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# Optimal Prizes in Dynamic Elimination Contests: An Experimental Analysis[1]

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**Abstract**

This paper investigates the effects of different prize structures on the effort choices of participants in two-stage elimination contests. A format with a single prize is shown to maximize totaleffort over both stages, but induces low effort in stage 1 and high effort in stage 2. By contrast, a format that allocates the same total amount to multiple prizes in such a way that the predicted effort remains constant across stages yields lower total effort provision. Experimental evidence suggests that (i) total effort is higher in the single prize format, but only for risk-neutral subjects; (ii) effort is constant across stages in the format with multiple prizes, independently of risk-attitudes; and (iii) the runner-up prize in the multiple prize format increases stage-1 and decreases stage-2 efforts in line with the theoretical prediction.

**Keywords**

Dynamic Contests, Multiple Prizes, Experiment, Over-provision

**JEL Classification**

C72, D72, J33

# 1 Introduction

Contests are situations in which agents compete by expending valuable resources to win a prize. Such situations appear in many different areas of economics – including election campaigns, R&D competitions, military conflicts, or the competition for bonus payments and promotions on internal labor markets. Given the multiplicity of applications, contests may vary in several dimensions, for example, with respect to the number of participants, the number of prizes, or with respect to their structure. The effect of different modeling choices in these dimensions on behavior of contest participants has been studied extensively in theoretical work, which typically determines the optimal contest design with respect to a given optimality criterion.[1] Two criteria are particularly prominent in the literature on optimal prizes in dynamic contests, namely the *maximization of aggregate incentives* (operationalized as the sum of efforts provided by all agents across all stages of the contest), and the *maintenance of incentives across stages* of the contest (operationalized as constant individual efforts over stages). A common motivation for both objectives is that effort provision by contestants is valuable for the entity organizing the contest, henceforth called the contest designer. The maximization of aggregate incentives is a natural objective of the contest designer, in particular when efforts across stages are additively separable, see Sisak (2009) for an excellent survey of the literature addressing this criterion. Alternatively, complementarities between the efforts at different stages can imply that incentive maintenance across stages is the relevant criterion for the contest designer. The classical reference for this case is Rosen (1986), who argued that incentive maintenance is particularly important in corporate tournaments in which workers are incentivized by wage increases that are associated with promotions to higher hierarchy levels within the same organization.

In this paper, we study the optimal design of a two-stage elimination contest with four homogeneous participants. Assuming that the overall prize money is fixed, our analysis first replicates the result of Fu and Lu (2012) that a "winner-takes-all" structure with a single prize for the winner of the final round maximizes total effort under the standard assumption of rational and risk-neutral contestants.[2] Then, we derive the prize structure that ensures incentive maintenance across stages in the sense of Rosen (1986). This structure turns out to be a format with multiple prizes, where the winner of the final receives most of the prize money, while a smaller part is assigned to the runner-up prize. Thus, the theoretical analysis shows that there is a trade-off between the two optimality criteria 'maximization of aggregate efforts' and 'incentive maintenance across stages' in the standard benchmark of a pair-wise

[1] See Konrad (2009) for a literature review.

[2] To be precise, we consider a pair-wise elimination rather than pyramid contest. However, the result by Fu and Lu (2012) carries over to this format, since the underlying economic intuition is exactly the same.

elimination contest:[3] The **single-prize** format (abbreviated as **SP** in the sequel) maximizes aggregate efforts, while the **multiple-prizes** format (abbreviated as **MP**) delivers constant effort across stages.

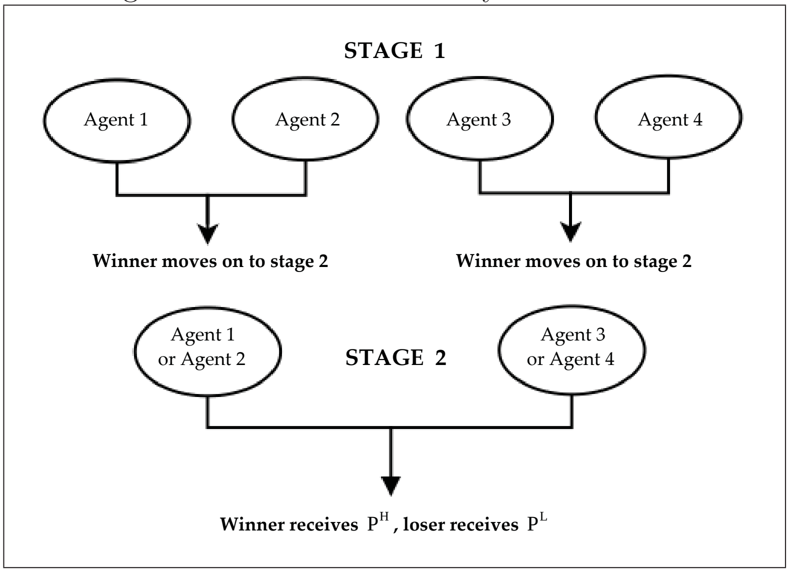
We test these predictions in lab experiments. In line with the theoretical model, we find that total effort is higher in **SP** than in **MP**. However, the observed difference between treatments is smaller than predicted and statistically insignificant at conventional levels. On the other hand, incentive maintenance across stages in **MP** holds almost exactly as predicted by theory. A closer look at the disaggregate data reveals that risk-aversion of experimental subjects can account for the departure from the theoretical prediction in the total effort dimension. Specifically, we find that total effort provision by risk-averse subjects is higher (and not lower) in the **MP** than in **SP** format, while the behavior of risk-neutral and risk-loving subjects is in line with the theoretical prediction. Intuitively, the **MP** format is more attractive for risk-averse subjects, since the runner-up prize provides insurance against situations where costly effort is provided but no prize is won, while such insurance is not important for risk-neutral participants. Overall, the results of this paper suggest that there is a trade-off between the two goals 'total effort provision' and 'constant effort across stages' under the standard assumption of risk-neutral contestants, but this trade-off might be mitigated if contestants are sufficiently risk-averse. In such a case, a format that awards multiple prizes might well be the dominant option in both performance dimensions.

Our results contribute to the recent literature on the behavior in contests. So far, the experimental literature has mainly focused on static contests.[4] Exceptions are the studies of Altmann, Falk, and Wibral (2012) and Sheremeta (2010), which both compare static (one-shot) and dynamic (two-stage) contests. The paper by Altmann et al. (2012) considers a prize structure which predicts incentive maintenance across stages in the theoretical benchmark, and one of their main findings in the experiments is that effort provision by subjects in the first stage is much higher than in the second stage. Sheremeta (2010), on the other hand, investigates a single-prize two-stage contest format and compares it to an analogous one-stage contest interaction. Our paper combines the two approaches and analyzes a systematic variation of the prize structure in dynamic contests. Moreover, our paper is the first experimental test of the result by Fu and Lu (2012) that a "winner-takes-all" prize structure maximizes total effort in dynamic Tullock contests with homogeneous participants. Finally, this paper is also related to recent work by Delfgaauw, Dur, Non, and Verbeke (2011), who investigate whether a more convex prize spread affects relative effort exertion across different stages of a dynamic contest.

[3]This trade-off exists if effort provision by contest participants is costly. As shown by Matros (2005), a "winner-takes-all" structure maximizes aggregate incentives and ensures incentive maintenance if contestants receive an endowment (which cannot be cashed out) and are then asked to allocate it across different stages of a contest.

[4]See, for example, Harbring and Irlenbusch (2003), Harbring and Lünser (2008), or Sheremeta (2011).

Figure 1: Structure of the Dynamic Contest




Using data from a field experiment, they find that the effect of the prize structure on relative effort provision across stages is rather weak. The same effect appears to be much stronger in our experimental data. A likely explanation for this difference in magnitude could be that our prize spread variation is more extreme, since we compare a "winner-takes-all" structure with a multiple prizes setting, while Delfgaauw et al. (2011) investigate the effects of a more modest variation of prizes in a setting with multiple prizes.

The remainder of this paper is organized as follows: Section 2 derives the theoretical benchmark for a simple dynamic contest model. Section 3 outlines the experimental design and derives our main hypotheses. The experimental results are presented and discussed in Section 4. Section 5 concludes.

# 2 A Simple Dynamic Contest Model

**Set-up.** We consider a simple two-stage pair-wise elimination contest where four identical agents compete for two prizes. In the first stage, there are two pair-wise interactions, and in the second stage, the winners of the two stage-1 interactions compete against each other. Figure 1 illustrates the sequence of events: In stage 1, two pairs of agents compete simultaneously for the right to move on to stage 2. Participation in stage 2 is valuable, since two prizes are awarded to the participants of this stage: The loser of the stage-2 interaction receives the prize $P^L$, while $P^H$ is awarded to the winner, where $P^H > P^L \geq 0$. In each of the three interactions of this contest model, two risk-neutral agents independently choose their effort level to maximize their expected payoffs. The effort of agent $i$ in stage $s \in \{1, 2\}$ is denoted $x_{si} \geq 0$. For each invested unit, agents incur constant marginal costs of one.

The benefit of effort provision is that the probability to win an interaction is increasing in the amount invested into the contest. Thus, agents face a trade-off. For simplicity, we assume that the probability to win is given by a lottery contest success function à la Tullock (1980).[5] That is, given investments $x_{si}$ and $x_{sj}$ by agents $i$ and $j$ in stage $s$, the probability that agent $i$ wins in stage $s$ equals

$$p_{si}(x_{si}, x_{sj}) = \begin{cases} \frac{x_{si}}{x_{si}+x_{sj}} & \text{if} \quad x_{si} + x_{sj} > 0 \\ \frac{1}{2} & \text{if} \quad x_{si} + x_{sj} = 0 \end{cases} .$$

**Equilibrium.** Due to the dynamic structure of the contest, the equilibrium concept is Subgame Perfect Nash. The equilibrium is determined by applying backward induction. Since all agents are identical, the identity of the agents who compete in stage 2 does not affect the solution. Therefore, without loss of generality, it is assumed that agents $i$ and $j$ interact in stage 2. The formal optimization problem for agent $i$ reads

$$\begin{aligned} \max_{x_{2i} \geq 0} \Pi_{2i}(x_{2i}, x_{2j}) &= \frac{x_{2i}}{x_{2i} + x_{2j}} P^H + \left(1 - \frac{x_{2i}}{x_{2i} + x_{2j}}\right) P^L - x_{2i} \\ &= \frac{x_{2i}}{x_{2i} + x_{2j}} (P^H - P^L) + P^L - x_{2i}, \end{aligned}$$

and delivers the first-order condition[6]

$$\frac{\partial \Pi_{2i}(x_{2i}, x_{2j})}{\partial x_{2i}} = \frac{x_{2j}}{(x_{2i} + x_{2j})^2}(P^H - P^L) - 1 = 0.$$

Using symmetry leads to equilibrium efforts

$$x_2^* \equiv x_{2i}^* = x_{2j}^* = (P^H - P^L)/4. \tag{1}$$

Inserting equilibrium efforts in the objective functions gives the expected stage-2 equilibrium payoff

$$\Pi_2^* \equiv \Pi_{2i}(x_{2i}^*, x_{2j}^*) = \Pi_{2j}(x_{2i}^*, x_{2j}^*) = (P^H + 3P^L)/4. \tag{2}$$

Consequently, reaching stage 2 has value $\Pi_2^*$ for an agent participating in stage 1. Agent $k$ will take this value into account when choosing his stage-1 effort $x_{1k}$. As in stage 2, the identity of agents does not matter in stage 1, since all agents are identical by assumption. Without loss of generality, consider

[5]For an axiomatization of this technology, see Skaperdas (1996).

[6]The first-order condition is necessary and sufficient – see Perez-Castrillo and Verdier (1992) for details.

the interaction between agents $k$ and $l$. Agent $k$ faces the optimization problem

$$\begin{aligned}\max_{x_{1k}\geq 0} \Pi_{1k}(x_{1k}, x_{1l}) &= \frac{x_{1k}}{x_{1k}+x_{1l}} \Pi_2^* - x_{1k} \\ &= \frac{x_{1k}}{x_{1k}+x_{1l}} \left( \frac{P^H + 3P^L}{4} \right) - x_{1k}.\end{aligned}$$

As in the solution of stage 2 above, the first-order condition together with symmetry yields the equilibrium efforts on stage 1 as

$$x_1^* \equiv x_{1k}^* = x_{1l}^* = \left(P^H + 3P^L\right)/16. \tag{3}$$

**Optimal Prize Structures.** Assuming that the overall prize money is fixed, we consider two goals of the contest designer: maximization of aggregate incentives, and maintenance of incentives across stages. Assuming that $P$ units are available as total prize money, it holds that $P^H = P - P^L$. Inserting this expression into (1) and (3), we obtain

$$x_1^* = \frac{P + 2P^L}{16} \qquad \text{and} \qquad x_2^* = \frac{P - 2P^L}{4} \tag{4}$$

as stage-1 and stage-2 equilibrium efforts, respectively. Since four agents provide effort in stage 1, while only two of them reach stage 2, total effort $\mathcal{E}$ amounts to

$$\mathcal{E} = \frac{3P - 2P^L}{4}. \tag{5}$$

This expression confirms that that total effort is maximized in a "winner-takes-all" contest, i.e., if $P^L = 0$ and $P^H = P$ (since $\mathcal{E}$ is strictly decreasing in $P^L$).[7] With respect to the criterion of incentive maintenance across stages, equalizing the expressions for stage-1 and stage-2 effort given in (4) implies a runner-up prize of $P^L = 3P/10$, and a winner prize $P^H = 7P/10$. Thus, there is a trade-off between the two goals: While total effort is maximal with a single prize equal to the total prize money for the winner of the final, incentive maintenance across stages requires two prizes: One equal to 30% of the prize money for the loser of the final, and one equal to the rest for the winner of the final.

[7] One can easily show that this result does not hinge on the number of stages and/or the specific lottery contest success function considered here. In fact, a "winner-takes-all" contest maximizes total effort in any Tullock contest with pair-wise elimination, provided the equilibrium is in pure strategies, which exists if the contest success function involves sufficient noise in terms of low discriminatory power.

Table 1: Parametrization and Theoretical Predictions

| | Single Prize (**SP**) | Multiple Prizes (**MP**) |
|---|---|---|
| Total Effort ($\mathcal{E}$) | 180 | 144 |
| Stage-1 Effort ($x_1^*$) | 15 | 24 |
| Stage-2 Effort ($x_2^*$) | 60 | 24 |
| Prizes ($P, P^L, P^H$) | (240,0,240) | (240,72,168) |

# 3 Design of the Experiments

**Experimental Parameters and Treatments.** We consider two treatments with different prize structures. Independent of the treatment, the total prize money available, $P$, amounts to 240 units, which implies that $P^H + P^L = 240$ must hold. As shown above, total effort is predicted to be maximized in a "winner-takes-all" contest, i.e., by setting $P^L = 0$ and $P^H = 240$. This prize structure is implemented in the single prize treatment **SP**. With respect to the "incentive maintenance across stages" criterion, our results above imply a runner-up prize of $P^L = 72$, and a winner prize $P^H = 168$. We implement this prize structure in the multiple-prizes treatment **MP**.

**Testable Hypotheses.** Table 1 shows the theoretical predictions for both treatments with respect to total effort and individual effort provision in each stage. As derived above, total effort is higher in **SP** than in **MP**. Therefore, the comparison of total effort in treatments **SP** and **MP** allows us to test the hypothesis:

**Hypothesis 1** (**Total Effort Maximization**). *Total effort provided by all four participants in both stages is higher in **SP** than in **MP**:*

$$\mathcal{E}^{\text{SP}} > \mathcal{E}^{\text{MP}}$$

Apart from information on total effort provision, Table 1 provides the individual equilibrium effort levels in each stage of both treatments. First, individual effort provision by participants in the **MP** treatment is predicted to be the same in both stages, which leads to Hypothesis 2.

**Hypothesis 2** (**Incentive Maintenance**). *Individual efforts are identical across stages in **MP**:*

$$x_1^{\text{MP}} = x_2^{\text{MP}}$$

Second, individual effort in stage 1 is higher in treatment **MP** than in **SP**, while the opposite holds for stage-2 effort. The formal expressions in (4) show why this is the case: Stage-1 effort is strictly increasing in the runner-up prize $P^L$, since a high runner-up prize makes participation in stage 2 more valuable. Stage-2 effort is, however, decreasing in $P^L$. The reason is that each participant of stage 2 has the runner-up prize for sure, such that the two participants compete only for the residual prize $P^H - P^L$. We call this mechanism the "Runner-up Prize Effect" and test it in Hypothesis 3:

**Hypothesis 3 (Runner-up Prize Effect).** *In stage 1, individual effort provision is higher in **MP** than in **SP**, while the opposite holds for stage-2 effort:*

$$\begin{aligned} &(a) \quad x_1^{\text{MP}} > x_1^{\text{SP}} \\ &(b) \quad x_2^{\text{MP}} < x_2^{\text{SP}}. \end{aligned}$$

Note that the strength of the "Runner-up Prize Effect" is at the heart of the result that a "winner-takes-all" prize structure maximizes total effort. Intuitively, we consider a setting where the higher effort exertion in early stages cannot compensate for the lower effort exertion in later stages, even though the number of participants is higher in early stages. As shown by Fu and Lu (2012) and Krishna and Morgan (1998), this relation holds whenever the contest technology is sufficienty noisy.[8]

**Implementation.** We adopt a between-subject design; that is, our experimental subjects encountered either the **MP** or the **SP** treatment. The protocol of an experimental session was the same for both treatments: First, participants received some general information about the experimental session. Then, instructions for the respective treatment (either **SP** or **MP**) were distributed.[9] After each participant confirmed that he/she had read and understood the instructions, and participants had to answer a set of control questions correctly. Only then did the first decision round start. Overall, each subject participated in 30 decision rounds with different opponents. After the main treatment, we first elicited risk preferences using a standard incentivized procedure, and then asked participants to fill out a questionnaire (voluntary and non-incentivized). Only thereafter participants were informed about their payoff in the experimental session. We ran a total of 8 computerized sessions with 20 participants each. The experiment was programmed in z-Tree (Fischbacher 2007). All 160 participants were students from the University of Innsbruck, which were recruited using ORSEE (Greiner 2004). Each session lasted approximately 70 minutes in total (including the distibution of instructions at the

[8] Fu and Lu (2012) show that a "winner-takes-all" prize structure maximizes total effort in any dynamic (pyramid) contest with risk-neutral and homogeneous participants as long as the impact function is not too convex (see their Proposition 4 for details). Krishna and Morgan (1998) consider a difference (rather than ratio) contest success function with additive noise and find that multiple prizes maximize total effort in sequential elimination contests only if the noise parameter has very narrow bounds.

[9] A translated version of the instructions is provided in the Appendix. The original instructions, which are in German, are available from the authors upon request.

beginning and the payment at the end), and participants earned between 9-13 Euro (approximately 11 Euro on average).[10]

**Treatments.** Each participant played the same contest game 30 times, knowing that the identities of his/her opponents are randomly determined in each decision round. We used the experimental currency "Taler", where 200 Taler corresponded to 1.00 Euro. The only variation across the two treatments **SP** and **MP** concerned the prize structure; everything else was kept constant. The role of investments into the contest (effort) was explained to subjects using an analogy between the chosen contest success function and a lottery. Participants were told that they could buy a discrete number of balls in each interaction.[11] The balls purchased by the subjects as well as those purchased by their respective opponents were then said to be placed in the same ballot box, out of which one ball would be randomly drawn subsequently. This replicates the ratio contest success function à la Tullock (1980) from the theoretical set-up. Players had to buy (and pay for) their desired number of balls before they knew whether or not they won a pair-wise interaction in the contest. For this purpose, each participant received an endowment of 240 Taler in each round. This endowment could be used to buy balls on both stages, i.e., a subject that reached stage 2 could use whatever remained of his/her endowment to buy balls in the stage-2 interaction. The part of the endowment that a participant did not use to buy balls was added to the payoffs for that round. Since the endowment was as high as the total prize money $P$, agents were not budget-constrained at any time.[12] Experimental subjects were told that the endowment could only be used in a given round, that is, that transfers across decision rounds were not possible. Therefore, the strategic interaction is the same in each of the 30 decision rounds. Random matching in each round ensured that the same participants did not interact repeatedly; matching groups corresponded to the entire session. After each decision round, participants were informed about their own decision, the decision(s) of their immediate opponent(s), and about their own payoff. This allows for an investigation of whether players learn when completing the task repeatedly. In order to minimize the potential impact of income effects participants were told that only four decision rounds (out of 30) would be randomly chosen and paid out at the end of the experiment.

[10] In two out of three sessions of the **SP** treatments, an additional experiment was conducted *after* the risk-elicitation part. This experiment was entirely unrelated to the tournament experiment and subjects were not informed about what to expect in this second experiment. All they knew is that the session also included a third part, rather than only two parts. These sessions where approximately 15 minutes longer, and payoffs in this additional experiment amounted to approximately 2.50 Euros on average.

[11] The chosen prizes ensured that equilibrium investments in both stages of both contest specifications were positive integers, which implies that the discrete grid had no consequences for the equilibrium strategies; the equilibrium in pure strategies is unique in both treatments.

[12] This is also confirmed by the experimental data on effort.

Table 2: Experimental Results

| | SP | | | MP | | |
|---|---|---|---|---|---|---|
| | N | Data | Theory | N | Data | Theory |
| Total Effort ($\mathcal{E}$) | 3 | **304.513** (28.314) | 180 | 5 | **277.861** (6.796) | 144 |
| Stage-1 Effort ($x_1^*$) | 60 | **33.660** (2.911) | 15 | 100 | **45.238** (2.957) | 24 |
| Stage-2 Effort ($x_2^*$) | 60 | **85.134** (4.658) | 60 | 100 | **45.976** (2.614) | 24 |

Note: The numbers in the columns "Data" denote averages over all rounds of the experimental sessions. Total effort is the sum of individual efforts over subjects and stages, and stage-1 (stage-2) effort is individual effort in that stage (in experimental currency, Taler). Standard errors in parentheses. The column "Theory" provides the theoretical equilibrium prediction for the respective effort measure.

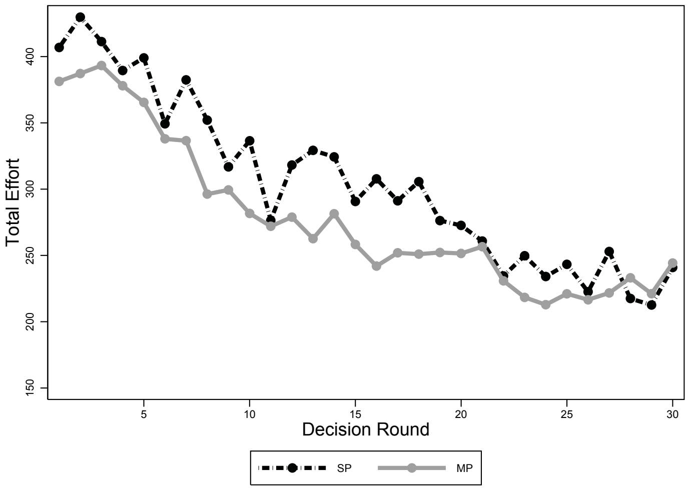
**Elicitation of Risk Attitudes.** We used a choice list similar to the one employed by Dohmen, Falk, Huffman, and Sunde (2010) to elicit risk attitudes.[13] Specifically, each subject was exposed to a series of 21 binary choices between a cash gamble and a safe payoff. While the cash gamble remained the same in all 21 binary choices – it always gave either 400 Taler or 0 Taler, each with 50 percent probability – the safe payoff increased in steps of 20 Taler from 0 Taler in the first choice to 400 Taler in the last choice. Given this design a decision maker whose preferences satisfy ordering (completeness and transitivity) and strict monotonicity switches exactly once from the cash gamble to the safe payoff. For subjects who switch exactly once we use the first choice scenario in which the subject decides in favor of the save payoff as our measure of risk attitude (we do not classify subjects with multiple switching points).

# 4 Experimental Results

Our main experimental results are summarized in Table 2. The table displays the theoretical predictions from Section 2 as well as observed means for stage-1, stage-2, and total effort provision in both treatments. The data match all qualitative relations that were predicted, even though the empirically observed efforts exceed their theoretical counterparts quite substantially in quantitative terms. This

[13] In the Dohmen, Falk, Huffman, and Sunde (2010) procedure, each subject is exposed to a series of choices between a safe payment (which is systematically varied) and a binary lottery (which remains constant across choices). This is cognitively simpler than the procedure employed by Holt and Laury (2002), where a subject is confronted with a series of choices between two binary lotteries that are both varied systematically. The instructions which experimental subjects received right before the risk-elicitation part are provided in the Appendix.

Figure 2: Total Effort by Decision Round and Treatment




finding of quantitative over-provision is in line with much of the existing experimental literature and will be discussed at the end of this section.

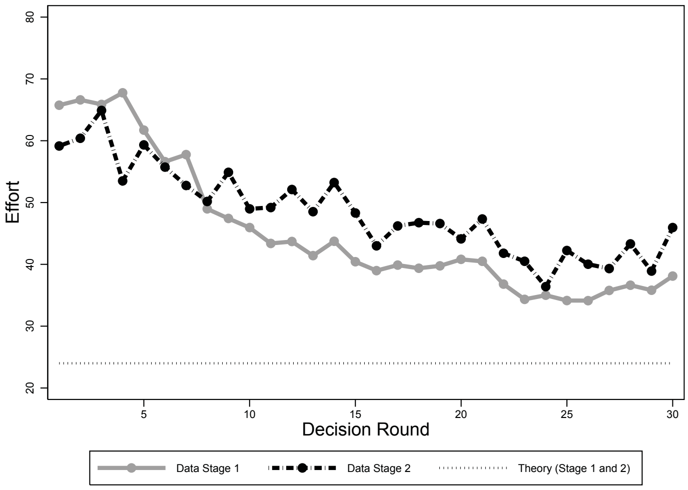
## 4.1 Baseline Results Regarding the Hypotheses

We proceed in the same order as in Section 3, starting with the comparison of total effort between treatments. In line with the theoretical prediction, total effort is higher in **SP** than in **MP** (304.513 compared to 277.861, see Table 2 for details). However, the difference is smaller than predicted in relative terms (total output in **MP** is only 10% lower than in **SP**, while theory predicts that it is 25% lower) and the difference is not statistically significant at conventional levels. Indeed, the p-value for a test of the null of equality of session means is above 0.10 both for the parametric t-test and the non-parametric Mann-Whitney-U-test (MWU-test).[14] Figure 2 plots the evolution of total effort over time from round 1 to 30 and shows two things: The pattern shows that total effort is decreasing over time in both treatments. It seems that participants realize after a few rounds that they initially provided too much effort, even though total effort in later decision rounds is still well above the risk-neutral benchmark in both treatments. Second, total effort in both treatments becomes very similar in later rounds of the experiment, i.e., even the small initial difference in total effort across treatments disappears in later rounds of the experiment. We summarize our findings with respect to total effort provision as follows:

**Result 1 (Total Effort Maximization).** *Total effort over all contestants and both stages of the contest is higher in **SP** than in **MP**, in line with the theoretical prediction. However, the difference is smaller than predicted and not significantly different from zero.*

[14] The p-values are 0.2825 (t-test) and 0.4561 (MWU-test). In the following, we only report p-values for the non-parametric MWU-test unless noted otherwise.

Figure 3: Individual Effort in Treatment **MP** by Decision Round




Hypothesis 2 is concerned with the maintenance of incentives across stages and states that individual efforts in **MP** are not expected to differ across stages. According to Table 2, this is exactly what we observe in the experiment: Subjects invest approximately 45 units of effort in both stages, and we cannot reject the null of equality of individual session means ($p < 0.001$). Figure 3 plots the stage-1 and stage-2 effort choices in treatment **MP** over the different rounds of the experiment and might help to explain why we observe incentive maintenance, while Altmann, Falk, and Wibral (2012) do not. Altmann et al. employ an experimental design where participants interact only once. In contrast, in our experiment the same contest is repeated 30 times with random matching.[15] If we only consider the first decision round, the data replicate the pattern observed by Altmann, Falk, and Wibral (2012): In this round, subjects choose, on average, an effort of 65.75 in stage 1, compared to 59.16 in stage 2 in treatment **MP**.[16] However, this pattern disappears and is even reversed in later rounds, as Figure 3 shows. In fact, the equality of stage-1 and stage-2 efforts can be rejected in some of the first seven decision rounds, while equality cannot be rejected in any subsequent round. Finally, Figure 3 illustrates that both stage-1 and stage-2 efforts are decreasing with experience in the experiment, but remain well above the theoretical benchmark even in the last decision round. This gives our second result:

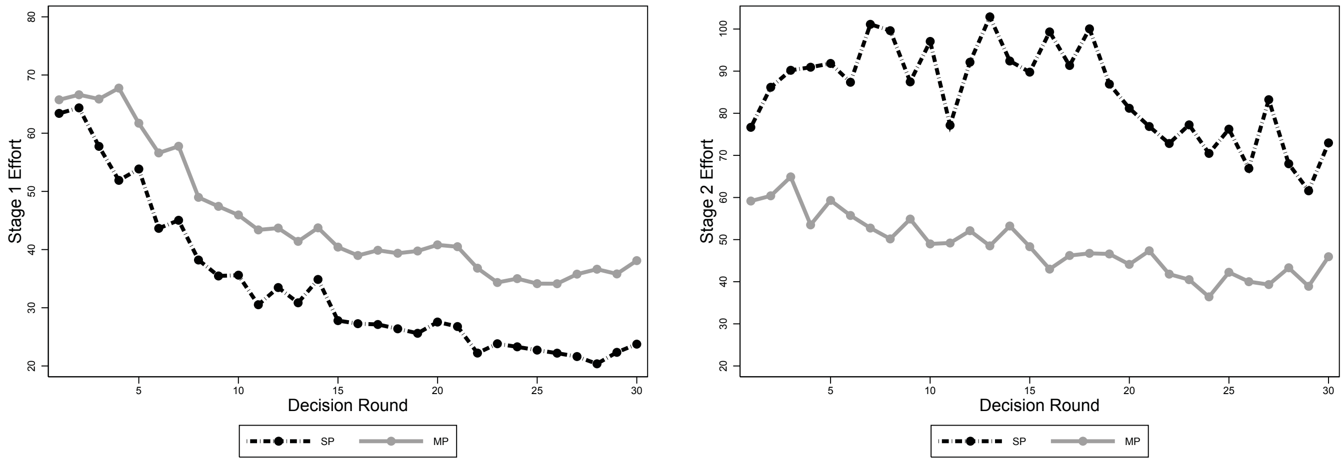
**Result 2** (**Incentive Maintenance**). *Efforts are approximately identical across stages in* ***MP*** *when considering session means. In the initial decision rounds, however, effort provision is somewhat higher in stage 1 than in stage 2.*

Our third and last hypothesis addresses the effect of the runner-up prize. Theory predicts that a runner-up prize increases individual effort in stage 1, while at the same time decreasing stage-2 effort.

[15] Another difference of their experimental design is that they use a 'difference' contest success function rather than the 'ratio' technology we employ. For a theoretical comparison of these technologies, see Hirshleifer (1989).

[16] This difference is significantly different from zero at the 5%-level.

Figure 4: Individual Effort by Stage, Decision Round, and Treatment




(a) Stage-1 Effort

(b) Stage-2 Effort

Table 2 shows that this pattern is present in the experimental data: Effort provision by experimental subjects in stage 1 is higher in **MP** than in **SP** (45.238 vs. 33.660), and equality of mean effort can be rejected at the 1% level. In contrast, stage 2 effort is higher in **SP** than in **MP** (85.134 vs. 45.976), and again the difference is highly significant ($p < 0.01$). Figure 4 illustrates that this pattern is present in each single decision round when comparing individual session means; only in the very first rounds, stage-1 efforts are rather similar across treatments. In addition, Figure 4 shows that individual efforts in the last decision rounds are much closer to the theoretical prediction in **SP** than in **MP**; this holds both in stage 1 and in stage 2.[17] Summing up, our findings are well in line with Hypothesis 3:

**Result 3** (**Runner-up Prize Effect**). *The comparison of efforts in a given stage across treatments shows that the introduction of a runner-up prize has the predicted effect: Stage 1 effort is higher in* ***MP*** *than in* ***SP****, while stage 2 effort is higher in* ***SP*** *than in* ***MP****.*

## 4.2 Discussion and Additional Results

**Risk Preferences.** Overall, the choices of 138 participants exhibit a unique switching point in the risk-preference elicitation procedure, while 9 (13) subjects in treatment **SP** (**MP**) have multiple switching points. Considering only subjects with a unique switching point, Table 3 disaggregates the data into two classes of risk preferences, namely risk-averse subjects and risk-neutral or risk-loving subjects.[18] We find that incentive maintenance across stages holds for both risk classes. Moreover, when

[17]In stage 1 of the **SP** (**MP**) treatment, effort approaches 20 (40) in the experiment, compared to a theoretical prediction of 15 (24). Similarly, in stage 2, effort approaches 65 (45) in treatment **SP** (**MP**), compared to a prediction of 60 (24).

[18]Risk-loving and risk-neutral subjects are pooled, since less than 20% of all subjects are risk-loving. Moreover, risk-neutral and risk-loving subjects show fairly similar behavior, such that this pooling does not affect the results. Details

Table 3: Results by Risk Attitude

| | *risk-averse* | | *risk-neutral/loving* | |
|---|---|---|---|---|
| | **SP** | **MP** | **SP** | **MP** |
| Stage-1 Effort ($x_1^*$) | 33.649 | 51.710 | 27.330 | 39.830 |
| | (4.391) | (7.355) | (3.223) | (2.747) |
| Stage-2 Effort ($x_2^*$) | 78.584 | 48.752 | 89.226 | 42.078 |
| | (7.449) | (4.641) | (4.391) | (3.505) |
| Total Effort ($\mathcal{E}$) | **291.764** | **304.344** | **287.772** | **243.476** |

Note: The numbers for stage-1 and stage-2 effort denote session averages by risk averse or risk neutral/loving participants. In **SP**, 21 (30) subjects are risk-averse (-neutral/loving), compared to 31 risk-averse and 56 risk-neutral/loving subjects in **MP**. Total effort is the sum of individual efforts (in experimental currency, Taler). Standard errors in parentheses.

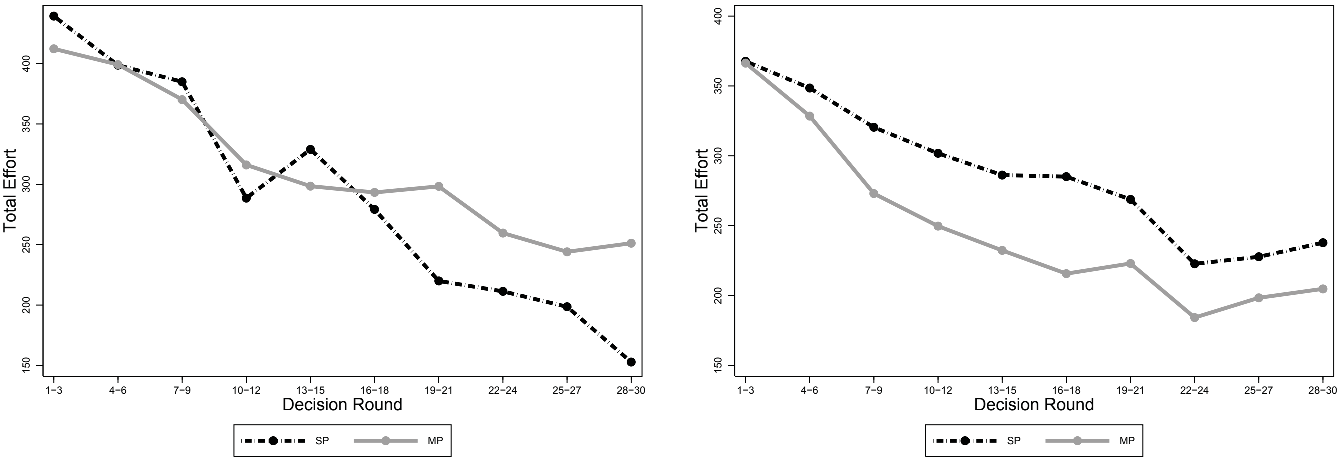
comparing efforts in a given stage across treatments, Table 3 shows that the runner-up prize increases stage-1 effort but decreases stage-2 effort, independent of risk-attitudes. Interestingly, however, the relation of total effort provision across treatments differs between risk-averse subjects on the one hand and risk-neutral or risk-loving subjects on the other hand: In line with the theoretical benchmark, risk-neutral (and risk-loving) subjects provide more effort in **SP** than in **MP** on average.[19] However, total effort provision by risk-averse subjects is higher in **MP** than in **SP** (304.344 versus 291.764). This suggests that risk-attitudes are a potential explanation for the result that the difference in total effort provision across treatments is insignificant in the aggregate. It seems that risk-averse subjects value the insurance provided by the runner-up prize in **MP** higher than risk-neutral and risk-loving subjects, while the higher prize for the overall winner in **SP** is especially attractive for risk-neutral and risk-loving subjects. Figure 5(a) shows how this effect evolves over the rounds in the two treatments: Initially, total effort provision by risk-averse subjects is higher in **SP** than in **MP**. Subsequently, total effort provision declines much faster in **SP** than in **MP**, however, and in the second half of the experimental sessions, total effort is always higher in the **MP** treatment. Figure 5(b) shows that the pattern is more stable for the class of risk-neutral and risk-loving subjects, who consistently provide more effort in the single-prize than in the multiple-prizes treatment.

**Over-provision of Effort.** As mentioned at the beginning of this section, we observe a substantial amount of effort over-provision relative to the theoretical prediction, with total effort in the experi-

are available from the authors upon request.

[19] In fact, the difference across treatments for the class of risk-neutral and risk-loving subjects amounts to 20%, which is relatively close to the 25% difference predicted by theory.

Figure 5: Total Effort by Risk Attitude, Decision Round, and Treatment




(a) Risk-Averse

(b) Risk-Neutral (or -Loving)

mental session being between 70% and 90% higher than predicted. This finding complements earlier evidence on over-provision in tournament experiments – see Davis and Reilly (1998), Gneezy and Smorodinsky (2006), or Sheremeta (2010), for instance.[20] Several explanations have been put forward in the literature to explain this phenomenon. First, the endowment that experimental subjects receive at the beginning of each decision round may lead to over-provision if subjects perceive the endowment as ‘play money’ (Thaler and Johnson 1990). In this case, subjects provide more effort due to this perception than they would without an endowment. In line with this argument, observed effort choices in experiments without endowments are often much closer to the theoretical prediction.[21] In our experiments, we explicitly decided to use endowments to avoid negative payoffs for the losers of a contest and the associated problem of limited liability. Arguably, we could also have solved this issue through additional prizes for the losers, as in Altmann, Falk, and Wibral (2012). Then, however, the contrast between a single- and a multiple-prizes treatment, which is central for our research question, would be less clear. A second explanation for over-provision is that subjects experience a ‘joy of winning’ in strategic interactions, which amplifies the valuation of prizes awarded in contests. Since individual efforts are strictly increasing in the prizes at stake, non-monetary values of winning can rationalize over-provision of effort. Sheremeta (2011) experimentally elicits a measure for the ‘joy of winning’ and finds that it is highly correlated with the amount of effort provided by individual subjects. This supports the hypothesis that the ‘joy of winning’ is at least partly responsible for over-provision relative to the benchmark. According to Potters, de Vries, and van Winden (1998), a third explanation for over-provision might be that experimental subjects are prone to make mistakes in experimental

[20]Sheremeta (2010), for example, reports similar degrees of over-provision. In his single-prize treatment with two stages, which is almost identical to our **SP** treatment, total effort is on average almost 90% higher than theory predicts.

[21]See Altmann, Falk, and Wibral (2012), for example.

settings. If this is the case, a higher endowment increases the chance to make mistake. Sheremeta (2010) varies the endowment and finds evidence that is in line with this argument.[22]

It is important to note that none of these potential explanations for over-provision predicts a systematic difference between the two treatments contrasted here, since the 'joy of winning' is unlikely to differ systematically across treatments, and both the endowment and the overall amount available for prizes are identical in the two treatments we consider.[23]

# 5 Conclusion

This paper has tested the impact of variations in the prize structure on effort decisions in dynamic contests. Specifically, we have compared two prize-structures: A "winner-takes-all" setting that is predicted to maximize total effort, and a structure with multiple prizes which is predicted to ensure incentive maintenance across stages. We have tested (i) whether total effort is indeed higher in the single-prize treatment; (ii) whether incentive maintenance is observed in the multiple-prizes treatment; and (iii) whether a runner-up prize increases stage-1 and decreases stage-2 efforts as theory predicts. We found strong evidence in support of (ii) and (iii). The evidence for (i) – that total effort is higher in the single-prize treatment – is mixed at best: Even though total effort is somewhat higher in the single-prize than in the multiple-prizes treatment, the difference across treatments is less pronounced than predicted by theory and statistically insignificant. When controlling for risk-attitudes of experimental subjects, our evidence suggests that risk-averse subjects value the insurance effect of the runner-up prize in the multiple-prizes treatment and consequently provide more effort in that environment than in a contest with a single prize. At the same time, the behavior of risk-neutral and risk-loving subjects is qualitatively in line with the theoretical prediction, which explains the mixed findings in this dimension in the aggregate. Overall, our results indicate that the format with multiple prizes does not perform substantially worse in the total effort dimension, and significantly better in terms of eliciting constant effort across different stages of the contest. Our findings also suggest a more systematic investigation of the role of risk attitudes for behavior in dynamic tournaments as a fruitful direction for future research.

[22]Sheremeta (2010) uses the concept of a Quantal Response Equilibrium (QRE) by McKelvey and Palfrey (1995), which allows for mistakes of decision makers. He finds that a reduction of the endowment causes a proportional reduction of total effort, even if the endowment is not binding for equilibrium effort levels. Low (though non-binding) endowments even lead to under-provision of effort.

[23]The explanation based on errors would only be an issue if, e.g., the endowment were to bind more often in one than in the other treatment. However, the share of experimental subjects who spend their entire endowment is very low and does not systematically differ between the two treatments. If we exclude, for instance, all observations in which the endowment is binding, total output is somewhat lower in both treatments, but the qualitative findings remain unchanged. Details are available upon request.

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# Appendix

## Appendix: Experimental Instructions

The experimental instructions consist of three parts: First, experimental subjects receive some general information about the experimental session. Then, they are informed about the main treatment (Experiment 1), which is either the **SP** or the **MP** specification (both versions are provided). Finally, subjects receive instructions for the elicitation of risk attitudes (Experiment 2).

## WELCOME TO THIS EXPERIMENT AND THANK YOU FOR YOUR PARTICIPATION

### General Instructions:

You will participate in 2 different experiments today. Please stop talking to any other participant of this experiment from now on until the end of this session. In each of the two experiments, you will have to make certain decisions and may earn an appreciable amount of money. Your earnings will depend upon several factors: on your decisions, on the decisions of other participants, and on random components, i.e. chance. The following instructions explain how your earnings will be determined.

The experimental currency is denoted **Taler**. In addition to your Taler earnings in experiments 1 and 2, you receive 3 EURO show-up fee. You may increase your Taler earnings in experiments 1 and 2, where 2 Taler equal 1 Euro-Cent, i.e.

**200 Taler correspond to 1 Euro.**

At the end of this experimental session your Taler earnings will be converted into Euro and paid to you in cash.

Before the experimental session starts, you receive a card with your participant number. All your decisions in this experiment will be entered in a mask on the computer, the same holds for all other participants of the experiment. In addition, the computer will determine the random components which are needed in some of the experiments. All data collected in this experiment will be matched to your participant number, **not** to your name or student number. Your participant number will also be used for payment of your earnings at the end of the experimental session. Therefore, your decisions and the information provided in the experiments are completely anonymous; neither the experimenter nor anybody else can match these data to your identity.

We will start with experiment 1, followed by experiment 2. The instructions for experiment 2 will only be distributed right before this experiment starts, i.e. subsequent to experiment 1.

You will receive your earnings in cash at the end of the experimental session.

## Experiment 1 [*SP Treatment*]

Overall, there are 30 decision rounds with two stages each in Experiment 1. The course of events is the same in each decision round. You will be randomly and anonymously placed into a group of **four participants** in each round, and the identity of participants in your group changes with each decision round.

### Course of events in an arbitrary decision round

All four participants of each group receive an **endowment of 240 Taler** at the beginning of a decision round. The endowment can be used to buy a certain amount of balls in two subsequent stages of a decision round. It is important to note that you receive one endowment only which must suffice to buy balls in both stages. The costs for the purchase of a ball are the same for all participants: Participants have to pay **1.00 Taler** for each ball they buy in stage 1 **or** stage 2, i.e.

**1 ball costs 1.00 Taler**
**2 balls cost 2.00 Taler**
**(and so on)**

When deciding how many balls you want to buy, you do not know the decision of other participants. Also, your decision is not revealed to any other participant.

All interactions in the experiment are pair-wise. Assume that you are in one group with participant A, participant B, and participant C. Then, you interact with participant A in stage 1, while participants B and C simultaneously meet each other in the second stage 1 interaction. If you reach stage 2, you will interact either with participant B or C, depending on the outcome in the second stage 1 interaction. In stage 1, there are two ballot boxes:

- all balls bought by you or participant A are placed in ballot box 1
- all balls bought by participants B and C are placed in ballot box 2

One ball is randomly drawn from each ballot box, and each ball drawn with the same probability. The two participants whose balls are drawn from ballot box 1 and 2, respectively, reach stage 2; the decision round is over for the other two participants (whose balls were not drawn), i.e. they drop out from this decision round. Any participant has to pay the balls he or she bought in stage 1, whether or not he/she reached stage 2. The respective amount is deducted from the endowment.

The two participants who reached stage 2 do again buy a certain number of balls, using whatever remains from the endowment they received after costs for balls in stage 1 were deducted. The balls are then placed into ballot box 3. One ball is randomly drawn from ballot box 3. The participant whose ball is drawn receives a prize of **240 Taler**. The other participants do not receive any prize in this decision round. Independent of whether or not a participant receives the prize, he/she does always have to pay for the balls bought in stage 2.

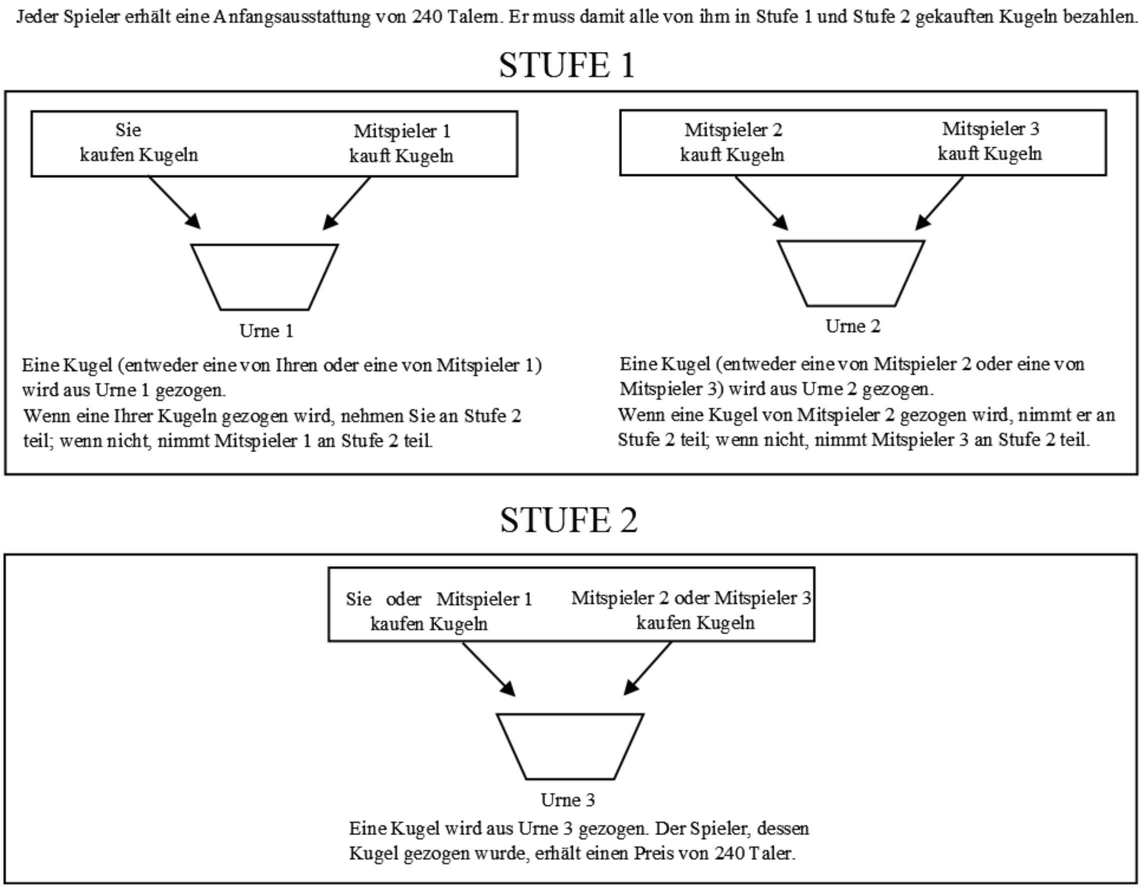
Let's take a closer look at the random draw of balls from ballot boxes. Assume, for example, that all balls which you bought are green colored, and that you interact with participant A in stage 1. Then, the probability that one of your balls is drawn (such that you make it to stage 2) satisfies

$$\textbf{probability}(\textbf{green ball is drawn}) = \frac{\textbf{\# green balls}}{\textbf{\# green balls} + \textbf{\# balls by participant A}}$$

where # is short for number. The same probability rule does also hold for other participants in your group. Consequently, the probability that one of your balls in drawn is higher

- the more balls you purchased
- the less balls the other participant with whom you interact purchased.

The random draw is simulated by the computer according to the procedures outlined above. If both participants of a pairing choose to buy zero balls, each participant wins with a probability of 50%.




**Your Payoff**
Assume that you bought "**X1**" balls in stage 1, and that you buy "**X2**" balls whenever you reach stage 2. Then, there are three possibilities for your payoff:

1) None of your balls is drawn in stage 1

$$\textbf{Your Payoff} = \textbf{endowment} - \textbf{X1} * \textbf{1 Taler}$$
$$= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler}$$

2) one of your balls is drawn from the ballot box in stage 1; in stage 2, none of your balls is drawn

$$\textbf{Your Payoff} = \textbf{endowment} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler}$$
$$= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler}$$

3) one of your balls is drawn from the ballot box in stage 1; also, one of your balls is drawn in stage 2

$$\textbf{Your Payoff} = \textbf{endowment} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{prize}$$
$$= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{240 Taler}$$

Therefore, your payoff is determined by the following components: by the number of balls you buy in stage 1 ("**X1**"); by the number of balls you buy in stage 2 ("**X2**") if you reach it; by up to two random draws (one of your balls is drawn/not drawn in stage 1 and potentially stage 2). The same holds for any other participants of the experiment.

**Information:**

- After you made your decision in stage 1, you are informed whether or not you can participate in stage 2, i.e. whether or not one of your balls was drawn from ballot box 1.
- If you did not reach stage 2, you are informed about how many balls participant A bought in stage 1.

- If you reach stage 2, you receive information about the remaining endowment (after costs for the purchase in stage 1 are deducted.
- After you made your decision in stage 2, you learn whether or not one of your balls was drawn from ballot box 3 and how many balls the participants who you met in stages 1 and 2, respectively, bought. Further, you learn your payoff for the respective decision round.

**Decision:** In each of the 30 decision rounds you have to decide how many balls you want to buy in stage 1. If you reach stage 2, you face a similar decision in stage 2. In both cases, you have to enter a number into a field on the computer screen. An example of the decision screen in stage 1 is shown below.


**Your Total Payoff:** Four out of 30 decision rounds are paid. These rounds are randomly determined, i.e., the probability that some decision round is paid is identical ex-ante for all 30 decision rounds. You will receive the sum of payoffs for the respective decision rounds.

**Remember:**
You receive an endowment of 240 Taler at the beginning of each decision round and have to decide how many balls you want to buy in stage 1; if you reach stage 2, you have to decide again. Overall, there are three additional participants in each group who face the same problem. The identity of these participants is randomly determined in each decision round. Every participant has to pay **1.00 Taler** for each ball he/she buys in stage 1 **or** stage 2.

If you have any questions, please raise your hand now!

## Experiment 1 [*MP Treatment*]

Overall, there are 30 decision rounds with two stages each in Experiment 1. The course of events is the same in each decision round. You will be randomly and anonymously placed into a group of **four participants** in each round, and the identity of participants in your group changes with each decision round.

### Course of events in an arbitrary decision round

All four participants of each group receive an **endowment of 240 Taler** at the beginning of a decision round. The endowment can be used to buy a certain amount of balls in two subsequent stages of a decision round. It is important to note that you receive one endowment only which must suffice to buy balls in both stages. The costs for the purchase of a ball are the same for all participants: Participants have to pay **1.00 Taler** for each ball they buy in stage 1 **or** stage 2, i.e.

**1 ball costs 1.00 Taler**
**2 balls cost 2.00 Taler**
**(and so on)**

When deciding how many balls you want to buy, you do not know the decision of other participants. Also, your decision is not revealed to any other participant.

All interactions in the experiment are pair-wise. Assume that you are in one group with participant A, participant B, and participant C. Then, you interact with participant A in stage 1, while participants B and C simultaneously meet each other in the second stage 1 interaction. If you reach stage 2, you will interact either with participant B or C, depending on the outcome in the second stage 1 interaction. In stage 1, there are two ballot boxes:

- all balls bought by you or participant A are placed in ballot box 1
- all balls bought by participants B and C are placed in ballot box 2

One ball is randomly drawn from each ballot box, and each ball drawn with the same probability. The two participants whose balls are drawn from ballot box 1 and 2, respectively, reach stage 2; the decision round is over for the other two participants (whose balls were not drawn), i.e. they drop out from this decision round. Any participant has to pay the balls he or she bought in stage 1, whether or not he/she reached stage 2. The respective amount is deducted from the endowment.

The two participants who reached stage 2 do again buy a certain number of balls, using whatever remains from the endowment they received after costs for balls in stage 1 were deducted. The balls are then placed into ballot box 3. One ball is randomly drawn from ballot box 3. The participant whose ball is drawn receives the main prize of **168 Taler**. The other participant of stage 2, whose ball is not drawn from ballot box 3, receives a runner-up prize of **72 Taler.** Independent of the prize which a stage 2 participant receives, he/she does always have to pay for the balls bought in stage 2. Participants who did not reach stage 2 do not receive any prize.

Let's take a closer look at the random draw of balls from ballot boxes. Assume, for example, that all balls which you bought are green colored, and that you interact with participant A in stage 1. Then, the probability that one of your balls is drawn (such that you make it to stage 2) satisfies

$$\textbf{probability}(\textbf{green ball is drawn}) = \frac{\textbf{\# green balls}}{\textbf{\# green balls} + \textbf{\# balls by participant A}}$$

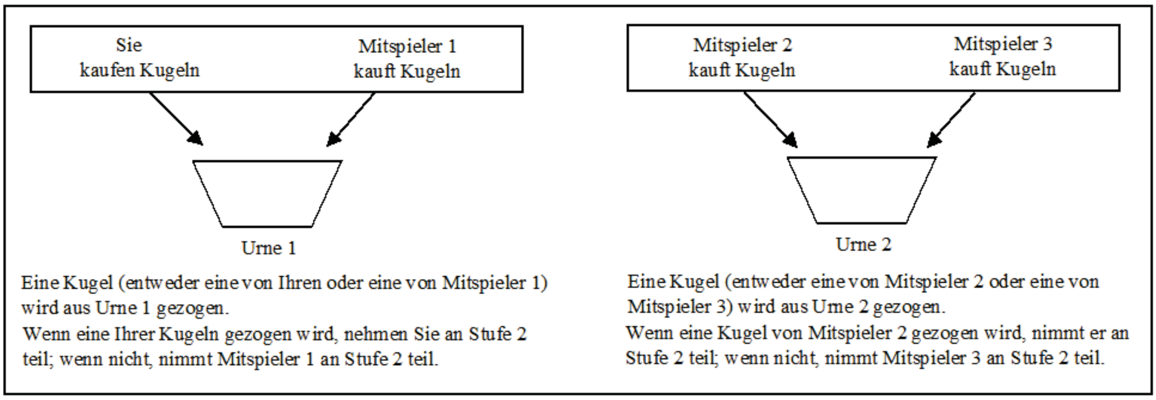
where # is short for number. The same probability rule does also hold for other participants in your group. Consequently, the probability that one of your balls in drawn is higher

- the more balls you purchased
- the less balls the other participant with whom you interact purchased.

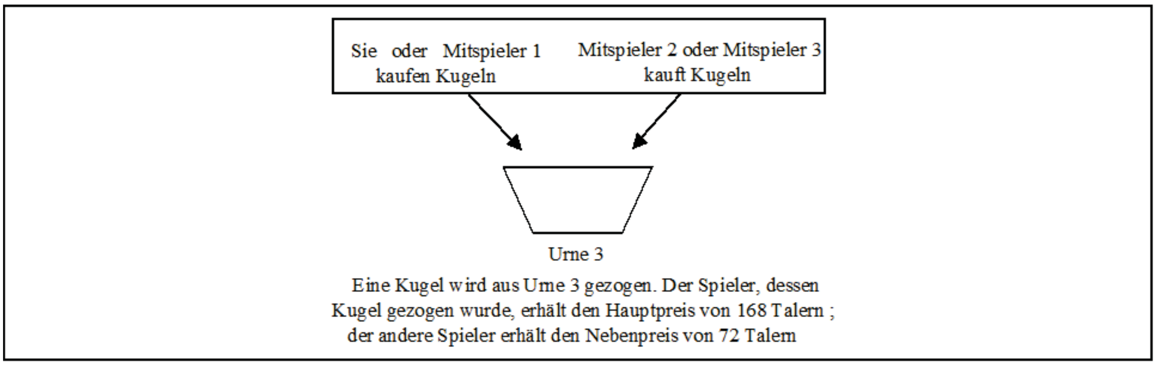
The random draw is simulated by the computer according to the procedures outlined above. If both participants of a pairing choose to buy zero balls, each participant wins with a probability of 50%.

Jeder Spieler erhält eine Anfangsausstattung von 240 Talern. Er muss damit alle von ihm in Stufe 1 und Stufe 2 gekauften Kugeln bezahlen.

## STUFE 1




## STUFE 2




### Your Payoff

Assume that you bought "**X1**" balls in stage 1, and that you buy "**X2**" balls whenever you reach stage 2. Then, there are three possibilities for your payoff:

1) None of your balls is drawn in stage 1

$$\begin{aligned}\textbf{Your Payoff} &= \textbf{endowment} - \textbf{X1} * \textbf{1 Taler}\\ &= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler}\end{aligned}$$

2) one of your balls is drawn from the ballot box in stage 1; in stage 2, none of your balls is drawn

$$\begin{aligned}\textbf{Your Payoff} &= \textbf{endowment} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{runner up prize}\\ &= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{72 Taler}\end{aligned}$$

3) one of your balls is drawn from the ballot box in stage 1; also, one of your balls is drawn in stage 2

$$\begin{aligned}\textbf{Your Payoff} &= \textbf{endowment} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{main prize}\\ &= \textbf{240 Taler} - \textbf{X1} * \textbf{1 Taler} - \textbf{X2} * \textbf{1 Taler} + \textbf{168 Taler}\end{aligned}$$

Therefore, your payoff is determined by the following components: by the number of balls you buy in stage 1 ("**X1**"); by the number of balls you buy in stage 2 ("**X2**") if you reach it; by up to two random draws (one of your balls is drawn/not drawn in stage 1 and potentially stage 2). The same holds for any other participants of the experiment.

**Information:**

- After you made your decision in stage 1, you are informed whether or not you can participate in stage 2, i.e. whether or not one of your balls was drawn from ballot box 1.
- If you did not reach stage 2, you are informed about how many balls participant A bought in stage 1.

- If you reach stage 2, you receive information about the remaining endowment (after costs for the purchase in stage 1 are deducted.
- After you made your decision in stage 2, you learn whether or not one of your balls was drawn from ballot box 3 and how many balls the participants who you met in stages 1 and 2, respectively, bought. Further, you learn your payoff for the respective decision round.

**Decision:** In each of the 30 decision rounds you have to decide how many balls you want to buy in stage 1. If you reach stage 2, you face a similar decision in stage 2. In both cases, you have to enter a number into a field on the computer screen. An example of the decision screen in stage 1 is shown below.


**Your Total Payoff:** Four out of 30 decision rounds are paid. These rounds are randomly determined, i.e., the probability that some decision round is paid is identical ex-ante for all 30 decision rounds. You will receive the sum of payoffs for the respective decision rounds.

**Remember:**
You receive an endowment of 240 Taler at the beginning of each decision round and have to decide how many balls you want to buy in stage 1; if you reach stage 2, you have to decide again. Overall, there are three additional participants in each group who face the same problem. The identity of these participants is randomly determined in each decision round. Every participant has to pay **1.00 Taler** for each ball he/she buys in stage 1 **or** stage 2. Two prizes are awarded: the main prize of 168 Taler for the participant whose ball is drawn in stage 2, and the runner-up prize of 72 Taler for the other participant of the stage 2 interaction.

If you have any questions, please raise your hand now!

## Experiment 2

In Experiment 2, you will face **21 decisions**. Each decision is a **choice between option 1 and option 2**. Each choice affects you own payoff, but not the payoff of any other participant of the experiment. When choosing option 1, your payoff is affected by chance, while option 2 implies a certain payment. You may be asked, for example, whether you prefer option 1, in which you receive either 400 Taler or 0 Taler with a 50% chance, or if you rather like option 2, which implies a sure payoff of c Taler. In the experiment, you will have to choose the option you prefer. This decision problem would be presented to you as follows:

| **Option 1** | **Option 2** | Your Choice |
|---|---|---|
| with 50% probability **400 Taler**<br>with 50% probability **0 Taler** | with certainty ***c*** **Taler** | Option 1 ◯ ◯ Option 2 |

As previously mentioned, you will encounter 21 decision problems of this kind. Your payoff from Experiment 2 is determined as follows:
At the end of all experiments, one of the 21 decision problems will be randomly chosen for each experimental participant. The option you chose in this decision problem determines your payoff. Assume, for example, that the previous example is chosen for you, and that you preferred option 1 over option 2. Then, you would receive 400 Taler or 0 Taler, each with a probability of 50%. Whether you receive 400 Taler or 0 Taler is determined by a simulated random draw of the computer.