Does a Short-Term Increase in Incentives Boost Performance?

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Does a short-term increase in incentives boost performance?

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Abstract

If agents are exposed to continual competitive pressure, how does a short-term variation of the severity of the competition affect agents' performance? In a real-effort laboratory experiment, we study a one-time increase in incentives in a sequence of equally incentivized contests. Our results suggest that a short-term increase in incentives induces a behavioral response but does not boost total performance.

Keywords:
contest, tournament, real-effort, experiment, contract theory, forward-looking

JEL classifications:
C91, D91, J22, J33, L2, M5

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1. Introduction

It is generally accepted in economic theory that competitive pressure improves agents' performance (see, e.g., Jenkins Jr et al., 1998, Dechenaux et al., 2015).[4] Thus, one way to improve performance in a dynamic competitive environment may be to vary the severity of competition over time. For example, it is a common recommendation for sales managers to use short-term contests in order to boost performance (Roberge, 2015).

However, whether and how a short-term increase in incentives will affect total performance is not obvious due to several countervailing effects. First, performance under continual competitive pressure may cause stress and fatigue.[5] If fatigue or stress play a role, higher effort in one period increases effort cost in the next period, leading to a decline in effort after times of high incentives. Second, the change in incentives over time may influence agents' attitudes. They may perceive periods with low incentives as less valuable due to the presence of periods with higher incentives. Therefore, effort in periods with low incentives may decrease in anticipation of periods with high incentives or after experiencing high incentives. In summary, it is not clear whether total effort will be higher under variable incentives than under uniform incentives.

The literature so far does not provide an answer to this question. There are a few empirical papers that study how incentives in competitive environments affect behavior over time. However, they focus either on forward-looking behavior (e.g., Lackner et al., 2015, Maria Raya, 2015) or on ex-post effort choice after periods of high incentives (e.g., McGee and McGee, 2013, Johnson and Salmon, 2016).

We study experimentally the effect of a short-term increase in incentives in a dynamic competitive environment, i.e., in a sequence of three two-player contests. We compare an incentive scheme where all contests feature "low" and uniform incentives over time with an incentive scheme where the pattern of uniform incentives is interrupted by a period of "high" incentives. The setting we investigate has two important features. First, the total amount of incentive pay, i.e., the sum of winner and loser prize in all contests and for all incentive schemes, is always the same. Second, in contrast to previous studies, we do not provide subjects with feedback about own earnings between contests. In this way, we focus on incentive effects only and control for feedback effects such as discouragement (see, e.g., Johnson and Salmon, 2016). Our results suggest that a one-time increase in incentives improves performance in the short run but does not lead to an increase in total performance. The latter finding is mainly driven by slacking after times of high incentives. This study adds to the growing literature on behavior in dynamic competitive environments, but also provides useful insights for practitioners who design compensation plans.

2. Experimental design

The computerized real-effort laboratory experiment was divided into two identical parts consisting of the same sequence of three contests. Subjects received instructions for part two only after part one was

[4] This assumes that agents do not exit the game by shirking or choking.

[5] The potential negative (and costly) consequences can be inefficient work outcomes (due to bad judgments and inferior decisions) and even sick-leave, burnout or an early exit from the work force (Kant et al., 2003).

completed. Part one was conducted to allow subjects to get acquainted with the task and the strategic environment. We paid for all contests and all parts and used a between-subjects design.[6]

In each contest, subjects worked for eight minutes on the real effort slider task developed by Gill and Prowse (2013). Subjects were supposed to move sliders from position 0 to position 50 (the middle of 100 possible integer positions) using the computer mouse only. Every two minutes a new screen with 48 sliders would appear to ensure that running out of work was impossible. At the end of each contest, subjects were randomly paired. The subject with the higher number of correctly positioned sliders received the winner prize and the other subject the loser prize.[7] If tied, subjects equally shared the sum of the winner and the loser prize. An on-screen count informed subjects about their own performance (i.e. the number of correctly positioned sliders) at any time. However, they were neither informed about the performance of others, nor whether they won or lost any of the contests.

Figure 1 gives an overview of the treatments and specifies winner and loser prizes as well as the number of subjects per treatment. Note that, due to the absence of feedback between contests, each subject yields an independent observation. 'RHOMB' and 'UNIFORM' refer to the shape of the prize structure within a treatment, and the number in RHOMB to the winner prize in the second contest. In the UNIFORM treatment, the three contests were identically incentivized, i.e., the prize spreads were the same in all contests.[8] Within and between the RHOMB-treatments, we varied the winner and the loser prize across contests to get different prize spreads, and thus different incentives while the total amount of incentive pay remained constant at 1400 ECU across contests and treatments.

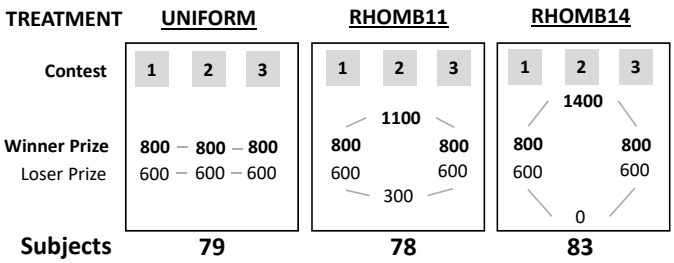

Figure 1: Treatments and number of subjects

3. Results

In our analysis, we measure performance as the number of correctly positioned sliders. For ease of comparison across treatments we also use a normalized measure of performance. The latter is the absolute difference between a subject's performance in each contest and that subject's performance in the last contest of part one.[9]

Figure 2 (left panel) plots the average normalized performance across contests and treatments. In part one, we observe a steady significant growth in performance within treatments and no significant

[6]For the instructions see the supplementary material.
[7]We also paid 1 ECU (= 0.005 EUR) per correctly positioned slider.
[8]The prize spread is the difference between the winner and the loser prize.
[9]This normalization accounts for individual differences in performance in part one, e.g., due to learning dynamics.

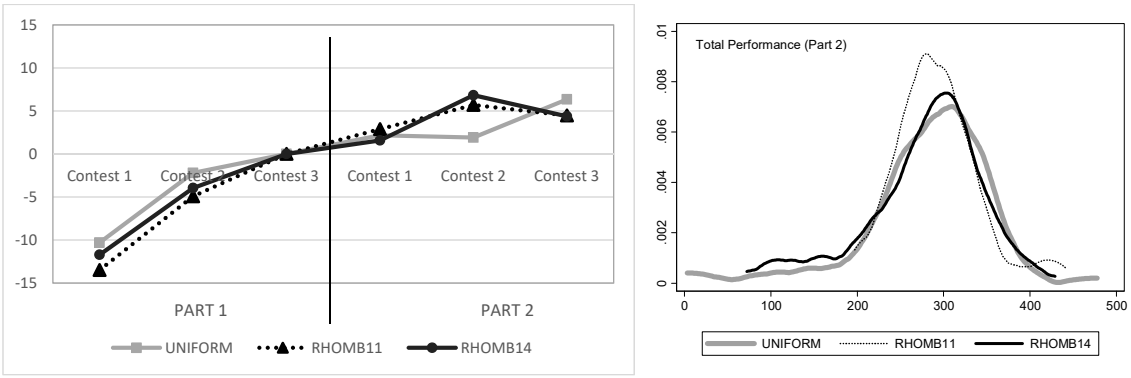

Figure 2: Average normalized performance by contest and treatment (left), distribution of total performance in part two by treatment (right)

differences in performance across treatments.[10] Subjects seem to predominantly learn in part one, and they do so at a similar pace in all treatments. Thus, they enter part two being similarly familiar with the task and presumably similarly exhausted.[11] The subsequent analysis will therefore focus on part two.

We first test whether the introduction of higher competitive pressure indeed leads to higher performance.[12] In part two, we observe a strong reaction to the increase in incentives. While performance is virtually the same in contests 1 and 2 in the UNIFORM treatment (see Figure 2, left panel), it is significantly higher in contest 2 (high incentives) than in contest 1 (low incentives) in both RHOMB–treatments (both $p \leq 0.004$, paired t-test).[13]

Having established that subjects respond to a change in incentives, we can now move to our key question: Does a short-term increase in incentives within a sequence of contests boost total performance?

Result: The one-time increase in incentives in a sequence of contests does not improve total performance.

OLS regressions of total performance and total normalized performance on treatment dummies for RHOMB11 and RHOMB14, using UNIFORM as a reference category (see Table 1) do not reveal any significant difference between the UNIFORM incentive scheme and both RHOMB treatments (with variable incentives). We also compare the distribution of total performance across treatments (see the right panel of Figure 2) using a two-sample Kolmogorov-Smirnov test. We cannot reject the null hypothesis of equality of distributions neither when comparing UNIFORM with RHOMB14 ($p = 0.822$), nor when comparing UNIFORM with RHOMB11 ($p = 0.532$). We also do not find any difference in average total performance between UNIFORM and both RHOMB–treatments when applying a Mann-Whitney-U test ($p = 0.9273$ for UNIFORM vs. RHOMB11, and $p = 0.6462$ for UNIFORM vs. RHOMB14). All these

[10] The pairwise comparisons across treatments for a given contest do not yield significant results. In contrast, the difference in performance between contest 1 (resp. 2) and 2 (resp. 3) within a treatment is significant for all treatments.

[11] A more detailed analysis of part one is provided in the supplementary material.

[12] The number of subjects in part two who chose not to compete is negligible: two in UNIFORM and two in RHOMB14. Results do not change if we exclude those subjects from the analysis.

[13] Throughout the paper we report two-sided tests.

	(1) Total performance	(2) Total normalized performance
RHOMB11	10.90	2.62
	(10.44)	(4.35)
RHOMB14	-3.521	2.35
	(10.28)	(4.28)
Constant	280.8***	10.43***
	(7.358)	(3.06)
Observations	240	240
R-squared	0.009	0.002
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 1: OLS regressions (part two)

tests suggest that the total performance is not significantly different between the two incentive schemes.

What can account for the absence of a boost in total performance? A closer look at changes in performance between the contests in part two provides an explanation (see Figure 2, left panel). The average change in performance from contests 2 to 3 in UNIFORM is positive in contrast to the RHOMB treatments where the average change is negative. Indeed, a difference-in-differences approach reveals significant effects between UNIFORM and RHOMB11 ($p = 0.007$, t-test), and between UNIFORM and RHOMB14 ($p = 0.013$, t-test). This suggests a tendency to slack after times of high incentives. There are two potential reasons for why this is the case. First, subjects in the RHOMB-treatments may be more tired than in UNIFORM and therefore *not able* to increase their performance in contest 3 as subjects in UNIFORM do. Second, subjects in the RHOMB treatments may *not be willing* to work hard when incentives drop because they may perceive working for the lower incentives in contest 3 as less attractive after experiencing a contest with higher powered incentives. We plan to disentangle the two effects in future research.

Another interesting question is whether subjects strategically anticipate a change in incentives. The average normalized performance in contest 1 (part two) is not significantly different between UNIFORM and both RHOMB treatments (both $p \geq 0.5834$, t-test).[14] Therefore, we can neither confirm nor exclude forward-looking behavior.

4. Conclusions

In a real effort experiment, we study how a variation of the severity of competition over time affects agents' performance. We compare two incentive schemes where agents either participate in a sequence of identically incentivized contests (scenario UNIFORM) or the pattern of 'low' and uniform incentives is interrupted by a contest with 'high' incentives (scenario RHOMB). We find that introducing a contest

[14] OLS regression results confirm the results of all reported t-tests.

with a large prize spread boosts performance in that contest, but does not result in an increase in total performance.[15]

Most of this zero-net-effect result is explained by slacking after the contests with high incentives. Potential reasons for this drop in effort are stress, fatigue and/or a discounting in the perception of low incentives after times of high incentives. We can exclude discouragement effects as an explanation, as subjects did not receive feedback on winning and losing between contests. Furthermore, we do not find sufficient evidence for strategic resting or forward-looking behavior.

In summary, our results confirm the conventional belief that higher incentives lead to higher effort in the short run. But they also reveal the existence of countervailing behavioral effects (before and) after times of high incentives that should be considered when designing incentive schemes in dynamic competitive environments.

5. Acknowledgements

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References

Dechenaux, E., Kovenock, D., Sheremeta, R.M., 2015. A survey of experimental research on contests, all-pay auctions and tournaments. Experimental Economics 18, 609–669. doi:10.1007/s10683-014-9421-0.

Jenkins Jr, G.D., Mitra, A., Gupta, N., Shaw, J.D., 1998. Are financial incentives related to performance? a meta-analytic review of empirical research. Journal of Applied Psychology 83, 777. doi:10.1037/0021-9010.83.5.777.

Johnson, D., Salmon, T.C., 2016. Sabotage versus discouragement: Which dominates post promotion tournament behavior? Southern Economic Journal 82, 673–696. doi:10.1002/soej.12115.

Kant, I., Bültmann, U., Schröer, K., Beurskens, A., Van Amelsvoort, L., Swaen, G., 2003. An epidemiological approach to study fatigue in the working population: the maastricht cohort study. Occupational and Environmental Medicine 60, i32–i39. doi:10.1136/oem.60.suppl_1.i32.

Lackner, M., Stracke, R., Sunde, U., Winter-Ebmer, R., 2015. Are competitors forward looking in strategic interactions? evidence from the field. Discussion Paper .

[15] Goette and Huffmann (2006) also report a zero net effect on total performance in a dynamic environment although in a different setting. They measure performance of bicycle messengers who initially face a lower piece rate, which is then increased once and forever. Although messengers initially react to the piece rate increase, their performance drops in the course of the day, such that their total performance does not differ between the two piece rates.

Maria Raya, J., 2015. The effect of strategic resting in professional cycling: evidence from the tour de france and the vuelta a españa. European Sport Management Quarterly 15, 323–342. doi:10.1080/16184742.2015.1021825.

McGee, A., McGee, P., 2013. After the tournament: Outcomes and effort provision. Discussion Paper .

Roberge, M., 2015. The right way to use compensation. Harvard Business Review 93, 70–75.

Does a short-term increase in incentives boost performance? — Supplementary Material

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The supplementary material includes instructions and screenshots from the lab experiment, as well as additional information on the experimental data.

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1. Data

Table 1 contains the (rounded) average and total performance, and Table 2 the (rounded) average normalized performance. Figure 1 plots the average performance from Table 1. Table 3 provides the p-values for the pairwise comparison of performance between contests within treatments. Table 4 contains the p-values for the pairwise comparison of performance between treatments for each contest. Table 5 lists average changes in performance between a pair of consecutive contests, and Table 6 provides the p-values for the comparison of those changes across treatments. Note that, due to our definition of *normalized* performance, Tables 5 and 6 also apply to normalized performance.

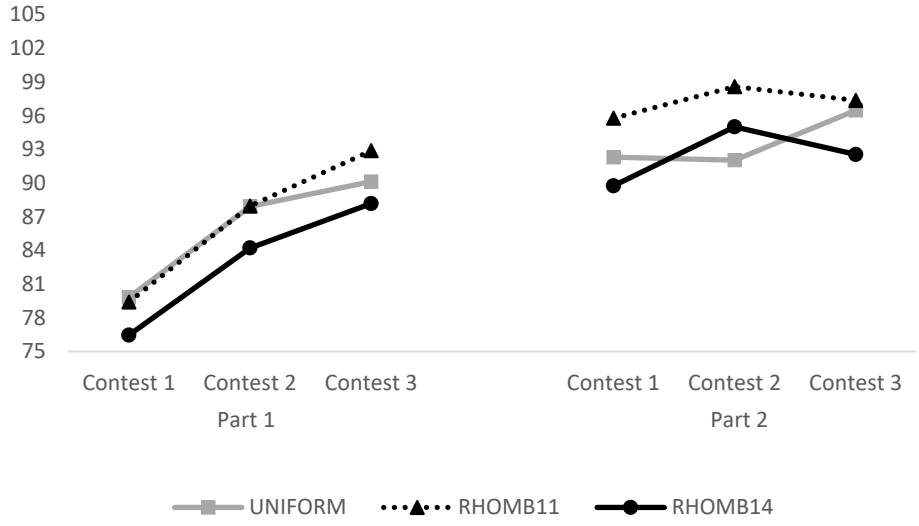

Figure 1: Average performance by contest, part, and treatment

	Part 1			Part 2			Total	
	Contest 1	Contest 2	Contest 3	Contest 1	Contest 2	Contest 3	Part 1	Part 2
UNIFORM	79.82	87.92	90.13	92.30	92.04	96.47	257.87	280.81
	(2.41)	(2.43)	(2.79)	(2.97)	(3.11)	(2.91)	(63.53)	(75.84)
RHOMB11	79.40	87.96	92.88	95.77	98.58	97.36	260.24	291.71
	(1.39)	(1.65)	(1.72)	(1.77)	(1.91)	(1.96)	(39.40)	(47.59)
RHOMB14	76.46	84.22	88.17	89.75	95.00	92.54	248.84	277.29
	(2.02)	(2.09)	(2.25)	(2.91)	(2.43)	(2.85)	(54.75)	(69.03)

Table 1: Average performance with standard deviations in parentheses

	Part 1			Part 2			Total	
	Contest 1	Contest 2	Contest 3	Contest 1	Contest 2	Contest 3	Part 1	Part 2
UNIFORM	-10.30	-2.20	0.00	2.18	1.91	6.34	-12.51	10.43
	(17.01)	(13.95)	(0.00)	(8.63)	(16.19)	(10.83)	(29.29)	(26.78)
RHOMB11	-13.49	-4.92	0.00	2.88	5.69	4.47	-18.41	13.05
	(9.80)	(7.73)	(0.00)	(7.45)	(8.69)	(10.21)	(15.44)	(21.86)
RHOMB14	-11.71	-3.95	0.00	1.58	6.83	4.37	-15.66	12.78
	(13.12)	(11.07)	(0.00)	(14.50)	(10.87)	(16.88)	(22.63)	(31.51)

Table 2: Average normalized performance and standard deviations in parentheses

		UNIFORM	RHOMB11	RHOMB14
Part 1	Contest 1 vs. contest 2	0.0000	0.0000	0.0000
	Contest 2 vs. contest 3	0.1645	0.0000	0.0017
	Contest 1 vs. contest 3	0.0000	0.0000	0.0000
Part 2	Contest 1 vs. contest 2	0.8832	0.0015	0.0039
	Contest 2 vs. contest 3	0.0163	0.2336	0.2365
	Contest 1 vs. contest 3	0.0013	0.1344	0.0958

Table 3: P-values from a two-sided paired t-test, comparing performance within treatments

		UNIFORM vs. RHOMB11	UNIFORM vs. RHOMB14	RHOMB11 vs. RHOMB14
Part 1	Contest 1	0.8789	0.2844	0.2379
	Contest 2	0.9899	0.2473	0.1650
	Contest 3	0.4029	0.5843	0.1008
Part 2	Contest 1	0.3195	0.5394	0.0833
	Contest 2	0.0762	0.4521	0.2533
	Contest 3	0.8003	0.3364	0.1711

Table 4: P-values from a two-sided unpaired t-test, comparing performance across treatments in a given contest

	Part 1			Part 2	
	Δ_{12}	Δ_{23}	Δ_{31}	Δ_{12}	Δ_{23}
UNIFORM	8.10	2.20	2.18	-0.27	4.43
	(10.13)	(13.95)	(8.63)	(16.02)	(16.04)
RHOMB11	8.56	4.92	2.88	2.81	-1.22
	(8.41)	(7.73)	(7.45)	(7.54)	(8.96)
RHOMB14	7.76	3.95	1.58	5.25	-2.46
	(8.53)	(11.07)	(14.50)	(16.09)	(18.78)

Table 5: Δ_{ij} is the average difference between (normalized) performance in contest j and contest i, the standard deviations are in parentheses (Δ_{31} refers to the change between contest 1 of part 2 and contest 3 of part 1)

	Part 1			Part 2	
	Δ_{12}	Δ_{23}	Δ_{31}	Δ_{12}	Δ_{23}
UNIFORM vs. RHOMB11	0.7561	0.1333	0.5834	0.1270	0.0073
UNIFORM vs. RHOMB14	0.8161	0.3769	0.7514	0.0302	0.0133
RHOMB11 vs. RHOMB14	0.5479	0.5220	0.4775	0.2236	0.5974

Table 6: P-values from two-sided t-tests comparing changes in (normalized) performance across treatments

2. Instructions from the Lab Experiment

The instructions below have been translated from German. The complete original versions are available from the authors upon request. The instructions differ between treatments only in the prizes in contest 2. These differences are shown in the third column of Table 7 below.

2.1. General Instructions

PLEASE TAKE THIS SHEET WITH YOU AFTER THE EXPERIMENT! WITHOUT IT, YOU WILL NOT RECEIVE YOUR PAYMENT!

General information

This experiment consists of 2 parts. At the beginning of each part, you will receive detailed instructions. On the other sheet on your table, you will find the instructions for Part I. The instructions for Part II will appear on your screen later on.
The 2 parts of the experiment are independent of each other; decisions in one part have no effect on your earnings in the other part. Your earnings from both parts will be paid to you in cash. You can get your money either on the ... from ... to ... or on the ... from ... to ... in room ... in return for this sheet. If you are unable to attend at these dates, please contact ... by the ... at the latest to make a different appointment. For administrative reasons a bank transfer is not possible.
All information is given in an experimental currency, the ECU (Experimental Currency Unit). The exchange rate is: 100 ECU = 0.5 Euro (= 50 cents).
We will ask you to complete a short questionnaire at the end of the experiment.
Attention: You are not allowed to use the keyboard in this experiment! You can only work with the mouse. All mice are set to be equally fast.

2.2. Instructions for Part 1

INSTRUCTIONS
PART I

These instructions are the same for all participants. Please read them carefully. If there is anything you do not understand, please raise your hand. We will answer your questions privately. You will make your decisions on the computer. All decisions will remain anonymous.
Part I consists of **3** periods. In each period, you can earn money by moving sliders to a certain position using the mouse. The slider can be moved to any position from 0 to 100. You will get **1 point** for each slider which you move **exactly to position 50 (center)**. For each point that you earn, you will be paid 1 ECU. In addition, you can earn extra money. After each period, the points you earned will be compared to the points of a randomly selected other participant in that period. This comparison will lead to the following payments:

Table 7:

	Period 1	Period 2	Period 3
The participant with the **larger** number of points will get an additional	800 ECU	[UNIFORM] 800 ECU **[RHOMB11] 1100 ECU** **[RHOMB14] 1400 ECU**	800 ECU
The participant with the **smaller** number of points will get an additional	600 ECU	[UNIFORM] 600 ECU **[RHOMB11] 300 ECU** **[RHOMB14] 0 ECU**	600 ECU

A participant with 0 points in a period will get 0 ECU regardless of the number of points the other participant earned. If both participants have the same number of points in a period, each of them will receive 700 ECU. The same two participants will be compared to one another not more than once during the experiment.
You can see your current number of points at any time during a period on your screen. At the end of each period, you will be informed about the number of points that you earned in this period.

slider, initial position

slider, position 50

Each period lasts 8 minutes. In order to provide you with sufficiently many tasks, you will get a new screen every 2 minutes. So there will be 4 screens per period.
Before starting the experiment, you can briefly familiarize yourself with the task. A shortened (1 screen) sample period will be shown. The result of this trial period will not be taken into account when calculating your payoff. The experiment will start only after you have correctly placed 5 sliders in this sample period, meaning that you have received 5 points. (Your number of points is displayed in the upper right corner of the screen.)

You can only start the trial period after having correctly answered the two questions below. As soon as you have written down the answers, please raise your hand, so that an experimenter can check your answers. If all answers are correct, the experimenter will ask you to start the experiment.

Summary of the experiment:

1. Answer questions and have them checked;
2. Trial period;
3. Part I of the experiment;
4. Read instructions for Part II on the screen;
5. Part II of the experiment.

Questions:

Question 1 Assume you have earned 200 points in period 1. Suppose the other participant with whom you are compared has earned 150 points in the same period. What is your payoff (in ECU) in period 1?

Question 2 Assume you have earned 200 points in period 2. Suppose the other participant has earned 350 points in the same period. What is your payoff in period 2?

2.3. Instructions for Part 2

Instructions for part 2 were given on screen after the end of part 1. They consisted of the following two sentences. "Part 1 will be conducted once more. There are no changes in the instructions."

3. Screenshot from the Lab Experiment

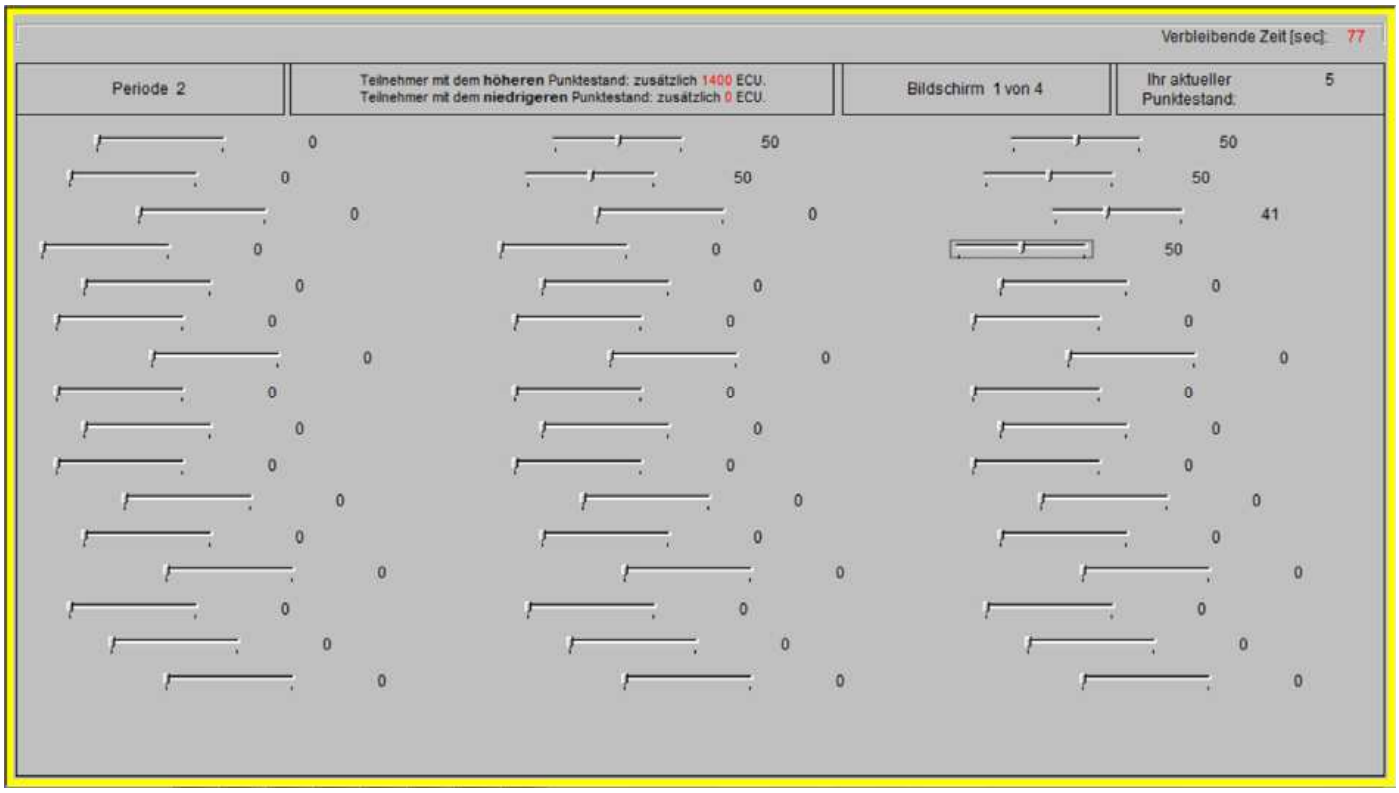

Figure 2: Screenshot from the lab experiment