This concludes the derivations for freedom Φ^f.

The non-interference measure Φ_1^{ni} for a general function g is:

$$\Phi_1^{ni}(subg(\supset, y), \theta_{1|y}) =$$
$$-\sum_{r\leq y}\sum_{v\in U_2}\theta_{1|y}(v)\sum_{u\in U_1}\theta_{1|y}(u|v)\sum_{c\in\{A,B\}} g(o(r,1,c),u)\theta_{1|y}(o(r,1,c)|v)\log_2\frac{\theta_{1|y}(o(r,1,c)|v)}{\theta_{1|y}(o(r,1,c))}$$
$$-\sum_{r>y}\sum_{v\in U_2}\theta_{1|y}(v)\sum_{u\in U_1}\theta_{1|y}(u|v)\sum_{c\in\{A,B\}} g(o(r,2,c),u)\theta_{1|y}(o(r,2,c)|v)\log_2\frac{\theta_{1|y}(o(r,2,c)|v)}{\theta_{1|y}(o(r,2,c))} \tag{28}$$

In all treatments, $\theta_{1|y}(o(r,1,c)|v) = \theta_{1|y}(o(r,1,c))$: if Player 1 has the decision right, the outcome is independent of Player 2's preferences. Thus, Φ_1^{ni} can be written, for all treatments, as:

$$\Phi_1^{ni}(subg(\supset, y), \theta_{1|y}) =$$
$$-\sum_{r>y}\sum_{v\in U_2}\theta_{1|y}(v)\sum_{u\in U_1}\theta_{1|y}(u|v)\sum_{c\in\{A,B\}} g(o(r,2,c),u)\theta_{1|y}(o(r,2,c)|v)\log_2\frac{\theta_{1|y}(o(r,2,c)|v)}{\theta_{1|y}(o(r,2,c))} \tag{29}$$

Since the non-interference measure captures "interferences", it captures what happens if Player 2 has the decision right, and not what happens if Player 1 has the decision right. The remaining probabilities are as follows:

$$\begin{aligned}
\forall v\in U_2: &\quad \theta_{1|y}(v) = 1/2\\
\forall v\in U_2:\forall u\in U_1: &\quad \theta_{1|y}(u|v) = 1/2\\
\forall v\in U_2:\forall r\leq y: &\quad \theta_{1|y}(o(r,2,A)|v) = \begin{cases}\frac{1}{100}, & v = u_2^A\\ 0, & \text{else}\end{cases}\\
\forall v\in U_2:\forall r\leq y: &\quad \theta_{1|y}(o(r,2,B)|v) = \begin{cases}\frac{1}{100}, & v = u_2^B\\ 0, & \text{else}\end{cases}\\
\forall r\leq y: &\quad \theta_{1|y}(o(r,2,A)) = 1/50\\
\forall r\leq y: &\quad \theta_{1|y}(o(r,2,B)) = 1/50
\end{aligned} \tag{30}$$

The non-interference measure therefore simplifies to:

$$\Phi_1^{ni}(subg(\supset, y), \theta_{1|y}) = -\frac{1}{400}\sum_{r>y}\sum_{u\in U_1}(g(o(r,2,A),u) + g(o(r,2,B),u)) \tag{31}$$

It is then straightforward to insert the values for $g(o,u)$ in the above equations. Summing up, for freedom we have:

$$\begin{aligned}
\Phi^{f,c}(subg(\eth_1,y),\theta_{1|y}) &= \Phi^{f,c}(subg(\eth_2,y),\theta_{1|y}) = \frac{y}{100} \\
\Phi^{f,d}(subg(\eth_1,y),\theta_{1|y}) &= \Phi^{f,d}(subg(\eth_2,y),\theta_{1|y}) = \frac{y}{100}\left(\pi_1^{high}-\pi_1^{low}\right) \\
\Phi^{f,c}(subg(\eth_3,y),\theta_{1|y}) &= \Phi^{f,d}(subg(\eth_3,y),\theta_{1|y}) = 0
\end{aligned} \tag{32}$$

For non-interference we have for all $\eth \in \{\eth_1,\eth_2,\eth_3\}$:

$$\begin{aligned}
\Phi^{ni,c}(subg(\eth,y),\theta_{1|y}) &= -\frac{100-y}{100} \\
\Phi^{ni,d}(subg(\eth,y),\theta_{1|y}) &= -\frac{100-y}{100}\left(\pi_1^{high}-\pi_1^{low}\right)
\end{aligned} \tag{33}$$

Power is largely analogous to $\Phi^{f,d}$ and therefore gives:

$$\begin{aligned}
\Phi^{p,d}(subg(\eth_1^{p},y),\theta_{1|y}) = \Phi^{p,d}(subg(\eth_2^{p},y),\theta_{1|y}) &= \frac{y}{100}\left(\pi_2^{high}-\pi_2^{low}\right) \\
\Phi^{p,d}(subg(\eth_1^{np},y),\theta_{1|y}) = \Phi^{p,d}(subg(\eth_2^{np},y),\theta_{1|y}) &= 0 \\
\Phi^{p,d}(subg(\eth_3,y),\theta_{1|y}) &= 0
\end{aligned} \tag{34}$$

Appendices For Online Publication

B Predictions for the authority game

In this section, we apply our theoretical framework to the authority-delegation game conducted by Fehr et al. (2013). In the authority-delegation game two matched participants, Player 1 and Player 2, play a game involving the selection of a card out of 36 available cards. The selected card has payoff consequences for both players. A randomization device (Nature) randomly determines the player's preferences over the 36 cards. One default card is known to give a fixed known payoff $\bar{\pi}$ to each player, but the preferences over the remaining 35 cards are unknown to both players at the beginning of the game. One of these cards gives a high payoff $\hat{\pi}_1$ to Player 1 and a lower payoff $\check{\pi}_2$ to Player 2. Another card gives a high payoff $\hat{\pi}_2$ to Player 2 and a lower payoff $\check{\pi}_1$ to Player 1. All other cards give an extremely low payoff $\not{\pi}$ to deter the player with the decision right to randomly choose a card. Payoffs for each Player i are ordered as follows: $\hat{\pi}_i > \check{\pi}_i > \bar{\pi} > \not{\pi}$.

In stage 1 (delegation stage), Player 1 (the Principal) can choose to delegate or not the decision right to Player 2 (the Agent). In stage 2 (effort decision stage), both players can simultaneously invest effort (payoff) to raise the probability with which they are informed about their preferences over the 35 cards in the following stage. Let p_i be the probability that the player with the decision right observes his preferences and q_j be the probability that the player without the decision right observes his preferences. After players are informed about their preferences with the given probabilities (stage 4), the player without the decision right can make a suggestion to the other player (stage 5).[28] In the last stage (card selection stage) the player with the decision right selects one of the cards.

Let $U_p \in \{1, \ldots, 35\}$ represent the possible preferences of the Principal for his favorite card. Similarly, let $U_a \in \{1, \ldots, 35\}$ represent the possible preferences of the Agent for his favorite card. In this example, players are assumed to be risk neutral and have identical preferences for freedom, power, and non-interference.[29]

The game can be solved using backward induction. Obviously, the last stage, i.e., the card selection, is not influenced by preference for freedom, non-interference, and power. If Player i (with the decision right) knows his preferences, he chooses the card giving payoff $\hat{\pi}_i$ to himself and $\check{\pi}_j$ to the other player. If he does not know his preferences, but the other player has made a suggestion, he follows the suggestion if he believes it is the card giving him payoff $\check{\pi}_i$ (in equilibrium, this is the case). In all other cases, Player i chooses the default card giving payoff $\bar{\pi}$.

For Player j (without the decision right) strategies are similarly simple since the recommendation he makes in stage 5 is not influenced by preference for freedom, non-interference, and power. If Player j knows his preferences, he recommends the card giving payoff $\hat{\pi}_j$ to himself and $\check{\pi}_i$ to the other player. If he does not know his preferences, he recommends the card giving payoff $\bar{\pi}$.

In stage 4, Nature determines randomly whether the players observe their preferences over cards. These observations happen with the probabilities determined in stage 2: p_i for the player with the decision right and q_j for the player without the decision right.

The stage at which preference for freedom, non-interference, and power influences behavior is stage 2, when effort is chosen. Under Nash equilibrium behavior with risk

[28] In stage 3 beliefs are elicited.

[29] It has already been verified by Fehr et al. (2013) that the players' measured risk/loss aversion cannot explain the behavior in the game.

aversion, we should observe the following optimal efforts:

$$p_i^{*NE} = \arg\max_{p_i} p_i\hat{\pi}_i + (1-p_i)(q_j^{*NE}\check{\pi}_i + (1-q_j^{*NE})\bar{\pi}) - c(p_i) \tag{35}$$

$$q_j^{*NE} = \arg\max_{q_j} p_i^{*NE}\check{\pi}_j + (1-p_i^{*NE})(q_j\hat{\pi}_i + (1-q_j)\bar{\pi}) - c(q_j) \tag{36}$$

To determine efforts given preference for freedom, non-interference, and power, we need to measure these in the subgame after effort has been invested. Let $a(p_i, q_j, D)$ be the node in the game where the player with the decision right has invested p_i and the player without the decision right has invested q_j and where delegation decision $D \in \{0, 1\}$ has been made.

The freedom of Player i with the decision right is:

$$\begin{aligned}\Phi^{f}_{i,dr}(subg(\supset, a(p_i, q_j, D)), \theta) = \\ \sum_{s\in\{1,\ldots,35\}} \frac{p_i}{35} g(o_{i,s}, u_{i,s}) \ln\left(\frac{35p_i}{p_i + (1-p_i)q_j}\right) \\ + \sum_{s\in\{1,\ldots,35\}} \sum_{t\in\{1,\ldots,35\}\setminus s} \frac{(1-p_i)q_j}{35\cdot 34} g(o_{i,t}, u_{i,s}) \ln\left(\frac{35(1-p_i)q_j}{34(p_i + (1-p_i)q_j)}\right)\end{aligned} \tag{37}$$

Non-interference for Player i with the decision right is:

$$\begin{aligned}\Phi^{ni}_{i,dr}(subg(\supset, a(p_i, q_j, D)), \theta) = \\ - \sum_{s\in\{1,\ldots,35\}} \frac{(1-p_i)q_j}{35} g(o_{i,s}, u_{j,s}) \ln\left(\frac{35(1-p_i)q_j}{p_i + (1-p_i)q_j}\right) \\ - \sum_{s\in\{1,\ldots,35\}} \sum_{t\in\{1,\ldots,35\}\setminus s} \frac{p_i}{35\cdot 34} g(o_{i,t}, u_{j,s}) \ln\left(\frac{35p_i}{34(p_i + (1-p_i)q_j)}\right)\end{aligned} \tag{38}$$

The power of Player i with the decision right is:

$$\begin{aligned}\Phi^{p}_{i,dr}(subg(\supset, a(p_i, q_j, D)), \theta) = \\ \sum_{s\in\{1,\ldots,35\}} \frac{p_i}{35} g(o_{j,s}, u_{i,s}) \ln\left(\frac{35p_i}{p_i + (1-p_i)q_j}\right) \\ + \sum_{s\in\{1,\ldots,35\}} \sum_{t\in\{1,\ldots,35\}\setminus s} \frac{(1-p_i)q_j}{35^2} g(o_{j,t}, u_{i,s}) \ln\left(\frac{35(1-p_i)q_j}{34(p_i + (1-p_i)q_j)}\right)\end{aligned} \tag{39}$$

The freedom of Player j without the decision right is:

$$\begin{aligned}\Phi^{f}_{j,ndr}(subg(\supset, a(p_i, q_j, D)), \theta) = \\ \sum_{s\in\{1,\ldots,35\}} \sum_{t\in\{1,\ldots,35\}\setminus s} \frac{p_i}{35\cdot 34} g(o_{j,t}, u_{j,s}) \ln\left(\frac{35p_i}{34(p_i + (1-p_i)q_j)}\right) \\ + \sum_{s\in\{1,\ldots,35\}} \frac{(1-p_i)q_j}{35} g(o_{j,s}, u_{j,s}) \ln\left(\frac{35(1-p_i)q_j}{p_i + (1-p_i)q_j}\right)\end{aligned} \tag{40}$$

Non-interference for Player j without the decision right is:

$$\begin{aligned}\Phi^{ni}_{j,ndr}(subg(\ni, a(p_i, q_j, D)), \theta) = \\ - \sum_{s\in\{1,\dots,35\}} \sum_{t\in\{1,\dots,35\}\setminus s} \frac{(1-p_i)q_j}{35\cdot 34} g(o_{j,t}, u_{i,s}) \ln\left(\frac{35(1-p_i)q_j}{34(p_i+(1-p_i)q_j)}\right) \\ - \sum_{s\in\{1,\dots,35\}} \frac{p_i}{35} g(o_{j,s}, u_{i,s}) \ln\left(\frac{35p_i}{p_i+(1-p_i)q_j}\right) \end{aligned} \tag{41}$$

The power of Player j without the decision right is:

$$\begin{aligned}\Phi^{p}_{j,ndr}(subg(\ni, a(p_i, q_j, D)), \theta) = \\ \sum_{s\in\{1,\dots,35\}} \sum_{t\in\{1,\dots,35\}\setminus s} \frac{p_i}{35\cdot 34} g(o_{i,t}, u_{j,s}) \ln\left(\frac{35p_i}{34(p_i+(1-p_i)q_j)}\right) \\ + \sum_{s\in\{1,\dots,35\}} \frac{(1-p_i)q_j}{35} g(o_{i,s}, u_{j,s}) \ln\left(\frac{35(1-p_i)q_j}{p_i+(1-p_i)q_j}\right) \end{aligned} \tag{42}$$

As in the main text, we use two different specifications for $c(o,u)$. First, we set $c(o,u)=1$, yielding measures $\Phi^{f,c}$, $\Phi^{ni,c}$, and $\Phi^{p,c}$. Second, we set $c(o,u)=\Delta\pi_i=\hat{\pi}_i-\check{\pi}_i$ for Player i's freedom and non-interference and $c(o,u)=\Delta\pi_j=\hat{\pi}_j-\check{\pi}_j$ for Player i's power, yielding measures $\Phi^{f,d}$, $\Phi^{ni,d}$, and $\Phi^{p,d}$.

Note that a stronger preference for freedom, for non-interference, and for power will give qualitatively similar predictions: lower delegation rate and higher equilibrium effort by the player with the decision right. Since Fehr et al. (2013) do not have a treatment where having the decision right gives a fixed outcome without a choice stage, we cannot distinguish among the three qualitatively, but only quantitatively in the fit of p_i^* and q_i^*.

Under preference for freedom, power, and non-interference, the optimal efforts are given by the system of equations:

$$\begin{aligned} p_i^{*\Phi} = \arg\max_{p_i} \quad & EU_i(subg(\ni, a(p_i, q_j^{*\Phi}, D) \\ & + \alpha\Phi^{f}_{i,dr}(subg(\ni, a(p_i, q_j^{*\Phi}, D), \theta) \\ & + \beta\Phi^{ni}_{i,dr}(subg(\ni, a(p_i, q_j^{*\Phi}, D), \theta) \\ & + \gamma\Phi^{p}_{i,dr}(subg(\ni, a(p_i, q_j^{*\Phi}, D), \theta) \end{aligned} \tag{43}$$

$$\begin{aligned} q_j^{*\Phi} = \arg\max_{q_j} \quad & EU_j(subg(\ni, a(p_i^{*\Phi}, q_j, D)) \\ & + \alpha\Phi^{f}_{j,ndr}(subg(\ni, a(p_i^{*\Phi}, q_j, D), \theta) \\ & + \beta\Phi^{ni}_{j,ndr}(subg(\ni, a(p_i^{*\Phi}, q_j, D), \theta) \\ & + \gamma\Phi^{p}_{j,ndr}(subg(\ni, a(p_i^{*\Phi}, q_j, D), \theta) \end{aligned} \tag{44}$$

For both players, marginal utility from effort has increased, but even more so for Player i. Player j will only gain from his knowledge of his preferred card with probability $1-p_i$, i.e., if Player i is not informed about his preferred card. Therefore, we should expect p_i^* to be higher if both players have $\alpha>0$, $\beta>0$, or $\gamma>0$ than if they maximize expected utility with parameters $\alpha=\beta=\gamma=0$.

In the delegation stage, given expected payoff maximization, we have:

$$\begin{aligned} D^{*NE} = \mathbb{1}(p_1^*\hat{\pi}_1 + (1-p_1^*)(q_2^*\check{\pi}_1 + (1-q_2^*)\bar{\pi}) - c(p_1^*) < \\ p_2^*\check{\pi}_1 + (1-p_2^*)(q_1^*\hat{\pi}_1 + (1-q_1^*)\bar{\pi}) - c(q_1^*)) \end{aligned} \tag{45}$$

with $\mathbb{1}$ being the indicator function. Player 1 simply compares the situation in which

he has the decision right and plays the optimal p_1^* to the situation in which he does not have the decision right and plays the optimal q_1^*, given that Player 2 plays the optimal p_2^* and q_2^*. Under preference for freedom, non-interference, and power, Player 1 compares his aggregate valuations with or without delegation:

$$D^{*\Phi} = \mathbb{1}\left(V_{1,dr}(subg(\supset, a(p_1^*, q_2^*, 0), \theta) < V_{1,ndr}(subg(\supset, a(p_2^*, q_1^*, 1), \theta)\right) \tag{46}$$

where we use the fact that p_i^* and q_i^* do not depend on U_i and U_j and therefore V_1 does not depend on whether it is measured at $a(p_i^*, q_j^*, D)$ or at the node following the delegation decision. The above condition can be interpreted as follows. Player 1 compares his aggregate valuation of expected utility, freedom, non-interference, and power if he has the decision right ($V_{1,dr}$) after he has not delegated ($D = 0$) and has played p_1^* and Player 2 has played q_2^* to his aggregate valuation if he does not have the decision right ($V_{1,ndr}$) after he has delegated ($D = 1$) and has played q_1^* and Player 2 has played p_2^*. Looking back at Equations 37-42, a player with a large α, β, or γ requires much larger gains in expected payoffs to delegate, compared to a player maximizing expected utility. Under preference for freedom/non-interference/power we should therefore observe lower delegation rates.

Treatment	$\hat{\pi}_1$	$\check{\pi}_2$	$\check{\pi}_1$	$\hat{\pi}_2$	$\bar{\pi}$	$\not{\pi}$
PLOW	40	35	20	40	10	0
LOW	40	20	20	40	10	0
HIGH	40	35	35	40	10	0
PHIGH	40	20	35	40	10	0

Table 9: Payoffs in each treatment

Using the same payoffs and cost functions employed by Fehr et al. (2013), we predict the effect of preference for freedom, power, and non-interference on the behavior of a representative player.[30] In Table 10 we report the predicted strategies for the effort decisions p_1, q_2, p_2, and q_1 and the delegation decision D for various specifications of the parameters α, β, and γ given $g(o, u) = 1$ and $g(o, u) = \Delta\pi$. For simplicity, we only allow one parameter to differ from 0 in each panel of the table. We set the parameters to minimize the squared error of the p_i choices, since for the q_j choices Fehr et al. (2013) presume additional motivation effects, which we cannot capture without additional data and assumptions. On the lowest panel of Table 10, we report the average strategies observed by Fehr et al. (2013).

Due to the inclusion of an additional parameter, the fit is naturally better for models which allow for preference for freedom, power, or non-interference. Positive preference for any of these leads to a better fit of the effort decisions. Note that freedom and power, compared to non-interference, provide a better fit of the effort decision but a worse fit of the delegation decision. Indeed, to match the delegation pattern using freedom or power under specification $g(o, u) = 1$, we would need parameters α and γ that lead to predictions of $p_i^* = 100$ and $q_i^* = 0$. The better fit of the delegation decision under preference for non-interference can be explained as follows. For the player with the decision right, freedom and power are strongly influenced by his effort decision p_i, since it directly affects his ability of making an informed card choice. However, interference is much more influenced by the effort decision of the other player q_j. Therefore, a comparably higher parameter β is needed to match the effort pattern p_i. Moreover, the delegation decision D strongly influences the other player's effort and, therefore, the probability with which the other player will interfere in the outcome. Thus, at the delegation stage, the principal will be reluctant to give up the decision right.

Finally, we highlight that preference for non-interference appears to be similar to

[30] Payoffs are reported in Table 9 and the cost function for all players was $c(p) = 25 \cdot p^2$.

the one documented in our experiment. However, to verify this point, a more detailed comparison of the datasets would be necessary.

treatment	p_1	q_2	p_2	q_1	D	(α, β, γ)	$g(o,u)$
PLOW	54.5	27.3	42.9	34.3	0	*(0,0,0)*	$g = 1$
LOW	54.5	27.3	54.5	27.3	0		
HIGH	42.9	34.3	42.9	34.4	100		
PHIGH	42.9	34.3	54.5	27.3	100		
PLOW	66.5	21.2	56.1	28.5	0	*(0.941,0,0) or*	$g = 1$
LOW	66.5	21.2	66.5	21.2	0	*(0,0,0.941)*	
HIGH	56.1	28.5	56.1	28.5	100		
PHIGH	56.1	28.5	66.5	21.2	100		
PLOW	64.7	32.2	57.6	36.3	0	*(0,5.823,0)*	$g = 1$
LOW	64.7	32.2	64.7	32.2	0		
HIGH	57.6	36.3	57.6	36.3	0		
PHIGH	57.6	36.3	64.7	32.2	0		
PLOW	65.5	21	43.6	37.2	0	*(0.043,0,0)*	$g = \Delta\pi$
LOW	65.3	21.9	65.3	21.9	0		
HIGH	45.5	33.5	45.5	33.5	100		
PHIGH	43.6	37.2	65.5	21	100		
PLOW	68.4	24.9	48.9	48.8	0	*(0,0.581,0)*	$g = \Delta\pi$
LOW	72.9	35.5	72.9	35.5	0		
HIGH	51.1	34.9	51.1	34.9	0		
PHIGH	48.9	48.8	68.4	24.9	0		
PLOW	57.8	28.	62.4	23.1	0	*(0,0,0.062)*	$g = \Delta\pi$
LOW	70.4	18.8	70.4	18.8	0		
HIGH	46.7	33	46.7	33	100		
PHIGH	62.4	23.1	57.8	28	100		
PLOW	55.7	22.8	68.1	16.5	16.3	*observed*	
LOW	66.1	14.3	68.3	16.2	13.9		
HIGH	48.2	26.5	58.7	19.6	35.5		
PHIGH	58.2	17.3	65.1	20.7	42.7		

Table 10: Strategies: predicted (upper panels), observed (lowest panel)

C Locus of control

We implement the Levenson Multidimensional Locus of Control Test as designed by Levenson (1981) and translated from English to German by Krampen (1981). In personality psychology, locus of control refers to the extent to which individuals believe that they can control events that affect them. A person's locus is either internal (i.e., the person believes that events in his life derive primarily from his own actions) or external (i.e., the person believes that events in his life derive primarily from external factors, such as chance and other people's actions, which he cannot influence). Three separate scales are used to measure locus of control: Internal Scale (I scale), Powerful Others External Scale (P scale), and Chance External Scale (C scale). The I-scale measures the degree to which individuals believe that they control their lives. The P-scale measures the degree to which individuals believe that other persons control their lives. Finally, the C-scale measures the degree to which individuals believe that chance plays a role in their lives.

The questionnaire is reported in Table 12. There are eight items on each of the three scales, which are presented to the subject as one unified attitude scale of 24 items. The specific content areas mentioned in the items are counterbalanced so as to appear equally often for all three dimensions. To score each scale, the points of the answers for the items appropriate for that scale (from 1 for strongly disagree to 6 for strongly agree) are added up. The possible range on each scale is from 0 to 48. Each subject receives three scores indicative of his or her locus of control on the three dimensions of I, P, and C.

Table 11 reports summary statistics of the three scales across all participants. Since the empirical distribution does not differ across treatments, Table 11 pools all treatments together.

scale	No.	mean	standard deviation	min	25% percentile	median	75% percentile	max
I-scale	244	36	4	16	33	36	38	46
P-scale	244	24	5	10	21	24	27	38
C-scale	244	25	5	11	22	25	28	39

Table 11: Locus of Control: summary statistics of each scale.

We assess whether attitudes toward locus of control are correlated with preference for freedom or non-interference. To do so, we employ the coefficients of preference for freedom and preference for non-interference estimated from the model of Equations 17-22. As shown in Table 13, model I suggests that the P-scale predicts preference for freedom and non-interference but model II does not suggest so. Thus, we conclude that general attitudes toward locus of control are unrelated to preference for control over outcomes.

1. (I) Whether or not I get to be a leader depends mostly on my ability.
2. (C) To a great extent my life is controlled by accidental happenings.
3. (P) I feel like what happens in my life is mostly determined by powerful people.
4. (I) Whether or not I get into a car accident depends mostly on how good a driver I am.
5. (I) When I make plans, I am almost certain to make them work.
6. (C) Of ten there is no chance of protecting my personal interests form bad luck happenings.
7. (C) When I get what I want, it is usually because I'm lucky.
8. (P) Although I might have good ability, I will not be given leadership responsibility without appealing to those positions of power.
9. (I) How many friends I have depends on how nice a person I am.
10. (C) I have often found that what is going to happen will happen.
11. (P) My life is chiefly controlled by powerful others.
12. (C) Whether or not I get into a car accident is mostly a matter of luck.
13. (P) People like myself have very little chance of protecting our personal interests when they conflict with those of strong pressure groups.
14. (C) It's not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune.
15. (P) Getting what I want requires pleasing those people above me.
16. (C) Whether or not I get to be a leader depends on whether I'm lucky enough to be in the right place at the right time.
17. (P) If important people were to decide they didn't like me, I probably wouldnt make many friends.
18. (I) I can pretty much determine what will happen in my life.
19. (I) I am usually able to protect my personal interests.
20. (P) Whether or not I get into a car accident depends mostly on the other driver.
21. (I) When I get what I want, it's usually because I worked hard for it.
22. (P) In order to have my plans work, I make sure that they fit in with the desires of people who have power over me.
23. (I) My life is determined by my own actions.
24. (C) It's chiefly a matter of fate whether or not I have a few friends or many friends.

Table 12: Locus of Control questionnaire

model		I-scale	C-scale	P-scale
(I) $\Delta EU = \alpha V^{f,c} + \beta V^{ni,d} + \epsilon$	$\hat{\alpha}$	-0.1632	-0.2132*	-0.2930**
	$\hat{\beta}$	0.1596	0.1799	0.2258*
(II) $\Delta EU = \alpha V^{f,d} + \beta V^{ni,c} + \epsilon$	$\hat{\alpha}$	-0.0917	0.1124	-0.0096
	$\hat{\beta}$	0.1732	0.0215	0.0363

Table 13: Correlation of estimated preference parameters with Locus of Control scores. *: $p < 0.05$, **: $p < 0.01$

D Inequality aversion

Our experimental design also allows for the estimation of fairness preferences. We implement the Fehr and Schmidt (1999) model, which gives the following optimal bid condition:

$$b - \frac{\pi_1^{hi} - \pi_1^{low}}{2} = \lambda V^{dis} + \mu V^{adv} \tag{47}$$

$$V^{dis} = \max\left(0, \tfrac{\pi_2^{high}+\pi_2^{low}}{2} + w_2 - \pi^{high} - w_1 + b\right) - \max\left(0, \pi_2^{high} + w_2 - \tfrac{\pi_1^{high}+\pi_1^{low}}{2} - w_1\right)$$

$$V^{adv} = \max\left(0, \pi_1^{high} + w_1 - b - \tfrac{\pi_2^{high}+\pi_2^{low}}{2} - w_2\right) - \max\left(0, \tfrac{\pi_1^{high}+\pi_1^{low}}{2} + w_1 - \pi_2^{high} - w_2\right)$$

where V^{dis} stands for the difference in disadvantageous inequality between having and not having the decision right, and V^{adv} stands for the difference in advantageous inequality between having and not having the decision right. An individual behaving according to the above model compares not only the utility values resulting from having or not having the decision right, but also the expected payoff inequalities resulting from having or not having the decision right. Note that whether Player 1 experiences advantageous or disadvantageous inequality depends not only on the payoff levels but also on the bid chosen by Player 1.

For better readability, we define:

$$\eta_1 = \pi_1^{high,L} - \frac{\pi_1^{high,R} + \pi_1^{low,R}}{2} \tag{48}$$

$$\eta_2 = \frac{\pi_1^{high,L} + \pi_1^{low,L}}{2} - \pi^{high,R} \tag{49}$$

$$\eta_L = \pi_1^{high,L} - \frac{\pi_2^{high,L} + \pi_2^{low,L}}{2} \tag{50}$$

$$\eta_R = \frac{\pi_1^{high,R} + \pi_1^{low,R}}{2} - \pi_2^{high,R} \tag{51}$$

$$\eta_w = w_1 - w_2 \tag{52}$$

The optimal bid b^* is then implicitly defined via:

$$b^*(\lambda,\mu) = \begin{cases} \eta_1 - \frac{\lambda}{1+\lambda}\eta_2 & \text{if } (\eta_L + \eta_w < b^*) \wedge (\eta_R + \eta_w < 0) \\ \frac{1}{1+\lambda}[\eta_1 + \lambda(\eta_w + \eta_L) + \mu(\eta_w + \eta_R)] & \text{if } (\eta_L + \eta_w < b^*) \wedge (\eta_R + \eta_w > 0) \\ \eta_1 + \frac{\mu}{1-\mu}\eta_2 & \text{if } (\eta_L + \eta_w > b^*) \wedge (\eta_R + \eta_w > 0) \\ \frac{1}{1-\mu}[\eta_1 - \mu(\eta_w + \eta_L) + \lambda(\eta_w + \eta_R)] & \text{if } (\eta_L + \eta_w > b^*) \wedge (\eta_R + \eta_w < 0) \end{cases} \tag{53}$$

Which case in Equation 53 is relevant depends on the round and the parameters λ and μ. The optimal bid is nonlinear in λ and μ. We estimate the parameters λ and μ via nonlinear least squares on the bids. We include a constant to account for preference for non-interference.[31] The estimated model is:

$$b_{i,t} = b^*_{i,t}(\lambda,\mu) + \gamma + \epsilon_{i,t}. \tag{54}$$

λ	.013038	(.0514239)
μ	-.0886128*	(.044491)
γ	12.44203***	(1.783147)
obs	2440	
subjects	122	
R^2	0.7604	

Table 14: Estimation results of the model from Equation 54. We use a grid of 10^3 starting points for the three parameters and obtained standard errors via bootstrapping with clusters at the individual level and 100 repetitions. Standard errors are shown in parenthesis: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

We find only weak evidence of preference for advantageous inequality. Participants seem to engage more in competitive bidding when they are in an advantageous situation. The main explanation for overbidding relative to the Nash equilibrium predictions is still non-interference.

There are several reasons why inequality aversion seems to play a minor role in explaining the data. First, in more complex decision tasks individuals may focus more strongly on their own payoffs than on inequality concerns. Second, unlike decision problems such as the dictator game, the decision problem in our experiment is not clearly framed as one where individuals are morally obliged to share. Finally, experiment participants may not have been aware of the effect that their bids had on the payoffs of the other player.

[31] Technically, this is not quite the same definition of non-interference as in the main body of the paper, where the model additionally accounts for risk attitudes. Since in both the risk-neutral and the risk-averse case there is strong evidence for preference for non-interference, we interpret this as an additional robustness result.

E Instructions

The experiment was conducted in German and the original instructions were in German. Below we provide the translation in English.

Introduction

You are about to participate in a scientific study. Please read the following instructions carefully. The instructions inform you about everything you need to know to participate in the study. If you do not understand something, please raise your hand and an instructor will come to you and answer your question.
For participating in this study and arriving on time, you have already earned a show up fee of 2.50 Euro. During the study you may receive additional money by earning points. The amount of points you earn will depend on your decisions and the decisions of other participants. All points earned during the study will be converted to Euro at the end of the session. The conversion rate is:

12 Points = 1 Euro

At the end of the study you will receive the amount of money that you earned plus the 2.50 Euro show up fee.
During the study, it is strictly forbidden to communicate with each other. In addition, please use only the functions on the computer which relate directly to the study. Communication or using the computer in a way unrelated to the study will lead to exclusion from the study. If you have questions we are happy to assist you.

All participants are divided into two groups: **Participants 1 and Participants 2**. You will be randomly assigned a group and remain in this group for the whole duration of the session.

This study consists of three parts:

Part 1: Part 1 lasts for **20 rounds**. In each round a Participant 1 and a Participant 2 will be matched randomly. At no time will you or any other participant be informed of the identity of the individuals that you are matched with. At the end of the session, **one** of the 20 rounds will be randomly selected and you will be **paid** according to the points earned in **the selected round only**. Before Part 1 starts, there will be a trial round which does not count toward your earnings.

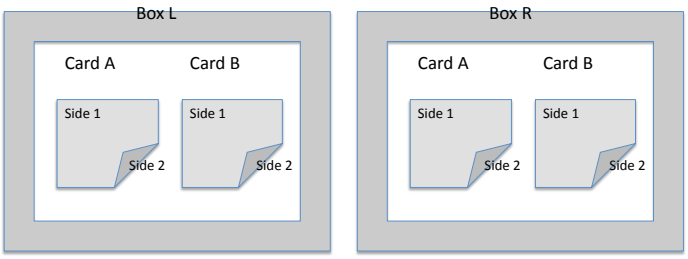
Part 2: Instructions for Part 2 will be provided once Part 1 has ended.

Part 3: Instructions for Part 3 will be provided once Part 2 has ended.

Part 1 (Treatment 1 and 2)

[In Part 1, Treatment 1 and 2 differ only in the endowment of Participant 2. Sentences that differ in the two treatments are highlighted.]

In each round each Participant 1 will be randomly matched with a Participant 2. In each round Participant 1 and Participant 2 have the task of choosing a single card and will earn points depending on the chosen card. There are 2 boxes, Box L and Box R. Each box contains 2 cards, Card A and Card B.



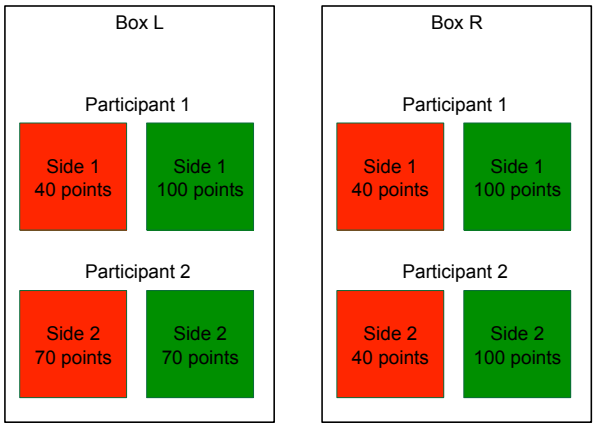
Card A and Card B each have 2 sides. One side is marked 'Side 1', the other 'Side 2'. The color of Side 1 determines the points Participant 1 receives. The color of Side 2 determines the points Participant 2 receives. Each side of a card can be Red or Green.
The cards' colors in Box L are independent from the cards' colors in Box R. The cards' colors are also independent across rounds.

Each round has the following steps:

1. **Information about points:** Both participants learn the points associated with the card selection.
2. **Bidding:** [*In Treatment 1:* Both participants receive an endowment of 100 points. *In Treatment 2:* Participant 1 receives an endowment of 100 points.]. Participant 1 uses his/her endowment to bid for the right to choose the card. *Depending on the submitted bid:*
   - *either* Participant 1 receives the decision right and pays a fee
   - *or* Participant 2 receives the decision right, in which case neither participant pays any fee
3. **Information about cards:** If Participant 1 has the decision right, Box L is opened. If Participant 2 has the decision right, Box R is opened. The computer randomly determines the colors of Side 1 and Side 2 on the cards in the opened box.
   - Participant 1 learns the color of Side 1 on the cards in the opened box.
   - Participant 2 learns the color of Side 2 on the cards in the opened box.
4. **Card selection:** The participant with the decision right selects a card out of the opened box.
5. **Earnings:** The points earned by each participant in the round are recorded, but each participant learns his/her earnings only at the end of the session.

Each step is explained in more detail below:

- **Step 1 - Information about points**
  Information about points resulting from the card selection is provided in a table. The table below is an example.



In this example:

- If the card is selected from Box L:
  Participant 1 receives 40 points if Side 1 is red, 100 points if Side 1 is green.
  Participant 2 receives 70 points if Side 2 is red, 70 points if Side 2 is green.
- If the card is selected from Box R:
  Participant 1 receives 40 points if Side 1 is red, 100 points if Side 1 is green.
  Participant 2 receives 40 points if Side 2 is red, 100 points if Side 2 is green.

- **Step 2 - Bidding**
  [*In Treatment 1:* Both participants receive an endowment of 100 points. *In Treatment 2:* Participant 1 receives an endowment of 100 points.]. Using the endowment, Participant 1 bids for the right to make the card selection at the end of the round. Participant 2 cannot bid.

  - If the bid of Participant 1 is successful, Participant 1 will have the decision right. A fee will be paid by Participant 1.
  - If the bid of Participant 1 is unsuccessful, Participant 2 will have the decision right. No fee will be paid by either participant.

  Participant 1 chooses a bid between 0 and 100 points.

  $$\mathbf{0 \leq bid \leq 100}$$

  Whether the bid of Participant 1 is successful and, if so, which fee is deducted, is determined as follows. The computer randomly draws one number out of the integers between 1 and 100. Each number is equally likely to be drawn. If the drawn number is smaller than or equal to the bid, then the bid is successful and Participant 1 will pay a fee equal to the drawn number. If the drawn number is larger than the bid, then the bid is unsuccessful and neither participant pays any fee.

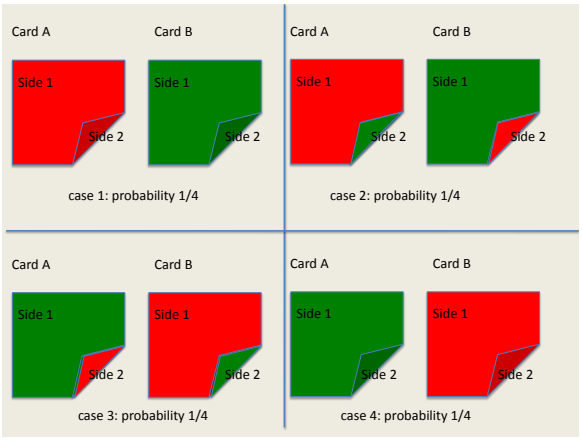
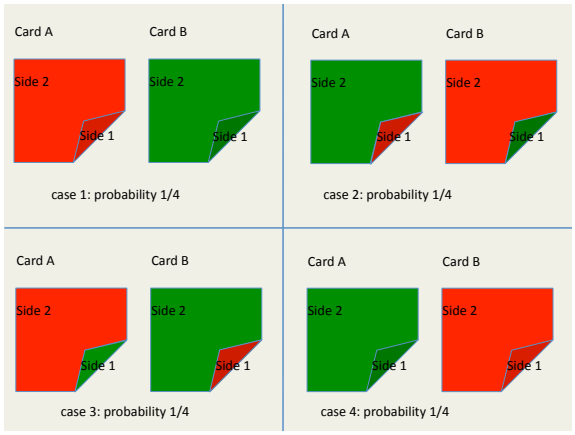
  Examples:

  1. Participant 1 chooses a bid equal to 15:
     If the computer draws a number between 1 and 15, for example 10, then Participant 1 has the decision right and will pay a fee equal to 10. If the number is larger than 15, then Participant 2 has the decision right and neither participant pays any fee.

2. Participant 1 chooses a bid equal to 75:
   If the computer draws a number between 0 and 75, for example 60, then Participant 1 has the decision right and will pay a fee equal to 60. If the number is larger than 75, then Participant 2 has the decision right and neither participant pays any fee.

Given these rules, it is in the interest of Participant 1 to choose a bid which represents how much he/she values the decision right.

- **Step 3 - Information about cards**

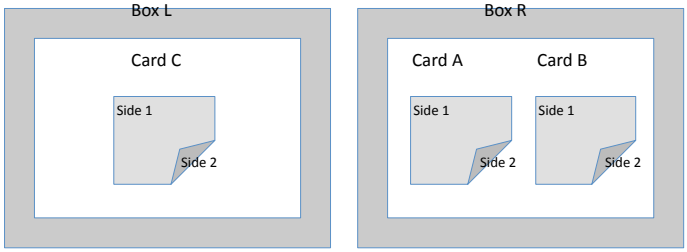
Box L	**Box R**
If Participant 1 has the decision right, Box L is used. The computer randomly determines the colors of Side 1 and Side 2 on the cards in Box L, by picking one of the four cases shown below.	If Participant 2 has the decision right, Box R is used. The computer randomly determines the colors of Side 1 and Side 2 on the cards in Box R, by picking one of the four cases shown below.
	
Then Box L is opened. Participant 1 observes Side 1 of Card A and Card B, but not Side 2. Participant 2 observes Side 2 of Card A and Card B, but not Side 1.	Then Box R is opened. Participant 1 observes Side 1 of Card A and Card B, but not Side 2. Participant 2 observes Side 2 of Card A and Card B, but not Side 1.

- **Step 4 - Card selection**
  The participant with the decision right selects Card A or Card B.
  - If Participant 1 has the decision right, he/she selects a card out of Box L.
  - If Participant 2 has the decision right, he/she selects a card out of Box R.

- **Step 5 - Earnings**
  The points earned in the round depend on the selected card. The color of Side 1 determines the points Participant 1 receives. The color of Side 2 determines the points Participant 2 receives.
  Participant 1's earnings are: **Endowment - Fee + Points from card selection**
  Participant 2's earnings are: [*In Treatment 1:* **Endowment + Points from card selection**] [*In Treatment 2:* **Points from card selection**]

Part 1 (Treatment 3)

In each round each Participant 1 will be randomly matched with a Participant 2. In each round Participant 1 and Participant 2 have the task of choosing a single card and will



earn points depending on the chosen card. There are 2 boxes, Box L and Box R. Box L contains one card, Card C. Box R contains two cards, Card A and Card B.
Card A, B and C each have 2 sides. One side is marked 'Side 1', the other 'Side 2'. The color of Side 1 determines the points Participant 1 receives. The color of Side 2 determines the points Participant 2 receives. Each side of a card can be Red or Green.
The cards' colors in Box L are independent from the cards' colors in Box R. The cards' colors are also independent across rounds.

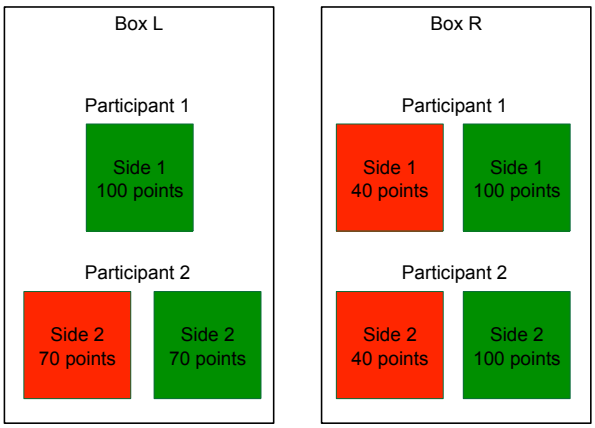
Each round has the following steps:

1. **Information about points:** Both participants learn the points associated with the card selection.
2. **Bidding:** Participant 1 receives an endowment of 100 points. Participant 1 uses his/her endowment to bid for Box L to be used instead of Box R. *Depending on the submitted bid:*
   - *either* Box L is used and Participant 1 pays a fee
   - *or* Box R is used, in which case neither participant pays any fee
3. **Information about cards:** If Participant 1's bid is successful, Box L is opened. Otherwise, Box R is opened. The computer randomly determines the colors of Side 1 and Side 2 on the card(s) in the opened box. Side 1 of Card C is always Green.
   - Participant 1 learns the color of Side 1 on the card(s) in the opened box.
   - Participant 2 learns the color of Side 2 on the card(s) in the opened box.
4. **Card selection:** If Box L is opened, Card C is selected automatically. If Box R is opened, Participant 2 selects a card out of Box R.
5. **Earnings:** The points earned by each participant in the round are recorded, but each participant learns his/her earnings only at the end of the session.

Each step is explained in more detail below:

- **Step 1 - Information about points**

  Information about points resulting from the card selection is provided in a table. The table below is an example.



In this example:

- If Card C is selected from Box L:
  Participant 1 receives 100 Points, since Side 1 is green.
  Participant 2 receives 70 Points if Side 2 is red, 70 Points if Side 2 is green.
- If the card is selected from Box R:
  Participant 1 receives 40 Points if Side 1 is red, 100 Points if Side 1 is green.
  Participant 2 receives 40 Points if Side 2 is red, 100 Points if Side 2 is green.

- **Step 2 - Bidding**
  Participant 1 receives an endowment of 100 points. Using the endowment, Participant 1 bids for Box L to be used instead of Box R. Participant 2 cannot bid.
  - If the bid of Participant 1 is successful, Box L is used. A fee will be paid by Participant 1.
  - If the bid of Participant 1 is unsuccessful, Box R is used. No fee will be paid by either participant.

  Participant 1 chooses a bid between 0 and 100 points.

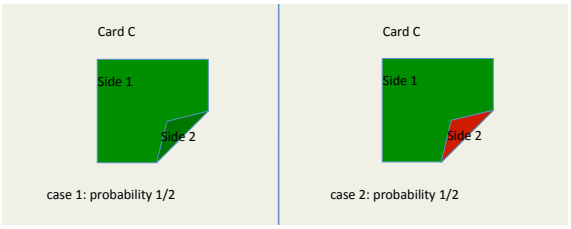
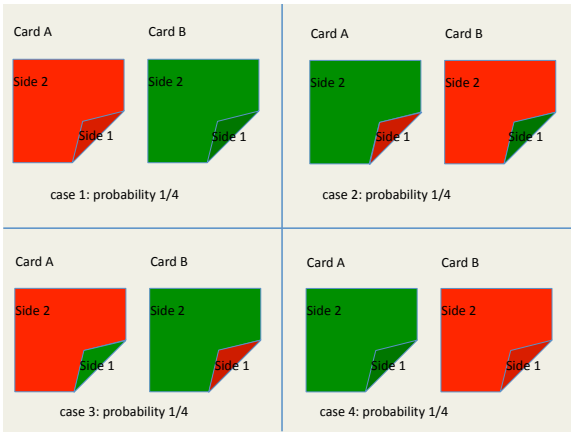
  $$\mathbf{0 \leq bid \leq 100}$$

  Whether the bid of Participant 1 is successful and, if so, which fee is deducted, is determined as follows. The computer randomly draws one number out of the integers between 1 and 100. Each number is equally likely to be drawn. If the drawn number is smaller than or equal to the bid, then the bid is successful and Participant 1 will pay a fee equal to the drawn number. If the drawn number is larger than the bid, then the bid is unsuccessful and neither participant pays any fee.
  Examples:

  1. Participant 1 chooses a bid equal to 15:
     If the computer draws a number between 1 and 15, for example 10, then Box L is used and Participant 1 will pay a fee equal to 10. If the number is larger than 15, then Box R is used and neither participant pays any fee.
  2. Participant 1 chooses a bid equal to 75:
     If the computer draws a number between 0 and 75, for example 60, then Box L is used and Participant 1 will pay a fee equal to 60. If the number is larger than 75, then Box R is used and neither participant pays any fee.

Given these rules, it is in the interest of Participant 1 to choose a bid which represents how much he/she values the use of Box L instead of Box R.

- **Step 3 - Information about cards**

Box L	**Box R**
If the bid of Participant 1 is successful, Box L is used. The computer randomly determines the color of Side 2 of Card C in Box L, by picking one of the two cases shown below.	If the bid of Participant 1 is unsuccessful, Box R is used. The computer randomly determines the colors of Side 1 and Side 2 on the cards in Box R, by picking one of the four cases shown below.
	
Then Box L is opened. Participant 1 observes Side 1 of Card C, but not Side 2. Participant 2 observes Side 2 of Card C, but not Side 1.	Then Box R is opened. Participant 1 observes Side 1 of Card A and Card B, but not Side 2. Participant 2 observes Side 2 of Card A and Card B, but not Side 1.

- **Step 4 - Card selection**
  - If Box L is used, Card C is selected automatically.
  - If Box R is used, Participant 2 selects a card out of Box R.

- **Step 5 - Earnings**

  The points earned in the round depend on the selected card. The color of Side 1 determines the points Participant 1 receives. The color of Side 2 determines the points Participant 2 receives.

  Participant 1's earnings are: **Endowment - Fee + Points from card selection**

  Participant 2's earnings are: **Points from card selection**

Part 1: Comprehension questions

For each of the following statements, please select 'correct' or 'incorrect':

- If participant 1 has the decision right, box R is opened. (correct: Not True)
- It is in the best interest of participant 1, to bid equal to his/her true valuation for the decision right. (correct: True)
- The participants receive payments for each round of part 1. (correct: Not True)
- If the bid of participant 1 is higher than the randomly determined number, participant 1 has to pay a fee equal to the amount of the bid. (Correct: Not True)

Part 2: Lottery-choice questionnaire

In Part 2 you are presented with a series of decisions. Each decision is a paired choice between two options, Option A and Option B. Option A gives you a specific amount of points with certainty. Option B gives you either a high amount of points or a low amount of points, with equal probability. At the end of Part 2 one decision will be randomly selected and you will receive the points that have resulted from your own choice in that decision only.

Part 3: Locus of Control questionnaire

In Part 3 you are presented with a series of statements and you are asked to indicate the extent to which you agree or disagree to each of them, using a scale that ranges from 'strongly disagree' to 'strongly agree'. For each statement, please select the answer that best reflects your own opinion. Your answers will be always treated anonymously.

F Screen Shots

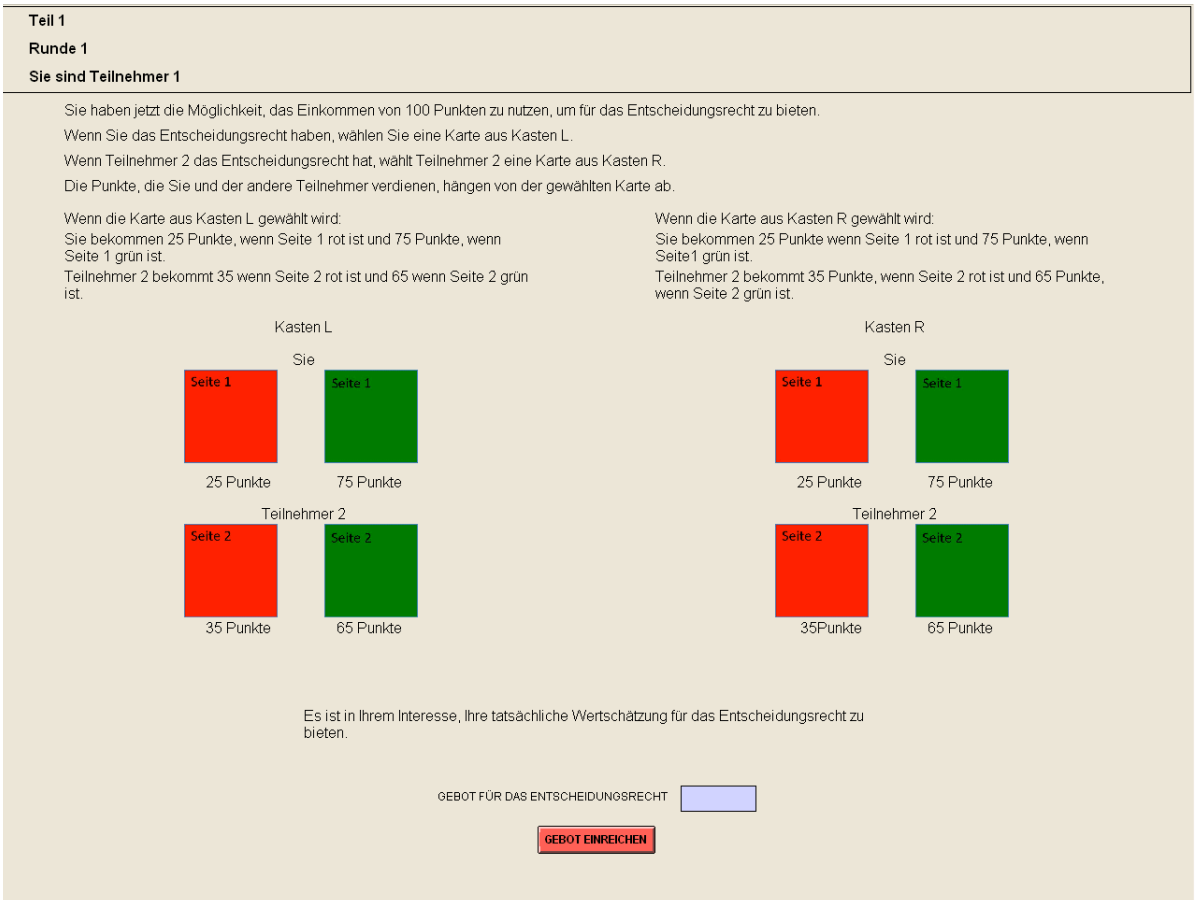


Figure 3: Example: Participant 1 will bid for the decision right, after observing the high and low payoffs for each participant for each box. From Box L, Participant 1 can earn 75 points (high payoff) or 25 points (low payoff), and Participant 2 can earn 65 points (high payoff) or 35 points (low payoff). From Box R, Participant 1 can earn 75 points (high payoff) or 25 points (low payoff), and Participant 2 can earn 65 points (high payoff) or 35 points (low payoff).

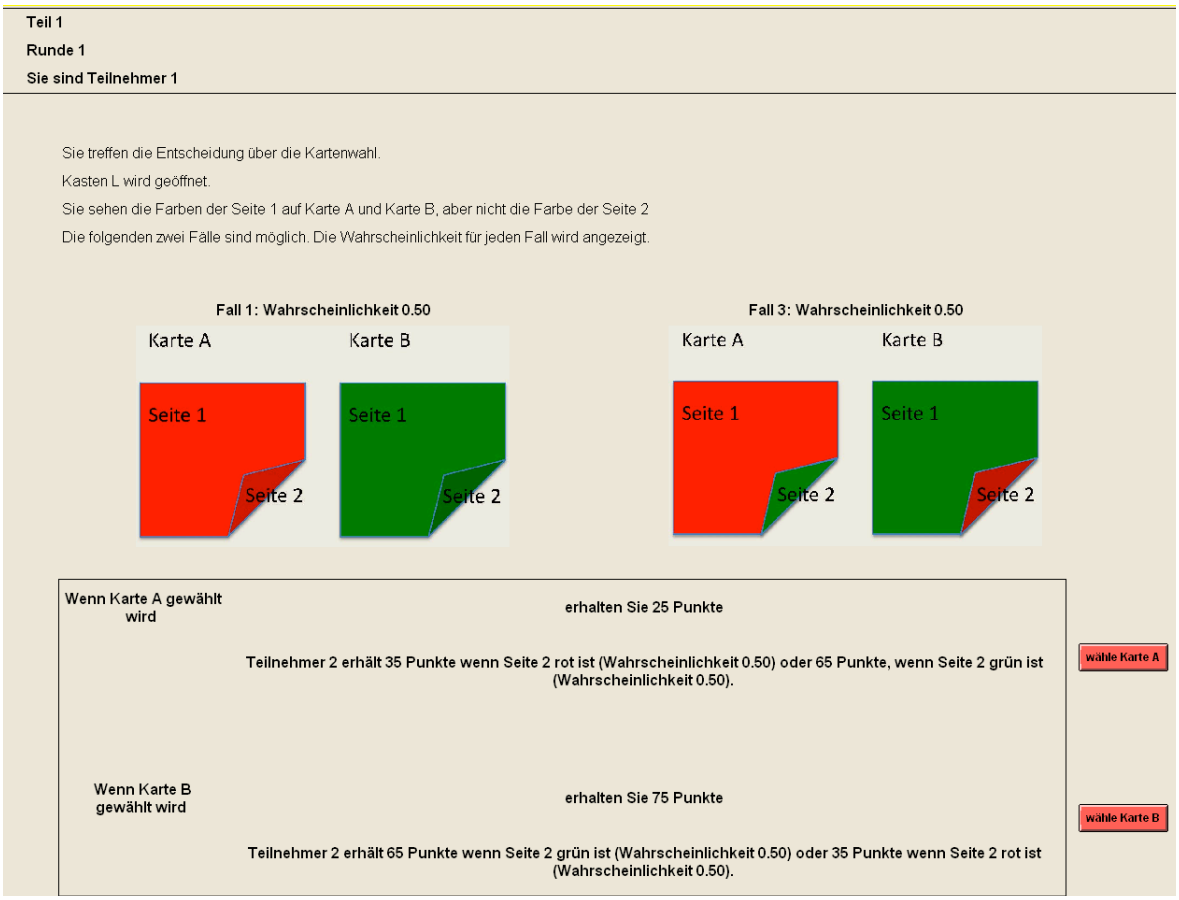


Figure 4: Example (cont.): Participant 1 has the decision right and will select a card from Box L, after observing that Card B gives him the high payoff (75 points) while Card A gives him the low payoff (25 points). Participant 1 does not observe which card gives the high payoff to Participant 2. If Card A is selected, Participant 2 is equally likely to receive the high payoff (65 points) or the low payoff (35 points). Analogously, if Card B is selected, Participant 2 is equally likely to receive the high payoff (65 points) or the low payoff (35 points).