Risk taking and investing in electoral competition

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**Abstract.** We analyze a two-player electoral contest game between a challenger and an incumbent. First, the challenger decides whether to choose a high-risk campaign (e.g., risky platforms, negative campaigning, an interactive Web technology) or a less risky one. In a second stage, both the challenger and the incumbent raise funds and invest in the electoral contest. The politicians differ in their fund-raising costs. According to theory, a high-cost challenger should choose high risk (gambling for resurrection). If the benefit of winning is sufficiently large, a low-cost challenger should take high risk either to discourage the incumbent or to prevent intense campaigning. Both effects are based on the fact that high risk campaigning reduces incentives to invest in the contest. In case of a rather small benefit of winning, a low-cost challenger should prefer low risk to avoid jeopardizing his competitive advantage. Our experimental findings show that gambling for resurrection plays a role. Taking low risk to preserve a competitive advantage is strongly supported by the data. However, reactions of low-cost challengers when facing high benefits of winning are heterogeneous.

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## 1. Introduction

In many election campaigns we observe strong competition between two players – the challenger and the incumbent. Whereas the incumbent typically has a well-known agenda and follows a safe strategy by trying to benefit from familiarity and office experience, the challenger often chooses a risky strategy to achieve a competitive advantage (e.g., Druckman et al., 2009; Militia et al., forthcoming; Darmofal et al., 2011; Walter and van der Brug, 2013). Such risky behavior includes negative campaigning, the use of interactive Web technologies, introducing personal features, taking clear issue positions, and partisan emphasis.[1] For example, negative campaigning by the challenger can harm the incumbent but may also backfire on the challenger if voters dislike aggressive behavior. The riskiness of clear political positions has been highlighted by a large number of publications in politics and political economy (e.g., Shepsle, 1972; Mayhew, 1974; Alesina and Cukierman, 1990). Taking a clear position is beneficial for the challenger if the majority of voters takes a similar position, but may be detrimental if there are considerable gaps between the challenger's policy preferences and those of his constituencies. When the challenger takes risk, he has to decide whether high or low risk is optimal in his specific situation.

In this paper, we theoretically and experimentally analyze the behavior of a challenger and an incumbent in a stylized electoral competition game. Our theoretical setting is based on the standard rank-order tournament model,[2] which is extended by a risk-taking stage. At the first stage, the challenger has to decide between taking low or high risk. At the second stage, for given risk, the challenger and the incumbent compete by raising and investing funds in a political campaign.[3] Funds are used to persuade the voters of being the right candidate that should be elected. The more funds a politician has raised, the higher will be his likelihood of being elected.

We assume that the challenger and the incumbent differ in fund-raising costs. Often, politicians are associated with different reliability from the voters' point of view, or they have different skills or abilities, which are common knowledge (e.g., politicians differ in

[1] In their empirical analysis of U.S. congressional campaigns, Druckman et al. (2009) used these measures as proxies for risky behavior of the politicians. The authors define risky behavior as choosing actions that have high variance outcomes.

[2] Rank-order tournaments have been first analyzed by Tullock (1980) and Lazear and Rosen (1981). For more recent work on tournaments see Sheremeta (2010b), Ryvkin (2010), Chowdhury and Sheremeta (2011), Amegashie (2012), Franke (2012), Kräkel (2012), and Lee (2012). For an overview see Congleton et al. (2008a), Congleton et al. (2008b), Konrad (2009), and Long (2013). For an application of tournament theory to electoral competition see Erikson and Palfrey (2000), Meirowitz (2008), and Konrad (2009). The empirical findings of Rekkas (2007) stress the importance of campaign spending in electoral competition.

[3] For example, during the 2004 presidential election campaign, President Bush and the Republicans spent \$1.14 billion, while expenditures of challenger Kerry and the Democrats amount to \$1.08 billion (see Edsall and Grimaldi, 2004). See Houser et al. (2011) on informative advertising in political campaigning. Fink (2012) analyzes the impact of campaign spending in German elections.

vocational qualifications). As a consequence, it is less costly (e.g., less time-consuming) for a leading or more able politician (the "favorite") to obtain financial resources from sponsors when competing against a trailing or less able opponent (the "underdog"). We can think of a situation where the incumbent politician is the natural favorite since he can make use of his previous political experience and his challenger is the underdog (e.g., Ashworth, 2006). However, there also exist situations in which the incumbent is the underdog due to past poor performance. In any case, the heterogeneity of the politicians has important implications for funding by interest groups.

Suppose that the risk taking challenger is the underdog. He should strictly benefit from a high risk since he has nothing to lose but good luck may compensate for the competitive disadvantage. Such behavioral pattern has been called a knife-edge or gambling for resurrection by Rose-Ackerman (1991), Downs and Rocke (1994), Carrillo and Mariotti (2001), and Eriksen and Kvaløy (2014). In our model, the underdog anticipates that in equilibrium he will not collect and invest more funds than the favorite. Thus, his winning probability cannot be larger than that of the favorite. The best the trailing challenger can do is to choose high risk in any situation in order to win the competition by luck. This strategic behavior is summarized as gambling for resurrection in the following.

Accordingly, if the risk taking challenger is the favorite, one would expect that he does not prefer a high risk which can jeopardize his favorable position. Our analysis shows that this guess is not necessarily true. We have to distinguish three different effects: First, there are situations in which risk taking influences the fund-raising efforts and, hence, effort costs of both politicians (cost effect). Following the cost effect, the favorite prefers high risk so that the outcome of the competition is mainly determined by luck. This high-risk strategy undermines overall incentives and, therefore, reduces both players' effort costs. Second, there are other situations in which the fund-raising efforts of both politicians do not react to risk taking – the favorite will always choose high effort and the underdog low effort. In this situation, risk only influences the politicians' likelihood of winning so that the favorite prefers a low-risk strategy to hold his predominant position (likelihood effect). This effect is the counterpart of gambling for resurrection by a risk-taking underdog. Third, if the benefit of winning the election is very large relative to the politicians' effort costs, the favorite will choose a high risk to further discourage his opponent (discouragement effect). In this situation, high risk destroys the underdog's incentives when collecting funds: It does not pay for him to invest in fund raising as he would bear rather high effort costs but the outcome of the electoral contest is mainly determined by luck. However, the favorite still invests in fund raising as he has to bear lower effort costs. Such discouragement will be very attractive for the favorite if the gain of winning the election is rather large (e.g., the politicians compete for becoming president or governor).

Altogether, the three effects point out that the challenger should not always prefer a rather safe strategy when being the favorite. On the contrary, both cost effect and discouragement effect make high risk a rational choice for a favorite. According to the cost effect, high risk prevents both politicians from acting too aggressively during the campaign, which would result into high effort costs. Following the discouragement effect, a risk taking favorite prefers a high-risk strategy in order to further demoralize his already trailing opponent.

The experimental part of the paper tests whether gambling for resurrection, the cost effect, the likelihood effect and the discouragement effect are relevant for real decision makers. Since the challenger is either the favorite or the underdog, we ran six treatments. The three treatments labeled disc_F, cost_F and likel_F consider risk taking by the favorite under the discouragement effect, cost effect and likelihood effect, respectively. In the treatments disc_U, cost_U and likel_U, we use the same parameter constellations as in the three treatments before but now the underdog is the risk taker.

Our experimental results point out that gambling for resurrection plays a role for underdogs when choosing risk. Underdogs most clearly gamble for resurrection when risk taking determines the players' winning probabilities but does not influence equilibrium efforts. This finding is quite intuitive since in the given situation subjects in the lab can fully concentrate on the direct effect of risk on the likelihood of winning without anticipating any spillover effects on the subsequent effort choices. The larger the underdogs' cost disadvantage relative to the favorites, the more often high risk is chosen by underdogs in stage 1. Intuitively, the more desperate the situation of the underdogs the more strongly they rely on the pure chance of winning by luck. Regarding the risk choice, the favorites very often make use of the likelihood effect and choose low risk to maximize their winning probability. They do not select high risk as often as theoretically predicted in the disc_F treatment. The behavior in the cost_F and cost_U treatments reveals two stable patterns: subjects either want to keep control by choosing low risk and high effort or make use of the cost effect by combining high risk with low effort. The subjects' effort choices as reactions to given risk are often in line with theory in the disc_ and likel_treatments. Our data shows that subjects indeed react to different amounts of risk.

Of course, our model and the experiment cannot capture all aspects that influence "real" political campaigns such as historical contingencies or candidate characteristics. Instead we focus on a specific aspect, namely risk taking, and study its impact on behavior of politicians. While we have to be cautious to transfer our findings one-to-one to "real" political campaigns and historical situations, we believe that our results offer valuable insights and help to understand the effects of risk taking in campaigns. Nevertheless, we want to briefly discuss some historical campaigns to give the reader an idea about the situations we had in mind. If we assume that taking clear issue positions can be interpreted as a high-risk strategy (see, e.g., Druckman et al., 2009, p. 345), U.S. presidential elections offer interesting examples of challengers that had precise issue positions. In 1996, Robert Dole challenged President Bill Clinton. During his campaign, Dole hit a hot topic by promising to tighten immigration legislation and to change the Constitution of the United States. According to the polls of the Gallup Survey previous to the 1996 election,[4] Clinton led by 52 per cent to 41 per cent against Dole, who thus was in the role of the underdog. Following the effects discussed in our paper, Dole's high-risk strategy can be interpreted as gambling for resurrection.

In the 2004 electoral competition between President George W. Bush and John Kerry, the latter one proclaimed to raise minimum wages from \$5.15 to \$7 per hour when being elected. While this policy might be popular for low-income earners or people with low vocational training, others became afraid of a looming economic disaster. Following the Gallup Survey, there was a head-to-head race between Bush and Kerry (according to the forecasts, each one held 49 per cent of the votes). Hence, there was neither a clear favorite nor a clear underdog in the 2004 election so that only the cost effect was of relevance for the challenger Kerry when taking risk.

In the presidential campaign 2008, Barack Obama favored a universal health care system that guaranteed each US citizen eligibility for necessary health care. This hot topic has been intensively discussed since Obama's plan led to more regulation and raised national debt considerably. According to the Gallup Survey, Obama was leading by 55 to 44 per cent against McCain at the end of the campaign.[5] Hence, Obama was a clear favorite. Choosing this high risk topic might be his strategy to discourage his opponent or to avoid expensive campaigning.

The paper is organized as follows. In the next section, we discuss the related literature. Section 3 introduces the game and the corresponding solution. In Section 4, we point out the three main effects of favorites' risk taking. In Section 5, we describe the experiment. Our testable hypotheses are introduced in Section 6. The experimental results are presented in Section 7. We discuss three puzzling results in Section 8. Section 9 concludes.

## 2. Related literature

Our paper is related to two fields in the economic literature – the work on electoral competition and the work on risk taking in rank-order tournaments. There is a large literature that addresses the problem of electoral competition. Like our paper, Rose-Ackerman (1991) addresses gambling for resurrection by an underdog. Lizzeri and Persico (2009) also address the problem of risk-taking by political candidates. However, they use their model for a comparison of majoritarian and proportional electoral systems. In a

[4] See http://www.gallup.com/poll/9442/election-polls-accuracy-record-presidential-elections.aspx.

[5] Note that McCain was not the incumbent in a strict sense, but he followed George W. Bush as candidate of the Republican Party.

recent paper, Jennings (2011) analyzes populism in a model with emotional voters. We also consider the possibility that the challenger can choose between different political programs, but concentrate on differences in risk-taking. Messner and Polborn (2004), Mattozzi and Merlo (2008) and Gersbach (2009), among others, investigate the problem of heterogeneous politicians. In particular, they show under which conditions bad politicians more likely run for office and/or win the competition than high-quality individuals. Our paper also considers heterogeneous politicians but does not analyze the problem of bad ones. There are also parallels to the paper by Carrillo and Mariotti (2001). In their paper, the selection of more risky candidates may be preferred by parties since gambling for resurrection is optimal in certain situations. This outcome corresponds to the risk-taking behavior of the underdog in our model.

There is also an experimental literature on political contests, for an overview please see Dechenaux et al. (2012) pages 66-67. Öncüler and Croson (2005) consider a Tullock contest with the winner prize being a lottery. For example, we can think of a nested contest where the winner of the primary still has to be successful in the main election. The experimental results show that players overinvest in the contest. Bullock and Ruthström (2007) investigate a Tullock contest with deterministic winner prize. They present experimental evidence for the over-dissipation of rents, i.e., total expenditures in the contest exceed the magnitude of the winner prize. Sheremeta (2010a) considers a two-stage political contest where part of the first-stage expenditures carries over to the second stage. In line with theory, players' first-stage (second-stage) expenditures increase (decrease) in the carryover rate. Expenditures in the experiment exceed the theoretically predicted values, which is in line with the finding of Öncüler and Croson (2005). Irfanoglu et al. (2010) analyze election contests that are organized either simultaneously or sequentially. Their experimental findings show that, contrary to equilibrium behavior, expenditures are higher if contests are arranged sequentially. Anderson and Freeborn (2010) use a laboratory experiment to analyze how different levels of competition affect resource expenditures. In contrast to our paper none of these papers analyzes risk taking in the lab.

The second field of related literature addresses risk taking in tournaments. Most of this work either fully concentrates on the players' risk choices by skipping the investment decisions, or considers symmetric investment choices within a two-stage game. The first strand of this literature is better in line with risk behavior of mutual fund managers or other players that can only influence the outcome of a winner-take-all competition by choosing risk (see, for example, Gaba and Kalra, 1999; Hvide and Kristiansen, 2003; Taylor 2003; and Nieken and Sliwka, 2010). The second strand of the risk-taking literature is stronger related to our paper. Hvide (2002) and Kräkel and Sliwka (2004) consider a symmetric two-stage tournament between two workers that compete for job promotion or bonuses within a firm. The workers decide on risk taking at stage 1 and subsequently choose efforts at stage 2. Kräkel and Sliwka (2004) allow for heterogeneous workers that have different abilities, but since abilities are additively combined with effort in the workers' production functions, only equilibria can exist in which workers choose identical effort levels.

Nieken (2010) experimentally investigates only the cost effect within a symmetric setting with bilateral risk taking. On the one hand, her results show that subjects rationally reduce their efforts when risk increases. On the other hand, subjects do not behave according to the cost effect very well as only about 50% (instead of 100%) of the players choose high risk. Our paper mainly builds on the theoretical work of Kräkel (2008). However, we transfer that setting with bilateral risk-taking into a model with unilateral risk taking by a challenger. Moreover, whereas Kräkel (2008) is a purely theoretical piece of work, we focus on the behavior of real decision makers by conducting a laboratory experiment. Concerning the theoretical results, in the bilateral risk-taking model of Kräkel (2008) there exist equilibria (a) in which both the favorite and the underdog prefer low risk and (b) in which the favorite prefers high risk but the underdog prefers low risk, although the players' cost-benefit ratios take only moderate values. Both findings are in sharp contrast to our paper with unilateral risk taking.

## 3. The game

We consider a two-stage electoral contest game with two risk neutral politicians. At the first stage (risk-taking stage), the challenger chooses the variance of the underlying probability distribution that characterizes risk in the contest. At the second stage (investment stage), both the challenger and the incumbent observe the chosen risk and then simultaneously decide on their fund-raising efforts. The politician with the higher relative success is elected and receives the benefit $B > 0$, whereas his opponent receives nothing. Relative success does not only depend on the effort choices but also on the realization of the underlying luck term.

The two politicians are heterogeneous in fund-raising costs.[6] Politician $F$ ("favorite") has low personal costs of raising funds (e.g., measured in opportunity cost of time), whereas obtaining resources for his political campaign entails rather high personal costs for politician $U$ ("underdog"). Let, for example, politician $F$ have higher reliability or higher vocational qualification than his opponent so that it is easier for the former one to collect funds from interest groups for his political campaign. However, the worse politician has to spend more time and effort to obtain the same amount of funding. In our model, both politicians can only choose between the two efforts $e_i = e_L$ and $e_i = e_H$ $(i = F, U)$ with $e_H > e_L \geq 0$ and $\Delta e := e_H - e_L > 0$. Choosing $e_H$ instead of $e_L$ means

[6]Since the players' cost-benefit ratios are decisive for the following results, the model can be reinterpreted as a setting in which players have identical cost functions but differ in their valuations of winning the election.

that politician $i$ prefers a high instead of a low activity level when collecting funds and, therefore, collects a high amount of money instead of a low amount.[7] Hence, there is a one-to-one relationship between fund-raising effort and collected money, which is then spent in the campaign. We assume that each politician can opt for $e_H$ but one of the politicians more easily establishes large funds than his opponent. For simplicity, player $i$'s costs of choosing $e_i = e_L$ are normalized to zero, but choosing high effort $e_i = e_H$ involves positive costs $c_i$ $(i = F, U)$ with $c_U > c_F > 0$. Thus, each politician receives a basic funding from his interest groups without bearing personal costs, but he has to incur positive costs if he wants to spend additional funding. Relative success of politician $i$ is described by[8]

$$RP = e_i - e_j + \varepsilon \tag{1}$$

with $\varepsilon$ as luck term which follows a symmetric distribution around zero with cumulative distribution function $G(\varepsilon; \sigma^2)$ and variance $\sigma^2$.

At the risk-taking stage, the challenger – which is either the underdog or the favorite – has to decide between two variances or risks. He can either choose a high risk $\sigma^2 = \sigma_H^2$ (e.g., a more risky agenda) or a low risk $\sigma^2 = \sigma_L^2$ (e.g., a less risky political program) with $0 < \sigma_L^2 < \sigma_H^2$. Technically, the distribution $G(\cdot; \sigma_L^2)$ is transformed into the distribution $G(\cdot; \sigma_H^2)$ by replacing $\varepsilon$ by $\alpha \cdot \varepsilon$ with $\alpha > 1$ so that the low-risk distribution has variance $Var[\varepsilon] =: \sigma_L^2$ and the high-risk distribution variance $Var[\alpha \cdot \varepsilon] = \alpha^2 \sigma_L^2 =: \sigma_H^2 > \sigma_L^2$. Politician $i$ prevails in the political competition and is elected if and only if $RP > 0$. Hence, his winning probability is given by

$$\text{prob}\{RP > 0\} = 1 - G\left(e_j - e_i; \sigma^2\right) = G\left(e_i - e_j; \sigma^2\right), \tag{2}$$

where the last equality follows from the symmetry of the distribution. In analogy, we obtain for politician $j$'s winning probability:

$$\text{prob}\{RP < 0\} = G\left(e_j - e_i; \sigma^2\right) = 1 - G\left(e_i - e_j; \sigma^2\right). \tag{3}$$

The symmetry of the distribution has two implications: first, each politician's winning probability will be $G(0; \sigma^2) = \frac{1}{2}$ if both choose the same effort. Second, if both politicians choose different efforts, the one that spends more has winning probability $G(\Delta e; \sigma^2) > \frac{1}{2}$ and the other one only wins with probability $G(-\Delta e; \sigma^2) = 1 - G(\Delta e; \sigma^2) < \frac{1}{2}$. Let

$$\Delta G\left(\sigma^2\right) := G\left(\Delta e; \sigma^2\right) - \frac{1}{2} \tag{4}$$

[7] Roughly, this simplified picture sketches the case of George W. Bush and John Kerry mentioned in footnote 5: both acquired and spent the huge amount of about \$1 billion to run for the Oval Office.

[8] Note that, technically, our investment stage equals the rank-order tournament model introduced by Lazear and Rosen (1981) with $\varepsilon$ as difference of the two players' i.i.d. noise terms. See also Baik (1998) and Che and Gale (2000) on the difference-form contest success function.

denote the additional winning probability of the politician with the higher effort compared to a situation with identical efforts by both politicians. Note that $\Delta G\left(\sigma^2\right) \in \left(0, \frac{1}{2}\right)$ and that increasing risk from $\sigma_L^2$ to $\sigma_H^2$ shifts probability mass from the mean to the tails so that $G\left(\Delta e; \sigma_L^2\right) > G\left(\Delta e; \sigma_H^2\right)$,[9] implying

$$\Delta G\left(\sigma_L^2\right) > \Delta G\left(\sigma_H^2\right). \tag{5}$$

When looking for subgame-perfect equilibria by backward induction we start by considering the investment stage. Here, both politicians observe $\sigma^2 \in \{\sigma_L^2, \sigma_H^2\}$ and simultaneously choose their efforts according to the following matrix game:

| | $e_F = e_H$ | $e_F = e_L$ |
|---|---|---|
| $e_U = e_H$ | $\frac{B}{2} - c_U$ , $\frac{B}{2} - c_F$ | $B \cdot G\left(\Delta e; \sigma^2\right) - c_U$ , $B \cdot G\left(-\Delta e; \sigma^2\right)$ |
| $e_U = e_L$ | $B \cdot G\left(-\Delta e; \sigma^2\right)$ , $B \cdot G\left(\Delta e; \sigma^2\right) - c_F$ | $\frac{B}{2}$ , $\frac{B}{2}$ |

The first (second) payoff in each cell refers to player $U$ ($F$) who chooses rows (columns). Note that $(e_U, e_F) = (e_H, e_L)$ can never be an equilibrium at the investment stage since

$$\begin{aligned} & B \cdot G\left(-\Delta e; \sigma^2\right) \geq \frac{B}{2} - c_F \Leftrightarrow c_F \geq B \cdot \Delta G\left(\sigma^2\right) \\ \text{and} \quad & B \cdot G\left(\Delta e; \sigma^2\right) - c_U \geq \frac{B}{2} \Leftrightarrow c_U \leq B \cdot \Delta G\left(\sigma^2\right) \end{aligned}$$

lead to a contradiction as $c_U > c_F$. Intuitively, it is impossible that, at the same time, the cost-benefit ratio is so large for the low-cost player that he does not invest in high effort, whereas the ratio is so small for the high-cost player that investing in high effort is optimal for him. Combination $(e_U, e_F) = (e_H, e_H)$ will be an equilibrium at the investment stage if and only if

$$\frac{B}{2} - c_i \geq B \cdot G\left(-\Delta e; \sigma^2\right) \Leftrightarrow B \geq \frac{c_i}{\Delta G\left(\sigma^2\right)} \tag{6}$$

holds for player $i = F, U$. In words, each politician will not deviate from selecting high effort if and only if, compared to $e_i = e_L$, the additional expected gain $B \cdot \Delta G\left(\sigma^2\right)$ is at least as large as the additional costs $c_i$. Similar considerations for $(e_U, e_F) = (e_L, e_L)$ and $(e_U, e_F) = (e_L, e_H)$ yield the following result:

**Proposition 1** *At the investment stage,* $(e_U^*, e_F^*) = (e_H, e_H)$ *is an equilibrium iff* $B \geq$

[9]Let $\tilde{G}$ denote the cdf of the standardized random variable $\varepsilon/\sigma$ with mean 0 and variance 1. Then, $G\left(\Delta e; \sigma_L^2\right) > G\left(\Delta e; \sigma_H^2\right)$ is equivalent to $\tilde{G}\left(\frac{\Delta e}{\sigma_L}; 1\right) > \tilde{G}\left(\frac{\Delta e}{\sigma_H}; 1\right) \Leftrightarrow \frac{\Delta e}{\sigma_L} > \frac{\Delta e}{\sigma_H} \Leftrightarrow \sigma_H > \sigma_L$, which is true.

*$c_U/\Delta G(\sigma^2)$. The combination $(e_U^*, e_F^*) = (e_L, e_H)$ is an equilibrium iff $c_U/\Delta G(\sigma^2) \geq B \geq c_F/\Delta G(\sigma^2)$. The combination $(e_U^*, e_F^*) = (e_L, e_L)$ is an equilibrium iff $B \leq c_F/\Delta G(\sigma^2)$.*

Figure 1 illustrates our results:

Place Figure 1 here. Caption: Equilibria at the investment stage

Our findings are quite intuitive: the favorite chooses at least as much effort as the underdog because of lower costs. If the underdog's (and, thus, also the favorite's) costs are sufficiently small relative to the additional expected gain, $B \cdot \Delta G(\sigma^2)$, it will pay off for both politicians to choose high effort. However, if the underdog's costs are sufficiently large and the favorite's ones sufficiently small relative to the expected gain, only the favorite will prefer high effort. For sufficiently large costs of both politicians neither one chooses high effort. According to Proposition 1, there exist two special parameter constellations that lead to multiple equilibria. If $B \cdot \Delta G(\sigma^2) = c_U$, the favorite will unambiguously prefer high effort, but the underdog is indifferent between high and low effort. Similarly, if $B \cdot \Delta G(\sigma^2) = c_F$, the underdog's cost-benefit relation will make him choose low effort, whereas the favorite is indifferent between both efforts. In the experiment, we avoid parameter constellations that lead to multiple equilibria.

At the risk-taking stage, the challenger selects risk $\sigma^2$. Equations (2) and (3) show that risk taking directly influences both politicians' winning probabilities. Furthermore, Proposition 1 points out that risk also determines the effort choices at stage 2. We obtain the following proposition:[10]

**Proposition 2** *(i) If $B \leq c_F/\Delta G(\sigma_L^2)$ or $B \geq c_U/\Delta G(\sigma_H^2)$, then the challenger will be indifferent between $\sigma^2 = \sigma_L^2$ and $\sigma^2 = \sigma_H^2$, irrespective of whether he is the favorite or the underdog. (ii) Let $B \in (c_F/\Delta G(\sigma_L^2), c_U/\Delta G(\sigma_H^2))$. When $F$ takes risk, he will choose $\sigma^2 = \sigma_L^2$ if $B < c_U/\Delta G(\sigma_L^2)$ and $\sigma^2 = \sigma_H^2$ if $B > c_U/\Delta G(\sigma_L^2)$. He will be indifferent between $\sigma_L^2$ and $\sigma_H^2$ if $B = c_U/\Delta G(\sigma_L^2)$. When $U$ is the risk taker, he will always choose $\sigma^2 = \sigma_H^2$.*

The result of Proposition 2(i) shows that risk taking becomes unimportant if both politicians' costs are very large or very small compared to the benefit $B$. In the first case, it never pays for the politicians to choose high effort, irrespective of the underlying risk. In the latter case, both politicians prefer to exert high efforts for any risk level since winning the electoral contest is very attractive. Hence, the risk-taking decision is only interesting for moderate parameter values that do not correspond to one of these extreme cases.

[10]The proof is relegated to the appendix.

Proposition 2(ii) deals with the situation of moderate cost values. Here, the underdog always prefers high risk when being in the role of the risk taking challenger. The intuition for this result comes from the fact that $U$ is in an inferior position at the investment stage according to Proposition 1 (i.e., he will never choose higher effort than player $F$), irrespective of the chosen risk level. Therefore, he has nothing to lose and unambiguously gains from choosing the high risk: in case of good luck, he may win the competition despite his inferior position; in case of bad luck, he will not really worsen his position as he has already a rather small winning probability. This high-risk strategy by the underdog has been called gambling for resurrection in the literature.[11]

The favorite is in a completely different situation when being the risk taking challenger. His optimal risk choice is illustrated by Figure 2.

Place Figure 2 here. Caption: Optimal risk taking by the favorite

According to Proposition 1, player $F$ is the presumable winner of the contest (i.e., he will never choose less effort than politician $U$) and does not like to jeopardize his favorable position by choosing high risk. However, Figure 2 shows that $F$'s preference for low risk will only hold if the benefit is smaller than a certain cut-off value. If $B$ is rather large, then it will pay for the favorite to choose high risk at stage 1. By this, he strictly gains from either discouraging his rival $U$ or from eliminating aggressive campaigning at the investment stage. These motives will be outlined in the next section.

## 4. Discouragement effect, cost effect and likelihood effect

The results of Proposition 2 have shown that player $U$ has a strong preference for choosing high risk (gambling for resurrection), whereas the risk taking behavior of player $F$ depends on the specific situation characterized by the players' parameter values. Since the three effects that drive player $F$'s risk choice are not well known in the literature so far, we will analyze them in more details in this section.

Recall that risk taking may influence both the politicians' effort choices and their winning probabilities. As mentioned in the introduction, particularly three main effects determine the favorite's risk taking – a discouragement effect, a cost effect and a likelihood effect. These three effects depend on the relationship between the benefit $B$, the players' costs (i.e., $c_F$ and $c_U$), and the additional winning probability of outperforming one's opponent (i.e., $\Delta G\left(\sigma^2\right)$).

If $F$'s incentives to win the electoral competition are sufficiently strong, that is if $B > \max\{c_F/\Delta G\left(\sigma_H^2\right), c_U/\Delta G\left(\sigma_L^2\right)\}$,[12] he wants to deter $U$ from exerting high effort, which we call the discouragement effect. From the proof of Proposition 2, we know that low

[11] See, for example, Downs and Rocke (1994) and Carrillo and Mariotti (2001).

[12] For the cut-off values see the proof of Proposition 2 in the appendix.

risk $\sigma_L^2$ leads to $(e_U^*, e_F^*) = (e_H, e_H)$, but high risk $\sigma_H^2$ induces $(e_U^*, e_F^*) = (e_L, e_H)$. Hence, when choosing high risk at stage 1, the favorite completely discourages his opponent and increases his winning probability by $\Delta G(\sigma_H^2)$ compared to low risk. This effect is shown in Figure 3. There, the cumulative distribution function given high risk, $G(\cdot;\sigma_H^2)$, is obtained from the low-risk cdf, $G(\cdot;\sigma_L^2)$, by flattening and clockwise rotation in the point $(0, \frac{1}{2})$. Low risk makes high effort attractive for both politicians since spending effort has still a real impact on the outcome of the electoral contest, resulting into a winning probability of $\frac{1}{2}$ for each player. Switching to a high-risk strategy $\sigma_H^2$ makes $U$ reduce his effort to $e_U^* = e_L$ so that the effort difference $e_F^* - e_U^*$ increases by $\Delta e$, which raises $F$'s likelihood of winning by $\Delta G(\sigma_H^2)$ without influencing his costs.

Place Figure 3 here. Caption: Discouragement Effect

The second effect can be labeled cost effect. In our discrete setting, this effect will influence $F$'s risk taking if $c_U/\Delta G(\sigma_L^2) < B < c_F/\Delta G(\sigma_H^2)$. Intuitively, this effect will determine $F$'s risk choice if the players' costs take moderate values and do not differ too much so that risk influences both players' decisions at the investment stage. Now, $\sigma^2 = \sigma_L^2$ leads to aggressive behavior $(e_U^*, e_F^*) = (e_H, e_H)$ at stage 2, but $\sigma^2 = \sigma_H^2$ implies overall low efforts $(e_U^*, e_F^*) = (e_L, e_L)$.

Place Figure 4 here. Caption: Likelihood Effect

Hence, in any case the winning probability of either player will be $\frac{1}{2}$, but only under low risk each one has to bear positive costs. Consequently, the favorite prefers high risk at stage 1 to commit himself (and his rival) to choose minimal effort at stage 2 in order to save costs. Concerning the cost effect, both politicians' interests are perfectly aligned as each one prefers a kind of implicit collusion in the electoral competition, induced by high risk.

The third effect arises when $c_F/\Delta G(\sigma_H^2) < B < c_U/\Delta G(\sigma_L^2)$, that is when players' costs clearly differ so that risk does not influence either player's decision at the investment stage. In this situation, the outcome is $(e_U^*, e_F^*) = (e_L, e_H)$, no matter which risk level has been chosen at stage 1. Here, risk taking only determines the politicians' likelihoods of winning so that this effect is called likelihood effect. If $F$ chooses risk, he will unambiguously prefer low risk $\sigma^2 = \sigma_L^2$. Higher risk taking would shift probability mass from the mean to the tails. This is detrimental for the favorite, since bad luck may jeopardize his favorable position at the investment stage. By choosing low risk, his winning probability becomes $G(\Delta e;\sigma_L^2)$ instead of $G(\Delta e;\sigma_H^2)$ $(< G(\Delta e;\sigma_L^2))$. An intuition can be seen from Figure 4. At $\Delta e$ the cdf describes the winning probability of player $F$, whereas $U$'s likelihood of winning is computed at $-\Delta e$. Thus, by choosing low risk instead of high risk, the favorite maximizes his own winning probability and minimizes that of his opponent.

To sum up, the analysis of risk taking by the favorite points to three different effects at the risk-taking stage of the game. These three effects together with gambling for resurrection by the underdog were investigated in a laboratory experiment which will be described in the next section. Thereafter, we will present the exact hypotheses to be tested and our experimental results.

## 5. Experimental design and procedure

We use a lab experiment to test the predictions of our model because a lab experiment offers the advantage of controlling many factors and allows to manipulate and test only the causal variables (see, e.g., Morton and Williams 2010, chapter 4). If we would have analyzed field data, for instance about past elections in the U.S., we would only be able to observe the chosen campaign themes and the amount of funds spent, but we would miss information about potential other themes for constructing the risk-measure and the effort it took to raise the funds. In the lab experiment we are able to control the choices and information of the subjects and can induce different risks and effort cost as well as the timing of events. By randomizing subjects over treatments we also randomize unobservables such as subjects' characteristics over treatments. However, using a lab experiment also raises the issue of generalizability (see, e.g., Druckman et al., 2011a; Druckman et al., 2011b; McDermott, 2011; Druckman and Kam, 2011; and Iyengar, 2011 for an extensive discussion). Nevertheless a lab experiment is – in our view – a suitable tool to test the theoretical framework and it allows to gain insight into actual behavior in a controlled environment (see, e.g., Roth, 1995; or Aldrich and Lupia, 2011)

We designed six different treatments. Three of them – called disc_F, cost_F and likel_F – let the favorite take risk in stage 1; they correspond to the discouragement effect, the cost effect, and the likelihood effect, respectively. The three remaining treatments – disc_U, cost_U and likel_U – use the same parameter constellations as the three treatments before but now the underdog acts as risk taking challenger. For each treatment we conducted four sessions, each including 5 groups of 6 participants. Each session consisted of 10 trial rounds and 5 rounds of the two-stage game. During each round, pairs of two players were matched anonymously within each group. After each round new pairs were matched in all groups. The game was repeated five times so that each individual interacted with each other individual exactly one time within a certain group. This perfect stranger matching was implemented to prevent reputation effects. Altogether, for each treatment we have 20 observations, which are independent of the other matching groups' behavior.[13] Within the 5 rounds of the experiment the participants had alternate roles.

[13]Strictly speaking one could also argue that we have one independent observation for each session (four for each treatment) because the participants for instance saw each other when entering the lab. However, it is rather common to assume that the observations are statistically independent if there was no interaction during the experiment which is the case between our matching groups.

Hence, each individual either played three rounds as a favorite and two rounds as an underdog or vice versa.

In each session, the players competed for the same benefit ($B = 100$) and chose between the same alternative efforts ($e_L = 0$ and $e_H = 1$). Thus, the players could either exert high or low effort. We used a uniformly distributed noise term $\varepsilon$ for each session which was either distributed between $-2$ and 2 ("low risk"), or between $-4$ and 4 ("high risk"). Hence, we had $\Delta G\left(\sigma_L^2\right) = \frac{1}{4}$ and $\Delta G\left(\sigma_H^2\right) = \frac{1}{8}$. However, we varied the effort costs between the treatments. In the discouragement treatments disc_F and disc_U we used $c_U = 24$ and $c_F = 8$, in the cost treatments cost_F and cost_U we had $c_U = 24$ and $c_F = 22$, and in the likelihood treatments likel_F and like_U we had $c_U = 60$ and $c_F = 8$. All parameter values $B$, $e_L$, $e_H$, $c_U$, $c_F$, as well as the intervals for $\varepsilon$ were common knowledge. It can easily be checked that the three different parameter constellations of the treatments satisfy the three different conditions for the benefit corresponding to the discouragement effect, the cost effect and the likelihood effect, respectively. The subgame perfect equilibria can be summarized as follows:

Table 1: subgame perfect equilibria

| | discouragement | cost | likelihood |
|---|---|---|---|
| risk choice Favorite | high risk | high risk | low risk |
| risk choice Underdog | high risk | high risk | high risk |
| efforts $(e_U^*, e_F^*)$ | $(e_L, e_H)$ | $(e_L, e_L)$ | $(e_L, e_H)$ |

Thus, the subgame perfect equilibria of the treatments disc_F and disc_U are identical as well as those of the treatments cost_F and cost_U. In the likelihood treatments likel_F and likel_U, the subgame at the investment stage has the same equilibrium irrespective of the identity of the risk taker, but the favorite optimally chooses low risk in treatment likel_F whereas the underdog prefers high risk in likel_U.

720 students (enrolled in the Faculty of Management, Economics, and Social Sciences or related fields) took part in the experiment which we conducted at the Cologne Laboratory of Economic Research. We used the online system ORSEE (Greiner, 2004) for recruiting the participants and the software z-tree (Fischbacher, 2007) for programming the experiment. The average earnings were 13.86 euro and a session took approximately one hour and 15 minutes.

Each participant had to draw a number from an urn at the beginning of each session which determined the cubicle the participant had to sit in. After the instructions had been distributed and had been read aloud by the experimenter, the participants had the opportunity to ask comprehension questions.[14] Note that the participants were not

[14]The instructions translated into english can be found in the appendix.

allowed to communicate with each other during the experiment. To check for their comprehension, participants had to answer a short questionnaire. After each participant correctly solved the questions, the experimental software was started.

Each round of the experiment then proceeded according to the two-stage game described in Section 3. It started with player $F$'s or player $U$'s risk choice at stage 1 of the game. He could either choose the low-risk distribution over the interval $[-2, 2]$ ("low risk") or the high-risk distribution over the interval $[-4, 4]$ ("high risk"). When choosing risk, the player knew the course of events at the next stage as well as both players' effort costs. At the beginning of stage 2, both players were informed about the interval that had been chosen by the risk taker before. Then both players were asked about their beliefs concerning the effort decision of their respective opponent.[15] Thereafter, each player $i$ ($i = U, F$) chose between score 1 (at costs $c_i$) and score 0 (at zero costs), i.e., between high and low effort. Next, the random draw was executed. In the treatments disc_F, cost_F and likel_F, the final score of player $F$ consisted of his initially chosen effort 0 or 1 plus the realization of the random draw, whereas the final score of player $U$ was identical with his initially chosen effort 0 or 1.[16] In the three other treatments disc_U, cost_U and likel_U, the final score of player $U$ was the sum of his chosen effort and the realization of the random draw. The final score of player $F$ was his initially chosen effort. The player with the higher final score was the winner of this round and the other one the loser. Both players were informed about both final scores, whether the guess about the opponent's choice was correct, and about the realized payoffs. Then the next round began.

Note that the players had the chance to become familiar with the game during 10 trial rounds. The players had to make all decisions for the favorite and the underdog as well and did not interact with another player during the trial rounds. For this purpose the screen was divided in two parts. On the left side of the screen, the player had to enter the decision of the risk taking challenger (favorite or underdog depending on the treatment) and on the right side he had to enter the decision of the incumbent. Hence, on the left side he had to first choose low or high risk and then he had to choose the effort level while he could only select the effort level on the right side of the screen. After all choices had been made for both roles, the players were informed about the outcome of the round. They learned the final score, the realization of the random draw and the generated payoffs. Then the next trial round began. On the bottom of the screen the players received detailed information on their choices and the outcomes of previous trial rounds to enable them to systematically check out several strategies. Note that we did

[15] The elicitation of the beliefs was incentivized. The participants received 15 Taler if their belief was correct and zero otherwise.

[16] In two sessions of each treatment, we checked whether individuals behave differently if the realization of the random draw is assigned to player $U$'s score. Note that both procedures lead to identical theoretic outcomes since exogenous noise is symmetrically distributed around zero. There are no significant differences between the behavior of the subjects in the different sessions for each treatment pooled over all rounds. Hence, in the following we pool the data of those sessions.

not ask about the beliefs concerning the effort choice of their opponent because they played against themselves. After the 10 trial rounds, the players were informed that now 5 rounds started were each decision could influence their payoff.

Each session ended after 5 rounds. At the beginning of each session, the players got 60 units of the fictitious currency "Taler." The purpose of this endowment was to cover potential losses. If for instance an underdog had chosen score 1 (high effort) in one of the likelihood treatments and lost, his cost of 60 Taler were covered by the initial endowment and he would receive zero. At the end of the session, one of the 5 rounds was drawn by lot, hence the 60 Talers covered all potential losses that might have occurred. For this round, each player got 15 Talers if his belief of the opponent's effort choice was correct and zero Talers otherwise.[17] The winner of the selected round received $B = 100$ Talers and the loser zero Talers. Each player had to pay zero or $c_i$ Talers for the chosen effort 0 or 1, respectively. The sum of Talers was then converted into Euro by a previously known exchange rate of 1 euro per 10 Talers. Additionally, each participant received a show up fee of 2.50 Euro independent of the outcome of the game. All players filled out a questionnaire at the end of the experiment containing questions regarding socio-demographic information as well as questions dealing with loss aversion and inequity aversion. We also elicited the risk attitude of the players with two questions taken from the German Socio Economic Panel (GSOEP).[18] The first question (referred to as risk attitude 1 in the regressions) elicits the general willingness to take risks where a lower number indicates more risk aversion. Dohmen et al. (2011) report that this general question is "the best all-round predictor for risky behavior." The second question is an investment decision in a hypothetical asset and is referred to as "risk attitude 2" in the regressions. Again a lower investment indicates more risk aversion.

The language was kept neutral at any time. For example, we did not use terms like "politician" and "candidate," "favorite" and "underdog," or "player $F$," and "player $U$," but instead spoke of "player $A$" and "player $B$." Moreover, we simply described the pure random draw out of the two alternative intervals without speaking of low or high risk. Instead risk takers chose between "alternative 1" and "alternative 2."

## 6. Hypotheses

We tested three hypotheses, two of them address players' risk-taking behavior and one of them the players' behavior at the investment stage. The first hypothesis deals with

[17]Paying subjects for correct beliefs might potentially lead to hedging behavior. Blanco et al. (2010) state that hedging of beliefs in experiments is not "a major problem unless hedging opportunities are very prominent." We do not believe that hedging opportunities are very prominent in our setting because winning the competition leads to 100 Taler compared to 15 Taler for a correct belief. Furthermore, for instance Kräkel and Nieken (2012) report no differences in the decisions of the subjects whether the beliefs about the other players' action was incentivized or not in a setting with relative performance.

[18]For more details regarding the exact wording of the questions please refer to the appendix.

gambling for resurrection by the underdog. Following theory, we can state:

**Hypothesis 1:** Underdogs choose high risk when being in the role of the risk-taking challenger.

The second hypothesis tests the relevance of the discouragement effect, the cost effect and the likelihood effect at stage 1 of the game when the risk taker is the favorite. Since we designed three different constellations by changing one of the cost parameters, respectively, each effect could be separately analyzed in a single treatment. Treatment cost_F is obtained from the treatment disc_F by increasing the favorite's cost parameter, whereas the design of the treatment likel_F results from increasing the underdog's cost parameter in the treatment disc_F.

**Hypothesis 2:** Favorites choose high risk in the treatment disc_F and in the treatment cost_F while favorites prefer the low risk in the treatment likel_F.

In a next step, we test whether the players select high or low effort at the second stage of the game. Since in any equilibrium at the investment stage the favorite should not choose less effort than the underdog, we have the following hypothesis:

**Hypothesis 3:** Favorites choose at least as often high effort as the underdogs. Given high risk, favorites choose high effort in the disc_F, disc_U and likel_F as well as the likel_U treatments while underdogs prefer low effort. Favorites and underdogs choose low effort in the cost_F and cost_U treatments if the risk is high. Given low risk, favorites always choose high effort while underdogs select high effort in the disc_F and disc_U as well as the cost_F and the cost_U treatments and low effort in the likel_F and likel_U treatment.

## 7. Experimental results

### *7.1 The risk-taking stage*

We test the hypotheses with the data of our experiment, starting with the risk choices of the underdogs as challengers. The left panel of Figure 5 shows the fractions of underdogs that choose high risk in the treatments disc_U, cost_U and likel_U. Note that all nonparametric tests reported in this paper take into account that we have 20 observations which are independent of the other matching groups behavior for each treatment due to our matching protocol. We conducted 4 sessions for each treatment and in each session the participants were matched in five groups of six players. We pooled the observations of all players with the same role (favorite or underdog) within each matching group over all rounds because they interacted with each other within the matching group. This leads to 20 observations for the nonparametric tests. The results remain qualitatively unchanged if we pool the data over subjects.

Place Figure 5 here. Caption: Choice of risk

The fraction of underdogs choosing high risk is 59% in the disc_U, 49% in the cost_U, and 73% in the likel_U treatment.[19] The preference to select high risk is quite stable over time: the fraction of underdogs choosing high risk over all rounds is 43% for the disc_U, 35.67% for the cost_U, and 60.67% for the likel_U treatment.

However, not all underdogs chose high risk as theoretically predicted (Hypotheses 1). As can be seen in Figure 5, the number of high-risk takers increases from cost_U to disc_U to likel_U. This observation is quite intuitive: note that the players' cost difference $c_U - c_F$ increases drastically from cost_U ($c_U - c_F = 2$) to disc_U ($c_U - c_F = 16$) to likel_U ($c_U - c_F = 52$). It seems quite plausible that underdogs tend more strongly to gamble for resurrection and rely on the pure chance of winning by luck, the more desperate their situation in the contest. There is another possible reason why underdogs most often gamble for resurrection in likel_U. Theory shows that, in this treatment, risk taking determines the players' winning probabilities but does not influence equilibrium efforts. Hence, when subjects in the lab behave according to theory, they can fully concentrate on the direct effect of risk on the likelihood of winning without anticipating potential spillover effects on the subsequent effort choices. To test our observation shown in Figure 5, we applied the Jonckheere-Terpstra test, which is significant ($p = 0.011$) and confirms the observation. Furthermore, one tailed sign tests show that underdogs prefer high over low risk in the disc_U and the likel_U treatment (disc_U $p = 0.0577$ and likel_U $p = 0.000$). Thus, while not all underdogs selected high risk our findings on risk taking by the underdogs is quite in line with gambling for resurrection in the disc_U and likel_U treatments.

In addition to the non-parametric tests, we run random effects probit regressions with the choice of risk as the dependent variable. The results are reported in columns (1) and (2) of Table 2. The cost_U treatment is the base category in this regression and we inserted dummy variables for the disc_U and the likel_U treatments. In column (1) we additionally control for the risk attitude of the players using the results from the general question about the willingness to take risks (risk attitude 1) from the GSOEP where lower outcomes indicate a more risk averse player. In column (2) we use the answers to the investment decision in a hypothetical asset (risk attitude 2) as an additional robustness check. Further robustness checks using probit regressions with robust standard errors

[19]These findings and the other descriptive results are summarized in Tables A1, A2, and A3 in the appendix.

clustered on groups or lagged variables controlling for the actions of the previous round are reported in Tables A4 and A5 in the appendix. In all tables we observe that the dummy variable for the likel_U treatment is highly significant while we cannot support the results of the non-parametric test for the disc_U treatment. Note that the risk attitude of the players has no significant influence on the risk taking decisions of underdogs.

Next, we investigate the risk choice of the favorites in the treatments disc_F, cost_F and likel_F. As can already be seen in the right panel of Figure 5, about 33% of the favorites select high risk in the disc_F treatment which does not support Hypothesis 2. Furthermore, about 52% of the favorites choose high risk in the cost_F treatment. In the likel_F treatment, the majority of the favorites chooses low risk (68%), which is in line with Hypothesis 2. The results of one-tailed sign tests confirm these first impressions: in the likel_F treatment significantly more favorites choose low risk than high risk ($p = 0.0002$), whereas we obtain no support for the theoretical predictions regarding the two other treatments. A type specific analysis shows that the behavior in the likel_F treatment is rather stable because 55.33% of the favorites stick to their decision to select low risk in all rounds. In the disc_F treatment only 17.33% of the favorites select high risk over all rounds while 34.33% of the favorites prefer high risk in all rounds in the cost_F treatment.

We compare the risk choices in the likel_F treatment (theory predicts low risk) with the two other treatments cost_F and disc_F (for both theory predicts high risk) by using random effects probit regressions with the likel_F treatment as the base category. Again, the choice of risk is the dependent variable and we use the afore mentioned control variables and additional robustness checks (see also Tables A4 and A5 in the appendix). The results shown in columns (3) and (4) of Table 2 reveal that the fraction of favorites selecting high risk in the cost_F treatment is significantly higher than in the likel_F treatment. We do not find significant differences in risk taking when comparing the likel_F with the disc_F treatment. These results are further supported by non-parametric tests (Mann-Whitney-U test: cost_F vs. likel_F $p = 0.0008$, disc_F vs. likel_F $p = 0.8370$). We do not observe a significant impact of the elicited risk preferences on the risk taking decisions of the favorites.

Table 2: Random effects probit regression: comparison of the risk choice between treatments

| | Underdog | | Favorite | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dummy disc | 0.473 | 0.467 | 0.134 | 0.130 |
| | (0.294) | (0.294) | (0.248) | (0.249) |
| Dummy cost | | | 0.960*** | 0.964*** |
| | | | (0.254) | (0.253) |
| Dummy likel | 1.227*** | 1.227*** | | |
| | (0.312) | (0.311) | | |
| Risk attitude 1 | 0.00512 | | −0.0129 | |
| | (0.0539) | | (0.0437) | |
| Risk attitude 2 | | 0.0421 | | −0.0334 |
| | | (0.0933) | | (0.0796) |
| Constant | −0.0638 | −0.101 | −0.823*** | −0.837*** |
| | (0.333) | (0.248) | (0.286) | (0.221) |
| Observations | 900 | 900 | 900 | 900 |
| Log Likelihood | −493.40816 | −493.31102 | −516.69796 | −516.65309 |

The dependent variable is risk choice. Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

*7.2 The investment stage*

Given the challenger's risk choice at stage 1, both the underdog and the favorite have to decide on whether to exert high or low effort at the second stage of the game. According to the subgame perfect equilibria, we would expect that the favorite (underdog) prefers to exert high effort (low effort) in the disc_F, disc_U and likel_f as well as likel_U treatments, whereas both players' choose low effort in the cost_F and cost_U treatments. Altogether, in stage 2 favorites should be more aggressive (i.e., choose more effort) than underdogs on average.[20] Recall that this theoretical result is independent of whether the underdog or the favorite has chosen risk at stage 1 (see Table 1). However, from a behavioral perspective the fact that either only the favorite or only the underdog is active at both stages of the game may influence the players' effort at the investment stage. Figure 6 shows the fraction of players spending high effort over all treatments.

Place Figure 6 here. Caption: Fraction of high effort over all treatments

In line with theory and our Hypothesis 3, favorites are clearly more aggressive than underdogs which is supported by a one-tailed sign test ($p = 0.000$). Recall that in the disc_F and disc_U as well as the cost_F and cost_U treatments different risk levels lead to different equilibria at the investment stage. Since both risk levels have been chosen at

[20]Uneven tournaments in the notion of O'Keeffe et al. (1984) were also considered in the experiments by Bull et al. (1987), Schotter and Weigelt (1992) and Harbring et al. (2007). In each experiment, favorites choose significantly higher input levels than underdogs.

stage 1, we can test whether players rationally react to a given risk level. According to theory, in the treatments disc_U and disc_F, the favorite should always choose to spend high effort independent of given risk, whereas the underdog should prefer high effort (low effort) if risk is low (high).[21] Figure 7 shows the effort decisions of the favorites and underdogs for the different levels of risk in the disc_F and disc_U treatments. If the risk is high, favorites spend significantly more effort than underdogs (one-tailed sign test, $p = 0.000$, disc_U and disc_F) which is perfectly in line with theory.

Place Figure 7 here. Caption: Fraction of high effort in the disc_F and disc_U treatments

As can already be seen from Figure 7, favorites also choose more effort than underdogs if the risk is low (two-tailed sign test, $p = 0.034$, disc_U; $p = 0.000$, disc_F). These findings are also supported by the results of random effects probit regressions as well as probit regressions with robust standard errors clustered on groups (see Tables A6 and A7 in the appendix). Again we also included control variables for the risk attitude of the players and did several robustness checks. Surprisingly many underdogs do not choose high effort if risk is low although this would increase their chance of winning the competition. However, note that the underdogs show a clear reaction to the underlying risk: they choose high effort significantly more often if the challenger has chosen low risk (one-tailed sign test, $p = 0.0207$, disc_U; $p = 0.021$, disc_F). Altogether, our findings support the theoretical fundamentals of the discouragement effect at the investment stage, but the underdogs do not react strong enough.

In Figure 8 we report the effort decisions of the subjects in the treatments cost_U and cost_F. It is obvious that their effort varies depending on the chosen risk, as predicted by theory. For the situation with low risk, theory predicts that both players should prefer aggressive behavior at the investment stage. We do not find significant differences when comparing the effort choices of favorites and underdogs in treatment cost_F, whereas underdogs select high effort slightly more often than favorites in treatment cost_U (two-tailed sign test, $p = 0.0923$).

Place Figure 8 here. Caption: Fraction of high effort in the cost_F and cost_U treatments

Moreover, if risk is high, in treatment cost_F underdogs select high effort weakly significantly more often than their opponents (two-tailed sign test, $p = 0.064$), but in cost_U favorites' effort choices significantly exceed those of the underdogs (two-tailed

[21] We focus on analyzing the behavior between favorites and underdogs in the investment stage within each treatment. However, it is also feasible to investigate the behavior of the different player types between treatments for a given level of risk. As this would go beyond the focus of this paper, we present the results of this analysis as a robustness check in the additional material which is available from the authors upon request.

sign test, $p = 0.0127$), which is not in line with theory. Again we run regressions which confirm our findings (see Tables A8 and A9 in the appendix).

Place Figure 9 here. Caption: Fraction of high effort in the likel_F and likel_U treatments

As Figure 9 shows, the results for the treatments likel_U and likel_F are in line with theory. For both risk levels favorites (underdogs) should exert high effort (low effort). In both risk situations, favorites select high effort significantly more often in stage 2 than underdogs (one-tailed sign test, low risk $p = 0.000$ and high risk $p = 0.000$, likel_U and likel_F).[22] Further support comes from the regressions reported in Tables A10 and A11 in the appendix. Note that we controlled for the risk attitudes of the subjects in all regressions. In some specifications (compare for instance the cost_U treatment in Table A8 and Table A9 columns (7) and (8)) a higher willingness to take risks has a significant impact on spending. However, these results are not robust as they are not stable for all estimation models and our different measures of risk attitudes.

## 8. Discussion

The experimental results of Section 7 show that individuals often behave rationally when deciding on risk and, in general, do react to risk when choosing effort. However, our findings also point to three puzzles, which should be discussed in the following: (1) favorites significantly choose low risk more often than high risk in the disc_F treatment; (2) both favorites and underdogs do not choose sufficient risk in the cost_F and cost_U treatments; (3) given high risk in the cost_F and cost_U treatments, underdogs' and favorites' effort choices significantly differ at the investment stage.

We start the discussion by analyzing puzzle (1). A look at type-specific behavior reveals that 50.67% of the favorites choose low risk in all rounds (67% of all risk choices in disc_F are low risk) while 17.33% of the favorites select high risk and stick to this strategy over all rounds (33% of all risk choices in disc_F are high risk). Hence, the behavior when selecting low risk is more stable over the course of the experiment. The investigation of the subjects' beliefs points out that in the low-risk state of treatment disc_F, favorites' equilibrium beliefs differ from their reported beliefs in the experiment.[23] About 53.47% of the favorites expect the underdogs to choose low effort. Actually, about one half of the underdogs selects low effort. Given that the favorites already had these beliefs when taking risk at stage 1, from a behavioral perspective, puzzle (1) can be explained as follows: a favorite expecting an underdog to contradict the theoretical prediction and

[22] To check if most of the subjects of a certain type choose the predicted effort under a given risk, we used one-tailed sign tests. See Table A12 and Table A13 in the appendix for the complete results.

[23] For an overview about effort choices for given beliefs see Table A14 in the appendix.

choose low effort in both a low-risk and a high-risk state, should rationally prefer high effort in both states. When the favorites decide on risk taking at stage 1 and anticipate $(e_U, e_F) = (0, 1)$ under both risks, the underlying discouragement problem now turns into a perceived likelihood problem from the viewpoint of the favorites. Given the anticipated biased behavior of the underdogs leading to a perceived likelihood problem, the favorites should optimally choose a low risk in order to maximize their winning probability (see Figure 4), which explains puzzle (1). Indeed 85.19% of the favorites selecting low risk and expecting the underdog to select low effort, invest in high effort. Further support comes from a type-specific analysis showing that 43% of the favorites play the low risk-high effort strategy over all rounds in the disc_F treatment.

Puzzle (2) shows that in the treatments cost_F and cost_U favorites as well as underdogs choose less risk than theoretically predicted. To generate the cost effect as equilibrium behavior, we must ensure that the subjects do not differ very much because both players should react to risk taking. For this reason, our experiment design stipulates that the underdog has cost $c_U = 24$ in case of high effort, whereas the favorite's cost for high effort amounts to $c_F = 22$. In the other treatments, $c_U$ is three times higher than $c_F$ (disc_F and disc_U treatments), or even 7.5-times higher than $c_F$ (likel_F and likel_U treatments). Thus, in the cost_F and cost_U treatments subjects face a rather homogeneous and, hence, intense competition. This competition leads to two behavioral patterns, which are remarkably stable as highlighted by Table A2 in the appendix. One part of the risk takers seems to have the primary aim not to lose control about the outcome of the contest. Following this aim, they prefer to choose low risk and high effort (pattern 1). The other part of the risk takers seems to be primarily interested to eliminate the intense competition as far as possible by choosing high risk according to the cost effect. Consequently, high risk is combined with low effort, which yields pattern 2. In Table A2 we find that 71.33% (71.24%) of the low-risk takers in treatment cost_F (cost_U) follow pattern 1, and 73.89% (72.79%) of the high-risk takers in treatment cost_F (cost_U) follow pattern 2.[24] Altogether, since a considerable part of favorites and underdogs follow the control motive of pattern 1, from a behavioral perspective it is non-surprising that about half of the risk takers prefer low risk in the cost_F and cost_U treatments.

It is interesting to compare our findings with the results of Nieken (2010). This paper considers bilateral risk taking by both players at stage 1 and focuses on the cost effect with completely homogeneous contestants. Quite similar to our results, only about 50% of the subjects choose high risk although Nieken uses a completely different framework (bilateral risk choice, normally distributed noise, effort chosen between zero and 100). Furthermore, the subjects seem to care solely for their own risk choice despite the fact

[24] A type-specific analysis reveals that 22.33% of the risk takers in the cost_F treatment and 25.33% of the risk takers in cost_U treatment follow pattern 1 over all rounds while 26% of the risk takers in the cost_F treatment and 25.33% of the risk takers in the cost_U treatment stick to pattern 2.

that common risk is determined by both players' risk taking. Interestingly, the same behavioral patterns as in our paper can be observed: those subjects who prefer low risk choose relatively high effort, whereas subjects with high risk choices prefer roughly half of the effort. Nieken offers several behavioral intuitions for her observation. First, bounded rationality may be responsible for the subjects' behavior. Second, subjects may become victim of an egocentric bias. Third, subjects may primarily want to control the course of the game. Finally, own risk choice may be an anchor for the subsequent choice of effort. Since our paper considers unilateral risk taking and hence eliminates any biases from interaction at the risk taking stage, our findings clearly stress the control argument as the most plausible behavioral explanation.

Although subjects do react to risk in the cost_F and cost_U treatments, the effort choice of favorites seems to differ from that of underdogs. Given high risk, underdogs are significantly more aggressive than favorites when deciding on effort in treatment cost_F, whereas we observe just the opposite pattern with high risk in treatment cost_U. Thus, we have symmetric unpredicted behavior of the subjects given high risk choice by a certain player. This observation describes our puzzle (3). Controlling for risk aversion, loss aversion, inequity aversion and the history of the game does not yield new insights. In particular, one might expect the players' history in the game to have explanatory power: from a behavioral perspective, subjects might react to the outcomes of former rounds when choosing whether to exert high or low effort in the actual round. However, our results do not show a clear impact of experienced success or failure in previous tournaments.

Since both types of players behave symmetrically there should be a systematic bias that determines the choice of effort. Recall that the two treatments differ because in cost_F the favorite has more decision power than the underdog since the favorite is active at the risk taking stage and at the investment stage. In the treatment cost_U, we have just the opposite situation with the underdog deciding twice. Although this fact should not influence rational decision making, it might be crucial from a behavioral perspective. Hence, we conjecture that the player who has less decision power (i.e., being not the risk taker) is biased towards more aggressive behavior when investing in stage 2 in order to compensate for his weaker position. In other words, the risk taker seems to be in an advantageous position since he can influence the outcome of the game twice and the other player feels the need to compensate for this disadvantage when he has to make his unique decision at the investment stage. Indeed, in cost_F the favorite plays the more active part in the game and the underdog chooses significantly more often high effort. Treatment cost_U interchanges the positions of the two players but yields exactly the same outcome: now the underdog is more active and the favorite selects high effort significantly more often than the underdog.

## 9. Conclusion

Typically, in an electoral competition between two politicians, the challenger first decides whether to attack the incumbent via a high-risk or a low-risk strategy. Thereafter, the challenger and the incumbent choose efforts to raise funds that are spent during the campaign. In our model, we find four effects that mainly determine the challenger's risk taking – gambling for resurrection if the challenger is the underdog, and a cost effect, a likelihood effect, and a discouragement effect if the challenger is the favorite.

The game-theoretic predictions on the four effects recommend the following rational behavior for the politicians: (1) the underdog should always choose a high-risk strategy since he has nothing to lose (gambling for resurrection); (2) if both politicians' effort costs are moderate and do not differ too much, optimal efforts will be sensitive to risk taking so that the favorite should prevent mutually aggressive campaigning (i.e., high efforts) by taking high risk (cost effect); (3) if the politicians' costs clearly differ so that optimal efforts of both politicians are not sensitive to risk, the favorite should rely on his competitive advantage at the investment stage and prefer a low risk (likelihood effect); (4) if only the optimal effort of the underdog is sensitive to risk and the political position is very attractive, the favorite should choose both to be elected: high risk and high fund raising effort (discouragement effect). Our experimental findings point out that subjects understand the implications of risk taking since effort decisions are often in line with theory under the discouragement effect, the cost effect and the likelihood effect. However, the subjects do not make use of the three effects as often as predicted by theory, which is particularly true for the discouragement effect.

Of course, we have to be careful to transfer our results one-to-one to "real" political campaigns because a lab experiment raises the question of external validity. As the extensive discussion for example in Druckman et al. (2011a), Druckman et al. (2011b), McDermott (2011), Druckman and Kam (2011), and Iyengar (2011) shows, lab experiments provide a useful tool to analyze behavior in a controlled environment and often students samples lead to valuable insights. We, therefore, believe that our setting sheds light on the question how risk-taking can be used to influence the campaigning effort and by that the outcome of political elections.

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## Appendix

**Proof of Proposition 2:** (i) Since we have two risk levels, $\sigma_L^2$ and $\sigma_H^2$, there are four cutoffs with $\frac{c_F}{\Delta G(\sigma_L^2)}$ being the smallest one and $\frac{c_U}{\Delta G(\sigma_H^2)}$ the largest one because of (5). According to Proposition 1, both players will always (never) choose high effort if $B \geq \frac{c_U}{\Delta G(\sigma_H^2)}$ $(B \leq \frac{c_F}{\Delta G(\sigma_L^2)})$, irrespective of risk taking in stage 1.

(ii) We have to differentiate between two possible rankings of the cutoffs:

$$\begin{array}{ll} \text{scenario 1:} & \dfrac{c_F}{\Delta G(\sigma_L^2)} < \dfrac{c_F}{\Delta G(\sigma_H^2)} < \dfrac{c_U}{\Delta G(\sigma_L^2)} < \dfrac{c_U}{\Delta G(\sigma_H^2)} \\ \text{scenario 2:} & \dfrac{c_F}{\Delta G(\sigma_L^2)} < \dfrac{c_U}{\Delta G(\sigma_L^2)} < \dfrac{c_F}{\Delta G(\sigma_H^2)} < \dfrac{c_U}{\Delta G(\sigma_H^2)}. \end{array}$$

If $\frac{c_F}{\Delta G(\sigma_L^2)} < B < \min\left\{\frac{c_F}{\Delta G(\sigma_H^2)}, \frac{c_U}{\Delta G(\sigma_L^2)}\right\}$, then in both scenarios the choice of $\sigma_L^2$ will imply $(e_U^*, e_F^*) = (e_L, e_H)$ at stage 2, whereas $\sigma^2 = \sigma_H^2$ will lead to $(e_U^*, e_F^*) = (e_L, e_L)$. In this situation, player $F$ prefers $\sigma^2 = \sigma_L^2$ when taking risk since

$$B \cdot G\left(\Delta e; \sigma_L^2\right) - c_F > \frac{B}{2} \Leftrightarrow B > \frac{c_F}{\Delta G(\sigma_L^2)}$$

is true. However, player $U$ prefers $\sigma^2 = \sigma_H^2$ because of

$$\frac{B}{2} > B \cdot G\left(-\Delta e; \sigma_L^2\right).$$

If $\frac{c_U}{\Delta G(\sigma_H^2)} > B > \max\left\{\frac{c_F}{\Delta G(\sigma_H^2)}, \frac{c_U}{\Delta G(\sigma_L^2)}\right\}$, then in both scenarios the choice of $\sigma_L^2$ will result into $(e_U^*, e_F^*) = (e_H, e_H)$ at stage 2, but $\sigma^2 = \sigma_H^2$ will induce $(e_U^*, e_F^*) = (e_L, e_H)$. In this case, player $F$ prefers the high risk $\sigma_H^2$ since

$$B \cdot G\left(\Delta e; \sigma_H^2\right) - c_F > \frac{B}{2} - c_F.$$

Player $U$ has the same preference when being the risk taker because

$$B \cdot G\left(-\Delta e; \sigma_H^2\right) > \frac{B}{2} - c_U \Leftrightarrow \frac{c_U}{\Delta G(\sigma_H^2)} > B$$

is true.

Two cases are still missing. Under scenario 1, we may have that

$$\frac{c_F}{\Delta G\left(\sigma_H^2\right)} < B < \frac{c_U}{\Delta G\left(\sigma_L^2\right)}.$$

Then any risk choice leads to $(e_U^*, e_F^*) = (e_L, e_H)$ at stage 2 and player $F$ prefers $\sigma_L^2$ because of

$$B \cdot G\left(\Delta e; \sigma_L^2\right) - c_F > B \cdot G\left(\Delta e; \sigma_H^2\right) - c_F,$$

but $U$ favors $\sigma_H^2$ when being active at stage 1 since

$$B \cdot G\left(-\Delta e; \sigma_H^2\right) > B \cdot G\left(-\Delta e; \sigma_L^2\right).$$

Under scenario 2, we may have that

$$\frac{c_U}{\Delta G\left(\sigma_L^2\right)} < B < \frac{c_F}{\Delta G\left(\sigma_H^2\right)}.$$

Here, low risk $\sigma_L^2$ implies $(e_U^*, e_F^*) = (e_H, e_H)$, but high risk $\sigma_H^2$ leads to $(e_U^*, e_F^*) = (e_L, e_L)$. Obviously, each type of risk taker prefers the choice of high risk at stage 1. Our findings are summarized in Proposition 2(ii).

**Risk Attitudes of the players**

We used two questions from the German Socio Economic Panel to elicit the risk attitudes of the players.

1. "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?" The participants could select a number between zero and 10 where the value zero means 'risk averse', and the value 10 means 'fully prepared to take risks'. We refer to the results of this question as "risk attitude 1" in the regressions.

2. "Imagine that you had won 100,000 euros in the lottery. Almost immediately after you collect the winnings, you receive the following financial offer from a reputable bank, the conditions of which are as follows: There is the chance to double the money within two years. It is equally possible that you could lose half of the amount invested. You have the opportunity to invest the full amount, part of the amount or reject the offer. What share of your lottery winnings would you be prepared to invest in this financially risky, yet lucrative investment?" Possible answers: Invest 100,000 euro, 80,000 euro, 60,000 euro, 40,000 euro, 20,000 euro, or nothing. A lower investment indicated a more risk averse person. We refer to the results of this question as "risk attitude 2" in the regressions.

The correlation between the two measures is 0.3554 and highly significant.

Place Figure 10 here. Caption: Histogram of the general question about the willingness to take risks (riskattitude1).

Place Figure 11 here. Caption: Histogram of the investment question (risk attitude2)

Table A1: Descriptive statistics: risk choice

| | fraction of high risk | fraction of low risk |
|---|---|---|
| disc_F | 0.3267 | 0.6733 |
| disc_U | 0.5900 | 0.4100 |
| | | |
| cost_F | 0.5233 | 0.4767 |
| cost_U | 0.4900 | 0.5100 |
| | | |
| likel_F | 0.3200 | 0.6800 |
| likel_U | 0.7267 | 0.2733 |

Table A2: Descriptive statistics: choice of effort

| | | low risk | | high risk | |
|---|---|---|---|---|---|
| | | low effort | high effort | low effort | high effort |
| disc_F | favorite | 0.1386 | 0.8614 | 0.2245 | 0.7755 |
| | underdog | 0.4455 | 0.5545 | 0.7143 | 0.2857 |
| disc_U | favorite | 0.0976 | 0.9024 | 0.1525 | 0.8475 |
| | underdog | 0.3659 | 0.6341 | 0.7006 | 0.2994 |
| cost_F | favorite | 0.2867 | 0.7133 | 0.7389 | 0.2611 |
| | underdog | 0.3497 | 0.6503 | 0.5350 | 0.4650 |
| cost_U | favorite | 0.3660 | 0.6340 | 0.5374 | 0.4626 |
| | underdog | 0.2876 | 0.7124 | 0.7279 | 0.2721 |
| likel_F | favorite | 0.0441 | 0.9559 | 0.1875 | 0.8125 |
| | underdog | 0.7794 | 0.2206 | 0.8958 | 0.1042 |
| likel_U | favorite | 0.1463 | 0.8537 | 0.1376 | 0.8624 |
| | underdog | 0.6829 | 0.3171 | 0.9358 | 0.0642 |

Table A3: Descriptive statistics: beliefs about effort choice opponent: Note that we report the fraction of players who belief their opponent will choose a high or low effort for a given risk. Therefore, the underlying number of observations differs for each cell.

| | | low risk | | high risk | |
|---|---|---|---|---|---|
| | | belief low effort | belief high effort | belief low effort | belief high effort |
| disc_F | favorite | 0.5347 | 0.4653 | 0.5918 | 0.4082 |
| | underdog | 0.1485 | 0.8515 | 0.1837 | 0.8163 |
| disc_U | favorite | 0.3333 | 0.6667 | 0.6045 | 0.3955 |
| | underdog | 0.0976 | 0.9024 | 0.1299 | 0.8701 |
| cost_F | favorite | 0.2308 | 0.7692 | 0.5924 | 0.4076 |
| | underdog | 0.2448 | 0.7552 | 0.5223 | 0.4777 |
| cost_U | favorite | 0.3333 | 0.6667 | 0.6122 | 0.3878 |
| | underdog | 0.3856 | 0.6144 | 0.5510 | 0.4490 |
| likel_F | favorite | 0.8676 | 0.1324 | 0.8750 | 0.1250 |
| | underdog | 0.1176 | 0.8824 | 0.1667 | 0.8333 |
| likel_U | favorite | 0.7927 | 0.2073 | 0.8991 | 0.1009 |
| | underdog | 0.2195 | 0.7805 | 0.0826 | 0.9174 |

Table A4: Random effects probit regression: comparison of the risk choice between treatments with lagged variables for the risk in the previous round as well as the effort decision of the partner in the previous round

| | Underdog | | Favorite | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dummy disc | 0.470 | 0.461 | 0.0975 | 0.0950 |
| | (0.299) | (0.299) | (0.254) | (0.254) |
| Dummy cost | | | $0.982^{***}$ | $0.980^{***}$ |
| | | | (0.271) | (0.271) |
| Dummy likel | $1.304^{***}$ | $1.298^{***}$ | | |
| | (0.337) | (0.336) | | |
| Lagged risk | −0.155 | −0.158 | 0.241 | 0.242 |
| | (0.190) | (0.190) | (0.158) | (0.159) |
| Lagged effort | −0.00896 | −0.00712 | 0.207 | 0.208 |
| partner | (0.174) | (0.174) | (0.177) | (0.177) |
| Risk attitude 1 | 0.0228 | | 0.00895 | |
| | (0.0551) | | (0.0447) | |
| Risk attitude 2 | | 0.0218 | | −0.00747 |
| | | (0.0950) | | (0.0814) |
| Constant | 0.0103 | 0.0894 | $-1.128^{***}$ | $-1.073^{***}$ |
| | (0.367) | (0.288) | (0.339) | (0.287) |
| Observations[25] | 720 | 720 | 720 | 720 |
| Log Likelihood | −409.837 | −409.896 | −425.549 | −425.564 |

The dependent variable is risk choice. Standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A5: Probit regression with robust standard errors clustered on groups: comparison of the risk choice between treatments including round dummies

| | Underdog | | Favorite | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dummy disc | 0.257 | 0.255 | 0.0172 | 0.0157 |
| | (0.158) | (0.157) | (0.145) | (0.146) |
| Dummy cost | | | 0.525*** | 0.528*** |
| | | | (0.136) | (0.136) |
| Dummy likel | 0.635*** | 0.634*** | | |
| | (0.148) | (0.145) | | |
| Risk attitude 1 | 0.00157 | | −0.0106 | |
| | (0.0317) | | (0.0220) | |
| Risk attitude 2 | | 0.00714 | | −0.0166 |
| | | (0.0436) | | (0.0461) |
| Dummy round 2 | 0.206* | 0.206* | 0.0754 | 0.0736 |
| | (0.106) | (0.106) | (0.116) | (0.117) |
| Dummy round 3 | 0.252** | 0.252** | 0.120 | 0.119 |
| | (0.0985) | (0.0981) | (0.117) | (0.118) |
| Dummy round 4 | 0.0442 | 0.0443 | 0.0448 | 0.0427 |
| | (0.100) | (0.100) | (0.101) | (0.102) |
| Dummy round 5 | 0.421*** | 0.421*** | −0.0781 | −0.0786 |
| | (0.113) | (0.113) | (0.118) | (0.118) |
| Constant | −0.217 | −0.220 | −0.449*** | −0.475*** |
| | (0.195) | (0.138) | (0.165) | (0.146) |
| Observations | 900 | 900 | 900 | 900 |
| Pseudo $R^2$ | 0.04 | 0.04 | 0.03 | 0.03 |
| Log Pseudolikelihood | −580.732 | −580.712 | −583.822 | −583.858 |

The dependent variable is risk choice. Robust standard errors in parentheses are calculated by clustering on groups. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A6: Random effects probit regressions Hypothesis 3: disc_F and disc_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | disc_F | | disc_U | | disc_F | | disc_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | 3.305*** | 3.345*** | 3.174*** | 3.161*** | 1.516*** | 1.524*** | 2.055*** | 2.014*** |
| | (0.854) | (0.867) | (0.406) | (0.406) | (0.235) | (0.235) | (0.444) | (0.437) |
| Risk attitude 1 | 0.192 | | −0.114 | | 0.129 | | 0.0656 | |
| | (0.129) | | (0.0927) | | (0.0803) | | (0.135) | |
| Risk attitude 2 | | 0.384 | | −0.204 | | 0.0789 | | 0.0331 |
| | | (0.241) | | (0.164) | | (0.144) | | (0.220) |
| Constant | −2.318*** | −1.959*** | −0.524 | −0.718** | −0.207 | 0.311 | 0.805 | 1.026* |
| | (0.846) | (0.644) | (0.486) | (0.362) | (0.425) | (0.286) | (0.708) | (0.560) |
| Observations | 196 | 196 | 354 | 354 | 404 | 404 | 246 | 246 |
| Log Pseudolikelihood | −95.493 | −95.293 | −149.542 | −149.528 | −181.691 | −182.861 | −95.189 | −95.301 |

The dependent variable is effort. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A7: Probit regressions with robust standard errors clustered on groups and round dummies Hypothesis 3: disc_F and disc_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | disc_F | | disc_U | | disc_F | | disc_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | 1.396*** | 1.413*** | 1.576*** | 1.564*** | 0.950*** | 0.956*** | 0.953*** | 0.953*** |
| | (0.241) | (0.241) | (0.237) | (0.232) | (0.150) | (0.154) | (0.253) | (0.257) |
| Risk attitude 1 | 0.0989 | | −0.0527 | | 0.0717 | | 0.0118 | |
| | (0.0623) | | (0.0446) | | (0.0502) | | (0.0564) | |
| Risk attitude 2 | | 0.191** | | −0.0927 | | 0.0702 | | 0.0952 |
| | | (0.0887) | | (0.0727) | | (0.0905) | | (0.107) |
| Dummy round 2 | 0.0973 | 0.0125 | −0.414 | −0.393 | 0.364* | 0.386* | −0.183 | −0.167 |
| | (0.302) | (0.317) | (0.269) | (0.267) | (0.215) | (0.203) | (0.234) | (0.245) |
| Dummy round 3 | 0.150 | 0.0592 | −0.163 | −0.151 | 0.166 | 0.185 | −0.0779 | −0.0792 |
| | (0.267) | (0.279) | (0.203) | (0.210) | (0.164) | (0.153) | (0.252) | (0.264) |
| Dummy round 4 | 0.133 | 0.172 | −0.0916 | −0.0873 | 0.242 | 0.221 | −0.266 | −0.286 |
| | (0.276) | (0.293) | (0.263) | (0.259) | (0.151) | (0.144) | (0.202) | (0.223) |
| Dummy round 5 | −0.145 | −0.169 | −0.0763 | −0.0822 | 0.245 | 0.248 | 0.0545 | 0.0602 |
| | (0.346) | (0.338) | (0.161) | (0.162) | (0.157) | (0.153) | (0.275) | (0.257) |
| Constant | −1.119*** | −0.904*** | −0.144 | −0.236 | −0.396 | −0.153 | 0.405 | 0.320 |
| | (0.330) | (0.209) | (0.278) | (0.256) | (0.274) | (0.185) | (0.361) | (0.264) |
| Observations | 196 | 196 | 354 | 354 | 404 | 404 | 246 | 246 |
| Pseudo $R^2$ | 0.2040 | 0.2060 | 0.2521 | 0.2521 | 0.1162 | 0.1074 | 0.1044 | 0.1112 |
| Log Pseudolikelihood | −107.854 | −107.576 | −180.638 | −180.651 | −215.654 | −217.806 | −119.262 | −118.361 |

The dependent variable is effort. Robust standard errors in parentheses are calculated by clustering on groups.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A8: Random effects probit regressions Hypothesis 3: cost_F and cost_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | cost_F | | cost_U | | cost_F | | cost_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | −0.510** | −0.510** | 0.832*** | 0.814*** | −0.206 | −0.206 | −0.465* | −0.444* |
| | (0.236) | (0.236) | (0.264) | (0.263) | (0.292) | (0.293) | (0.249) | (0.252) |
| Risk attitude 1 | 0.0894 | | 0.152 | | 0.129 | | 0.304*** | |
| | (0.0986) | | (0.122) | | (0.113) | | (0.116) | |
| Risk attitude 2 | | 0.195 | | 0.196 | | 0.155 | | 0.225 |
| | | (0.182) | | (0.210) | | (0.209) | | (0.189) |
| Constant | −0.812 | −0.696* | −1.850*** | −1.402*** | 0.349 | 0.711* | −0.306 | 0.845** |
| | (0.521) | (0.378) | (0.689) | (0.454) | (0.578) | (0.428) | (0.581) | (0.403) |
| Observations | 314 | 314 | 294 | 294 | 286 | 286 | 306 | 306 |
| Log Likelihood | −161.741 | −161.578 | −146.311 | −146.660 | −143.320 | −143.683 | −149.605 | −152.782 |

The dependent variable is effort. Standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Table A9: Probit regressions with robust standard errors clustered on groups and round dummies Hypothesis 3: cost_F and cost_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | cost_F | | cost_U | | cost_F | | cost_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | −0.557*** | −0.557*** | 0.552*** | 0.517*** | 0.163 | 0.171 | −0.258** | −0.209* |
| | (0.196) | (0.201) | (0.189) | (0.172) | (0.177) | (0.172) | (0.103) | (0.108) |
| Risk attitude 1 | 0.0587 | | 0.0716 | | 0.0752* | | 0.124*** | |
| | (0.0415) | | (0.0504) | | (0.0389) | | (0.0431) | |
| Risk attitude 2 | | 0.147 | | 0.0593 | | 0.0572 | | 0.104 |
| | | (0.0942) | | (0.103) | | (0.105) | | (0.0773) |
| Dummy round 2 | −0.0908 | −0.130 | 0.0502 | 0.0819 | −0.0434 | −0.0320 | −0.140 | −0.192 |
| | (0.194) | (0.194) | (0.232) | (0.237) | (0.209) | (0.204) | (0.232) | (0.229) |
| Dummy round 3 | 0.0786 | 0.0446 | −0.0983 | −0.0993 | 0.0344 | 0.0328 | −0.0498 | −0.0586 |
| | (0.202) | (0.195) | (0.187) | (0.186) | (0.206) | (0.202) | (0.159) | (0.155) |
| Dummy round 4 | 0.0618 | 0.0504 | −0.0543 | −0.0248 | −0.364* | −0.357* | −0.0747 | −0.106 |
| | (0.164) | (0.167) | (0.170) | (0.171) | (0.198) | (0.194) | (0.198) | (0.202) |
| Dummy round 5 | 0.208 | 0.205 | 0.252 | 0.253 | 0.0462 | 0.0283 | −0.124 | −0.113 |
| | (0.210) | (0.215) | (0.205) | (0.198) | (0.199) | (0.191) | (0.173) | (0.175) |
| Constant | −0.413 | −0.360 | −1.005*** | −0.748** | 0.117 | 0.374 | 0.0461 | 0.502** |
| | (0.262) | (0.222) | (0.331) | (0.318) | (0.229) | (0.259) | (0.313) | (0.252) |
| Observations | 314 | 314 | 294 | 394 | 286 | 286 | 306 | 306 |
| Pseudo $R^2$ | 0.0473 | 0.0546 | 0.0474 | 0.0397 | 0.0267 | 0.0159 | 0.0397 | 0.0153 |
| Log Pseudolikelihood | −195.990 | −194.481 | −184.149 | −185.639 | −174.113 | −176.052 | −185.689 | −190.398 |

The dependent variable is effort. Robust standard errors in parentheses are calculated by clustering on groups.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A10: Random effects probit regressions Hypothesis 3: likel_F and likel_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | likel_F | | likel_U | | likel_F | | likel_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | 4.086*** | 4.047*** | 3.706*** | 3.730*** | 3.522*** | 3.525*** | 1.745*** | 1.734*** |
| | (1.061) | (1.043) | (0.363) | (0.366) | (0.400) | (0.401) | (0.286) | (0.282) |
| Risk attitude 1 | −0.0153 | | 0.124* | | 0.0235 | | 0.0975 | |
| | (0.108) | | (0.0635) | | (0.0633) | | (0.0618) | |
| Risk attitude 2 | | 0.261 | | −0.0531 | | 0.0940 | | 0.127 |
| | | (0.203) | | (0.111) | | (0.120) | | (0.120) |
| Constant | −2.313*** | −2.761*** | −2.709*** | −2.079*** | −1.248*** | −1.273*** | −0.938*** | −0.672*** |
| | (0.862) | (0.789) | (0.411) | (0.301) | (0.369) | (0.271) | (0.340) | (0.251) |
| Observations | 192 | 192 | 436 | 436 | 408 | 408 | 164 | 164 |
| Log Likelihood | −70.278652 | −69.411915 | −125.20829 | −134.01814 | −134.26167 | −134.26167 | −81.87795 | −82.600033 |

The dependent variable is effort. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A11: Probit regressions with robust standard errors clustered on groups and round dummies Hypothesis 3: likel_F and likel_U treatments

| | High risk | | | | Low risk | | | |
|---|---|---|---|---|---|---|---|---|
| | likel_F | | likel_U | | likel_F | | likel_U | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dummy Favorite | 2.168*** | 2.249*** | 2.674*** | 2.629*** | 2.481*** | 2.483*** | 1.591*** | 1.579*** |
| | (0.241) | (0.235) | (0.258) | (0.238) | (0.221) | (0.216) | (0.233) | (0.239) |
| Risk attitude 1 | −0.00530 | | 0.0921** | | 0.0115 | | 0.0876 | |
| | (0.0401) | | (0.0467) | | (0.0419) | | (0.0566) | |
| Risk attitude 2 | | 0.172 | | −0.0440 | | 0.0595 | | 0.109 |
| | | (0.114) | | (0.0753) | | (0.0740) | | (0.138) |
| Dummy round 2 | −0.0331 | −0.0446 | 0.0478 | 0.0159 | −0.265 | −0.273 | 0.295 | 0.289 |
| | (0.307) | (0.306) | (0.261) | (0.252) | (0.277) | (0.279) | (0.440) | (0.398) |
| Dummy round 3 | 0.215 | 0.254 | −0.196 | −0.174 | −0.0426 | −0.0550 | 0.399 | 0.349 |
| | (0.318) | (0.319) | (0.161) | (0.151) | (0.273) | (0.270) | (0.445) | (0.483) |
| Dummy round 4 | 0.0934 | 0.179 | −0.0205 | 0.0196 | −0.159 | −0.182 | 0.344 | 0.312 |
| | (0.341) | (0.318) | (0.155) | (0.159) | (0.174) | (0.165) | (0.316) | (0.340) |
| Dummy round 5 | −0.255 | −0.261 | −0.156 | −0.162 | −0.240 | −0.247 | 0.679* | 0.643* |
| | (0.378) | (0.386) | (0.154) | (0.152) | (0.247) | (0.248) | (0.355) | (0.359) |
| Constant | −1.271*** | −1.635*** | −1.908*** | −1.401*** | −0.686*** | −0.707*** | −1.196*** | −0.935** |
| | (0.367) | (0.288) | (0.374) | (0.285) | (0.250) | (0.262) | (0.386) | (0.435) |
| Observations | 192 | 192 | 436 | 436 | 408 | 408 | 164 | 164 |
| Pseudo $R^2$ | 0.4146 | 0.4286 | 0.5494 | 0.5399 | 0.4803 | 0.4814 | 0.2647 | 0.2553 |
| Log Pseudolikelihood | −77.522 | −75.669 | −135.658 | −138.518 | −143.645 | −143.337 | −81.8244 | −82.870 |

The dependent variable is effort. Robust standard errors in parentheses are calculated by clustering on groups.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A12: Results on effort for Favorite-Treatments (one-tailed sign tests)

| | player: data | disc_F | cost_F | likel_F |
|---|---|---|---|---|
| high | $F$ | $e_F = 1^{***}$ | $e_F = 0^{***}$ | $e_F = 1^{***}$ |
| risk | $U$ | $e_U = 0^{***}$ | $e_U = 0$ | $e_U = 0^{***}$ |
| low | $F$ | $e_F = 1^{***}$ | $e_F = 1^{***}$ | $e_F = 1^{***}$ |
| risk | $U$ | $e_U = 1^{**}$ | $e_U = 1^{*}$ | $e_U = 0^{***}$ |

($^{*}0.05 < \alpha \leq 0.1$; $^{**}0.01 < \alpha \leq 0.05$; $^{***}\alpha \leq 0.01$)

Table A13: Results on effort for Underdog-treatments (one-tailed sign tests)

| | player: data | disc_U | cost_U | likel_U |
|---|---|---|---|---|
| high | $F$ | $e_F = 1^{***}$ | $e_F = 0$ | $e_F = 1^{***}$ |
| risk | $U$ | $e_U = 0^{***}$ | $e_U = 0^{***}$ | $e_U = 0^{***}$ |
| low | $F$ | $e_F = 1^{***}$ | $e_F = 1^{***}$ | $e_F = 1^{***}$ |
| risk | $U$ | $e_U = 1$ | $e_U = 1^{***}$ | $e_U = 0^{***}$ |

($^{*}0.05 < \alpha \leq 0.1$; $^{**}0.01 < \alpha \leq 0.05$; $^{***}\alpha \leq 0.01$)

Table A14: Effort choice for a given belief about the opponent's effort: Note that we report the fraction of players choosing a high or low effort for a given risk and a given belief. Therefore, the underlying number of observations differs for each cell

| | | | low risk | | high risk | |
|---|---|---|---|---|---|---|
| | | belief | low effort | high effort | low effort | high effort |
| disc_F | favorite | low | 0.1481 | 0.8519 | 0.2414 | 0.7586 |
| | | high | 0.1277 | 0.8723 | 0.2000 | 0.8000 |
| | underdog | low | 0.5333 | 0.4667 | 0.8889 | 0.1111 |
| | | high | 0.4302 | 0.5698 | 0.6750 | 0.3250 |
| disc_U | favorite | low | 0.2195 | 0.7805 | 0.0366 | 0.9634 |
| | | high | 0.1495 | 0.8505 | 0.1571 | 0.8429 |
| | underdog | low | 0.8333 | 0.1667 | 0.3153 | 0.6847 |
| | | high | 0.6957 | 0.3043 | 0.7013 | 0.2987 |
| cost_F | favorite | low | 0.7273 | 0.2727 | 0.8710 | 0.1290 |
| | | high | 0.1545 | 0.8455 | 0.5469 | 0.4531 |
| | underdog | low | 0.6286 | 0.3714 | 0.7073 | 0.2927 |
| | | high | 0.2593 | 0.7407 | 0.3467 | 0.6533 |
| cost_U | favorite | low | 0.6275 | 0.3725 | 0.6111 | 0.3889 |
| | | high | 0.2353 | 0.7647 | 0.4211 | 0.5789 |
| | underdog | low | 0.5254 | 0.4746 | 0.8642 | 0.1358 |
| | | high | 0.1383 | 0.8617 | 0.5606 | 0.4394 |
| likel_F | favorite | low | 0.0395 | 0.9605 | 0.2024 | 0.7976 |
| | | high | 0.0741 | 0.9259 | 0.0833 | 0.9167 |
| | underdog | low | 0.8750 | 0.1250 | 1.0000 | 0.0000 |
| | | high | 0.7667 | 0.2333 | 0.8750 | 0.1250 |
| likel_U | favorite | low | 0.1538 | 0.8462 | 0.1327 | 0.8673 |
| | | high | 0.1176 | 0.8824 | 0.1818 | 0.8182 |
| | underdog | low | 0.9444 | 0.0556 | 0.8889 | 0.1111 |
| | | high | 0.6094 | 0.3906 | 0.9400 | 0.0600 |

**Instructions (here: for the disc_F treatment):**

**Welcome to this experiment!**
You will participate in an economic decision making experiment. All decisions are anonymous, that means that none of the other participants learns the identity of someone having made a certain decision. The payment is also anonymous, none of the participants learns how much other participants earned. Please read the instructions of the experiment carefully. If you have difficulties understanding something, look at the instructions again. If any questions are left, give us a hand signal.

**Overview of the experiment**
The experiment consists of five rounds. Before the experiment starts, you have the opportunity to become familiar with it during ten trial rounds. These trial rounds have no influence on your payment and their only purpose is to foster a better understanding of the experiment.
Each round consists of two stages: **Stage 1 and Stage 2**. You will be matched with another participant in each round. All participants are divided into groups of six, out of which pairs for one round are randomly matched. If you were matched with a particular participant in one round, you will not be matched with this participant again. Please note that **only one of the five rounds will be selected for payment**. The computer randomly selects which round will be paid. Therefore, please think carefully about your decisions because each round might be selected. Your decisions and the decisions of the other participant with whom you play influence your payment. All payments resulting from the experiment are described in the fictitious currency taler. The **exchange rate** is **1 euro for 10 talers**.
At the beginning of the experiment, an amount of 60 talers will be credited to your experiment account. If you receive further payments out of the randomly selected round, they will be added to your account and the whole sum will be paid. If your payment of the selected round is negative, it will be charged with your initial endowment and the remaining amount will be paid.
There are two different player roles in the experiment, player **role A** (player A in the following) and player **role B** (player B in the following). At the beginning of the experiment, you are randomly assigned to one of these roles. In each round, you may be assigned to another role. You will be matched with a participant who has been assigned the other player role. For both participants **a score is calculated at the end of each round**. The player's score, depending on the player role, is influenced by several components which will be explained in the following:

**If you are player A:**
Your score at the end of a round (after stage 2) is calculated as follows:

$$\text{Score } \mathbf{A} = \mathbf{Z}_A + \mathbf{x}$$

$\mathbf{Z}_A$ is a number which you select as player A in stage 2. You can choose between $\mathbf{Z}_A = \mathbf{0}$ and $\mathbf{Z}_A = \mathbf{1}$. The selected number will be taken into account for the calculation of your score. Dependent on the choice of $\mathbf{Z}_A$, different costs occur: If you choose $Z_A = 0$, this costs you nothing. If you choose $Z_A = 1$, this costs you $\mathbf{C}_A = \mathbf{8}$ talers.

**Influence of x:**
As **player A** you decide between **two alternatives** at **stage 1**:

**Alternative 1**:
If you choose **alternative 1**, $x$ is randomly drawn from the interval $-2$ to 2 (each value between $-2$ and 2 occurs with the same probability). The randomly chosen $x$ is specified on two decimal places.

**Alternative 2**:
If you choose **alternative 2**, $x$ is randomly drawn from the interval $-4$ to 4 (each value between $-4$ and 4 occurs with the same probability). The randomly chosen $x$ is specified on two decimal places.
The randomly selected $x$ influences your score at stage 2 (see above).

**If you are player B:**
If you act as player B, you do not make any decision at stage 1.
Your score at the end of stage 2 is calculated as follows:

$$\text{Score } \mathbf{B} = \mathbf{Z}_B$$

$\mathbf{Z}_B$ is a number which you select at stage 2. You can choose between $Z_B = 0$ and $\mathbf{Z}_B = \mathbf{1}$. The selected number will be taken into account for the calculation of your score. If you choose $Z_B = 0$, this costs you nothing. If you choose $\mathbf{Z}_B = \mathbf{1}$, this costs you $\mathbf{C}_B = \mathbf{24}$ talers.
At the end of stage 2, the scores of both players will be compared. The player with the **higher score** receives **100 talers**. The other player receives **zero talers**. If both players achieved the same score, it will be randomly selected which score will be regarded as the higher one. In any case, the costs of a chosen number will be subtracted from the achieved talers.

**Course of a round**
**Stage 1:**
First you receive the following information:

- which of the roles A and B is assigned to you
- if you are **player A**: Information about your own costs $\mathbf{C}_A$ which occur if you choose $Z_A = 1$ at stage 2 and about the costs $\mathbf{C}_B$ of the other player if he chooses $Z_B = 1$ at stage 2.
- if you are **player B**: Information about your own costs $\mathbf{C}_B$ which occur if you choose $Z_B = 1$ at stage 2 and about the costs $\mathbf{C}_A$ of the other player if he chooses $Z_A = 1$ at stage 2.

If you act as **player A**, you will be asked at stage 1 which of the **alternatives 1 or 2** you want to choose. After you have selected one of the alternatives, stage 2 of the experiment begins.
**Stage 2:**
At stage 2, both players are **informed** about the chosen **alternative of player A**.
After that, you and the other player are asked to state your belief regarding the number $Z$ the other one will choose. **If your belief is correct you will receive 15 talers, otherwise nothing.**
Then both players choose a **number Z**.

- if you are **player A**, you can choose between $Z_A = 0$ and $Z_A = 1$. This influences your score. If you choose $Z_A = 1$, costs of $\mathbf{C}_A$ occur.
- if you are **player B**, you can choose between $Z_B = 0$ and $Z_B = 1$. This influences your score. If you choose $Z_B = 1$, costs of $\mathbf{C}_B$ occur.

After that, you and the other player will be informed about the decisions and the scores, $x$ is randomly drawn and the player with the higher score is announced. In addition, you are informed how many talers you would earn if this round were selected for payment later. Hence, you receive the following information:

| |
|---|
| **Your score:**<br>**Score of the other player:**<br>**The player with the higher score is player_.**<br>**Your belief was correct/false.**<br>**Additionally, you would receive _ talers**<br>**Altogether, you would receive _ talers in this round.** |

Then the next round begins following the same procedure. Altogether you will play five rounds. After round five, it is randomly chosen which round will be paid. Thereafter, a questionnaire appears on the screen which you are to answer.
**Overview about the possible payments:**

| Payment for the player with the higher score: |
|---|
| 100 talers<br>– costs $C_A$ or $C_B$ respectively, if $Z = 1$ was chosen<br>+ 15 talers for a correct belief about<br>the other player's choice of $Z$ |
| |
| Payment for the player with the lower score: |
| 0 talers<br>– costs $C_A$ or $C_B$ respectively, if $Z = 1$ was chosen<br>+ 15 talers for a correct belief about<br>the other player's choice of $Z$ |

The payments will be added to your experiment account. In addition you will be paid 2.50 euro for participating in our experiment.
Now please answer the comprehension questions below. As soon as all participants have answered them correctly, the ten trial rounds will start.
Please stay on your seat at the end of the experiment until we invoke your cabin number. Bring this instruction and your cabin number to the front. Only then the payment for your score can begin.

**Thanks a lot for participating and good luck!**

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