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Endogenous and Heterogeneous Goal Setting

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Abstract

In this study, we aim to construct a new model of goal setting. Our model includes four features: endogeneity of the goal, influence of the goal on performance, and heterogeneity in responses to high goals. We showed the validity of our model with a laboratory experiment. First, we found that there is heterogeneity in responses to a high goal, as we assumed in the model. That is, there are some subjects who have higher performance with the high goal, while other subjects have lower performance. Second, we showed that people are aware of the relative performance, and the sensitivity for relative performance differs among individuals. Third, we found that the assumption of goal endogeneity can explain the subjects' behavior well. Finally, using the relationship between sensitivity toward externality and the goal that each subject set, we found that performance is influenced by the height of the goal. We found that there is unavoidable heterogeneity and endogeneity, and that a model that includes these features can explain actual human behavior well.

Key words: Goal setting, Relative income, Laboratory experiment

JEL: C91, D03, D01

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1 Introduction

A myriad of goals surround us: individual goals, such as the school of one's choice or a level of savings; firm goals, such as sales targets; and national goals, such as the inflation target or Kyoto Protocol. Do such goals influence our behavior? In this study, we try to answer this question.

Psychological studies under the banner of "goal-setting theory" (Locke, 1968) reveal that goals influence our performance. There are many laboratory experiments in this field, and they show that setting high goals improves subjects' performance. Some studies have also examined features related to goal-setting behavior, for example, being given a concrete goal improves subjects' performance more than just being told to "do your best" (Locke, Cartledge, and Knerr, 1970).

In economics, the role of goals is usually discussed in the context of self-control. Camerer et al. (1997) found that goals change our performance, based on data of the behavior of taxi drivers. Taxi drivers set their daily income target in a way that contradicts economic theory. However, their daily goals have a positive effect on their self-control. Ariely and Wertenbroch (2002) conducted an experiment on the effects of deadlines, and found that a deadline can improve the performance of students and decrease procrastination. They found that a self-set deadline also improves performance, but is less effective than a deadline given by the teacher. Freeman and Gellber (2010) examined how the height of a goal influences performance using an experiment with various tournament prizes. They found that goals that are too high or too low do not improve performance.

It is more likely that we set goals on our own, but these previous economic studies have not uncovered the endogenous mechanism of goal setting. How do we set goals? What goals do we set? These questions are studied in the psychological literature of "level of aspiration," and the level of aspiration can be considered one of the goals. Previous psychological studies have found that there is heterogeneity in the way the aspiration level is constructed, and that the level of aspiration relates to one's personality, such as a tendency toward risk avoidance (Atkinson and Litwin, 1960) or risk-taking behavior (Atkinson, 1957). On the other hand, few economic studies consider the endogeneity and heterogeneity of goal setting. Falk and Knell (2004) developed the endogenous reference group setting model and revealed that ability influences the choice of reference group. There are few studies on goals in economics, but it is an important topic. For example, goal setting is related to individual characteristics that are often discussed in economics, such as risk aversion (Atkinson, 1957) or time discounting (Ariely and Wertenbroch, 2002).

The purpose of this study is to construct a new model of goal setting and to use a laboratory experiment to test the validity of our model. Our model represents a novel approach for four reasons. First, our model assumes that people choose their goals endogenously. Second, our model also assumes that goals influence performance. These two assumptions are based on the findings of goal-setting theory. Third, we consider the heterogeneity in responses to high goals. This heterogeneity shows that some people are encouraged and improve their performance in response to a high goal, while others lose enthusiasm and decrease their performance. Finally, our model also includes heterogeneity in its sensitivity to externalities. In our model, we assume that people obtain utility from both their own performance and the difference between their performances and goals. We consider that some people are very conscious of the goal, while others are not. The latter two heterogeneities come from the findings of existing studies on the level of aspiration, and these heterogeneities are considered an inherent characteristic, much like personality.

This study makes three contributions. First, it is the first economic study that focuses on the endogeneity and heterogeneity of goal setting. By allowing for the unavoidable existence of heterogeneity and endogeneity of reference points, our study describes a more realistic situation and provides a better explanation of actual human behavior than do previous models. As our model can be considered an application of the relative income model, this study contributes to the development of relative income theory. The second contribution is that we focus on internal motivation. In psychology, motivation can be divided into a drive and an incentive (Smith et al., 2003). Drive is the internal factor that triggers or changes our behavior, while an incentive is an external factor. Our study is one of the few economic studies to consider drive, because most previous economic studies focus on incentives.[1] Third, we show the validity of our model using a laboratory experiment. As noted below, we ask about subjective well-being and use it as utility.[2] Thus, our study is one of the few in experimental literature to use subjective well-being effectively.

The rest of this chapter is organized as follows. In section 2.2, we explain our model. Section 2.3 details the method of our experiment, and section 2.4 shows the results and explains how to test each assumption in our model. We present the discussion and conclusions in section 2.5.

2.2 Model

Based on psychological findings, we assumed that a goal can influence our performance, regardless of whether the goal is endogenous or exogenous. As noted in the introduction, we considered two heterogeneities related to goal-setting behavior. One is the heterogeneity in the responses to a high goal, and the other is the heterogeneity of the sensitivity to an externality.

Consider an individual who faces to the utility optimization problem. We assume that the utility depends on absolute performance, as well as the relative performance compared to one's goal. The degree of awareness of the relative performance differs among individuals. Our model is as follows:

$$\max_{g_i} u_i[(1-\alpha_i)y_i + \alpha_i(y_i - g_i)] \tag{1}$$

$$\text{subject to} \quad y_i = f_i(g_i) \tag{2}$$

[1] Note that the present study investigates how the existence of a goal influences our performance. We do not focus on whether people achieve their goal.

[2] Asking about subjective well-being and using it as measurable utility is used in the economics of happiness, which was started by van Praag (1971) and Easterlin (1974).

$$\alpha_i \in \mathbf{R} \tag{3}$$

We assume that the utility function, u_i, is differentiable and satisfies $u' > 0$ and $u'' < 0$. The variable y_i represents the absolute performance of individual i, and g_i is his/her goal. According to the findings of goal setting theory, we assume y_i is a function of g_i, and its functional form differs according to the type of individual. The individual whose performance is enhanced by a high goal satisfies the following inequality:

$$\frac{df_i(g_i)}{dg_i} > 0 \tag{4}$$

We refer to this individual as the "improvement type." On the other hand, the individual who loses enthusiasm and decreases performance under a high goal is referred to as the "decline type." We consider decline types to have the function in equation (5). Inequalities (4) and (5) represent the first heterogeneity, which concerns an individual's reaction to a high goal.

$$\frac{df_i(g_i)}{dg_i} < 0 \tag{5}$$

Then, we represent the secondary heterogeneity, namely sensitivity to an externality, as parameter α_i. We assume that α_i is an exogenous parameter and could have a negative value. Here, α_i denotes the degree to which the relative performance as compared to the person's goal influences his/her utility. The larger the value of α_i becomes, the more individual i is aware of the difference between his/her performance and the goal.

These two heterogeneities and goal endogeneity are closely interlinked, because the first-order condition of equation (1) is as follows:

$$\frac{df_i(g_i)}{dg_i} = \alpha_i \tag{6}$$

Each individual chooses an optimal goal to satisfy equation (6). In addition, both types of individuals need to satisfy inequality (7) for the second-order condition of equation (1).[3]

$$\frac{d^2 f_i(g_i)}{dg_i^{\,2}} < 0 \tag{7}$$

2.3 Experiment

Using a laboratory experiment, we obtained data on performance, goals, and utility. We used subjective happiness as utility. We calculated α_i using the values of u_i, y_i, and g_i obtained from the experiment, and tested the validity of our assumptions.

2.3.1 Task

Various tasks are adopted in goal setting theory experiments, including reaction time, perceptual speed, toy construction, and academic grade achievement. In this study, we used the addition of three 2-digit numbers, as in the study of Locke, Cartledge, and Knerr (1970). While previous studies have used the number of correct answers as a measure of performance, we use the time taken to complete the designated number of additions given the aims of our study. To control for the difficulty of the problem, we only use problems that require a carry over to the next digit in the ten's and one's places. We excluded problems in which the one's digit is 0 after the additions are completed, as well as those that are multiples of ten. There are eight questions in each session, and subjects are required to repeat a question until they give the correct answer. All procedures are performed on computer, but subjects can use paper and pencil to aid their calculations.

2.3.2 Experimental design

[3] See Appendix.

Our experiment has three conditions: (1) a goal-setting condition; (2) a goal-given condition; and (3) a no-goal condition. There are three factors within each subject experiment: four no-goal conditions; two goal-setting conditions; and two goal-given conditions. The order of each session is presented in Table 1.

In the goal-setting condition, subjects first set their target time to solve the eight questions. Next, they solve the questions with their goal on the display. In the goal-given condition, subjects are given goals exogenously and solve the questions with these goals displayed. These exogenous goals are set at 80%, 90%, 100%, and 110% of their own record in session 1 (a no-goal condition). To control for the effects of difficulty and order, the order of these four goal-given conditions is counterbalanced between subjects. The questions are set according to the session number. Thus, all subjects solve the same questions in the no-goal and goal-setting condition, but the questions for the 80% condition are different among individuals because of the counterbalance. The same is true for the 90%, 100%, and 110% condition. In the no-goal condition, subjects solve questions without setting or being given a goal. The presentation order of the eight questions is random for each of the conditions.

2.3.3 Materials

Our experiment was conducted using the original program.[4] The goal-setting condition progresses as shown in Figure 1: (1) subjects input their target time of this session; (2) this target time is then displayed for 5 seconds; (3) there is a countdown from three to zero; and (4) subjects calculate and input each answer. The number of correct answers is shown in the top, right corner of the display, and the difference between the goal and their performance is illustrated using a horizontal bar. Finally, (5) subjects are shown their result time (feedback) for 5 seconds, and (6) they describe their sense of well-being given the current performance. The goal-given condition starts

[4] The experimental program can be downloaded from http://evidence8money.web.fc2.com/endogoal/yss.zip (in Japanese).

from step (2), and the no-goal condition starts from step (3). In the no-goal condition, the display and calculation is denoted as (4)′ instead of (4), as shown in Figure 1. Only the elapsed time is shown in the bottom, right corner of the display with each question.

2.3.4 Procedure

After the general instructions, the subjects completed a trial session. The trial session asked subjects for the eight correct answers using the same method as the real session. Subjects were instructed about each condition before the goal-setting and goal-given conditions. When the eight sessions were finished, the subjects answered the questionnaire. The experiment required approximately 30 minutes per subject.

2.3.5 Subjects and rewards

The experiment was conducted from 30 October to 7 November 2008 at the Graduate School of Economics of Osaka University. The subjects consisted of 40 students from Osaka University (24 male and 16 female). The average age was 21.95 (SD = 1.99); three subjects were foreign students (one male and two female), and seven subjects had some experience in abacus. Twenty-seven subjects were in the Department of Economics, with the rest from other departments (Technology, Literature, and Japanology).

In this experiment, we gave a reward according to absolute performance, not for the achievement of goals. Subjects obtained the fixed rewards (1000 yen[5]) and bonus rewards according to their performance. The bonus ranges from 0 to 125 yen in each session, and from 0 to 1000 yen in total.[6] We instructed subjects about the bonus rewards, keeping specific times and amounts secret

[5] At this time, the exchange rate was about $1 = ¥99.
[6] Subject obtained 125 yen if his/her performance was less than 29 seconds, 100 yen from 30 to 34 seconds, 75 yen from 35 to 39 seconds, 50 yen from 40 to 44 seconds, 25 yen from 45 to 49 seconds, and no reward if it was more than 50 seconds.

until the experiment was finished so that the reward system did not influence their goal-setting behavior.

2.4 Results

2.4.1 Descriptive statistics

We begin by introducing the descriptive statistics. Table 2 represents the average records of each condition. The fastest record is the 80% goal-given condition (given the highest goal condition), and the slowest is the goal-setting condition. We found that, in general, having high goals improves performance.

Then, we show the average time of each session. The average record of session 1 is 50.81 seconds, 47.05 seconds in session 2, 45.01 seconds in session 3, 40.26 seconds in session 4, 44.25 seconds in session 5, 42.56 seconds in session 6, 42.52 seconds in session 7, and 37.28 seconds in session 8. The eighth session is significantly faster than session 1. On the other hand, there is no significant difference between session 8 and the other sessions. This result could be because the questions in session 8 were easier than the others. Thus, we use only the record of session 1, and not session 8, when normalizing the performance, as noted below.

In the following analysis, we use the records in which the sign of the performance time is reversed to more easily interpret our model and these parameters. Therefore, note that a smaller value indicates lower performance and a larger value indicates higher performance, even though we measured performance by speed of calculation.

2.4.2 Heterogeneity in the responses to a high goal

First, we investigate whether there are two types of subjects using 160 data items from the goal-given conditions. Figure 2 shows the relationship between the goal and the performance of all subjects. The vertical axis represents the record, which is normalized using the record of session 1, and its sign has been reversed. From Figure 2, we find that the reactions to a high goal vary among individuals. Some subjects exhibit greater performance with the higher goal, while others have a lower performance. To consider the issue more closely, we regressed the performance on the goal for each subject using only the goal-given condition. The subjects who had a positive coefficient on the goal are the improvement type, and those with a negative coefficient are the decline type. Using OLS estimation, 21 subjects improved, and 19 subjects declined. From Figure 2, for some people there is a nonlinear relationship between goal and performance, not monotonously increasing or decreasing. For example, some people's performance is enhanced by a medium-to-high goal, but is inhibited by a very high goal. Investigating this nonlinearity could be interesting, but is beyond the scope of this study.

We then consider the other type classification using the 110% and 90% conditions. As the goal shown in the goal-given condition is computed from the performance in the no-goal condition (session 1), the 90% condition represents a situation in which the goal is above the subject's ability. Similarly, the 110% condition is a situation in which the goal is within his/her ability. We classify subjects according to whether they performed better under the 90% condition or the 110% condition. If a subject performed better under the 90% condition than under the 110% condition, we consider this person to be the improvement type. If he/she performed better under the 110% condition, we consider him/her to be the decline type. According to this classification, there are 19 improvement types and 21 decline types. In both classifications, half are decline types.[7]

2.4.3 Heterogeneity in sensitivity to an externality

[7] The correlation of both classifications is 0.62, which corresponds at some level, although not completely.

Before examining the heterogeneity in the sensitivity to an externality, we need to examine whether the subjects were aware of their relative performance. If the relative performance does not affect utility, we have the restriction that $\alpha_i = 0, \forall i$ in our model. To test this restriction, we regress equation (1) using the 240 data items from the goal-setting and goal-given conditions. Although the goal is given exogenously in our model that assumes endogenous goal setting, we can estimate α_i using $\bar{g}_i$, y_i and $\bar{u}_i$, because the mechanism u_i still works. However, the subjects cannot maximize their utility under the exogenous goal.[8]

As noted in equation (1), we considered the utility function consisting of both the absolute and the relative performance compared to the goal. To estimate the impact of the relative performance in this section, we specified the utility function as a linear combination of the absolute performance, y_i, and the relative performance , $y_i - g_i$. Therefore, we use the estimation model of equation (8) and test the significance of α_i. If the subjects are aware of only the absolute performance, α_i should be 0.

$$u_i = \beta_1 + \beta_2 (y_i - \alpha_i g_i) \tag{8}$$

Table 3 shows the estimation results. As shown, α_i is positive and significant, irrespective of whether or not we consider the individual attributes. Therefore, we know that the relative performance influences our utility significantly[9]: the lower the goal, the greater is the well-being. The coefficient β_2, the influence of absolute performance, is also positive and significant. In other

[8] If the goal is given exogenously to our model, which assumes endogenous goal setting behavior, we have the following equation: $\bar{u}_i = u_i[(1-\alpha_i) \cdot y_i(\bar{g}_i) + \alpha_i \cdot (y_i(\bar{g}_i) - \bar{g}_i)]$. Here, $\bar{g}_i$ denotes the exogenous goal. As $u_i^* > \bar{u}_i$, subjects cannot maximize their utility. However, the mechanism u_i still works, so we can estimate α_i using $\bar{g}_i$, y_i, and $\bar{u}_i$.

[9] We regress the record on the individual variables, such as sex, age, department, or abacus experience, but there is no significant coefficient at the 5% significance level. The individual attributes do not influence performance.

words, the faster the absolute performance, the greater is the well-being.

Next, we test the validity of including the heterogeneity of sensitivity to an externality. Here, we consider the model that allows heterogeneity in absolute performance, and test the validity of including the heterogeneity in relative performance. Thus, the specification is as follows:

$$u_{it} = \beta_{1i} + \beta_{2i}(y_{it} - \alpha_i g_{it}) \tag{9}$$

If there is no heterogeneity in externality sensitivity, the restriction $\alpha_i = \alpha$ should hold for all individuals in our model. The model that has no heterogeneity is specified in equation (10):

$$u_{it} = \beta_{1i} + \beta_{2i}(y_{it} - \alpha g_{it}) \tag{10}$$

We test this restriction with a likelihood ratio test between equations (9) and (10) using 240 data items from the goal-setting and goal-given conditions. The result of the likelihood ratio test is χ^2 (39) = 113.48, p = 0.000[10], which reveals that there is heterogeneity in the sensitivity to an externality.[11]

Relative performance is often included in utility functions in the context of the relative income hypothesis, but there is no previous model that has considered the heterogeneity of α_i. We represent the variation of α_i here. Figure 3 shows the distribution of α_i, as estimated above. The average α_i is -0.016 (SD = 1.591), the maximum α_i is 1.841, and the minimum is -8.774. There are 23 subjects who have a positive α_i and 16 subjects with a negative α_i. A negative α_i represents the increasing types, who feel happier as goals become higher.

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[10] There is one subject whose well-being is constant during all sessions. We exclude these data, and the estimation uses the 234 remaining data items.

[11] We obtain the same result regardless of the specification of the utility function. We had the same estimation using the logarithmic function of $u_i = \beta_1 + \beta_2 \ln(y_i - \alpha_i g_i)$. The coefficient of α_i is highly significant and its sign is positive. The result of likelihood ratio test is χ^2 (39) = 109.29, and it is significant at the 0.1% level.

There should only be improvement types if $\alpha_i = 0, {}^\forall i$ or $\alpha_i = \alpha, {}^\forall i$ [12]. Thus, we previously rejected these restrictions in section 4.2 by the showing the existence of two types.

2.4.4 Relationship between goals and performance

Finally, we examined the relationship between performance and goals. We consider the case in which the goal is endogenous, but the function f_i does not exist. The model of Falk and Knell (2004) used this case because they considered an endogenous goal, but their production function did not include the goal. If there is no relationship between y_i and g_i, each individual chooses both y_i and g_i independently to maximize his/her utility, as in following equation:

$$\max_{y_i, g_i} u_i[(1-\alpha)y_i + \alpha_i(y_i - g_i)] \quad (13)$$

$$\text{subject to } \alpha_i \in \mathbf{R} \quad (14)$$

There are two ways to verify the relationship between y_i and g_i. One is to determine their relationship directly using regression. The other is to use the first-order condition of equation (13).

We begin with the first method. We specify the functional form, f_i, and examine the relationship between performance and goal using regression. We used three specifications, as follows:

$$y_i = \gamma_1 + \gamma_2 g_i \quad \text{(Specification 1)}$$

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[12] Under the restriction $\alpha_i = \alpha, {}^\forall i$, our model is noted as follows: $\max_{g_i} u_i(y_i)$, subject to $y_i = f_i(g_i)$. To differentiate this equation with respect to g_i, we obtain the following equation using the chain rule: $\partial u_i / \partial g_i = (\partial u_i / \partial y_i) \cdot (\partial y_i / \partial g_i)$. To satisfy the assumptions of the utility function, we need to hold $\partial u_i / \partial g_i > 0$ and $\partial u_i / \partial y_i > 0$. Therefore, all individuals satisfy equation (4); that is, all individuals are of the improvement type under the restriction $\alpha_i = \alpha, {}^\forall i$.

$$y_i = \gamma_1 + \gamma_2 g_i + \gamma_3 g_i^2 \qquad \text{(Specification 2)}$$

$$y_i = \gamma_1 + \gamma_2 \ln g_i \qquad \text{(Specification 3)}$$

Table 4 shows the estimation results. In all specifications, the coefficient of the goal is highly significant, and the sign is positive at the 0.1% level. There is a relationship between performance and the goal, which proves the validity of the assumption of goal endogeneity.

Next, we use the first-order condition of equation (13) to test the relationship between y_i and g_i. Let $w_i \equiv (1-\alpha_i)y_i + \alpha_i(y_i - g_i)$. The first-order condition with respect to g_i is $(\partial u_i / \partial w_i)\cdot(\partial w_i / \partial g_i) = -\alpha_i \cdot (\partial u_i / \partial w_i)$. We know that $(\partial u_i / \partial w_i) > 0$, so the optimal goal, g_i^*, that each subject chooses to maximize utility has a corner solution. Then, people who have a positive α_i take the corner solution with respect to the minimum value, and the people who have a negative α_i take the corner solution at its maximum value. In contrast, if the goal and performance are related each other, g_i^* has an interior solution. There are various g_i^* according to the value of α_i because the first-order condition is as shown in equation (6). Therefore, to confirm whether there is a relationship between the goal and performance, we check the relationship between α_i and g_i^* [13] directly.

The normalized goal is represented as g_i^*. We use the data of the self-set goals in the goal-setting condition. There are two goal-setting conditions, one in session 2 and one in session 7, so we normalize them by dividing by the record in session 1 (the no-goal condition) and calculate

[13] While y_i^* has an interior solution if we include the effort cost, e_i, we also have a corner solution with g_i^*.

the average of the two normalized goals. That is, a g_i^* that is less than 1 means setting a goal at a higher level than the performance in session 1, and a g_i^* greater than 1 means setting a goal that is lower than the performance level in session 1.

The average of g_i^* is 0.918 (SD = 0.115) among the 23 subjects who have a positive α_i and 0.827 among the 16 subjects with a negative α_i (SD = 0.124)[14]. We found it dubious that subjects have a corner solution. Figure 4 shows the scatter plot of g_i^* and α_i and demonstrates that the optimal goals do not have an extreme value, depending on the sign of α_i. This result suggests that the goal and performance interact with each other. Therefore, both methods tested in this section show there is the relationship between performance and the goal.

2.5 Discussion

The purpose of this study was to construct a new model of goal setting and to use a laboratory experiment to test the validity of the model. First, as we consider in our model, there is heterogeneity in the responses toward a high goal. We found that some subjects exhibit higher performance with a higher goal, while others record a lower performance. Second, we showed that people are aware of their relative performance, and that there is heterogeneity in their sensitivity to their relative performance. We revealed these two heterogeneities, which no previous study has examined. Finally, using the relationship between the sensitivity to an externality and the goal that each subject set, we found that performance is influenced by the height of the goal. Thus, the four assumptions of our

[14] The median of g_i^* is 0.909 among the positive α_i subjects and 0.849 among the negative α_i subjects.

model (endogeneity of the goal, influence of the goal on performance, heterogeneity of the sensitivity to an externality, and heterogeneity in response to a high goal) are validated.

Our model can be considered an application of the relative income model. We found that there is unavoidable heterogeneity and endogeneity, and that a model that includes these features can explain actual human behavior well. Future models will need to include such heterogeneity and endogeneity. Our model can also be expanded to a macroeconomic model. It would be interesting to study how the agents who have these heterogeneities affect society as a whole.

In this study, we only considered two types of reactions to a high goal, but we found that there are various ways of reacting to such a goal. For example, some people have nonlinear reactions to a goal. In other words, their performance may improve with a medium-to-high goal, but be inhibited by a very high goal. Further heterogeneities should be considered in future studies.

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Table 1 Order of each condition

Session number	Conditions
1	No goal
2	Goal setting
3	Given goal
4	Given goal
5	Given goal
6	Given goal
7	Goal setting
8	No goal

Table 2 Average records of each condition

Condition		Average time (seconds)
No goal		44.05
Goal setting		44.79
Given goal	Total	43.02
	80%	41.84
	90%	43.60
	100%	43.72
	110%	42.92
Total		43.72

Note: The row of "No-goal" shows the average of session 1 and 8, and "Goal-setting" lists the average of session 2 and 7.

Table 3 Estimation result of utility

(Dependent variable is well-being)

	Default		With attributions	
	Coef.	p-value	Coef.	p-value
α_i ; Relative performance	0.568	[0.000]**	0.626	[0.000]**
β_1 ; Constant	3.190	[0.000]**	1.407	[0.010]**
β_2 ; Absolute performance	0.000	[0.000]**	0.000	[0.000]**
Male			-0.215	[0.024]*
Age			0.089	[0.000]**
Economic student			-0.191	[0.060]
Abacus experience			0.137	[0.263]
Foreign student			-0.201	[0.266]

Note: ** and * denote 1% and 5% significance, respectively.

Table 4: The estimation results of three specifications

(Dependent variable is records)

	Specification 1		Specification 2		Specification 3	
Variables	Coef.	p-value	Coef.	p-value	Coef.	p-value
Goal	0.406	[0.000]**	0.935	[0.000]**		
Goal Squared			-0.00004	[0.007]**		
log Goal					2384.681	[0.000]**
Constant	2341.946	[0.000]**	915.424	[0.111]	-15710.3	[0.000]**
Individual var.	No		No		No	

Variables	Coef.	p-value	Coef.	p-value	Coef.	p-value
Goal	0.391	[0.000]**	0.932	[0.000]**		
Goal Squared			-0.00004	[0.008]**		
log Goal					2304.523	[0.000]**
Constant	3060.828	[0.015]*	1492.694	[0.271]	-14617.7	[0.000]**
Individual var.	Yes		Yes		Yes	

Note: ** and * denote 1% and 5% significance, respectively.

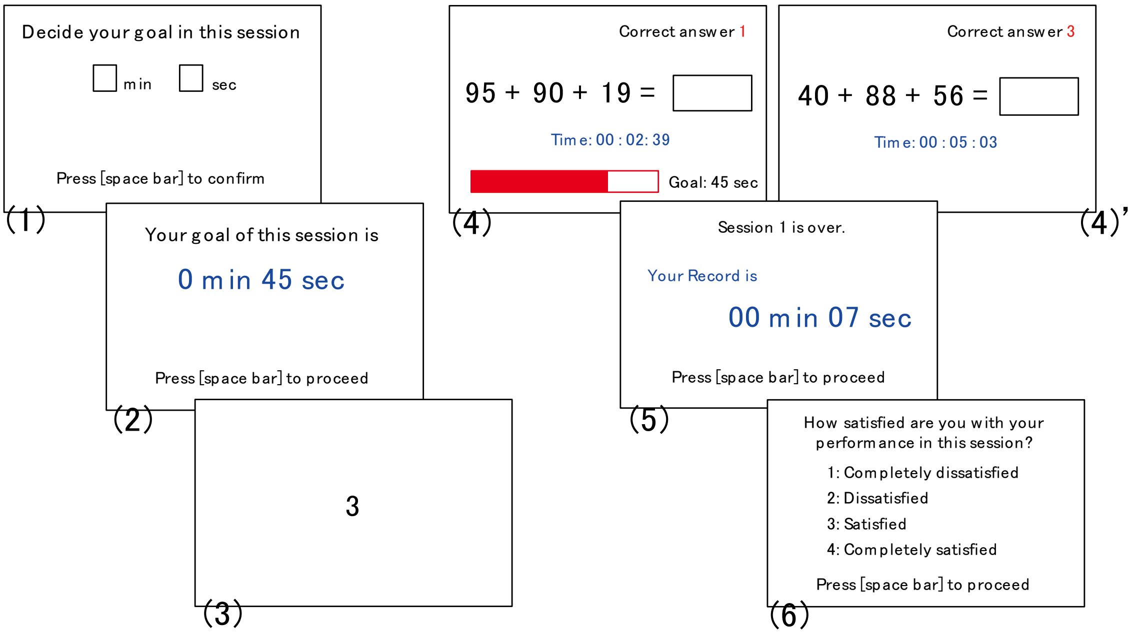

Figure 1 Flow of experimental program

The goal-setting condition goes with (1), (2), (3), (4), (5), and (6), while the goal-given condition goes with (2), (3), (4), (5), and (6). The no-goal condition follows (3), (4)′, (5), and (6).

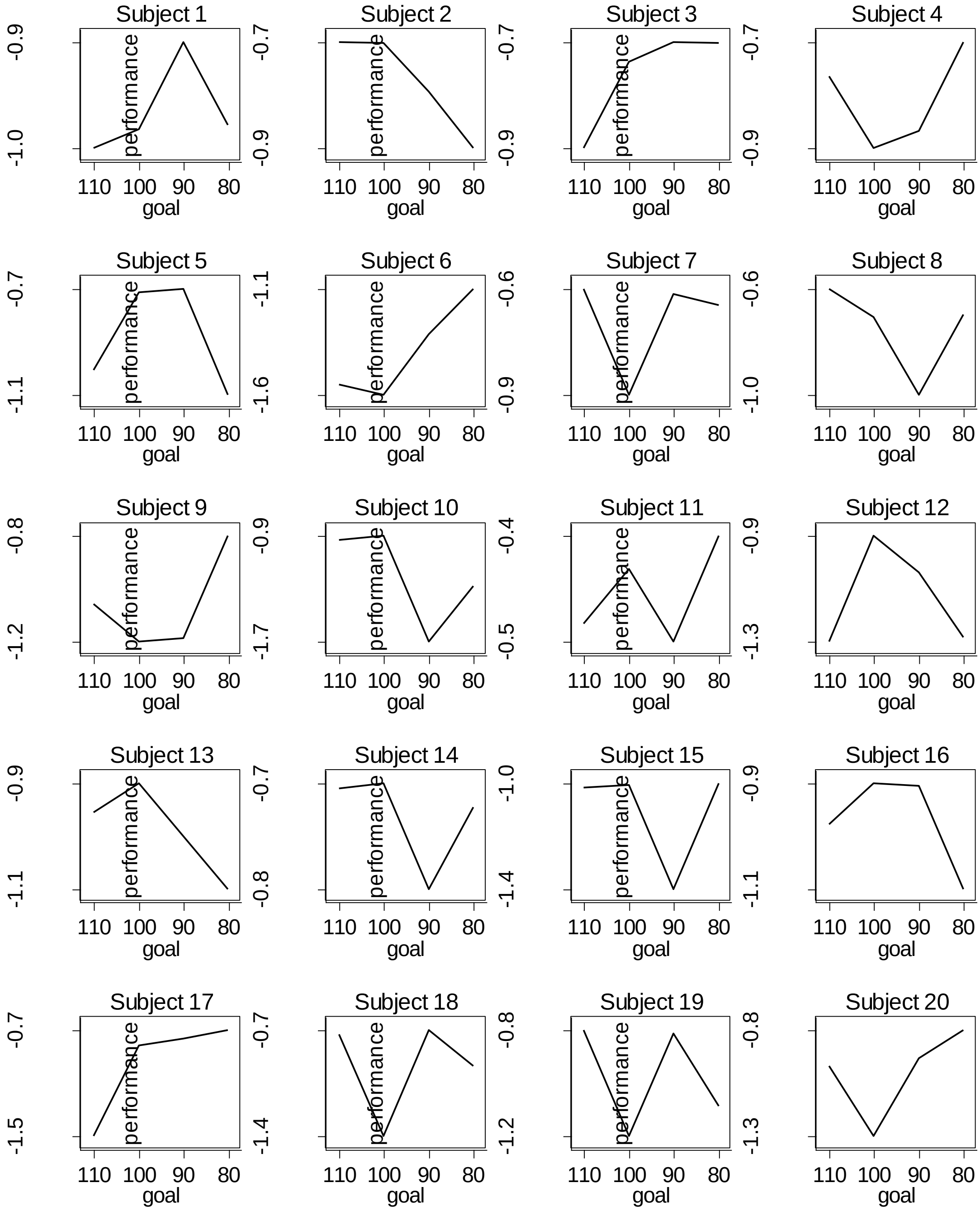

Figure 2: Shape of f_i**.**

Vertical axis is normalized performance by the record of session 1; horizontal axis is height of goal.

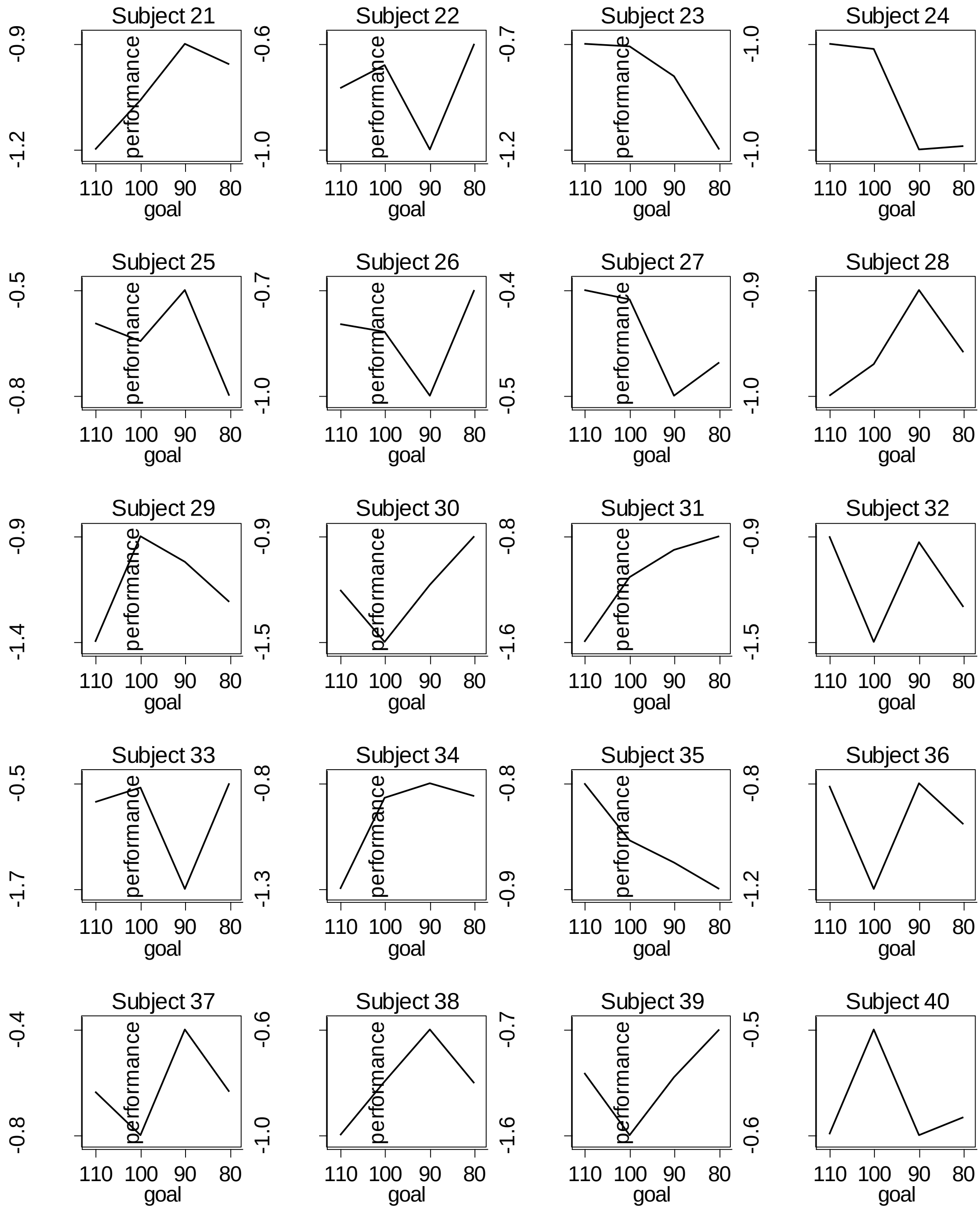

Figure 2 (Cont.)

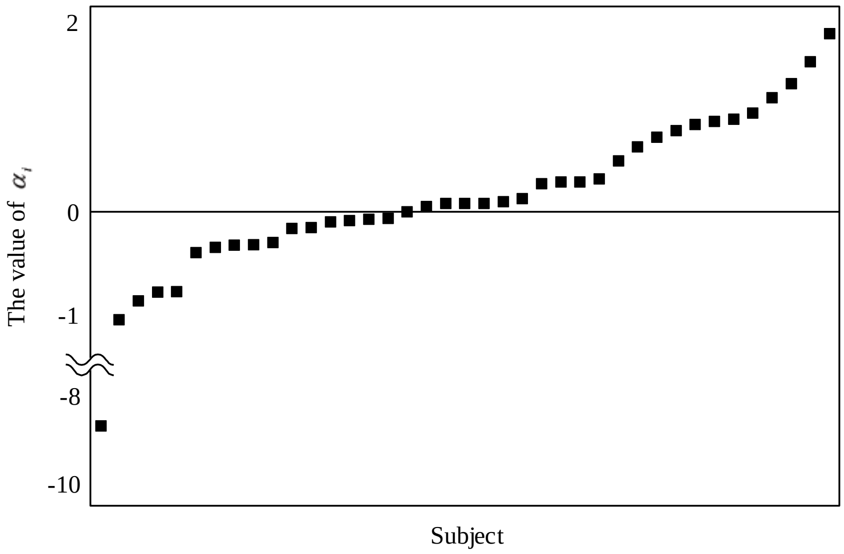

Figure 3: Distribution of α_i.

Vertical axis shows the values of α_i; horizontal axis is the subjects. Sorted by the values of α_i.

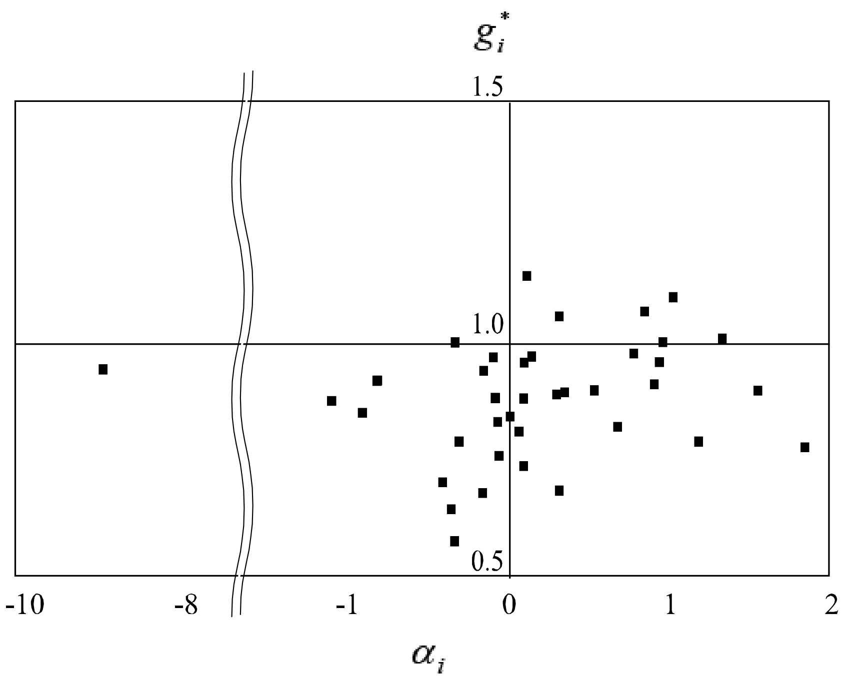

Figure 4: Scatter plot between g_i^* and α_i.

Vertical axis shows g_i^*; horizontal axis is α_i.

Appendix : First-order condition and second-order condition of equation (1)

Each individual solves the following problem:

$$\max_{g_i} u_i[(1-\alpha_i)y_i + \alpha_i(y_i - g_i)] \qquad \text{(A1)}$$

$$\text{subject to} \quad y_i = f_i(g_i) \qquad \text{(A2)}$$

Let $w_i \equiv (1-\alpha_i)y_i + \alpha_i(y_i - g_i)$. We have the following two assumptions with respect to the utility function, u_i:

$$\frac{du_i}{dw_i} > 0 \qquad \text{(A3)}$$

$$\frac{d^2u_i}{dw_i^{\,2}} < 0 \qquad \text{(A4)}$$

The first-order condition is as follows:

$$\frac{du_i}{dw_i} \cdot \left(\frac{df_i}{dg_i} - \alpha \right) = 0$$

Then, we have:

$$\frac{df_i}{dg_i} = \alpha_i \qquad \text{(A5)}$$

The second-order condition is follows:

$$\frac{d^2u_i}{dw_i^{\,2}} \cdot \left(\frac{df_i}{dg_i} \right)^2 + \frac{du_i}{dw_i} \cdot \frac{d^2 f_i}{dg_i^{\,2}} < 0$$

From (A3) and (A4), the sufficient condition for (A5) to give an optimal solution is:

$$\frac{d^2 f_i}{dg_i^{\,2}} < 0 \qquad \text{(A6)}$$