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**A NOVEL COMPUTERIZED REAL EFFORT TASK BASED ON  
SLIDERS**

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# A Novel Computerized Real Effort Task Based on Sliders\*

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## Abstract

In this note, we present a novel computerized real effort task based on moving sliders across a screen which overcomes many of the drawbacks of existing real effort tasks. The task was first developed and used by us in Gill and Prowse (2009). We outline the design of our “slider task”, describe its advantages compared to existing real effort tasks and provide a statistical analysis of the behavior of subjects undertaking the task. We believe that the task will prove valuable to researchers in designing future real effort experiments.

**Keywords:** Real effort task, Slider task, Design of laboratory experiments, Learning and time effects, Individual heterogeneity.

**JEL Classification:** C90, C91.

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# 1 Introduction

Many experimental designs feature a costly activity. For example, subjects choose how much effort to exert when competing in a tournament (Bull et al., 1987), when producing output as part of a team (van Dijk et al., 2001), when responding to the wages set by an employer (Fehr et al., 1997) and when earning endowments which then form the starting point for a bargaining game (Burrows and Loomes, 1994).

There are two ways of implementing costly activities in a laboratory experiment: via a monetary cost function which mimics effort by specifying output as a function of how much money the subject contributes (Bull et al., 1987); and using a real effort task. The monetary cost function allows the experimenter full control over the cost of effort. In particular, the experimenter can control the extent of any convexity in the cost of the activity and can also determine how the cost varies over individuals and over any repetitions of the game. Increasingly, laboratory experiments have featured real effort tasks, such as (i) solving mazes (Gneezy et al., 2003), mathematical problems (Sutter and Weck-Hannemann, 2003) or word games (Burrows and Loomes, 1994); (ii) answering general knowledge questions (Hoffman et al., 1994); (iii) counting (Abeler et al., 2009), decoding (Chow, 1983) or entering (Dickinson, 1999) strings of characters; (iv) performing numerical optimization (van Dijk et al., 2001); and (v) filling envelopes (Konow, 2000), cracking walnuts (Fahr and Irlenbusch, 2000) or other physical tasks. The main advantage of using a real effort task over a monetary cost function is the greater external validity of the experiment, which increases with how closely exerting effort in the task replicates the exertion of effort outside of the laboratory.

In this note we present a novel and simple computerized real effort task which overcomes many of the drawbacks of existing real effort tasks. Our task, first developed and used by us in Gill and Prowse (2009), consists of a single screen containing a number “sliders” which subjects move to a specified position within an allotted time. We call this the “slider task”. Section 2 outlines the design of the task. Section 3 details the advantages of our slider task compared to existing real effort tasks. Section 4 provides a statistical analysis of the behavior of subjects undertaking our task. Section 5 concludes.

## 2 Design of the Slider Task

Our novel and simple real effort task consists of a single screen displaying a number of “sliders”. This screen does not vary across experimental subjects or across repetitions of the task. A schematic representation of a single slider is shown in Figure 1. When the screen containing the effort task is first displayed to the subject all of the sliders are positioned at 0, as shown for a single slider in Figure 1(a). By using the mouse, the subject can position each slider at any integer location between 0 and 100 inclusive. Each slider can be adjusted and readjusted an unlimited number of times and the current position of each slider is displayed to the right of the slider. The subject’s “points score” in the task, interpreted as effort exerted, is the number of sliders positioned at 50 at the end of the allotted time. Figure 1(b) shows a correctly positioned

slider. As the task proceeds, the screen displays the subject's current points score and the amount of time remaining.

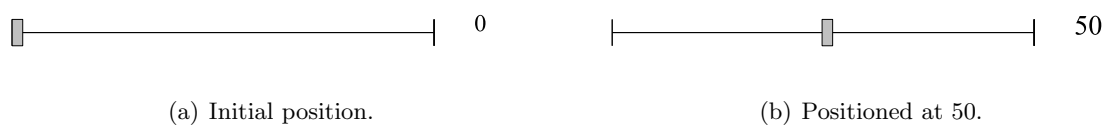


Figure 1: Schematic representation of a slider.

Figure 2 shows a screen containing 48 sliders, as shown to the subject in the laboratory.

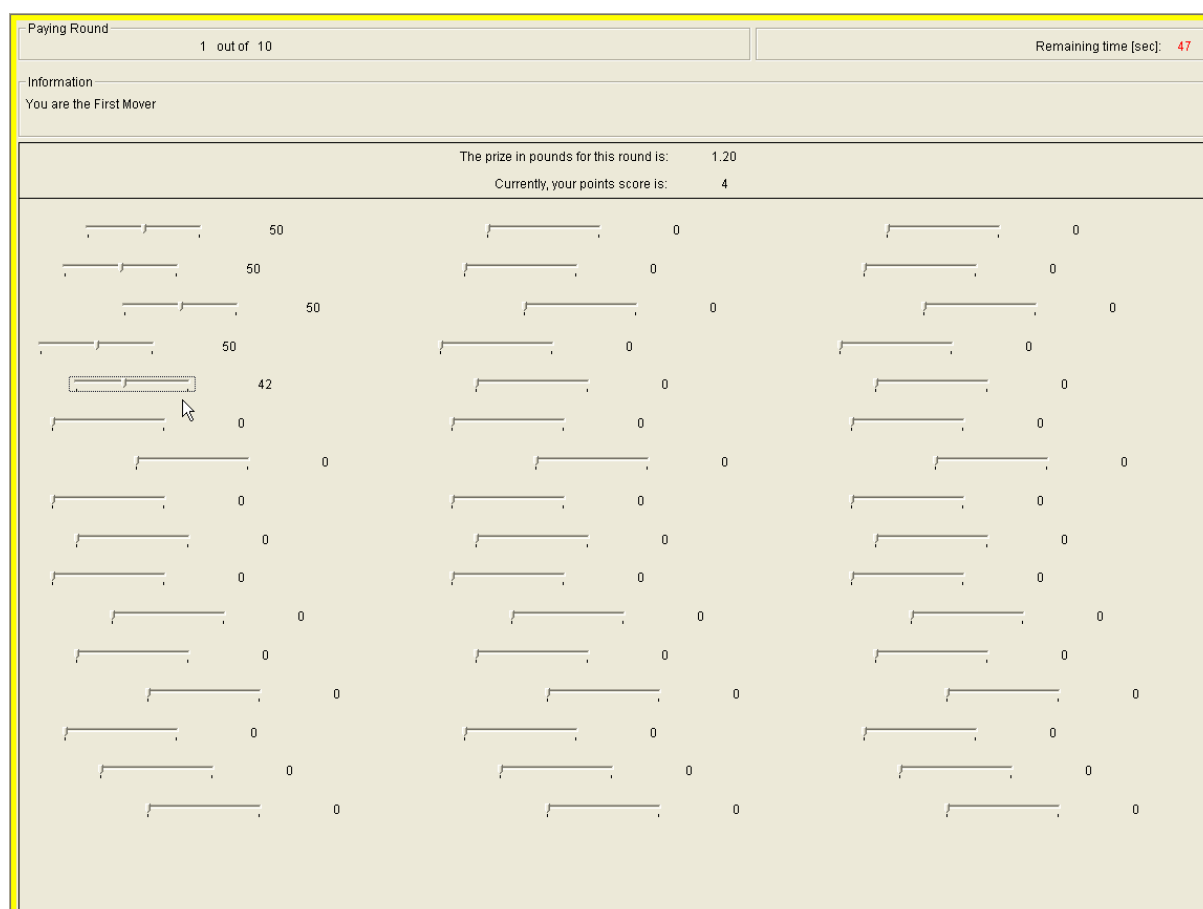


Figure 2: Screen showing 48 sliders.

In this example, the subject has positioned four of the sliders at 50 and a points score of 4 is shown at the top of the screen. A fifth slider is currently positioned at 42 and this slider does not contribute to the subject's points score as it is not correctly positioned. To ensure that all the sliders are equally difficult to position correctly, the 48 sliders are arranged on the screen such that no two sliders are aligned exactly one under the other. This prevents the subject being

able to position the higher slider at 50 and then easily position the lower slider by copying the position of the higher slider.

The number of sliders and task length can be chosen by the experimenter. With 48 sliders and an allotted time of 120 seconds, we believe it is impossible for any subject to position correctly all of the sliders (see Section 4). This ensures that the subject’s effort choice is not constrained by the design of the task, so there is no incentive to work hard for the purpose of being able to rest at the end of the task.

### 3 Advantages of the Slider Task

The slider task has a number of desirable attributes. First, the slider task is simple to communicate and to understand, and does not require or test pre-existing knowledge. Second, unlike solving mathematical problems, counting characters, solving anagrams, negotiating mazes or performing numerical optimization, the slider task is identical across repetitions. Third, the task involves little randomness, so the number of correctly positioned sliders corresponds closely to the effort exerted by the subject. Fourth, there is no scope for guessing, which complicates the design and interpretation of some existing tasks such as those based on counting characters or numerical optimization.

These attributes are also shared by the envelope filling task, in which subjects stuff real envelopes with letters. Crucially, however, the slider task allows a fine measure of effort within a short time scale. In Section 4 we see that with 48 sliders and an allotted time of 120 seconds, measured effort varies from 0 to over 40. Thus substantial variation in behavior can be observed, and by getting subjects to repeat the identical task many times the experimenter can control for persistent unobserved heterogeneity using panel data methods. This allows robust statistical inference. For example, the experimenter can use repeated observations of the same subjects to estimate a distribution of effort costs, enabling structural estimation. Thus the task’s design overcomes the principal drawback of using real effort up to now, namely that “Since the experimenter does not know the workers’ effort cost, it is not possible to derive precise quantitative predictions” (Falk and Fehr, 2003, p. 404). Furthermore, because the task is computerized, it is easy to implement and allows flexible real-time subject interactions.

### 4 Statistical Analysis of Behavior in the Slider Task

We used the slider task in 6 laboratory sessions conducted at the Nuffield Centre for Experimental Social Sciences in Oxford. Throughout, the slider task included 48 sliders (as shown in Figure 2) and the task length was 120 seconds. 20 subjects participated in each session.<sup>1</sup> At the beginning of every session half the subjects were told that they would be a “First Mover” and the other half told they would be a “Second Mover” for the duration of the session. At

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<sup>1</sup>All the sessions were conducted on weekdays at the same time of day. The subjects were students who did not report Psychology or Economics as their main subject of study. To move the sliders, the subjects used 800 dpi USB mice with the scroller disabled.

the beginning of each round, every First Mover was anonymously paired with a new Second Mover using the no contagion algorithm of Cooper et al. (1996). A prize for each pair was randomly chosen between £0.10 and £3.90 and revealed to the pair members. The First and Second Movers then completed the slider task sequentially, with the Second Mover discovering the points score of the First Mover she was paired with before starting the task. The prize was then awarded to one pair member based on the relative points scores of the two pair members and some element of chance.<sup>2</sup> In total we have data on 60 First Movers and 60 Second Movers, each observed during 10 rounds. For the purposes of analyzing behavior in the slider task, we look only at the behavior of the First Movers.<sup>3</sup>

Table 1 summarizes the observed efforts of the First Movers in each of the 10 rounds.

Round	Obs.	Whole sample				Men	Women
		Mean	Median	Minimum	Maximum	Mean	Mean
		Effort	Effort	Effort	Effort	Effort	Effort
1	60	22.20 (6.07)	23	1	33	22.48 (6.00)	21.93 (6.23)
2	60	22.68 (6.66)	23.5	0	33	21.55 (6.13)	23.74 (7.05)
3	60	24.80 (6.03)	25.5	0	37	26.20 (6.75)	23.48 (5.02)
4	60	24.61 (5.90)	25	0	35	23.41 (6.81)	25.74 (4.74)
5	60	25.18 (6.94)	26	0	38	26.27 (5.06)	24.16 (8.29)
6	60	24.66 (7.45)	26	1	37	24.41 (7.02)	24.90 (7.95)
7	60	25.91 (5.81)	26	9	37	25.86 (5.87)	25.96 (5.84)
8	60	26.88 (5.82)	27	9	41	26.82 (5.31)	26.93 (6.35)
9	60	25.65 (8.48)	28	0	38	25.75 (10.2)	25.54 (6.56)
10	60	26.31 (6.72)	27	1	40	25.75 (6.97)	26.83 (6.54)

Table 1: Summary of First Movers' efforts by round.

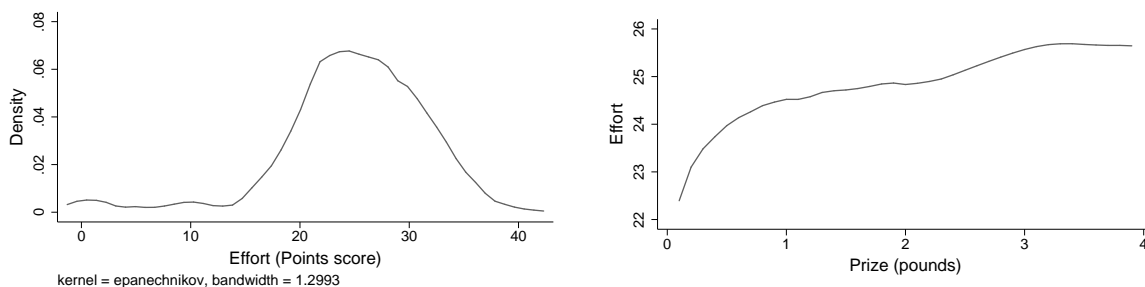
We see that the mean points score tended to increase over the 10 rounds, from an average of 22.2 sliders in the first round to 26.3 sliders in the final round. Given the average prize was constant over rounds, this increase in effort is interpreted as a learning effect. There are no clear differences between the efforts of men and women (a formal test of gender effects is presented below). The maximum observed effort was 41 and therefore it appears that no subject was able

<sup>2</sup>The probability of winning the prize for each pair member was 50 plus her own points score minus the other pair member's score, all divided by 100. In addition to any prizes accumulated during the experiment, all subjects were paid a show-up fee of £4. The subjects also initially played 2 practice rounds against an automaton for which they were not paid. We do not include the practice rounds in the data analysis.

<sup>3</sup>Gill and Prowse (2009) analyzes interactions between the efforts of the First and Second Movers.

to position correctly all 48 sliders in 120 seconds. We conclude that efforts were not constrained by the upper limit imposed by the design of the task. There are 7 observations of 0s. Of these, 5 correspond to two subjects who appear to have had difficulty positioning sliders at exactly 50 until a few rounds into the session. The remaining two observations of 0 correspond to a further two subjects who chose to exert no effort towards the end of their session in response to low prizes of £0.10 and £0.30.

Figure 3(a) shows the distribution of points scores. We see a substantial amount of variation in behavior. Specifically, a small cluster of subjects have zero or very low efforts, two-thirds of efforts lie between 20 and 30 inclusive, while around 20% of efforts exceed 30. Thus, despite subjects having only 120 seconds to complete the slider task, we see large differences in observed efforts. Figure 3(b) shows the results of a Lowess regression of the First Movers' efforts on the prize. We see that effort is increasing in the prize, particularly at low prizes. This provides evidence that subjects respond to financial incentives when completing the slider task.



(a) Distribution of efforts.

(b) Response of effort to the prize.

Figure 3: Graphic analysis of First Movers' efforts.

Table 2 presents the results of a sequence of fixed effects regressions of First Movers' efforts on the prize, subject gender and round number. In Model (1) the First Movers' efforts were regressed on a linear time trend. Time effects are significantly positive. In Model (2) a full set of time dummies is included. The F statistic for the null hypothesis that the time trend is linear is 3.17 which corresponds to a p value of 0.0048. Thus time effects are non-linear. However, we are unable to reject linearity of the time effects starting from round 4: the F statistic for the null hypothesis that the time trend is linear from round 4 onwards is 1.61 with a p value of 0.1595. In model (3) the prize is included as an additional control. We see that the First Movers' efforts increase significantly in the prize, with a £1 increase in the prize causing an increase in effort of 0.7 of a slider.<sup>4</sup> Models (4) and (5) show that there are no significant differences in the

<sup>4</sup>An additional regression, not reported, shows that there is no evidence of the square of the prize being a significant determinant of effort. Thus effort appears to be linear in the prize.

behavior of male and female subjects, either in terms of the level of effort or in the response to the prize. In all the models, persistent unobserved individual effects account for about 75% of the unobserved variation in performance.

	(1)	(2)	(3)	(4)	(5)
Prize	-	-	0.671*** (0.157)	0.667*** (0.155)	0.655*** (0.265)
Male	-	-	-	0.228 (0.286)	0.180 (0.832)
Male×Prize	-	-	-	-	0.024 (0.344)
Round number	0.434*** (0.084)	-	-	-	-
Round 2	-	0.483 (0.557)	0.404 (0.540)	0.404 (0.539)	0.403 (0.538)
Round 3	-	2.600*** (0.545)	2.498*** (0.565)	2.499*** (0.568)	2.495*** (0.565)
Round 4	-	2.417*** (0.562)	2.286*** (0.567)	2.287*** (0.568)	2.284*** (0.561)
Round 5	-	2.983*** (0.694)	2.823*** (0.682)	2.824*** (0.683)	2.822*** (0.685)
Round 6	-	2.467*** (0.797)	2.481*** (0.766)	2.481*** (0.767)	2.483*** (0.772)
Round 7	-	3.717*** (0.540)	3.694*** (0.516)	3.694*** (0.517)	3.691*** (0.510)
Round 8	-	4.683*** (0.686)	4.676*** (0.682)	4.676*** (0.685)	4.674*** (0.681)
Round 9	-	3.450*** (1.079)	3.482*** (1.044)	3.482*** (1.043)	3.481*** (1.044)
Round 10	-	4.117*** (0.754)	4.355*** (0.767)	4.354*** (0.767)	4.353*** (0.768)
Intercept	21.630*** (0.627)	22.200*** (0.466)	20.894*** (0.508)	20.783*** (0.514)	20.808*** (0.666)
$\sigma_\alpha$	5.494	5.494	5.491	5.493	5.493
$\sigma_\epsilon$	3.971	3.938	3.873	3.874	3.878
Observations	600	600	600	600	600
Subjects	60	60	60	60	60

Notes:  $\sigma_\alpha$  denotes the standard deviation of the time invariant individual specific fixed effects and  $\sigma_\epsilon$  is the standard deviation of the time varying component of the individual level error terms. Significance at the 10%, 5% and 1% levels is denoted by \*, \*\* and \*\*\*.

Table 2: Fixed effects regressions for First Movers' efforts.

To summarize the analysis, we observe a considerable degree of heterogeneity in behavior, subjects respond positively to the value of the prize, efforts tend to increase over time and there is no variation in behavior by gender.



## 5 Conclusion

In this note we have described a computerized real effort task designed to overcome some of the drawbacks of existing real effort tasks. In particular, our slider task provides a fine measure of output and can be repeated many times in an experimental session. This allows the experimenter to control for persistent unobserved heterogeneity, allowing robust statistical inference. We believe that the slider task is a valuable addition to the stock of existing tasks which will prove useful to researchers designing future real effort experiments.

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