Essays in Motivation

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To my friends,
my father and my wife.
In memory of my mother.

Essays in Motivation

by

Samuel Francis Terry Smithers

Abstract

This thesis consists of three self-contained papers developing the idea of goal setting, an intrinsic motivator, as an alternative motivator to monetary incentives. A non-binding goal is a specific, challenging target with which there are no monetary rewards or punishments associated with success or failure.

Chapter 2 focuses on studying the basis of goal setting, developing an experiment to test the effectiveness that assigning non-binding goals have on effort on a real effort task. It shows that setting a goal has a significant impact upon effort and that it is the result of both an increase in speed and accuracy.

Chapter 3 develops the first chapter further into a dynamic setting, focusing on comparing whether personalised goals are more effective than uniform goals. I find that personalised goals lead to a significantly higher number of attempts than a uniform goal level, however these extra attempts are not converted into statistically higher number of correct answers over the uniform goals group. Thus, if production is costly, a uniform goal level is more appropriate as a personalised goal would lead to higher average production costs.

Chapter 4 examines the effect of setting both assigned and personal (self-set) non-binding goals on a real effort task. Developing a simple model with goal-dependent preferences, we derive a set of conjectures for our experiment. In line with previous studies, we find that goal setting leads to a higher average level of effort. However, we also find that previously assigned goals affect agents' goal commitment, affecting future performance. We also observe that those with only personal goals perform worse on average than a control group with no goals. This suggests that there maybe a form of crowding-out of effort on the task when under personal goals versus no goals at all.

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Declaration

Chapter 2 is a sole authored piece published in Economics Letters under the title "Goals, Motivation and Gender", in June 2015. The version presented in this thesis is the preprint version submitted for publication. A previous working paper version can be found online under the same title.

This paper also received media coverage, including:

- Over 30 internet articles including the Telegraph, Men's Fitness, the Daily Mail and The Deccan Chronicle (a leading South Indian newspaper).
- An article in the Leicester Mercury newspaper.
- An interview to discuss my paper live on BBC Radio Leicester.

I have been invited to discuss my work and the future of goal setting research at a meeting of the 'Goal setting theory network' at the School of Business and Economics, Loughborough University.

Chapter 3 is a sole authored paper, which can be found online under the working title of "Does one Goal fit all? Homogeneous versus Heterogeneous Goals".

Chapter 4 is joint work with Dr. Joaquín Gómez-Miñambres (Bucknell University) and James Fan (Pennsylvania State University).

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Chapter 1

Introduction

Traditionally in labour economics, monetary incentives are considered as a dependable and predictable method of motivating people. However, research over the last decade has given evidence that monetary incentives can 'crowd-out' motivation (Gneezy and Rustichini, 2000; Ariely et al., 2009; Gneezy et al., 2011). Given this, the focus of this thesis is to examine an alternative motivator to monetary incentives, with the desire of reproducing the performance enhancing effects but without the crowding-out of effort. This thesis consists of three self-contained papers studying the effects of setting non-binding goals on production. A non-binding goal is a specific, challenging target with which there are no monetary rewards or punishments associated with success or failure. Goals invoke intrinsic motivation, an internal drive to want to perform for the inherent satisfaction or pleasure of the task at hand (Frey and Jegen, 2001; Gneezy et al., 2011). This is opposed to extrinsic motivators which play on human tendencies to perform activities for external rewards, namely monetary incentives.

The economics literature on goal-setting is very young. It has sought to build upon the work of psychologists (Latham and Locke, 1991) who argue that goals enhance workers' motivation and performance. The experimental literature in economics has focused mainly on showing the positive effect of assigned goals on workers' production (Heath et al., 1999; Smithers, 2015; Corgnet et al., 2015) and how increasing the monetary incentives enhance the effectiveness of assigned goals (Corgnet et al., 2015). Theoretical results have shown how a principal can utilise goal setting to increase an agents motivation to work, consequently increasing the performance of the agent at a reduced cost to the principal (Gómez-Miñambres, 2012). Other theoretical papers have demonstrated how personal goals can alleviate or mitigate the effects of self-control bias (Hsiaw, 2013; Koch and Nafziger, 2011).

The three essays presented in this thesis were written alongside the development of this recent literature. Chapter 2 designs an experiment to test the effectiveness

that assigning non-binding goals have on effort. First, I find that the mean effort under the high and low goals are 35% and 20% higher than in the control group. I observe that this is due to an increase in both the speed and accuracy of subjects. Second, contrary to results found in psychology, I find an indicative result that women perform better than men in the no goal setting but men thrive in both of the goal treatments. The results suggest that men are more responsive to goal than women.

Extending this experimental environment into a dynamic setting, chapter 3 compares whether goals tailored to individuals are more effective than a 'one goal fits all' approach. Consistent with previous studies I find that goals lead to a higher average level of output. This is true for all rounds under both goal schemes. Interestingly, I find that personalised goals lead to a significantly higher number of attempts than a uniform goal level, however these extra attempts are not converted into a statistically higher number of correct answers over the uniform goal group. Thus, if production is costly, a uniform goal level is more appropriate as a personalised goal would lead to higher average production costs.

Both of these essays focus only on assigned goals albeit two different types. Chapter 4, a co-authored essay, examines the effect of setting personal (self-set) non-binding goals and the interaction with assigned goals on a real effort task. Developing a simple model with goal-dependent preferences, we derive a set of conjectures for our experiment. In line with previous studies, we find that goal setting leads to a higher average level of effort. We also find that previously assigned goals affect agents' goal commitment, affecting future performance. However, we find novel results in that those who faced only personal goals, on average, performed worse than those who had no goal. This suggest that a form of motivation crowding-out can occur in this environment.

Chapter 2

Goals, motivation and gender

2.1 Introduction

A non-binding goal is a specific, challenging target with which there are no monetary rewards or punishments associated with success or failure. Such a goal should have no impact in an environment in which only final wealth levels matter, and only monetary rewards or punishments affect behaviour. However, I examine the effect of non-binding goals on effort using a timed addition task, similar to Niederle and Vesterlund (2007). I have three treatments: no goal, low goal and high goal in which I use the number of correct additions as a measure of effort. I find that goals promote speed and accuracy. Men are more responsive to goals than women.

The traditional view in labour economics is that monetary incentives consistently and predictably improve effort (Rebitzer and Taylor, 2011). Challenging this view, Ariely et al. (2009) find that paying people a lot leads to worse performance on mental tasks in the US and India. Gneezy and Rustichini (2000) find that low monetary incentives lead to worse performance than not paying at all.

I find that goal-setting, a motivational tool used by psychologists and managers, mostly overlooked by economists, can generate the desired positive effect of monetary incentives *without* the monetary cost. The motivation for this paper is Latham and Locke (1991)'s finding that setting a goal has some key properties: an increase in effort (energy put into the task), persistence (time spent on the task), attention (more focus on the task with the set goal and away from non-relevant activities) and it encourages the use and acquisition of knowledge.

The economics literature on these effects is sparse. There is work on how goals can help conquer self-control problems (Hsiaw, 2013; Koch and Nafziger, 2011) and on how individual personal standards affect the goal-effort relationship (Gómez-Miñambres, 2012), but the effect of goals has gone untested in economics.[1] I test

[1]Since writing, Corgnet et al. (2015) have forthcoming results looking at the interaction between goal levels and monetary incentives.

if goals increase effort, which would support the theory that intrinsic motivation is higher with goals. Heath et al. (1999) propose that goals can act as a reference point for evaluating performance. This *psychological utility* explains how a non-binding goal may have effects. Supporting this, Camerer et al. (1997) find that taxi drivers have a one-day time horizon and set themselves daily income targets (i.e. goals).

This paper contributes to the literature in two ways. First, I find that the mean effort under the high and low goals are 35% and 20% higher than in the control group. I also observe an increase in speed *and* accuracy by those with a goal. Second, contrary to the psychology literature, I find a gender difference such that women perform better than men in the no goal setting but men thrive in both of the goal treatments. The results suggest that men are more responsive to goal than women.

2.2 Experimental Design

Participants solve a real effort task under a standard piece rate setting. Following the task of Niederle and Vesterlund (2007), the participants face a simple addition task summing up sets of five two-digit, randomly drawn numbers over five minutes, where participants provide the solution by writing the sum in the empty box:

51	37	85	15	21	__

The task is selected as it is sufficiently cognitively demanding to require effort and focus to complete, but also it is a task which all participants have the skills to undertake.[2]

The number of correctly solved problems is interpreted as the effort exerted. Subjects receive 25p per correct answer on the addition task.

In each session participants were randomly assigned to either the control, low goal or high goal. The random assignment is given by a clear, extra line of instruction stating "For this task you have a goal to get 10 (15) correct additions".[3]

Participants also completed a small GMAT style test of five questions in five minutes just prior to the addition task. This task can be used to identify the underlying ability of the participants (Oswald et al., 2014). Participants were

[2]It was found to be a gender neutral task (Niederle and Vesterlund, 2007).
[3]15 was only achieved by the top 20% in the pilot and 10 was the mean.

rewarded 50p per correct answer and were informed of their results at the end of the experiment. The experiment concluded with a questionnaire asking for typical demographics including age, gender and education.

The subjects were informed that all information gathered will be kept anonymous and that it is key that they read everything that is presented to them carefully. The experiment had no show up fee as, owing to the experiments short duration, the show up fee would overpower the piece rate.

2.3 Results

The experiment was conducted at the University of Leicester UK, using subjects recruited from the student body. In total 109 participants took part, 36 in each of the control and goal-10 treatments and 37 in the goal-15 treatment. The experiment took 15 minutes and participants earned on average £4.50. Figure 2.1 summarises the main results.

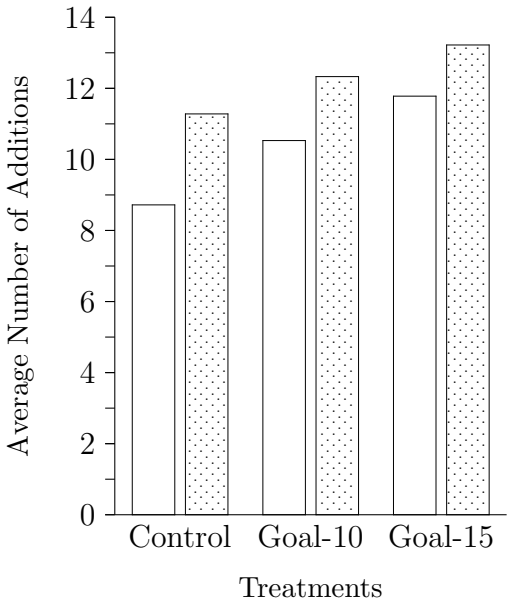


Figure 2.1: Addition task results by treatment (Correct □, Attempted ⊡)

The control, goal-10 and goal-15 treatments had mean scores (s.d.) of 8.72 (4.80), 10.53 (3.71) and 11.78 (5.24) respectively. On average, scores in the goal-10 treatment were 1.81 additions higher than the control group ($p = 0.079$).[4]

[4]In an effort to remain conservative all t-test p-values are for two-sided tests, even though the hypothesis, which suggests the sign of the effects, provides some justification for conducting one

Furthermore, scores in the goal-15 treatment were 3.06 additions higher than the control group ($p = 0.011$). However, the goal treatments were not significantly different ($p = 0.242$), suggesting that having a goal is more important than the specific value of the goal.

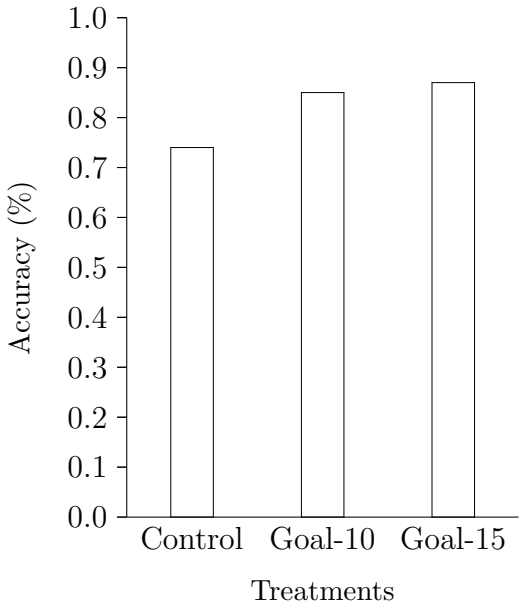


Figure 2.2: Average accuracy in addition task by treatment

Looking at the average number of questions attempted, the control group attempted 11.28 questions with the goal-10 group attempting 1.1 extra ($p = 0.285$), and the goal-15 group attempting 1.94 more ($p = 0.087$). These are 10% and 17% increases in speed over the control group.

The accuracy, calculated as the number of correct additions over the number of problems attempted, is illustrated in Figure 2.2. The mean accuracy is 74% for the control group, 85% for the goal-10 treatment and 87% for the goal-15 treatment. Both the goal-10 and the goal-15 treatments were significantly more accurate than the control group ($p = 0.015$ and $p = 0.002$). However there is no significant difference between the two goal treatments ($p = 0.458$), implying that those with a goal gave greater attention to the addition task than the control group.

Looking at the increase in scores, questions attempted and accuracy, the results imply that those in the goal treatments were exerting more effort, calculating answers quicker *and* more accurately. This suggests that effort, which is the product

sided-tests. Wilcoxon rank-sum tests give very similar results to all presented t-test p-values. Further robustness checks are performed controlling for maths skills (GMAT). The results of these checks are still robust.

of speed and accuracy, can be jointly enhanced at no extra monetary cost.

Group	Extra Additions	(£) Value
Goal-10	1.81	0.45
Goal-15	3.06	0.77

Table 2.1: Monetary Value of Goal Setting

Table 2.1 shows the monetary value of each goal, which can be calculated as the difference between the average score under the goal treatments and the control group multiplied by the value of output (25p). Over a five minute interval this is a significant increase. Over an hour, assuming that effort level could be sustained, the value of setting a high goal over no goal would be worth £9.24 per person.

Latham and Locke (1991) mention that there is "little evidence that [...] gender [...] moderate[s] the goal-performance relationship". Yet men appear to embrace the challenge of a goal more than women. One reason could be that the goal creates a competitive environment, which is consistent with the literature on how competition affects men and women differently (Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007).

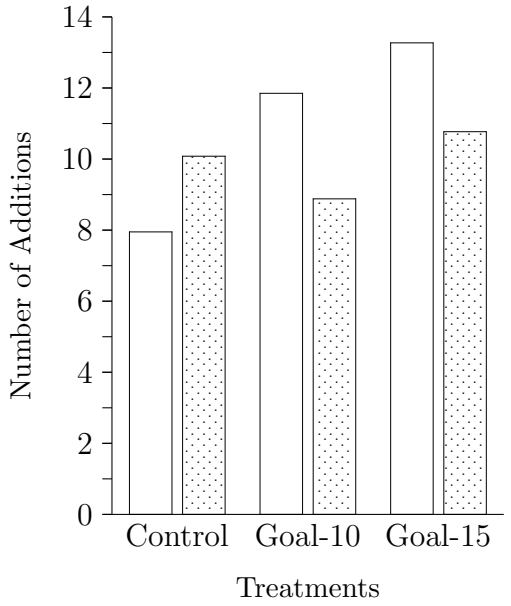


Figure 2.3: Effort across treatments by gender (Male □, Female ⊡)

There was no significant difference in the overall mean score for men (10.67; s.d.=5.19 and women (10.00; s.d.=4.24) ($p = 0.464$). However, comparing the

differences across treatments, as shown in Figure 2.3, the addition score of women on average remains relatively unaffected when introducing a goal, whereas men thrived under the goal.[5] Men in the goal-10 treatment scored on average 3.89 additions more than men in the control group ($p = 0.004$) and for the goal-15 treatment, on average 5.31 additions more ($p = 0.006$). The men's score was significantly different from the women's for the goal-10 treatment ($p = 0.014$) but the goal-15 ($p = 0.158$) treatment just falls short of statistical significance using a two-sided test.

2.4 Conclusion

This paper addresses the topic of exogenously given non-binding goals in a real performance task. I find that setting a goal induces higher effort. I show that this effect is driven by an increase in both speed and accuracy. Further research is needed to test the link between the level of incentives and the responsiveness to goals. Furthermore, a greater variance in the goal level needs to be examined to get a full picture of how people respond to goals.

This paper echoes results found by Locke and Latham (1990) on the effects of goals on effort in psychology. This paper is the first, though, to identify a gender difference: male participants thrived when presented with a non-binding goal, whereas female participants were unaffected. This result resonates with findings on gender differences in preferences (Croson and Gneezy, 2009) - in particular in the context of competition (Gneezy and Rustichini, 2004; Migheli, 2015; Niederle and Vesterlund, 2007). Future research should try to disentangle how much utility is derived from both the psychological effect of reaching a goal and the competition component (Guryan et al., 2009).

[5]For women's performance, goal-10 ($p = 0.444$), goal-15 ($p = 0.654$) are not significantly different from the control group.

Chapter 3

Can one goal be fit for all?

3.1 Introduction

Monetary rewards are at the heart of our society, from remunerating employee's to rewarding good behaviour in children. However, over the last decade research has shown that monetary incentives can have undesired and crowding out effect on motivation. For example Ariely et al. (2009) find that relatively high level incentives caused a worse performance on mental tasks for participants in the US and India. At the other end, Gneezy and Rustichini (2000) find that paying people a relatively low level incentive lead to a worse performance than not paying at all.

In this paper I abstract away from differing the level of monetary incentive and instead study the motivational effects of setting productivity goals on a real effort task in a experimental setting. Specifically, I set non-binding goals, a specific, challenging target with which there are no monetary rewards or punishments associated with the success or failure of meeting this target. The idea behind such a tool is to increase the intrinsic motivation for wanting to do well on a task. A goal in this sense gives a bar to pass, a line to focus on, which in turn should increase the effort put into the task through an increased motivation to meet this target.

Latham and Locke (1991), psychologists, who find that setting a goal has some key properties: an increase in effort; persistence, longer time spent on the task; attention, more focus on the task with the set goal and away from non-relevant activities; and it encourages the use and acquisition of knowledge. Following this, Heath et al. (1999) propose that goals can act as a reference point for evaluating performance in a Prospect Theory type framework. This psychological utility derived from the desire to work harder to avoid being in the domain of losses may explain how a non-binding goal can have an effect on effort.

Supporting this idea is a study by (Camerer et al., 1997) who were studying the labour supply of New York city taxi drivers. Their study concludes that drivers use a narrow frame of reference that amounts to dealing with each day as it comes

rather than intertemporal substitution of labour and leisure. More specifically they speculate that drivers may "set a loose daily income target and quit working once they reach that target". A goal would explain the behaviour as people would work (persist) to avoid being in the domain of losses.

The economics literature on goal setting is still in its infancy. The first group of papers were theory based focusing on dealing with self-control issues (Hsiaw, 2013; Koch and Nafziger, 2011). The focus is on the effect of setting yourself a non-binding goal to combat present bias behaviour. They find that self-set goals can temper this bias, as long as it is not too severe. However in this paper, I leave aside self-set goals in favour of focusing on exogenously assigned goals. Gómez-Miñambres (2012) looks at how personal standards, one's own level of acceptance, affect the goal-effort relationship through intrinsic motivation. They find that an agents' effort, and the level of goal set by a principal increases with an agents' personal standards. Furthermore, an agent with mid-ranged standards could end up being the most satisfied.

A second group of papers investigated the effect of goal-setting experimentally. Smithers (2015) analyses the raw effect of setting a non-binding goal upon effort upon a five minute real effort task. Setting a medium level and a high level goal to two separate groups, the author finds that setting a goal leads to an increase effort over and above a control group. This effect is found to be driven by both an increase in both speed and accuracy when on the task. Corgnet et al. (2015) studies the interaction of monetary incentives and goal levels. Here I abstract away from these concerns by keeping the piece rate the same across the experiment.

In this paper I look to further study the effect of setting non-binding goals on effort in a real effort task setting. Specifically I will build upon the work of Smithers (2015) by expanding upon the experimental environment used there. First, I look to support the findings of previous work on goal-setting by finding a significant effect of setting goals on effort. Moving beyond the current literature, subjects will be faced with five rounds of five minute addition questions, and will be set specific non-binding goals prior to beginning each task. By extending the environment to have several periods, this will allow me to study the effects of goal-setting over time. I look to see whether incrementing the goal over time leads to an increase in effort over each round. Furthermore, using this setting I have two different goal treatments, one in which the goal set is a uniform 'one size fits all' goal, and the other, a personalised goal based on past performance. I use this environment to

see whether setting a personalised goal can increase the average effort put into the task over using a uniform goal by assigning appropriate goals with respect to subject's performance.

This paper contributes to the literature in several ways. Contrary to environments where only final wealth levels should matter, I find that setting a non-binding goal leads to a higher level of effort compared to a control group. This result supports previous research by Corgnet et al. (2015) and Smithers (2015). Over and above the current literature, I find that this increased effort exerted under a goal can be maintained over several periods. However, this level of effort plateaus at this higher level from as early as the second period and is not pushed further by increments to the goal level. In comparison the control group's performance barely increases over the five periods, identifying a lack of a learning effect, which serves to strengthen the goal result. Furthermore, in all periods, the average performance by the control group is lower than that of both goal groups.

Furthermore, I find that setting personalised goals based on past performance leads to a significant increase in the number of overall additions attempted when compared to the uniform group. However, this increase in speed does not convert into a significant increase in correct additions compared to assigning a uniform goal level. This means that in terms of correct output, there is no difference between the two types of assigned goals. However, this result has huge implications if attempts are (financially) costly as personalised goals lead to the same average output but result in a higher average attempts made. In the case of manufacturing where materials are costly, it would appear appropriate to assign a uniform goal level, rather than a personalised goal to, on average, reduce the cost of production.

3.2 Experimental design

Participants will face a real effort task under a standard piece rate reward system, followed by a personality and demographic questionnaire. The real effort task will have participants performing a task based on Niederle and Vesterlund (2007)'s addition task and the extensions by Smithers (2015). The addition task has participants summing up randomly generated sets of five double-digit numbers, over five minutes. Participants provide the solution by entering the sum in the empty box to the right hand side of the number list:

36	18	72	75	62	__

The task is chosen as it is necessarily cognitively demanding to require effort and focus to complete, however it is a task in which all participants have the skills to undertake.[1] Given this I interpret the number of correctly solved additions as the amount of effort exerted in the experiment.

In the experiment participants are randomly assigned the role of either worker or manager. Workers will face the addition task whereas managers will observe real-time and end of round output and have an extra role given what treatment they are in. In each session there is only one manager. In the goal treatments, the manager is to assign the goal to the worker rather than the experimenter, as to limit any experimenter demand effects (Corgnet et al., 2015). Furthermore, to remove any framing effects from using the terms 'worker' and 'manager' I replace them with the terms role B and role C respectively.[2]

There are three groupings in this experiment: one control group and two goal treatments. To study the dynamics of goal setting, the five minute addition task is repeated five times with slight variations across the two goal treatments. A control group where participants play five rounds of the addition task is used as the benchmark for comparison and will identify learning effects in the task. The two goal treatments feature a line of text prior to starting each addition round stating, "The person in role C has set you a goal to get 'X' correctly answered questions completed this round".

The first goal treatment, the uniform goal group, features a fixed increasing goal whereby participants face five rounds of increasing goal difficulty. The goal increases by a fixed amount from a base of 10 in the first round, increasing by 1 every round thereafter. Thus everyone faces them same goal level from 10 up to 14 correct additions.

The second goal treatment, the personalised goal group, utilises the past performance of the participants to set a more appropriate goal. In the first period, participants face a goal of 10 correct additions as in the first goal treatment. However, for every round thereafter the goal is calculated as their previous round performance plus 10% (rounded to the nearest integer) or 1, which ever is greater. This allows for close comparability between the two goal treatments as for the majority of cases the increase in goal difficulty is 1 addition. However, this offers enough variety in goal levels to be able to see its impact on the overall effort put

[1]The maths skills required being learned at mid-to-end primary. Crucially as well, it was found to be a gender neutral task by Niederle and Vesterlund (2007)

[2]Screenshots of the instructions can be found in Appendix 6.2.

into the task.

The manager's options in the experiment differ by treatment but overall the interaction is minimal. In all treatments, the manager observes the real-time output of each worker on the screen and final amount at the end of round. In the control group, the role of the manager is only to observe output. In the uniform treatment, the manager has to assign a goal prior to each round, however he/she is restricted to only being able to assign the pre-chosen goal for that round. Similarly, for the personalised treatment, the manager only has the ability to assign the personalised goal calculated by the computer. The managers role here is purposefully designed in this restricted way as I am not studying the worker/manager interaction in this paper.

For the worker, at the end of each round only their own output is revealed to them. In the goal treatment the worker has a reminder on the screen during the task of the goal they have be assigned, which is also repeated alongside their output at the feedback stage at the end of each round.

Prior to conducting the addition task, participants had to complete a short GMAT style test of five questions in five minutes. This task is used to elicit the underlying ability of the participants (Oswald et al., 2014). After the addition task a questionnaire is completed to get data on the usual demographic variables, i.e age and gender.

Participants were paid a show-up fee of £2, and were paid 50p for each correct GMAT question, and 20p per correct addition. A manager would receive 20p times the average number of correct additions of their workers. Each participant is randomly assigned to a desk and given a printed copy of the instructions which are read aloud. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007).

3.3 Results

The experiment was conducted at the LExEcon experiment laboratory at the University of Leicester. 98 participants took part, earning on average £13.27 (s.d. 3.44) for a 50 minute experiment.[3] The Control group and the uniform goal group both had 33 'workers' and the personalised goal group had 32.

[3]The original number was 105 but 7 of which were managers which I discard for the sake of analysis.

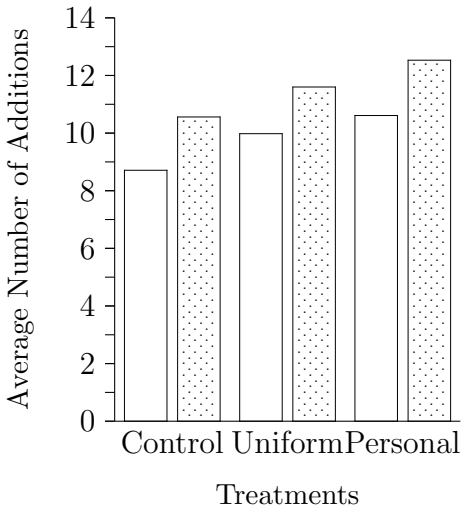


Figure 3.1: Average addition task results across all periods by treatment (Correct □, Attempted ⊡)

Looking first to the aggregate performance measures across the experiment, a clear picture of the treatment effects can be seen. Figure 3.1 summarises the average number of correct and attempted additions across all per periods. The control, uniform and personalised treatments have mean scores of (s.d.) 8.17 (2.29), 9.98 (2.82) and 10.61 (4.52) respectively. On average, the scores in the uniform treatment were 1.27 additions more than the control group ($p = 0.048$).[4] Similarly, scores in the personal goal group were 1.90 additions more than the control group ($p = 0.036$).

This result supports previous results found by Smithers (2015) that assigning a non-binding goal leads to a significant increase in effort above not assigning a goal. Furthermore, those is the personal treatment scored, overall, on average 0.63 additions more than those assigned a uniform goal level. However, there does not appear to be any significant difference between assigning the same goal for everyone and personalising ($p = 0.505$).

Participants in the control group attempted overall on average 10.56 additions with those in the uniform treatment attempting 1.04 more ($p = 0.002$) and the personal treatment attempting 1.97 more ($p = 0.000$) than the control group. Meaning that those assigned a goal were attempting a significant number more

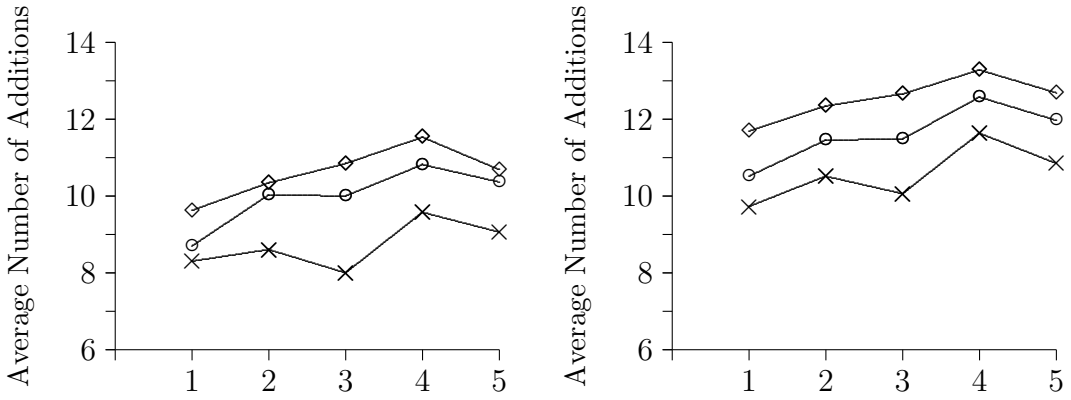
[4]In an effort to remain conservative all t-test p-values are for two-sided tests, even though the hypothesis, which suggests the sign of the effects, provides some justification for conducting one sided-tests. Wilcoxon rank-sum tests give very similar results to all presented t-test p-values. Further robustness checks are performed controlling for maths skills (GMAT). The results of these checks are still robust.

additions than those in the control group. To put this another way, participants in the control group were taking on average 30.68 seconds to answer a question, whereas those facing a goal took on average 27.82 seconds in the uniform treatment and 27.06 seconds in the personal treatment.

Furthermore, those in the personal group attempted 0.93 more additions than the uniform group ($p = 0.035$). So it would appear that a more appropriate goal level lead to a significant increase in the number of questions attempted. However, when combined with the above result these extra attempts are not translated into a significantly higher effort level than the uniform goal.

The accuracy of the participants, calculated as the number of correct additions over the number attempted, did not differ significantly across treatments. On average those in the control group got 83% correct, where similarly those in the uniform and personal group got 85% and 84%. This result differs from Smithers (2015) where it was found that those facing a goal were significantly more accurate than those in the control group.

Together these aggregate results imply that those facing a goal were calculating answers quicker and getting more correct than those in the control group, with the level of accuracy being constant across treatments.



(a) Additions correct (b) Additions attempted

Figure 3.2: Results by round (Control $\times$, Uniform $\circ$, Personal $\diamond$)

Table 3.1 (also figure 3.2a) gives the summary of the main results round by round. Looking first to the control group, it can be seen that there is very little learning in this task, as may well be expected from a task of this nature. The difference between the first round and the last round is an insignificant 0.76 additions ($p = 0.128$). The trends shown over the rounds for the goal treatments differ from

	Control (1)	Uniform (2)	Personal (3)	Diff.(1) ≠ (2)	Diff.(1) ≠ (3)
Round 1	8.30	8.70	9.63	0.40	1.33
	(3.47)	(2.88)	(4.43)		
Round 2	8.61	10.03	10.34	1.42**	1.73*
	(2.57)	(2.93)	(4.45)		
Round 3	8.00	10.00	10.84	2.00***	2.84***
	(2.31)	(3.27)	(4.83)		
Round 4	9.58	10.81	11.53	1.23*	1.96**
	(2.54)	(3.12)	(4.98)		
Round 5	9.06	10.36	10.69	1.30*	1.63*
	(2.70)	(3.31)	(4.70)		
Obs.	33	33	32		

Table 3.1: Round Comparison across treatments

what is seen in the control group. The average effort every round for both goal treatments, is higher than each corresponding round for the control group.

Comparing the differences between control group rounds, there is only a significant step between two of the rounds. Round 3 to 4 shows a significant increase of 1.58 additions ($p = 0.000$), however round 4 to 5 has a slightly significant decrease of 0.52 additions ($p = 0.078$).

For the uniform treatment, the first round performance is not significantly higher than the control group at 0.40 additions ($p = 0.617$). However, from the second round of the experiment and onwards, the average effort exceeds that of any effort in the control group. Most interestingly though, the performance plateaus at the level of approximately 10 additions for all rounds from the second to the last; even though the goal is still increasing by 1 addition per round. Given the plateau, and the lack of a learning effect, it suggests that the initial goal of 10 was at a reasonable yet challenging level. Furthermore, it shows that raising the goal incrementally by one unit, making the goal higher than the group average, did not have a detrimental effect on effort exerted.

Looking at the differences between uniform treatment rounds, round 1 to 2 shows a highly significant increase of 1.33 additions ($p = 0.000$); round 3 to 4 shows a significant increase of 0.82 additions ($p = 0.009$); and round 4 to 5 has a narrowly significant decrease of 0.45 additions ($p = 0.092$).

For the personal treatment, the difference in first round effort compared to the

control was not significant (1.33 extra additions, $p = 0.184$).[5] The average effort from round 2 onwards was significantly higher than the control group. Comparing rounds, round 1 to 2 shows a significant increase of 0.72 additions ($p = 0.039$); round 2 to 3's increase of 0.50 additions just misses significance ($p = 0.126$); round 3 to 4 shows a significant increase of 0.69 additions ($p = 0.030$); and round 4 to 5 shows a significant decrease of 0.84 additions ($p = 0.027$).

	Correct Additions	
Constant	6.863***	5.871***
	(1.019)	(1.030)
Uniform Goal	1.428*	1.428*
	(0.808)	(0.808)
Personal Goal	2.124***	2.124***
	(0.817)	(0.817)
GMAT	0.569**	0.569**
	(0.261)	(0.261)
Time Trend	-	0.331***
		(0.051)
σ_μ	3.181	3.189
σ_ϵ	1.677	1.595
Observations	490	490
Subjects	98	98

Table 3.2: Random effects regressions for effort on treatment dummies

Table 3.2 summarises the results of a random effects regression of effort on treatment dummies, whilst controlling for mathematical ability and also a time trend. The results support the difference in means test conducted above when controlling for the mathematical ability of the participants. However, controlling for mathematical ability and time, the regression puts more significance to the difference between the control group and personal treatment's effort at the 1% level compared to the 5% before. A test of the equality of coefficients of the two goal dummies shows that there is no significant difference.

Table 3.3 shows a random effects regression of effort on round dummies, controlling for mathematical ability, for each treatment. The first round is used as the reference category. The regression results suggest that for the control group the 4th and 5th round effort was significantly higher than the first round performance

[5]However using a one tailed test, it is just significantly different at the 10% level.

	Control	Uniform	Personalised
Round 2	0.303	1.333***	0.719**
	(0.419)	(0.369)	(0.353)
Round 3	-0.303	1.303***	1.219***
	(0.419)	(0.369)	(0.353)
Round 4	1.273***	2.121***	1.906***
	(0.419)	(0.369)	(0.353)
Round 5	0.758*	1.667***	1.063***
	(0.419)	(0.369)	(0.353)
GMAT	0.298	0.280	1.048*
	(0.346)	(0.383)	(0.571)
Constant	7.337***	7.866***	6.644***
	(1.219)	(1.261)	(1.812)
σ_μ	2.165	2.758	4.312
σ_ϵ	1.703	1.500	1.411
Observations	165	165	160
Subjects	33	33	32

Table 3.3: Random effects regressions for effort on round dummies

at 1% and 10% level respectively. However, for both of the goal treatments all rounds produced a highly significant increase in average effort over their respective first rounds. This is strongly supporting the idea that the goal has not only raised the effort levels put in, but has the participants sustaining that increased level of effort.

For every round, the average effort in the personal treatment was higher than that in the uniform treatment. However difference in means test show that this difference is not statistically significant for any of the rounds. This suggests, as with the aggregate analysis above, there is no significant effect upon effort of individualising the assigned goals over a uniform level.

Table 3.4 analyses the effort by looking within round. It shows regression results of effort for each round on treatment dummies controlling for mathematical ability, with the control group being the reference category. Compared to the simple difference in means test of uniform versus personalised goals reported in table 3.1, the regression results suggest in favour of personalised goals. For each corresponding round, the performance under the personalised goal is significantly higher than that in the control group. However, for those facing the uniform goal level only in the second and third round is the effort significantly different from

	Round 1	Round 2	Round 3	Round 4	Round 5
Constant	6.398***	7.185***	6.057***	7.537***	7.136***
	(1.115)	(1.052)	(1.113)	(1.132)	(1.120)
Uniform Goal	0.554	1.544*	2.163**	1.414	1.465
	(0.884)	(0.834)	(0.882)	(0.897)	(0.888)
Personal Goal	1.556*	1.912**	3.083***	2.206**	1.863**
	(0.895)	(0.844)	(0.893)	(0.908)	(0.899)
GMAT	0.588**	0.438	0.599**	0.629**	0.593**
	(0.285)	(0.269)	(0.285)	(0.289)	(0.286)
Observations	98	98	98	98	98

Table 3.4: Regressions for effort on treatment dummies by round

the control group.[6] These results give credence to the belief that personalising the goal to the individual is better overall for production than a uniform goal level.

3.4 Additional Results

Goal commitment can be thought simply as how determined and focused you are on meeting the assigned goal. Participants were asked to state how committed they were to a given goal on a scale from 0% to 100%, with 100% being fully committed to the goal. Table 3.5 reports the average across all participants of these commitment value given to each goal by round, from a post-experiment questionnaire. As these questions were asked after the experiment there is an inherent bias of reflection on the task rather than perhaps the actual commitment level at the time of facing the goal. The commitment questions were not asked during the experiment as to not put any additional emphasis on the goal. This serves only to strengthen the raw goal effects observed in the data. However, the results are still informative and at the very least indicative of the commitment to the assigned goal at the time.

What can be observed here, for both goal treatments, is an inverted-U shape for commitment as the rounds progress. Commitment to the goals in the later rounds of the uniform treatment shows a slightly lower average commitment than in the personal treatment. This difference could be explained by the uniform treatment having an always increasing goal regardless of the performance level,

[6]The p-value however for the fourth and fifth round is close to significance at 0.118 and 0.102 respectively.

	Pooled	Uniform	Personal
Round 1	83%	83%	82%
Round 2	86%	87%	85%
Round 3	83%	83%	83%
Round 4	79%	76%	82%
Round 5	76%	72%	79%
Obs.	64	32	32

Table 3.5: Commitment

whereas the personal treatment assigns goals closer to the level capable of the individual. However, there is no statistical significance in in either the round by round measure or the overall distribution.

3.5 Conclusion

This paper studies the effect of setting a non-binding goal on effort. More so, it focuses on two key topics, the dynamics of the goal's effect on effort, and the uniform versus personalisation of the goal level. I find that setting a goal induces higher effort echoing the results found by Locke and Latham (1990) and Smithers (2015). Furthermore, I find that the induced higher effort level can be sustained over several rounds, keeping effort at a higher level than in any round of the control group. The gap in the effort levels between the goal treatments and the control is small initially but increases over time.

However, in this paper I find mixed results of whether uniform or personalised goals are the best prescription. Difference in means tests showed that there were no significant differences in the levels of effort between the two goal treatments. However, regression analysis showed that, controlling for mathematical ability, personalised goals were leading to a significantly higher effort than the control group in all rounds, whereas the uniform goal only in two of the five rounds. Statistical significance aside, those facing personalised goals had, on average, a higher output, suggesting there is a gain to be achieved. Statistical conflicts and insignificance could potentially be due to needing more observations. Further research is needed to tease this effect out with a larger sample.

One crucial result however is that for the same level of average output, those under a personalised goal needed on average, more attempts than compared with

the uniform group. That is to say that those assigned a personalised goals worked quicker than those in the uniform group at the expense of converting less attempts into correct answers. If production was costly, for example materials in manufacturing, then personalised goals would be increasing the average cost of production in comparison. Thus, even though there is no significant differences in average production between the two goal schemes, a uniform goal level could potentially be superior conditional on the output and input costs of production.

Chapter 4

Assigned versus personal goals

4.1 Introduction

Effectively motivating a workforce is key to increasing productivity and growth. In economics, the standard bearer for analysing incentive-based motivation is the principal-agent framework, where monetary incentives (or penalties) are instrumental. However this framework discounts the impact of intrinsic motivation, an internal drive to want to perform for the inherent satisfaction or pleasure of the task at hand. This is opposed to extrinsic motivators which play on human tendencies to perform activities for external rewards, namely monetary incentives. Psychologists (Deci, 1971, 1975) and behavioural economists (Frey and Jegen, 2001; Gneezy et al., 2011) express the relevance of intrinsic motivation and how it can be "crowded-out" by extrinsic motivators. For example, Ariely and Heyman (2004) reported that the willingness of an individual to help a stranger load a sofa into a van was far less when a small incentive was present versus no incentive at all. It is clear that personal motivation is not always driven by monetary incentives, but what mechanism optimises worker performance remains an open question.

In this paper we examine the efficacy and interaction of both assigned and personal (self-set) non-binding goals, an alternative motivator to enhance workers' performance in a controlled laboratory experiment. A non-binding goal is a specific, challenging target with which there are no monetary rewards or punishments associated with success or failure, i.e. payoff irrelevant. So far, the experimental literature has mainly focused on showing the positive effect of assigned goals on workers' production (Heath et al., 1999; Smithers, 2015; Corgnet et al., 2015) and how increasing the monetary incentive enhances the effectiveness of assigned goals (Corgnet et al., 2015). Theoretical results have shown how a principal can utilise goal setting to increase an agents motivation to work, consequently increasing the performance of the agent at a reduced cost to the principal (Gómez-Miñambres, 2012). Other theoretical papers have demonstrated how personal goals can alle-

viate or mitigate the effects of self-control bias (Hsiaw, 2013; Koch and Nafziger, 2011).

Thus far, how assigned goals and personal goals interact and effect both current and subsequent performance has yet to be studied. We design a simple model to capture the motivational implications of the goals upon a worker before exploring our conjectures in our experimental setting. Given an assigned goal (low or high), we conjecture that personal goals should be more effective than low assigned goals, but not as effective as high assigned goals. Our experiment finds, in line with previous studies that those assigned goals had a higher output than those without a goal. However, we find novel results in that those who faced only personal goals, on average, performed worse than those who had no goal. This suggest that a form of motivation crowding-out can occur in this environment.

4.1.1 Literature Review

In psychology, goal-setting has been argued to enhance workers' motivation and performance. Psychologists Latham and Locke (1991) state that goal setting has four key facets: Goals (1) increase effort put into a task; (2) extend persistence, i.e. more time spent on the task; (3) boost attention, i.e. focus placed on the task with the set goal and away from irrelevant activities; and (4) encourage the use and acquisition of knowledge. A meta review conducted by Locke and Latham (2002) finds that goal-setting has worked in 90% of the studies analysed. This provides a strong premise for the assertion that goal-setting can enhance intrinsic motivation. Our work contributes to this previous research by replicating an incentivised workplace environment in which we can analyse the effect of both assigned and personal goals in a dynamic environment.

The economics literature on instrinsic motivation and goal setting is still relatively young as the focus has traditionally been on monetary incentives as the consistent and predicatble performance enhancer. However recent experimental research has found that extrinsic incentives can lead to the crowding-out of effort (see Gneezy et al. (2011)). Ariely et al. (2009) find that paying people a relatively high amount on mental tasks led to poorer performance when compared to those groups receiving a lower piece rate. Similarly, Gneezy and Rustichini (2000) find that paying people too low an incentive led to the worst performance, even lower than those who were unpaid. This inconsistency leads to the pursuit of intrinsic motivators that can provide an alternative form of motivation to enhance

performance.

Heath et al. (1999) propose that goals can act as a reference point for evaluating performance in a prospect theoretic framework. This psychological utility derived from the desire to work harder to avoid being in the domain of losses may explain how a non-binding goal can have an effect on effort. The goal acts as a reference point by which an individual can evaluate their perfromance with respect to a set target level. Using goals in this way, Hsiaw (2013) and Koch and Nafziger (2011) model the effect of setting yourself a non-binding goal to combat present bias behaviour showing that self-set goals can temper self-control issues, as long the bias is not too severe. In our setting we show how goals can affect agents production in a workplace setting.

Modifying the traditional principal-agent framework, Gómez-Miñambres (2012) has a principal who offers a standard piece rate wage to the agent, whilst also setting non-binding goals on the agents' production. Personal standards of the agent are introduced to determine what the agent believes to be challenging and rewarding to them, and thus the extent of their intrinsic motivation to achieve goals. He finds that the agents' production, as well as the goals set by the principal, increase with the agents' personal standards. Building on this, we extend the framework to study the effect of personal goals, and past goals on production through the modification of an agents personal standards. Focusing on the decision choice of the worker we abstract away from the concerns of the principal. Similarly, we conjecture that the agent's effort is increasing with the goal, however, that this is the case of assigned goals and that personal goals are not as effective as high assigned goals.

Our experiment builds upon an experimental literature that so far has been focused only on assigned goals in principal-agent styled environments. Corgnet et al. (2015) find that managers set goals that are challenging but attainable for workers of average ability, and workers respond to these goals by increasing effort and performance. Furthermore, by varying the level of piece rate incentive, they find that goal setting is most effective when monetary incentives are high. Smithers (2015) presents results on setting a low level and a high level goal to two separate groups, finding that both goals lead to an increase in performance over a control, with the high goal causing the greater increase, whilst holding the piece-rate scheme constant. This effect is found to be driven by an increase in both the speed and accuracy on the addition task.

We extend the real effort environment of Smithers (2015) into a multi period environment to allow us to study the interaction between types of goals across time. Participants are allocated to either a control group or one of three treatment groups, and are faced with four rounds of five minute addition questions. The first treatment has participants setting themselves personal goals each round. The second treatment has participants alternating between setting personal goals and being assigned goals, with the assigned goals first being low then high. The third treatment mimics this but reverses the order of the assigned goals to being high then low. With this approach we look to study not only the effect of non-binding goals on production but also the interaction between past goals and current goal setting policies

In our experiment, consistent with previous experimental results on goal setting, we find that assigning a goal leads to a higher average effort than no goal. Remarkably, we find that the group which only faced personal goals had a lower average performance than the control group for nearly every period. This suggests a sort of crowding-out effect on effort, with the self-set goals having an opposite effect to the assigned goals by lowering the average effort. Self-set goals are not providing the motivational push to move subjects towards their maximum potential output. Furthermore, those in the personal goal treatment on average set themselves goals that were not significantly different from the low assigned goal level. However, far fewer people attained the personal goals than the low assigned goals.

Additionally, we find that effort is increasing in the goal level, for both self-set and assigned goals; that the previous goal level faced, and if the previous goal was achieved both have a positive impact on performance. However, assigned goals only have a positive effect if the goal is 'reasonable', but personal goals always have a positive effect on effort.

4.2 Theory

In this section, we develop a simple model with goal-dependent preferences to inform our theoretical hypotheses. We start by describing an individual worker's preferences. We then discuss the motivational effects of assigned and personal goals. Through our model, we demonstrate that previous goals and performance can affect a worker's commitment to achieve current goals.

4.2.1 Worker Preferences

Let y denote the worker's performance/output in the current period. Let α denote the piece rate compensation for each unit of output. Therefore, αy is the worker's monetary incentive, or extrinsic utility function. Let g denote the goal given to the worker, either assigned by a manager or self by the worker. Let s denote the worker's personal standard which determines the agents intrinsic satisfaction from goal attainment in the sense described below. Let $V(y, g, s)$ denote the worker's goal dependent intrinsic utility, which is a function of the current period's output, goal, and personal standard. Let $c(y)$ denote the cost function of producing y output. For simplicity, we assume a standard quadratic cost function such that $c(y) = y^2/2$.

Therefore, the worker's utility function is given by:

$$U(\alpha, s, g, y) = \alpha y + V(y, g, s) - \frac{y^2}{2} \tag{4.1}$$

Following previous works in psychology (Locke and Latham, 2013) and behavioural economics (Gómez-Miñambres, 2012), we assume that workers intrinsic utility $V(y, g, s)$ has two different components: a *goal commitment* function $\psi(g, s)$, which is increasing in the goal but decreasing in the workers *personal standard*, s, and a *goal payoff* function that increases the worker's performance relative to the goal, $v(y, g)$. For simplicity, we assume $V(y, g, s) = v(y, g) \cdot \psi(g, s)$. Let $v(y, g)$ be a linear goal payoff function such that $v(y, g) = y - g$.[1] Moreover, we consider the following function for goal commitment:

$$\psi(g, s) = \begin{cases} g & if \;\; g \geq s \\ 0 & if \;\; g < s \end{cases} \tag{4.2}$$

Thus, $\psi(g, s)$ is a piecewise linear function that scales the goal payoff up if the goal, g, is greater than a certain threshold given by the workers personal standard, s. The goal commitment function is consistent with the idea that people with high standards (those who demand more of themselves) require more challenging goals in order to get satisfaction from goal attainment (see Mento et al. (1992) for

[1] Other authors have considered a more general goal dependent function consistent with prospect theory properties (Corgnet et al., 2015; Wu et al., 2008). Using a more general utility function would not affect our main results on the interaction between personal and assigned goals. Therefore, we prefer to build a model consistent with our experimental environment and hypotheses.

supporting evidence).

Taking into account both the goal commitment and goal payoff functions, the worker's overall utility is given by:

$$U(\alpha, s, g, y) = \begin{cases} \alpha y + g(y - g) - \frac{y^2}{2} & if \;\; g \geq s \\ \alpha y - \frac{y^2}{2} & if \;\; g < s \end{cases} \tag{4.3}$$

Note that in our model, easy goals (i.e. goals where $g < s$) have no impact on a worker's utility. Therefore, workers have an incentive to set challenging goals (i.e. goals where $g > s$), though this is no guarantee that workers will set optimal goals for themselves. In fact, our model will show that in certain settings, managerially assigned goals will encourage higher worker performance.

4.2.2 Goals and worker's performance

In this paper we will study two different types of goals: personal and assigned goals. Both types of goals will have differing motivational implications. We start studying the case of assigned goals. Given an assigned goal, g, a monetary compensation α, and a personal standard s, a worker chooses a level of performance, y^*, that maximises his overall utility. Thus,

$$y(g) = \underset{y}{\text{argmax}} \;\; U(\alpha, s, g, y) = \begin{cases} \alpha + g & if \;\; g \geq s \\ \alpha & if \;\; g < s \end{cases} \tag{4.4}$$

Notice that the worker's performance increases not just with the monetary incentive, but also with the goal, given that the goal is challenging enough ($g \geq s$) which is a direct consequence of our goal commitment function.

If the worker could instead decide his own goals, he will choose it in such a way that his utility is maximised given his performance y^*. Thus, the optimal personal goal is given by:

$$g^p = \underset{g}{\text{argmax}} \;\; U(\alpha, s, g, y(g)) = \begin{cases} \alpha & if \;\; \alpha \geq s \\ \emptyset & if \;\; \alpha < s \end{cases} \tag{4.5}$$

Notice that the personal goal is positive as long as the monetary incentives are high enough relative to the workers personal standard. The intuition is the following. A worker with a high personal standard requires a high goal in order to get intrinsic satisfaction from goal attainment. However, a high goal also requires

the worker to put forth higher effort in order to get high enough performance. Unless the monetary compensation is sufficient to compensate for this effort, the worker would prefer not to assign personal goals.

Given the personal goal, g^p, the workers performance is given by:

$$y(g^p) = \begin{cases} 2\alpha & if \ \ \alpha \geq s \\ \alpha & if \ \ \alpha < s \end{cases} \tag{4.6}$$

If goals are not challenging enough, this means that $y(g) = y(g^p) = \alpha$. Moreover, note that if the worker is committed to attain the goal, $y(g) > y(g^p)$ if and only if $g > \alpha$. In other words, in a low goals environment, for example a menial or simple job, it could be useful to delegate the goal setting decision to the agent; however, if high performance goals are required, assigned goals will be more effective.[2]

4.2.3 The effect of past goals on commitment

Goal commitment is a complex theme which has been studied at length in the psychology literature. Our goal commitment function $\psi(g, s)$ captures the intuitive idea that more demanding workers will require higher goals in order to be motivated by them. The key element in this piecewise function is the personal standard parameter, s, which is a threshold up to which goals start being relevant. According to Latham (2000), commitment to goals can depend on previously assigned goals. In other words, past goals set the bar for new achievements. The simplest way to capture this idea in our framework is to assume that a worker's personal standard is determined by the previous goal level, $s = g_{-1}$. Our experiment will allow us to test whether past goals affect workers commitment to current goals, thus, whether personal standards are affected by previously faced goals.

4.2.4 Hypotheses

The aim of our paper is not to test the point predictions derived from our model. Instead, we aim to assess the main implications of our theoretical framework re-

[2]With personal goals, there is no upper limit to g, as a worker would not set a goal level that generates negative utility. With assigned goals, we can consider an upper limit to g if we assume the worker cannot have a negative utility. However this assumes that the worker has an outside option, which is not the case in our experiment. Thus the worker cannot avoid the negative consequences of facing a very high goal and would choose to produce even if he gets a negative utility because he will be even worse by not working.

garding the interaction of assigned and personal goals. Below we state some hypotheses that are consistent with our theoretical framework.

Hypothesis 1 (Goal effectiveness)

[i] *Average performance in the goal setting treatments should be higher than the average performance in the baseline.* This follows from the fact that $y(g) \geq y(0)$.

[ii] *High assigned goals should lead to higher performance than low assigned goals.* This hypothesis follows directly from the fact that $y(g)$ weakly increases with g.

Our first two hypotheses are in line with other goal setting models who have found a positive effect of challenging non-binding goals on workers' performance (Heath et al., 1999; Gómez-Miñambres, 2012; Corgnet et al., 2015).

Hypothesis 2 (Personal vs. assigned goals)

[i] *High assigned goals should be more effective than personal goals. While, low assigned goals should be less effective than personal goals.* This hypothesis follows from the fact that $y(g) > y(g^p)$ if and only if $g > \alpha$.

[ii] *Low goals should be less effective if the worker has faced high goals in the past.* If a worker faced a high goal in the past he will be less committed to attain low goals in the present.

The joint study of personal and assigned goals is our main contribution. On the one hand we expect challenging goals to be more effective than personal goals. On the other hand, we expect previous assigned goals to increase the agents personal standard and hence require higher goals in order to be committed.

4.3 Experimental Design

To study the interaction of personal goals and assigned goals, participants will face a real effort task based on Niederle and Vesterlund (2007)'s addition task and augmentations by Smithers (2015). The addition task has participants summing up randomly generated sets of five double-digit numbers in five minute segments.

10	23	21	63	71	__

Table 4.1: Example of addition task

Participants provide the solution by entering the sum in the empty box to the right hand side of the number list (see table 4.1).

The task is chosen as it is significantly cognitively demanding, requiring effort and focus to complete, but also it is a task in which all participants have the skills to undertake.[3] Given this, we interpret the number of correctly solved problems as the effort exerted in the experiment. Participants are given a full five minute incentivised round to practice the task before the real task begins.

The goals set are of two forms in this experiment, assigned (exogenous) or personal goals (self-set). For the assigned goals there are two difficulty levels, low and high. To determine the difficulties, we examined what the top 50% and top 20% of the control group could achieve. A score of 10 correct additions was reached by half of the participants, and a score of 14 by the top 20%. This gives us a goal of low difficulty which is challenging for half the population and a high goal which is challenging for the vast majority.

In this experiment we run four treatments: a control group, a personal-goal only group, and two personal/assigned-goal groups. In the control group (and as the base for all treatments), participants face four rounds of the five minute addition task acting as our benchmark case. This group gives us an understanding of any learning effects that may present themselves over time on this task. For the personal-goal group, prior to each round, participants are asked to assign themselves a personal goal to reach on that respective round. This treatment allows us to see the evolution of performance and goal levels under an individual's self-motivational pressures. This acts as another benchmark for the absence of assigned goals.

In the goal interaction groups, participants set personal goals for themselves before the start of the first and third rounds of the addition task. Prior to the beginning of the second and fourth round, the participants are assigned a goal. One group, 'LH', is assigned the low goal prior to round two and the high goal prior to round four. The second interaction group, 'HL' assigns goals in reverse

[3]It features late primary level maths skills and it was found to be a gender neutral task by Niederle and Vesterlund (2007).

order, with the high goal assigned in round two and the low goal in round four. This allows us to study the interaction between the two goals on both the effort exerted and the personal goals chosen. Participants know what type of goals they will face from reading the instructions.[4]

Before participants attempt the addition task, they complete a short GMAT style test of five questions in five minutes. This task can be used to elicit the underlying ability of the participants (Oswald et al. (2014)).[5] After the addition task is completed, participants are asked to fill in a questionnaire which asks for typical demographic data, course title, as well as qualitative questions related to goal-setting.

Furthermore, at the very beginning and at the end of the experiment, subjects fill in a Self-Assessment Manikin (SAM) test. Created by Lang (1980), this short pictographic test seeks to reveal any impact the experiment has had on subject's emotional state by comparing pre and post-experiment self-reported measures.

The participants are paid a show-up fee of $5, rewarded $0.50 for each correct GMAT question, and rewarded $0.20 per correctly answered addition problem. The experiment is programmed and conducted with the software z-Tree (Fischbacher (2007)).

4.4 Results

The experiment was conducted at the LEMA experiment laboratory at Pennsylvania State University. 144 participants from the general student populace took part, earning on average $15.66 (3.63) for a 40 minute experiment. Throughout this section, unless otherwise stated, standard errors are presented in brackets after (or below in tables) estimates.

	Control	Goal LH			Goal PP			Goal HL		
	Correct	Correct	Goal	Achieved	Correct	Goal	Achieved	Correct	Goal	Achieved
	10.72	12.03	11.53	63%	10.37	10.36	63%	10.99	11.59	49%
	(3.00)	(4.24)	(3.69)	-	(3.08)	(4.00)	-	(3.71)	(3.10)	-
Obs.	120	164			128			164		

Table 4.2: Aggregate of results across treatments

Table 4.2 presents an aggregated summary of the average number of correct

[4]Screenshots of the instructions can be found in Appendix 6.3.

[5]As another control for ability we create a dummy variable for first correct table.

answers achieved, average goal levels and the percentage of people who either met or surpassed their goal, while table 4.3 breaks this down by round. Figure 4.1 provides a graphical representation of the average number of correct additions and attempted additions.

	Control	Goal LH			Goal PP			Goal HL		
Round	Correct	Correct	Goal	Achieved	Correct	Goal	Achieved	Correct	Goal	Achieved
1	10.03	11.32	10.15	76%	9.69	9.53	66%	10.66	10.32	71%
	(2.36)	(4.03)	(4.54)	-	(2.89)	(4.30)	-	(3.82)	(3.37)	-
2	10.20	12.12	10.00	78%	10.31	10.25	56%	11.32	14.00	22%
	(3.17)	(4.19)	-	-	(2.68)	(3.76)	-	(3.72)	-	-
3	11.30	12.37	11.98	66%	10.47	10.63	66%	11.02	12.05	32%
	(3.14)	(4.09)	(4.91)	-	(3.56)	(3.57)	-	(4.00)	(4.15)	-
4	11.33	12.32	14.00	34%	11.00	11.06	63%	10.95	10.00	71%
	(3.14)	(4.69)	-	-	(3.12)	(4.33)	-	(3.38)	-	-
Obs.	30	41			32			41		

Table 4.3: Summary of results by round across treatments

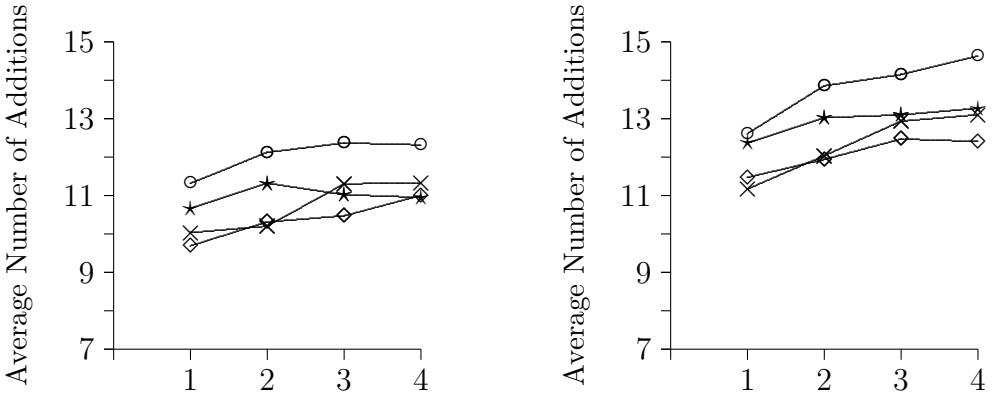
The first observation we can see is that we have variation in the average number of correct answers across treatments. Those in the goal LH treatment have a higher average number of correct answers than the control group and in fact any other treatment, for the respective rounds of the experiment. This partially supports our first hypothesis. Difference in means tests looking at pairwise comparisons between the overall performance of the goal LH treatment and all other groups show strong statistical significance.[6] Overall on average, the number of correct answers in the goal LH treatment were 1.31 additions more than the control group ($p = 0.004$). Similarly, the overall average was also higher than the goal HL treatment ($p = 0.018$) and the goal PP treamtment ($p = 0.000$).

Those in the personal goal only treatment however, surprisingly, bar one round, have a lower average number of correct answers than the control group. To analyse this further, we conduct Kolmogorov-Smirnov's test for equality of distributions. We find that the distribution of the number of correct answers for the goal PP treatment is significantly different to each of the other treatments.[7]

Using the same test we also look for a learning affect across time by splitting

[6]In an effort to remain conservative all t-test p-values are for two-sided tests, even though the hypothesis, which suggests the sign of the effects, provides some justification for conducting one sided-tests. Wilcoxon rank-sum tests give very similar results to all presented t-test p-values. Further robustness checks are performed controlling for maths skills (GMAT). The results of these checks are still robust.

[7]Kolmogorov-Smirnov p-values for each test: Vs. Control $p = 0.016$, vs. goal LH $p = 0.000$, vs. goal HL $p = 0.061$.



(a) Additions correct (b) Additions attempted

Figure 4.1: Results by round (Control $\times$, Goal LH $\circ$, Goal PP $\diamond$, Goal HL $\star$)

the experiment into two halves and comparing the distribution of two. We find that there are no significant differences across all treatments neither pooled nor individually when comparing the first and second half of each treatment.

Table 4.3 also shows the percentage of subjects in each round who achieved (met or exceeded) their respective goal for that round. Remember that round 1 and 3 in the goal treatments were self-set goal rounds. 62% of subjects in the personal goal treatment achieved their goals. This is surprising as from the table we can see that the average production for each round in that treatment is approximately equal to the average of the personal goals. Subjects were more successful at meeting the low goal of 10 in the goal LH and HL treatments, with 78% and 71% respectively. However, subjects all struggled with meeting the high goal of 14 with 34% in the goal LH group and only 22% in the goal HL group.

For the personal goal treatment, subjects were overall not setting themselves statistically significantly different goals from the low assigned goal of 10 given in the other treatments.[8] Furthermore, all personal goal averages were significantly different from the high goal of 14 at the 1% level.

To study further the determinants of production in the goal treatments, table 4.4 presents a random effects regression which looks at the effect that current and past goal levels, and whether the previous goal was attained, has on production, alongside a baseline regression. This allows us to understand what could be determining the personal standards of an individual when faced with a goal. Here

[8]All two-tailed t-test pairwise comparisons revealed p-values great than 0.1. However, round 4 was marginally significant using a one tailed test ($p = 0.088$).

	Correct	Correct
Goal LH (d)	1.527*	0.970*
	(0.70)	(0.56)
Goal HL (d)	0.606	-0.234
	(0.58)	(0.55)
GMAT	0.830***	0.477***
	(0.19)	(0.16)
Current Goal	-	0.218***
	-	(0.05)
Lagged Goal	-	0.348***
	-	(0.07)
Attain (d)	-	1.243***
	-	(0.33)
Time Trend	0.304***	-0.126
	(0.06)***	(0.13)
Intercept	6.889***	3.090***
	(0.68)***	(0.98)
σ_μ	3.080	1.473
σ_ϵ	1.538	1.499
Obs.	576	342

Table 4.4: Random Effects Regression for Production on Treatments (*10%, **5%, ***1% significance level)

we control for the mathematical ability of the individual and a time trend, whilst using the personal goal treatment as the reference group.

From the results we can see that for a goal in the current period, a higher goal, either self-set or assigned, predicts higher production. In other words, effort is increasing in the level of the goal. This supports our hypothesis 1[ii] that high goals should lead to a higher performance than low goals. When looking at the effect that a goal from the previous period has, we can see that it too has a positive and highly significant effect on this periods effort provision. In fact, this effect is of greater magnitude than the current period's goal. Because past goals strongly influence personal standards (in our model $s = g_{-1}$), we see that the effect from past goals and personal standards is crucial to predicting future performance. Furthermore, attaining the goal in the previous period leads to an increase in production in the current period, this supports our hypothesis.[9] Surprisingly, subjects are not correctly completing more additions, though they are attempting more.

[9]These results are robust to time effects and further controls show that there is no gender difference and that age has no impact.

	Personal		Assigned	
	Reasonable	Unreasonable	Reasonable	Unreasonable
Personal Goal	0.807***	0.353***	-	-
	(0.04)	(0.06)	-	-
Assigned Goal	-	-	0.736***	-0.044
	-	-	(0.08)	(0.12)
GMAT	0.162	0.863***	0.172*	0.997***
	(0.09)	(0.27)	(0.10)	(0.33)
Goal LH (d)	0.289	1.341	0.128	1.267
	(0.29)	(0.96)	(0.33)	(1.08)
Goal HL (d)	0.026	-0.294	-	-
	(0.28)	(1.08)	-	-
Time Trend	-0.141	-0.285	0.232	-0.111
	(0.11)	(0.23)	(0.15)	(0.28)
Attain (d)	0.174	2.031***	-0.012	0.929
	(0.24)	(0.74)	(0.32)	(0.73)
Intercept	1.965***	4.915***	1.714	8.245***
	(0.49)	(1.09)	(1.18)	(2.46)
σ_μ	0.829	2.801	0.527	3.706
σ_ϵ	0.963	1.405	1.131	1.718
Obs.	203	89	73	91

Table 4.5: Random Effects Regression for Production (*10%, **5%, ***1% significance level)

To break down the analysis of goals further we differentiate between what is a reasonable and an unreasonable goal. Following a similar analysis by Corgnet et al. (2015), we define a reasonable goal as one that is less than 3 correct additions away from realised production.[10] We define a reasonable goal is one that should have the greatest effect given its close proximity to a persons potential. In other words, it could be said that a reasonable goal is one that is in line with one personal standards. We look separately at reasonable personal goals and reasonable assigned goals. Table 4.5 shows the results.

From our results we can see that personal goals always have a positive impact on performance, regardless of whether they are reasonable or not. The only difference being is that sensibly a more reasonable personal goal has a higher relative effect on performance. However, if a person sets an unreasonable goal for him or herself this period, attaining the goal in the previous period has a highly significant positive effect on production. This resonates with the personal standards of an individual

[10]Results are robust to changing to less than 2 or 4 correct additions.

we discussed in the modelling section.

However the results for assigned goals is quite different. Production is increasing if an individual has been assigned a reasonable goal, whereas production is decreasing but not significantly if the goal assigned was unreasonable.

4.5 Conclusion

Motivation is key in any workplace to achieving results, and incentivising employees correctly is crucial. In this paper we abstract away from the issues of varying the level of monetary incentives and instead focus on non-binding goals, an alternative motivator to enhance workers' performance. We develop a simple model with goal-dependent preferences so as to derive a set of conjectures that we examine in our experiment.

We find that, in line with our model, that those faced with a goal have a higher average output than those in the control group. However this is not the case with the personal goal group, which for all rounds bar one, have a lower average output than the control group. This suggests that a form of crowding-out of effort is occurring due to the personal goal group when compared to the assigned goals or control group. However we do find that personal goals have a positive effect on effort regardless if they are reasonable or not. However assigned goals only have a positive affect if they are reasonable for the worker.

One thing we don't expand on in our paper is that our model provides conjectures with respect to the interaction of monetary incentives and goals. We find that not only are goal setting and monetary incentives are complementary (similar to what was found by Corgnet et al. (2015)) but also that personal goals are more effective relative to assigned goals as monetary incentives increase. We leave this to future work.

Chapter 5

Conclusion

This thesis presented three self-contained papers studying the effects of setting non-binding goals on production. All three of the papers present the initial result, supporting previous research, that goals lead to a higher level of effort provision. Chapter 2 identifies that this effect is driven by an increase in both the speed and accuracy of participants. Furthermore, it indicates that this result may be gender reliant as male participants thrived when presented with a non-binding goal, whereas female participants were unaffected. Further research is needed to examine the robustness of this observation.

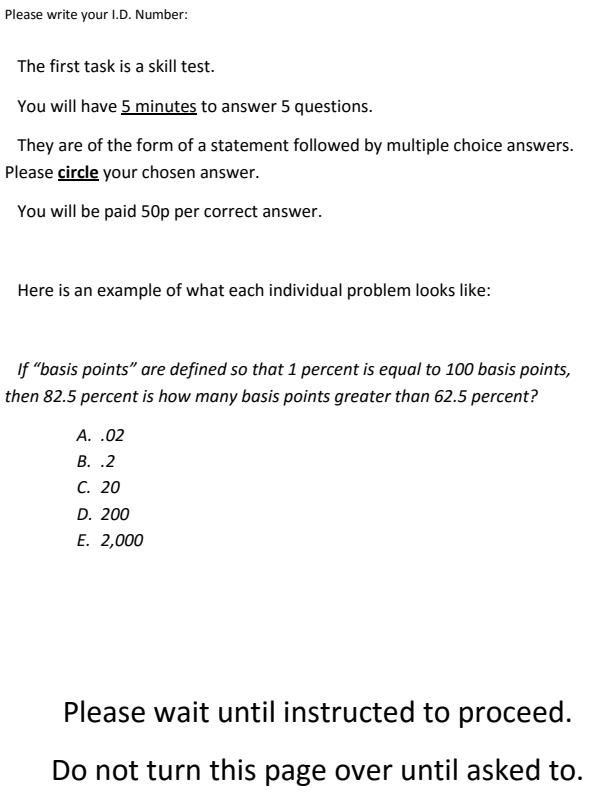
Chapter 3 found that this inducement of higher effort could be sustained over several rounds, with the initial difference between the goal treatments and the control group is small but increases over time. The crucial results is that those under a personalised goal needed on average more attempts than compared with the uniform group, to produce the same level of average output. Another way of saying this is that those assigned a personalised goal worked quicker than those in the uniform group at the expense of converting less attempts into correct answers. If production was costly, for example materials in manufacturing, then personalised goals would increase the average cost of production in comparison. Thus, even though there is no significant differences in average production between the goal schemes, a uniform goal level is superior if attempts are costly.

Chapter 4 found that those in a treatment where every round participants had to set themselves personal goals, for all rounds bar one, they had a lower average output than the control group. This suggests that a form of motivation crowding-out is occurring due to the personal goal group, compared to the assigned goals or control group. Furthermore, the model conjectures that not only are goal setting and monetary incentives complementary (similar to a previous result found by Corgnet et al. (2015)) but also that personal goals are more effective relative to assigned goals as monetary incentives increase. This is a potential avenue for future research.

Chapter 6

Appendix

6.1 Chapter 2 experiment instructions



Please write your I.D. Number:

The first task is a skill test.

You will have 5 minutes to answer 5 questions.

They are of the form of a statement followed by multiple choice answers. Please **circle** your chosen answer.

You will be paid 50p per correct answer.

Here is an example of what each individual problem looks like:

If "basis points" are defined so that 1 percent is equal to 100 basis points, then 82.5 percent is how many basis points greater than 62.5 percent?

A. .02
B. .2
C. 20
D. 200
E. 2,000

Please wait until instructed to proceed.

Do not turn this page over until asked to.

Figure 6.1: GMAT instructions

Please write your I.D. Number:

The second task is an addition task.

You will have 5 minutes to attempt the addition task.

The task involves a row of 5 numbers and an empty box.

You are asked to **add** (sum) **together** the 5 numbers in the row and write your answer in the empty box at the end of the row.

You will be paid 25p per correct answer.

Here is an example of what each individual problem looks like:

57	49	79	64	50	**299**

Write your answer here ↑

So you need to add the numbers together like this: 57+ 49 +79 +64 +50 =299

More Examples:

15	23	81	39	90	

72	33	28	51	19	

Please wait until instructed to proceed.

Do not turn this page over until asked to.

Figure 6.2: Control addition instructions

Please write your I.D. Number:

The second task is an addition task.

You will also have a ***goal*** to reach (a number of correct additions).

You will have 5 minutes to attempt the addition task.

The task involves a row of 5 numbers and an empty box.

You are asked to **add** (sum) **together** the 5 numbers in the row and write your answer in the empty box at the end of the row.

You will be paid 25p per correct answer.

Here is an example of what each individual problem looks like:

57	49	79	64	50	**299**

Write your answer here ↑

So you need to add the numbers together like this: 57+ 49 +79 +64 +50 =299

More Examples:

15	23	81	39	90	

72	33	28	51	19	

Your goal:

For this task you have a goal to get 10 correct additions.

Please wait until instructed to proceed.

Do not turn this page over until asked to.

Figure 6.3: Goal low addition instructions

Please write your I.D. Number:

The second task is an addition task.

You will also have a ***goal*** to reach (a number of correct additions).

You will have 5 minutes to attempt the addition task.

The task involves a row of 5 numbers and an empty box.

You are asked to **add** (sum) **together** the 5 numbers in the row and write your answer in the empty box at the end of the row.

You will be paid 25p per correct answer.

Here is an example of what each individual problem looks like:

57	49	79	64	50	**299**

Write your answer here ↑

So you need to add the numbers together like this: 57+ 49 +79 +64 +50 =299

More Examples:

15	23	81	39	90	

72	33	28	51	19	

Your goal:

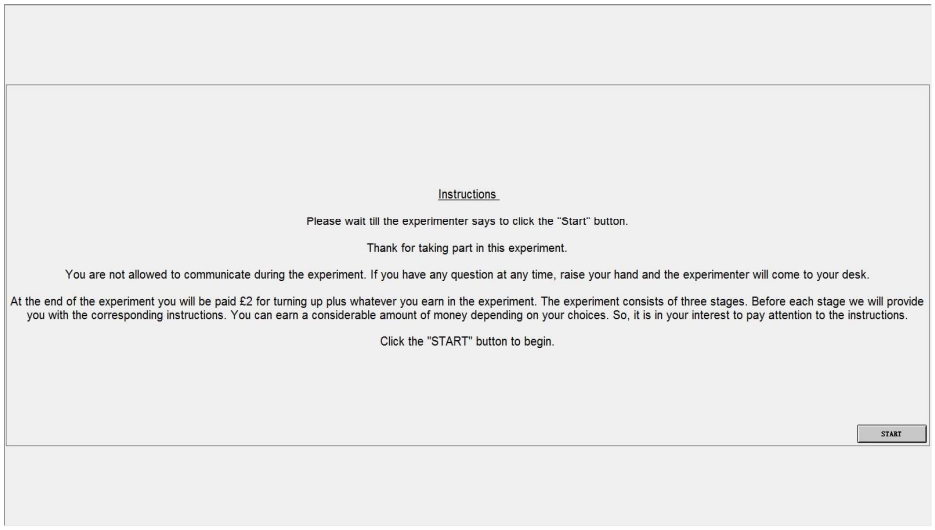
For this task you have a goal to get 15 correct additions.

Please wait until instructed to proceed.

Do not turn this page over until asked to.

Figure 6.4: Goal high addition instructions

6.2 Chapter 3 experiment instructions



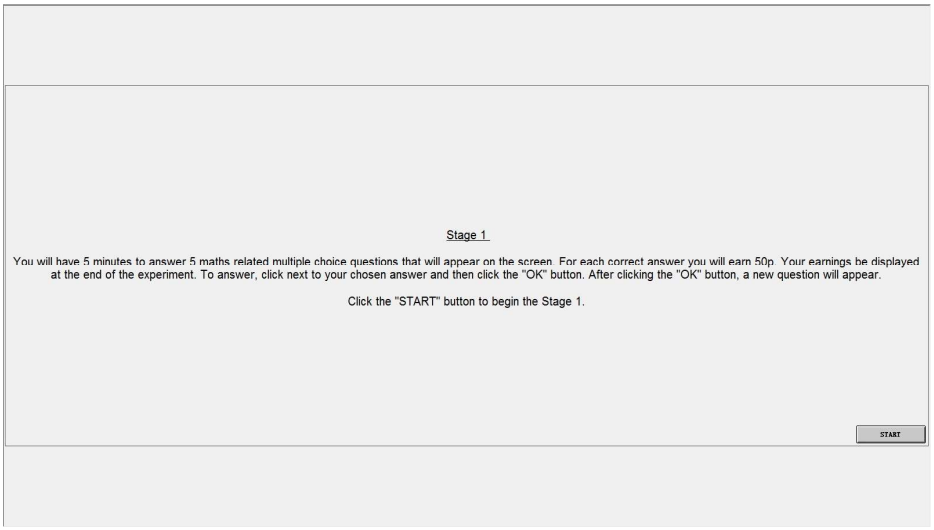
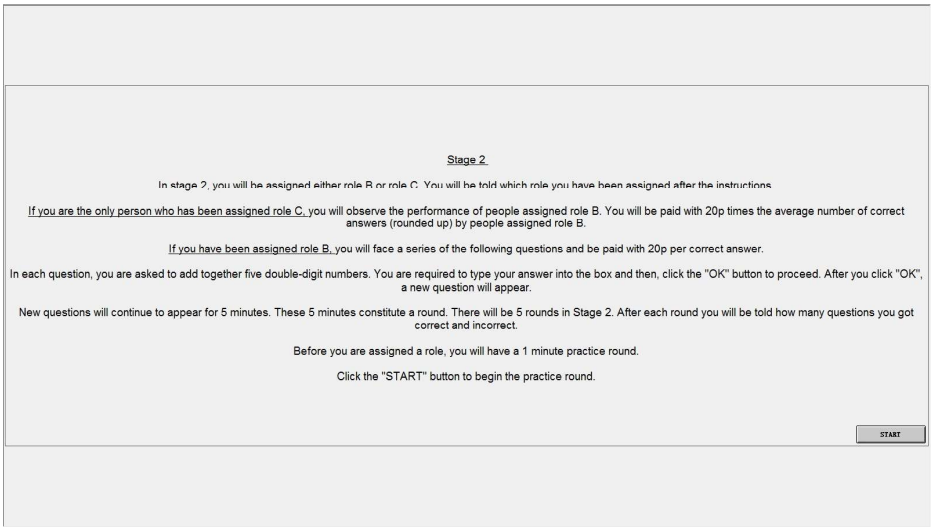


Figure 6.5: Control instructions



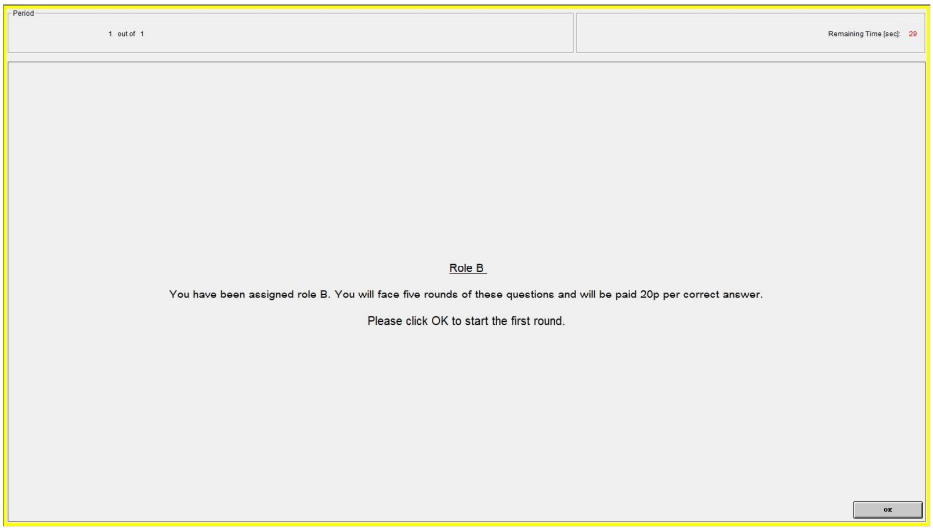
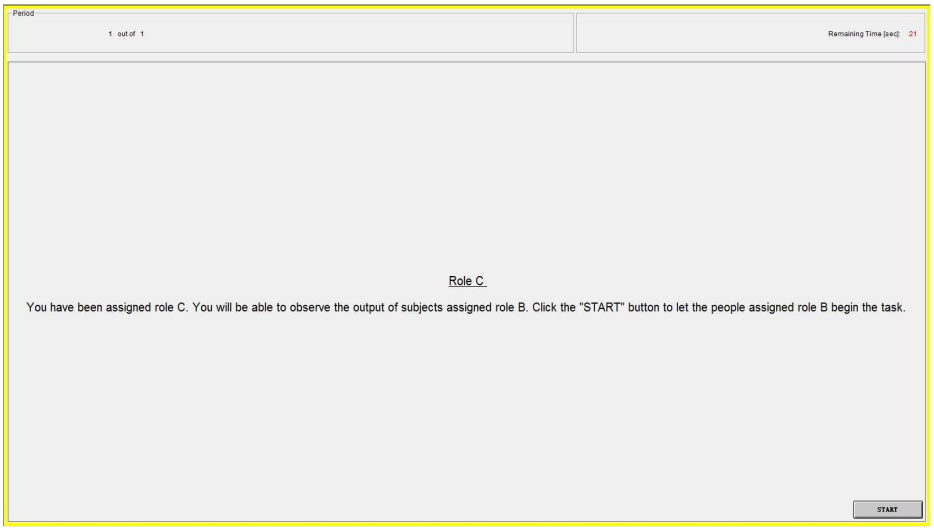


Figure 6.6: Control instructions continued



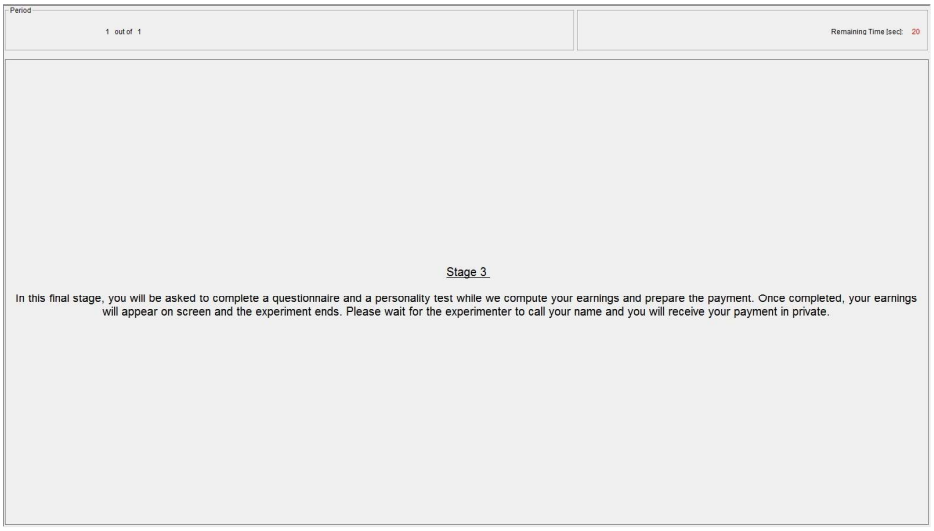


Figure 6.7: Control instructions continued

Figure 6.8: Uniform goals instructions

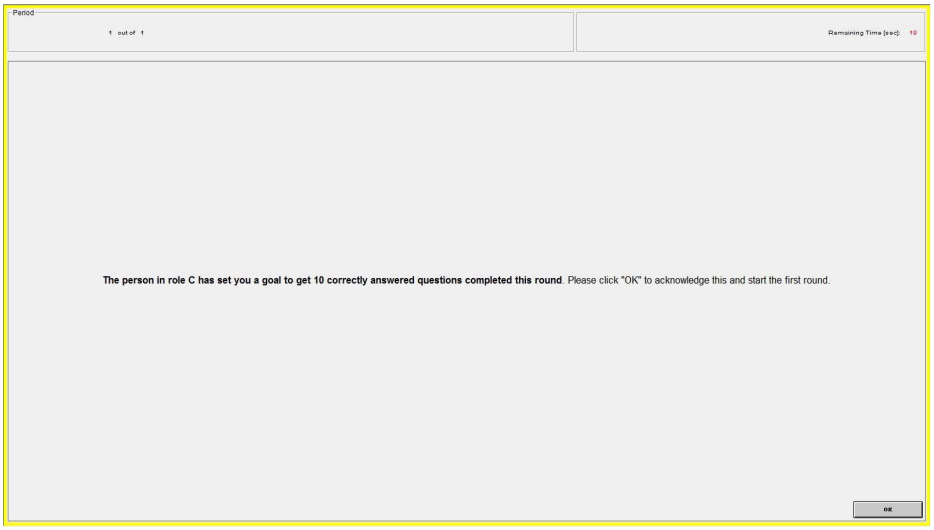


Figure 6.9: Uniform goals instructions continued

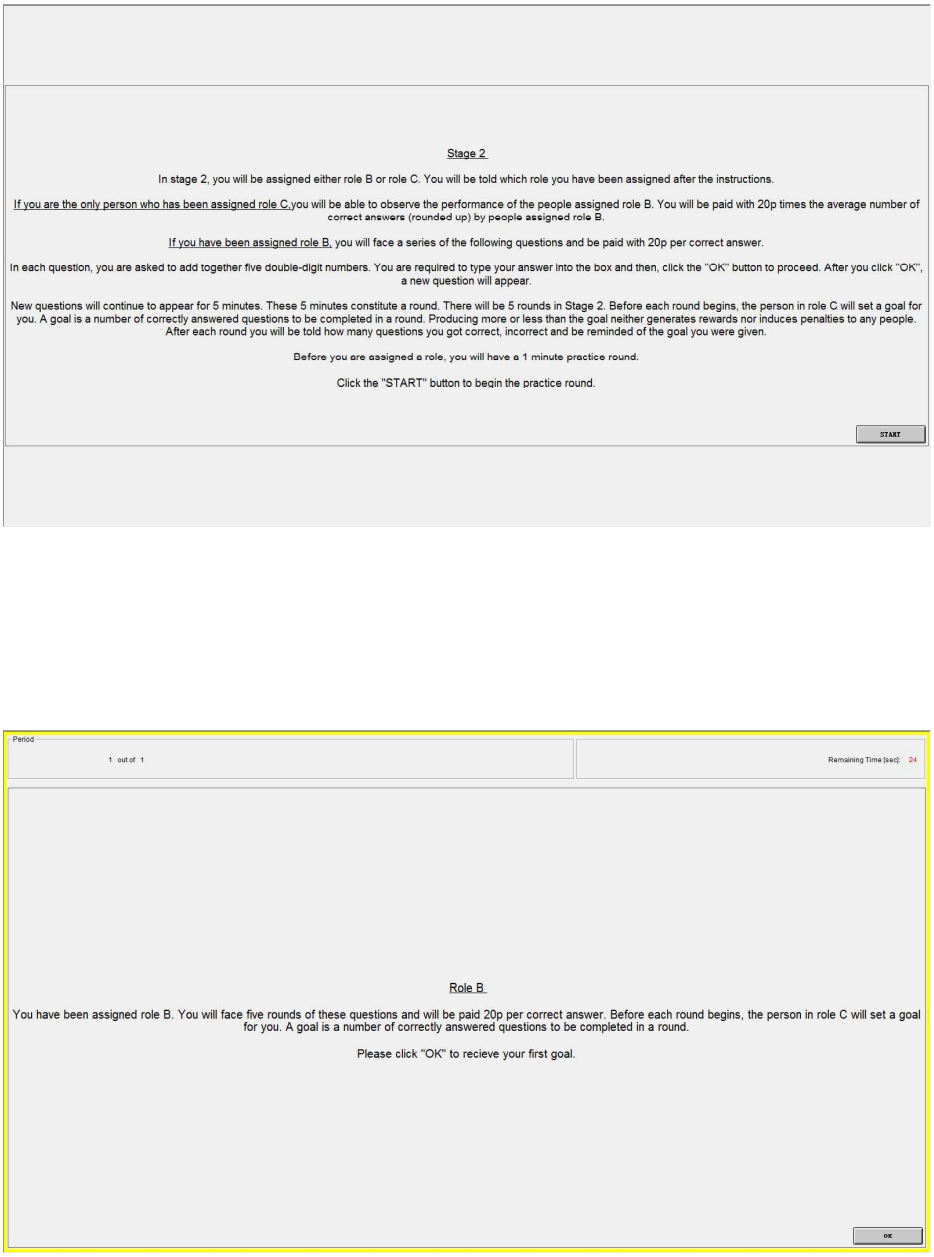


Figure 6.10: Personalised goals instructions

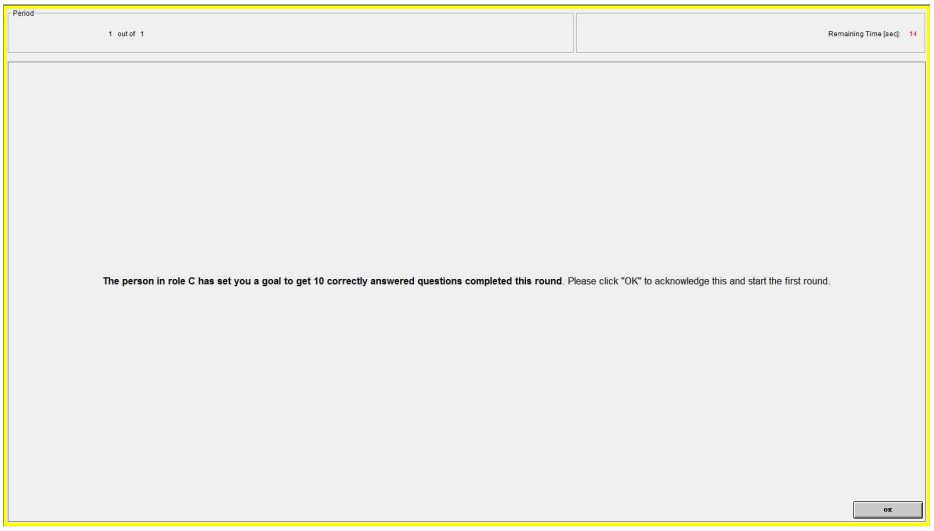
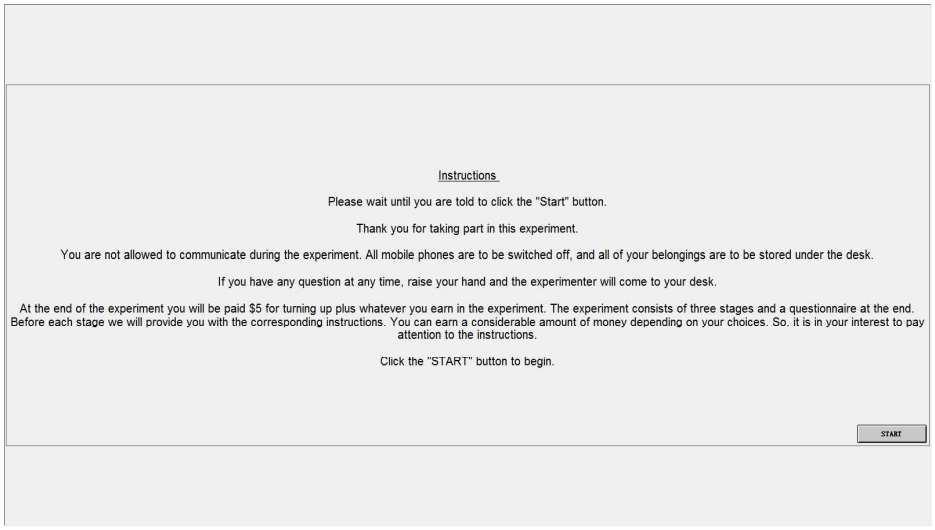


Figure 6.11: Personalised goals instructions continued

Figure 6.12: Personalised goals instructions continued

6.3 Chapter 4 experiment instructions



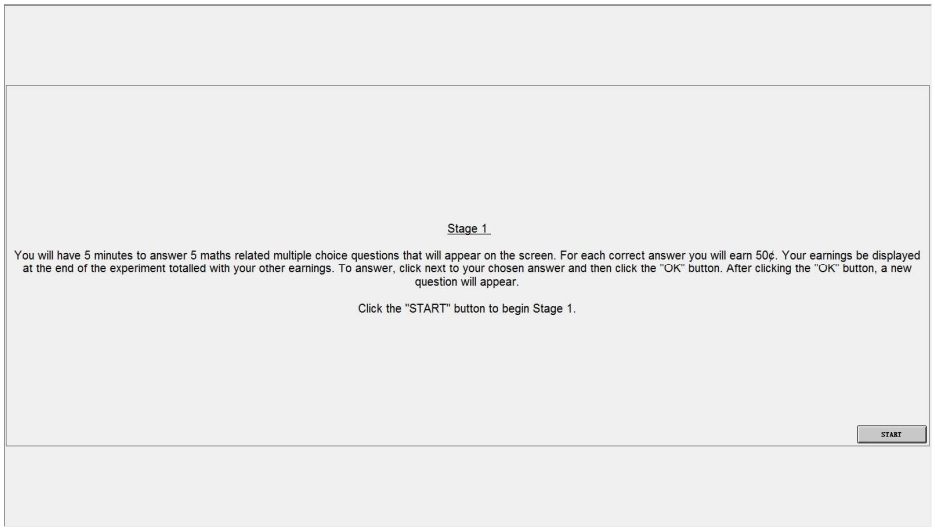
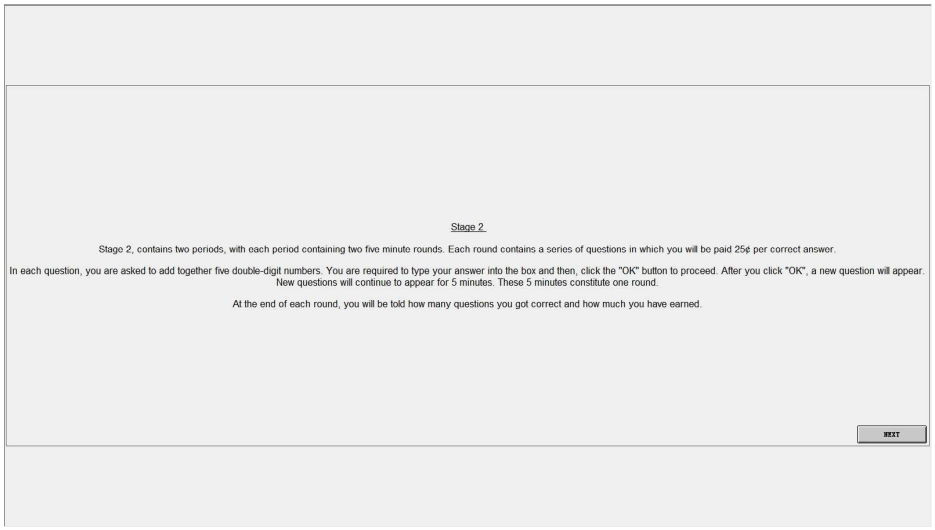


Figure 6.13: Control instructions



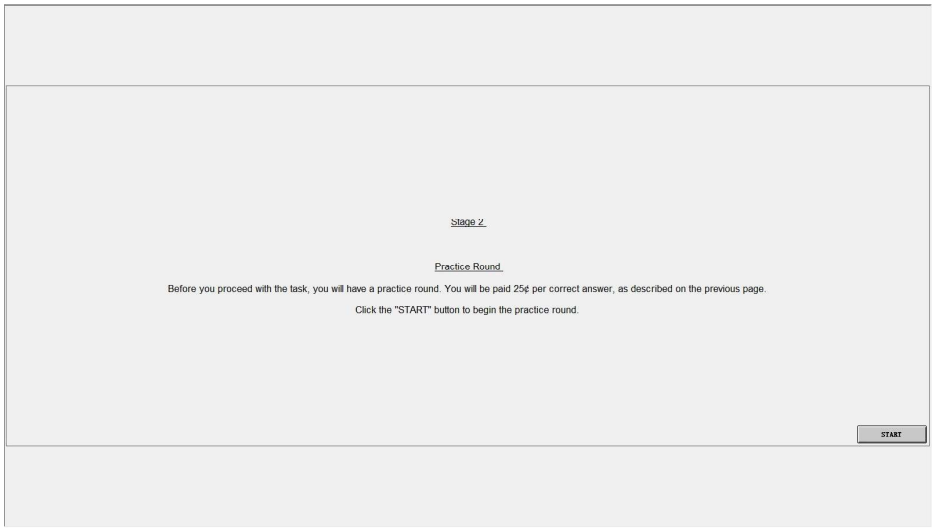


Figure 6.14: Control instructions continued

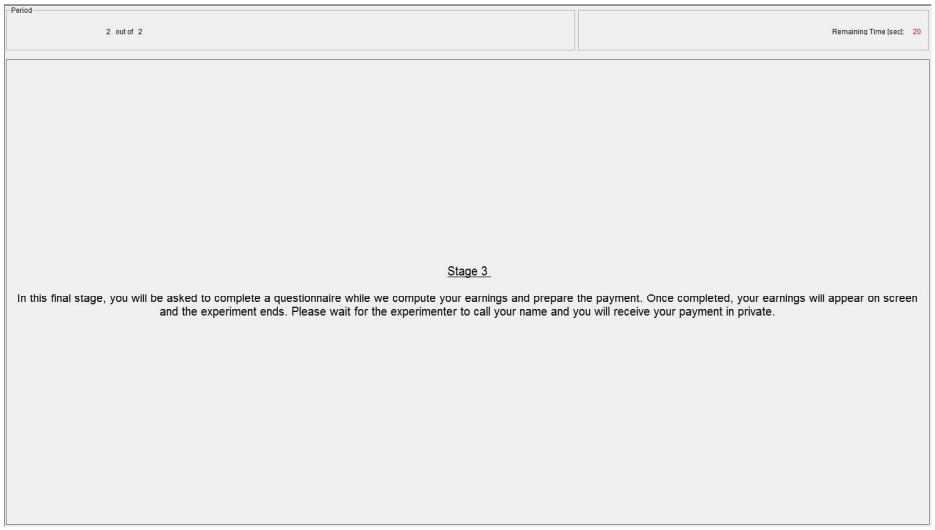
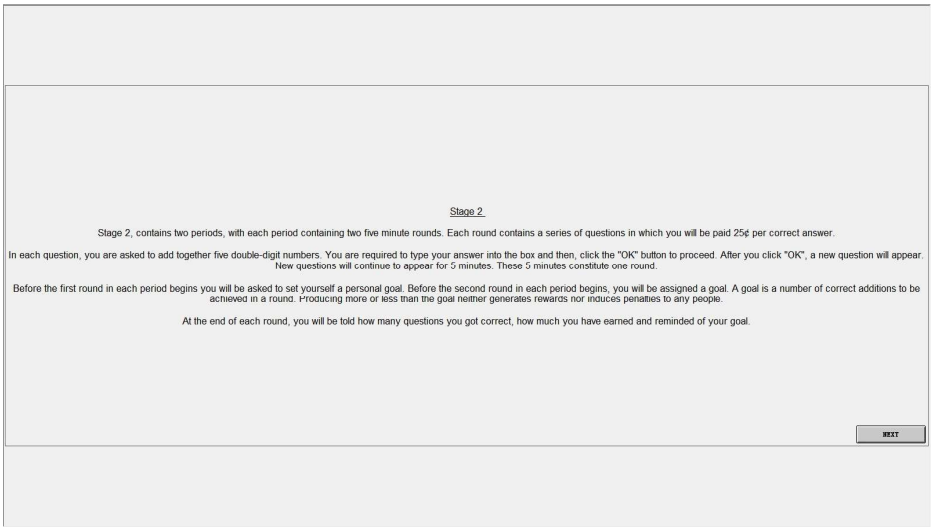


Figure 6.15: Control instructions continued



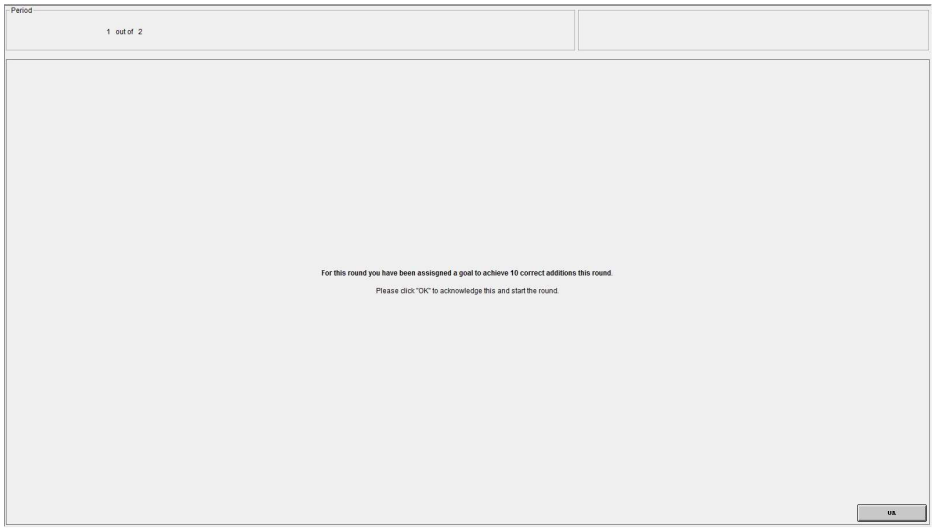


Figure 6.16: Both goal treatment instructions

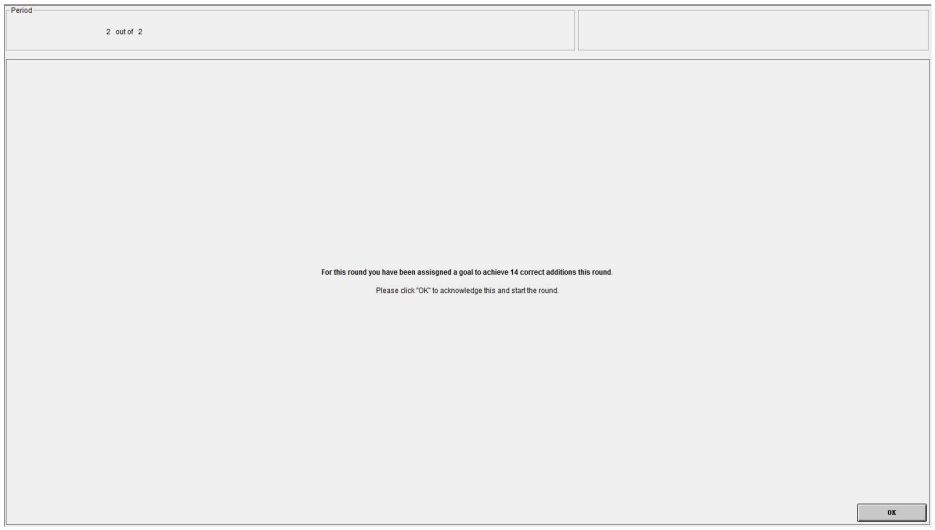


Figure 6.17: Both goal treatment instructions continued

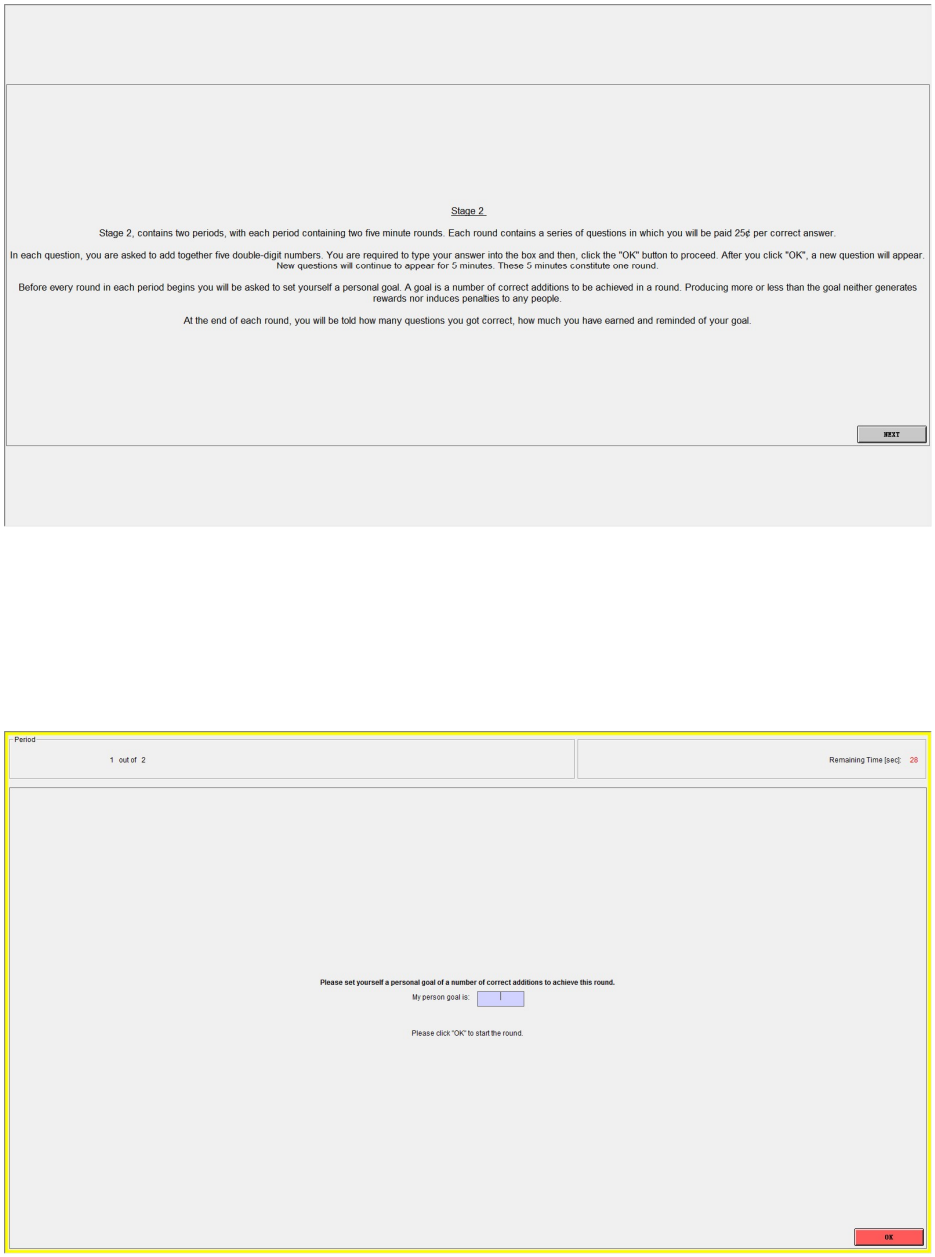


Figure 6.18: Personal goal instructions

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