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Abstract

The purpose of our study is to verify the argument of Cappelen et al. (2007) that insists on the pluralism of fairness ideals. Their experiments are based on the dictator game with production, and they suggest that three fairness ideals exist: strict egalitarianism, libertarianism, and liberal egalitarianism. However, because of the characteristics of the dictator game, the egoistic behavior of taking all of the endowments is a reasonable decision and cannot be ignored. In this paper, we show by estimation of modified models that strict egalitarians do not exist but that egoists do. We assume that people who follow different fairness ideals also place different weights on fairness, and we separate the weight parameter by the three fairness ideals. Especially in the case of strict egalitarianism, the estimated value of the weight parameter indicates that strict egalitarians behave like egoists who take all of the total product. This result implies that people rarely follow the strict egalitarian ideal under this kind of dictator game with a production phase and, instead, a high proportion of egoists take the total product without considering any fairness ideals.

Keywords: Fairness, Distributional Preferences, Dictator game

JEL Classification: C91 , D63 , D91

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- **Code availability**
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1 Introduction

Fairness ideals are pluralistic. Cappelen et al. (2007) show the coexistence and pluralism of fairness ideals through dictator games preceded by a production phase (Konow, 2000). They assume that an individual favors one of three fairness ideals: strict egalitarianism, libertarianism, or liberal egalitarianism. Strict egalitarianism insists that all inequality should be eliminated and seeks equality of outcomes regardless of individual performance or productivity, as in the models of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). Libertarians, whose views are philosophically based on Nozick (1974), place individual ownership first, claiming that people are responsible for all factors affecting their income, even if some factors are shaped by luck. Thus, each individual has the right to own his or her outcome. The liberal egalitarian fairness ideal, which is similar to Konow (2000)'s accountability principles, asserts that fair distribution should be based on an individual's choice or efforts while excluding the role of those that he or she cannot reasonably influence, that is, randomly assigned factors (e.g., a physical handicap). Cappelen et al. (2007) establish a choice model that describes the tradeoff between the ideal offer in the dictator game according to each of three fairness ideals and selfishness. Then, they estimate the distribution of outcome corresponding to the three fairness ideals and show the pluralism of fairness ideals followed by their experimental participants.

Different fairness ideals coexist in society, but the proportions of those espousing these fairness ideals are not constant in the population. Various experimental studies examined which socioeconomic factors influence the distribution of adherence to the three fairness principles by means of the experimental design and choice model of Cappelen et al. (2007). Almås et al. (2017) observe an effect of family background on the subject's choice of a fair distribution. They show that the proportion of liberal egalitarians was significantly higher than that of strict egalitarians in a group with high parental income and education levels. Cappelen et al. (2013) show that the predominant fairness principle differs between high-income and low-income countries. High-income countries have a much higher percentage of liberal egalitarians than of strict egalitarians, but in low-income countries, the percentages of strict egalitarians are higher than those of liberal egalitarians. Almås et al. (2010) conduct an experiment on children and adolescents, showing that the distribution of adherence to fairness ideals varies according to human development, that is, with age. As the grade increases, the proportion of strict egalitarians decreases, and the proportion of liberal egalitarians increases. These studies add a real-effort task in the production phase to Cappelen et al. (2007)'s experiments, so each subject's actual efforts determine the size of his or her group's endowment to be distributed. These studies suggest that the distribution of adherence to fairness ideals in the population may differ depending on the situation in each society. In general, it seems that the higher education and average income are, the more people choose the fairness ideal that values individual efforts or performance, namely, liberal egalitarianism.

Research on the factors affecting the distribution of adherence to fairness ideals in the population is important because it can help explain different choices of or conflicts over distribution policies across and within societies and organizations. However, studies based on Cappelen et al. (2007)'s estimation model are subject to critique. Essentially, the experiments in these studies are dictator games (Forsythe et al., 1994). In the dictator game, the receiver has no right to reject the dictator's offer, so the dictator's dominant strategy is to take all of the endowment. Although other previous experimental studies that include a production phase with real-effort tasks show that the dictator increases the receiver's share according to the latter's performance (Ruffle, 1998; List, 2007; Mittone and Ploner, 2012), over 20 percent of dictators still make the selfish choice, taking everything. However, in any studies based on the experimental and estimation method of Cappelen et al. (2007) above, the proportion of strict egalitarians never falls below 20 percent, and it seems that no subjects make selfish choices. In Cappelen et al. (2011), this point is revealed indirectly. They compare the self-reported data on subjects' adherence to fairness ideals and the estimation results. In the cases of the libertarian and liberal egalitarian fairness ideals, the proportions of subjects who follow each ideal in the preexperimental questions and the estimated proportions of adherents to the two ideals found in the experimental data are not significantly different. However, in the case of strict egalitarianism, less than 10 percent of subjects answer that they prefer this ideal in the preexperimental questions, but more than 20 percent of subjects are estimated to be strict egalitarians from the experimental data. Rodriguez-Lara and Moreno-Garrido (2012) and Ubeda (2014) also criticize Cappelen et al. (2007)'s results, arguing that few subjects consistently follow the specific fairness principle, but, rather, people tend to follow different principles in self-serving ways. People choose the fairness principles that give them higher payoffs depending on their performance and randomly assigned productivity. Therefore, they conclude that fairness ideals seem to be context dependent.

Against this background, we attempt to more accurately estimate the distribution of adherence to fairness ideals. Our study is based on Cappelen et al. (2007) and Almås et al. (2010), and we add some modifications to the experiments and estimation models. First, we use the finite mixture model (Moffatt, 2015). Previous studies have estimated the distribution using mixed logit with repeated choice (Revelt and Train, 1998) because the data on the dictator's offer are discrete. In these experiments, each subject chooses his or her own share from the given options, where, for example, the choice set includes multiples of 50. However, in our experiments, each subject can input his or her distribution of total production within the integer range. Since we widely expand the subjects' options, we use the finite mixture model (Moffatt, 2015). Second, we assume that the parameter representing the weight on the fairness ideal (β in Cappelen et al. (2007)) can reveal the characteristics of each fairness ideal. This is a point of difference with respect to Cappelen et al. (2007)'s assumption that since β is an individual characteristic, they can estimate only the distribution of β. Based on our assumption for β, we set different parameters (β^{SE}, β^{L}, and β^{LE}) in each fairness ideal model. Through these parameters, it is possible to compare how important each group of subjects following the same fairness ideal considers their ideal to be. Because we cannot conduct our analysis using the original data of Cappelen et al. (2007), we design and conduct our own experiments based on the experiment of Almås et al. (2010), which adds the real-effort task to Cappelen et al. (2007)'s experimental design.

The main results of our study are as follows. First, regarding the estimation of the weight assigned to the fairness ideal (β), strict egalitarians not only place a considerably lower weight on their ideal but also consequently exhibit egoistic behavior, namely, taking all of the group product. Moreover, weight parameter of liberal egalitarians is the largest, at over four times the magnitude of strict egalitarians. This result indicates that the importance of the fairness ideal differs based on which ideals people espouse. Second, from the first result, we can conclude that strict egalitarians do not actually exist, and instead, there is a considerable proportion of egoists. This may be an objection to the argument made by Rodriguez-Lara and Moreno-Garrido (2012) and Ubeda (2014) that people choose fairness ideals in self-serving ways—that is, that they seem to change their fairness ideals to maximize their payoffs rather than adhering to a specific ideal. We show that the proportion of egoists is quite high; moreover, we are able to document that approximately 60 percent of subjects hold the liberal egalitarian and libertarian fairness ideals. Third, by using the posterior type probability, we compare the fitness of the estimations from Cappelen et al. (2007)'s model and our modified models. Our own models that include egoists provide more accurate predictions of the observations and thus offer a better explanation for the pluralism of fairness ideals within the population.

This paper proceeds as follows. In Section 2, we describe the experimental design based on Cappelen et al. (2007) and Almås et al. (2010). Section 3 provides the details of the choice model and the three fairness ideals, and

Section 4 explains the estimation models of Cappelen et al. (2007) and our modifications. Section 5 presents the results, and Section 6 gives a summary and conclusions.

2 The Experiments

Our experiments are based on the experiments of Almås et al. (2010) that add a real-effort task to Cappelen et al. (2007)'s experiments. The experiments consist of two phases: the production phase with a real-effort task and the distribution phase.

After seating all participants, we distributed the instructions for the production phase only, and the computer read the instructions aloud. In this phase, each participant participated in the real-effort task, which was the slider task of Gill and Prowse (2012). This slider task can be performed simply on a computer in the laboratory, and it is easy to understand and less affected by individual skills (Charness et al., 2018). At the beginning of this task, all 48 sliders were positioned at 0. By using the mouse, the subject could move each slider to any location between 0 and 100. The subject obtained points in the task based on the number of sliders positioned at 50 at the end of the allotted time. We first conducted an exercise task, the allotted time for which was 120 seconds. Next, the new slider task was conducted for 120 seconds in sessions 1–3 and for 150 seconds in sessions 4–7. When the time was up, the result screen was shown. It included the points from the slider task (we call these point individual i's effort, q_i); the rate of return, which was randomly assigned to be high or low (we call this i's productivity, $a_i \in \{2, 4\}$); and the individual's output (x_i), which was the product of individual productivity a_i and effort q_i ($x_i = a_i q_i$). To prevent productivity from affecting the performance on the slider task, we presented each subject's productivity on the result screen after the tasks were finished.

After all participants checked their results from the production phase, the instruction for the distribution phase were distributed and read by the computer in the same way. In this phase, subjects with different productivity levels were randomly paired and made distribution decisions. The sum of own output (x_i) and the partner's output (x_j) became the group's total product ($X_i = x_i + x_j$), and each subject decided how to distribute the total group product to himself or herself and the partner. In this phase, each subject was informed of his or her own and the partner's points from the task (q_i, q_j), the rate of return (a_i, a_j), and output (x_i, x_j). This distribution decision was repeated for six rounds with perfect stranger matching, and the partner's decision was not provided. All participants knew that both subjects would make decisions independently as a dictator and that they would not be matched with the same partner again. The payment was the sum of two distribution results selected according to the following procedure: 1) we randomly selected two rounds out of the six, 2) we randomly selected one of the two subjects'

Table 1 Summary of Sessions

Session number	Time limit of the production phase	Average efforts	Average time per correct slider	Total number of subjects
1 – 3	120 seconds	15.43	7.78	79
4 – 7	150 seconds	17.76	6.78	82
Total				161

distribution decisions in the two selected rounds, 3) we summed the results of the two selected distribution decisions and paid each subject.

The experiments were conducted at Waseda University in October 2019, January 2020, and April and June 2021. We ran seven sessions with 18 to 30 subjects in each session, and all 161 participants were students in various majors from Waseda University (Table 1)[1]. The experiments were computerized with z-Tree (Fischbacher, 2007). Each session lasted 60 minutes, and the show-up payment was ¥800 (≈ \$7.3), and average earnings were ¥1222 (≈ \$11.2)[2].

3 The Choice Model

In the choice model of Cappelen et al. (2007), individual i trades off the amount for himself or herself (y_i) and the amount corresponding to his or her ideal fair distribution ($m^{k(i)}$), as in the following utility function.

$$V_i^{k(i)}(y_i) = y_i - \beta_i \frac{(y_i - m^{k(i)})^2}{2X_i} \tag{1}$$

where y_i is the offer for himself or herself (and $X_i - y_i$ is for his or her partner); $m^{k(i)}$ is a fairness ideal, which is the amount that i considers his or her fair income; $\beta_i (\geq 0)$ is the weight assigned to fairness; and X_i is the total product of i's group to be distributed. i's optimal offer for himself or herself is as follows by the first-order condition:

$$y_i^* = m^{k(i)} + \frac{X_i}{\beta_i}. \tag{2}$$

If $\beta_i = 0$, he or she is not interested in fairness at all, so he or she chooses to take all of X_i. However, the upper bound of y_i is X_i ($y_i \leq X_i$), and there exists $\beta_i \neq 0$ that derives the optimal $y_i^* = X_i$, the selfish choice. In this case, the optimal choice of a strict egalitarian and an egoist are indistinguishable in the results of our experiments. Thus, our new models exclude the strict egalitarian ideal and adopt the egoistic ideal.

There are three fairness ideals as mentioned in Section 1. First, by the strict egalitarian (SE) ideal, the outcome must be distributed equally ($m^{SE(i)}$). Second, according to the libertarian (L) ideal, each individual has the right to

[1] We had 162 participants in total, but we excluded the data on one outlier who distributed all of the total product to his or her partner.

[2] We convert Japanese yen into US dollars at the exchange rate of \$1=¥109, which was the average rate at the time that the experiments were conducted, October 2019, January 2020, and April and June 2021.

his or her own output because both his or her productivity and effort are due to the individual ($m^{L(i)}$). By the liberal egalitarian (LE) ideal, each individual is responsible only for his or her choice or effort, and the effects of luck should be excluded ($m^{LE(i)}$). In addition, we include the egoistic (EGO) ideal in our new model, according to which taking all is a reasonable choice when possible ($m^{EGO(i)}$). The fair shares under each fairness ideal are as follows:

$$
\begin{aligned}
m^{SE(i)} &= \frac{X_i}{2} \\
m^{L(i)} &= a_i q_i \\
m^{LE(i)} &= \frac{q_i}{q_i + q_j} X_i \\
m^{EGO(i)} &= X_i
\end{aligned}
$$

where q_i is the level of effort (in our experiment, total points from the slider task), a_i is productivity (in our experiment, the rate of return, high or low), and X_i is the total product of group i.

4 Finite Mixture Model Estimation

In our experiments, since the distribution decisions of subjects are continuous variables, mixed logit with repeated choices (Revelt and Train, 1998), which is used in Cappelen et al. (2007) and Almås et al. (2010), cannot be applied for our estimation. Thus, the estimation is conducted by the finite mixture model Moffatt (2015). This model estimates the distribution of multiple behavioral models by adapting them to the estimation. There are various approaches to the estimation of the finite mixture model, but Moffatt (2015)'s approach is adopted in our study as follows: First, the models of the three fairness ideals are decided, and a label is assigned to each. Second, a parametric model is specified for the behavior corresponding to each ideal. Third, the parameters of these three models are estimated jointly, along with the "mixing proportion"—the proportion of the subjects who follow each ideal. Finally, we determine the posterior probability of each subject following each ideal[3]. Specifically, we modify one assumption from Cappelen et al. (2007). In Cappelen et al. (2007), they assume that the parameter (β_i) is an individual variable, so they estimate only the approximate distribution of β_i by a log-normal distribution. However, we assume that the importance that a person assigns to fairness can be considered a characteristic of the group of subjects who follow the same fairness ideal. Thus, we separate the parameter β by fairness ideal, such that β^{SE}, β^{L}, and β^{LE}. In this section, we describe the estimation models.

[3] However, we cannot identify any subject's fairness ideal with certainty.

4.1 The Previous Empirical Model (Model P) of Cappelen et al. (2007)

First, we estimate the mixing proportion of the three fairness ideals by adopting Cappelen et al. (2007)'s method that estimates the integrated β. Cappelen et al. (2007) assume that β_i follows a log-normal distribution, and the average value of $\log(\beta)$ is estimated. However, since our study assumes the existence of $\beta_i > 0$ in which the egoistic offer $y_i^* = X_i$ becomes optimal as explained in Section 3, we estimate β without applying the log. Therefore, from the choice model in Section 3, the optimal offer y_i of each type including the error term is as follows:

1) Type 1 (Strict egalitarian, SE)

$$y_i = \frac{X_i}{2} + \frac{X_i}{\beta} + \epsilon_{1,i}^P. \tag{3}$$

2) Type 2 (Libertarian, L)

$$y_i = a_i q_i + \frac{X_i}{\beta} + \epsilon_{2,i}^P. \tag{4}$$

3) Type 2 (Liberal egalitarian, LE)

$$y_i = \frac{q_i}{q_i + q_j} X_i + \frac{X_i}{\beta} + \epsilon_{3,i}^P. \tag{5}$$

We assume that all three errors have the same variance as follows: $V(\epsilon_{1,i}^P) = V(\epsilon_{2,i}^P) = V(\epsilon_{3,i}^P) = \sigma^2$.

The mixing proportions of each ideal are p_1^P, p_2^P, and p_3^P, and the likelihood contribution of each subject i is as follows:

$$\begin{aligned} L_i^P = p_1^P \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{X_i}{2} - \frac{X_i}{\beta}}{\sigma} \right) + p_2^P \frac{1}{\sigma} \phi \left(\frac{y_i - a_i q_i - \frac{X_i}{\beta}}{\sigma} \right) \\ + (1 - p_1^P - p_2^P) \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{q_i}{q_i + q_j} X_i - \frac{X_i}{\beta}}{\sigma} \right). \end{aligned}$$

where ϕ is the probability density function of the normal distribution. The parameters to be estimated are β, σ, p_1^P, and p_2^P, and we conduct log-likelihood estimation.

4.2 Our Modified Model with Separate Parameters by Fairness Ideal (Model M1)

Next, we modify Cappelen et al. (2007)'s assumption of the parameter β as explained above; namely, in our context, the importance that a person assigns to fairness can be considered a characteristic of each fairness ideal. Thus, people who follow the same fairness ideal have their own parameters, such that β^{SE} for the strict egalitarian, β^{L} for the libertarian, and β^{LE} for the liberal egalitarian. Therefore, from our modified choice model, the optimal offer y_i of each type including the error term is as follows:

1) Type 1 (Strict egalitarian, SE)

$$y_i = \frac{X_i}{2} + \frac{X_i}{\beta^{SE}} + \epsilon^{M1}_{1,i}. \tag{6}$$

2) Type 2 (Libertarian, L)

$$y_i = a_i q_i + \frac{X_i}{\beta^{L}} + \epsilon^{M1}_{2,i}. \tag{7}$$

3) Type 2 (Liberal egalitarian, LE)

$$y_i = \frac{q_i}{q_i + q_j} X_i + \frac{X_i}{\beta^{LE}} + \epsilon^{M1}_{3,i}. \tag{8}$$

We assume that all three errors have the same variance as follows: $V(\epsilon^{M1}_{1,i}) = V(\epsilon^{M1}_{2,i}) = V(\epsilon^{M1}_{3,i}) = \sigma^2$.

The mixing proportions of each ideal are p^{M1}_1, p^{M1}_2, and p^{M1}_3, and the likelihood contribution of each subject i is as follows:

$$L^{M1}_i = p^{M1}_1 \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{X_i}{2} - \frac{X_i}{\beta^{SE}}}{\sigma} \right) + p^{M1}_2 \frac{1}{\sigma} \phi \left(\frac{y_i - a_i q_i - \frac{X_i}{\beta^{L}}}{\sigma} \right)$$
$$+ (1 - p^{M1}_1 - p^{M1}_2) \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{q_i}{q_i + q_j} X_i - \frac{X_i}{\beta^{LE}}}{\sigma} \right).$$

where ϕ is the probability density function of the normal distribution. The parameters to be estimated are $\beta^{SE}, \beta^{L}, \beta^{LE}, \sigma, p^{M1}_1$, and p^{M1}_2, and we conduct log-likelihood estimation.

4.3 Our Second Modified Model Excluding Strict Egalitarianism (Model M2)

As mentioned in the introduction, the distribution decisions of subjects are basically based on the dictator game. Thus, it is questionable to not postulate the egoistic behavior of always takes all of the total product because it is a reasonable decision in the dictator game. As a result of the estimation using our modified Model M1, β^{SE} for the strict egalitarian induces the optimal offer y_i^* approaching the total product X_i. We explain the details of this result in the next section, but in brief, strict egalitarians actually behave as egoists. From this result, we suggest another modified model that replaces the strict egalitarian with an egoist. We adopt the assumption of β in Cappelen et al. (2007) which estimates the average value of β because each individual who has the fairness ideal would place a different weight on his or her ideal. Therefore, we set the new parameter $\bar{\beta}$ for the subjects who have fairness ideals. From our second modified choice model, the optimal offer y_i of each type including the error term is as follows:

1) Type 1 (Egoist, EGO)

$$y_i = X_i + \epsilon_{1,i}^{M2}. \tag{9}$$

2) Type 2 (Libertarian, L)

$$y_i = a_i q_i + \frac{X_i}{\bar{\beta}} + \epsilon_{2,i}^{M2}. \tag{10}$$

3) Type 2 (Liberal egalitarian, LE)

$$y_i = \frac{q_i}{q_i + q_j} X_i + \frac{X_i}{\bar{\beta}} + \epsilon_{3,i}^{M2}. \tag{11}$$

where $\bar{\beta}$ is a parameter that represents subjects' weight assigned to their fairness ideal: liberal egalitarianism or libertarianism. The egoist does not have a fairness ideal, and takes all of the total product X_i, that is, $\bar{\beta}_i = 0$. We assume that all three errors have the same variance as follows: $V(\epsilon_{1,i}^{M2}) = V(\epsilon_{2,i}^{M2}) = V(\epsilon_{3,i}^{M2}) = \sigma^2$.

The mixing proportions of each ideal are p_1^{M2}, p_2^{M2}, and p_3^{M2}, and the likelihood contribution of each subject i is as follows:

$$L_i^{M2} = p_1^{M2} \frac{1}{\sigma} \phi \left(\frac{y_i - X_i}{\sigma} \right) + p_2^{M2} \frac{1}{\sigma} \phi \left(\frac{y_i - a_i q_i - \dfrac{X_i}{\bar{\beta}}}{\sigma} \right)$$

$$+ (1 - p_1^{M2} - p_2^{M2}) \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{q_i}{q_i + q_j} X_i - \frac{X_i}{\bar{\beta}}}{\sigma} \right).$$

where ϕ is the probability density function of the normal distribution. The parameters to be estimated are $\bar{\beta}, \sigma, p_1^{M2}$, and p_2^{M2}, and we conduct log-likelihood estimation.

4.4 Posterior Type Probabilities

According to Moffatt (2015), the posterior probability that each subject follows each fairness ideal can be calculated using the estimated parameters from the mixture model. For example, the equation for calculating the posterior probability of following each fairness ideal using the estimated value from Model P is as follows.

1) Strict egalitarian (SE)

$$P(i = \text{SE}|y_{i1}, ..., y_{iT}) = \frac{p_1^P \prod_{t=1}^T \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{X_i}{2} - \frac{X_i}{\beta}}{\sigma} \right)}{Li}$$

2) Libertarian (L)

$$P(i = \text{L}|y_{i1}, ..., y_{iT}) = \frac{p_2^P \prod_{t=1}^T \frac{1}{\sigma} \phi \left(\frac{y_i - a_i q_i - \frac{X_i}{\beta}}{\sigma} \right)}{Li}$$

3) Liberal egalitarian (LE)

$$P(i = \text{LE}|y_{i1}, ..., y_{iT}) = \frac{(1 - p_1^P - p_2^P) \prod_{t=1}^T \frac{1}{\sigma} \phi \left(\frac{y_i - \frac{q_i}{q_i + q_j} X_i - \frac{X_i}{\beta}}{\sigma} \right)}{Li}$$

This calculation is based on Bayesian rules. In the case of Model M1, we use the variables $\beta^{SE}, \beta^L, \beta^{LE}, \sigma, p_1^{M1}$ and p_2^{M1}, and in the case of Model M2, we include the variables $\bar{\beta}, \sigma, p_1^{M2}$ and p_2^{M2} in the equation for the posterior probability. Using each subject's six decisions in the distribution phase, we calculate the posterior probability of following each fairness ideal and the fairness ideal with the highest probability value is the type of each subject. When all of the posterior types of each subject are derived, the predictions of each subject's optimal offer (y_i) can be derived from the type using the estimated parameters. We compare the predictions of optimal offers from the posterior type and the observed offers and examine which model's estimation better fits the observations.

Table 2 MLEs from three models

	Model P	Model M1	Model M2
β	3.9617 (0.0475)		
$\bar{\beta}$			8.5157 (0.2826)
β^{SE}		2.1673 (0.0157)	
β^{L}		7.1437 (0.3623)	
β^{LE}		9.1184 (0.3084)	
Proportion of SE	0.3696 (0.0255)	0.3945 (0.0169)	
Proportion of EGO			0.3813 (0.0167)
Proportion of L	0.4282 (0.0210)	0.1721 (0.0184)	0.1750 (0.0185)
Proportion of LE	0.2022 (0.0233)	0.4334 (0.0205)	0.4436 (0.0207)
σ	17.0976 (0.2274)	12.2695 (0.1590)	12.5371 (0.1622)
Log-Likelihood	-14853.763	-13986.486	-14061.068

Standard errors are given in parentheses.
SE: Strict Egalitarian, EGO: Egoist, L: Libertarian, LE: Liberal Egalitarian.

5 Results

5.1 Estimation

Using the estimation models described in Section 4, we estimate the weight assigned to fairness (β, $\bar{\beta}$, β^{SE}, β^{L}, and β^{LE}) and the proportion of each type in the population as shown in Table 2.

First, from the estimation results of Model P, the proportion of strict egalitarians is 0.3696, which is within the range of estimates from previous studies: 0.18 in Cappelen et al. (2010), 0.301 in Cappelen et al. (2011), 0.365 in Almås et al. (2010), and 0.435 in Cappelen et al. (2007). Since the proportions of libertarians and liberal egalitarians vary across socioeconomic conditions in previous studies, it can be said that the results of this study are also similar to those of previous studies.

Second, interestingly, Model M1 shows completely different results from Model P, especially in terms of the estimation result for strict egalitarians. Model M1 is a modified model that assumes that each type has a different β as the characteristics of each type. As a result, the β^{SE} in Model M1 is 2.1673, which is considerably lower than β^{L} and β^{LE}. When we apply this value, 2.1673, to Equation (6) in Section 4.2, the optimal offer y_i of the strict egalitarian approaches X_i, the total product. In other words, a strict egalitarian actually behaves like an egoist who wants to take all of the total product. Therefore, the subject estimated to be a strict egalitarian is not following the strict egalitarian ideal, that is, distributing equally, but rather makes a rational decision in the dictator game, taking all. This result that strict egalitarians behave as egoists could be partially aligned with the arguments of Rodriguez-Lara and Moreno-Garrido (2012) and Ubeda (2014) that people adopt different ideals depending on the situation in self-serving ways to maximize their payoffs rather than adhering to a specific fairness ideal. Since our estimation result for the proportion of strict egalitarians in Model M1, 0.3945, implies that more than one-third of subjects actually behave as egoists, the studies by Rodriguez-Lara and Moreno-Garrido (2012) and Ubeda (2014) may be observing these egoists' behaviors.

Third, in the case of libertarians and liberal egalitarians, there are also different results from Model P in Table 2. Their weights assigned to fairness, β^L and β^{LE}, are 7.1437 and 9.1184, respectively. These are considerably higher than β^{SE} in Model M1 and β in Model P, and the values are 2.1673 and 3.9617, respectively. This result means that a liberal egalitarian and a libertarian place greater weight on their own fairness ideal than a strict egalitarian. In addition, β^{LE}, which is 9.1184, is slightly higher than β^L, which is 7.1437, implying that liberal egalitarians tend to assign a slightly larger weight to their own fairness ideal than libertarians. Therefore, estimating β without distinction across the group of adherents to different fairness ideals not only misses the characteristic of each type but also yields less accurate estimations.

Fourth, the proportions of libertarians and liberal egalitarians in Model M1 are also different from those in Model P. In Model P, libertarians account for the highest proportion at 42.82 percent, and liberal egalitarians account for the lowest proportion at 20.22 percent. However, in Model M1, the highest proportion at 43.3 percent corresponds to liberal egalitarians and the lowest proportion at 17.2 percent to libertarians. The change in the proportion of fairness ideals is examined by comparing the fitness in Section 5.3.

The results of Model M2, which is another modified model that replaces the strict egalitarian ideal with egoistic behavior, are similar to those of Model M1. $\bar{\beta}$ in Model M2 is 8.5157, which is close to the average of the β^L and β^{LE} in Model M1. The proportion of each fairness ideal is not different from that in Model M1. All of the proportions of each ideal are similar: 38.13 percent for strict egalitarians, 17.50 percent for libertarians, and 44.36 percent for liberal egalitarians. This similarity in the results of Models M1 and M2 is shown in greater detail in terms of the distribution of the posterior types in Section 5.2 and the fitness test in Section 5.3.

These estimation results show that the reasonable choice in the dictator game, taking all of the total product, should not be ignored, and this is the reason that a the strict egalitarian rarely exists in this experimental setting that is based on the dictator game. Moreover, the finding that the strict egalitarian ideal, which advocates equality of outcomes regardless of luck and

Table 3 Examples of posterior type probability

	Model P			Model M1			Model M2		
ID	SE	L	LE	EGO	L	LE	EGO	L	LE
1	0.01	0.99	0.00	1.00	0.00	0.00	1.00	0.00	0.00
12	0.48	0.02	0.50	0.00	0.98	0.02	0.00	0.98	0.02
14	0.29	0.38	0.33	0.00	0.22	0.78	0.00	0.24	0.76
24	0.00	1.00	0.00	0.00	0.63	0.37	0.00	0.57	0.43

SE: Strict Egalitarian, EGO: Egoist, L: Libertarian, LE: Liberal Egalitarian

effort, is replaced by the egoist ideal suggests that the possibility that strict egalitarianism exists may be small.

In the following sections, in line with the result that the strict egalitarian in Model M1 is actually an egoist, the strict egalitarian (SE) label is replaced with the egoist (EGO) label in Model M1.

5.2 Distribution of the Fairness Ideals by Posterior Type Calculation

Next, to compare the fitness of each model, it is necessary to predict the type of each subject based on the estimated parameters. Using the calculation of posterior type probability presented in Section 4.4, we can obtain the probability that each subject is classified into each fairness ideal type. Table 3 shows some examples in which the subject type is determined in this way.

For example, in the case of subject ID 1, when the posterior type is calculated with the estimated parameters of Model P, the probability of espousing the libertarian ideal is the highest at 99 percent, but when we use the parameters of Models M1 and M2, the probability of being an egoist is close to 100 percent. In the case of subject ID 12, in Model P, the probabilities of espousing the strict egalitarian ideal and the liberal egalitarian ideal are 48 percent and 50 percent, respectively, but in Models M1 and M2, the probabilities of espousing the libertarian ideal are the highest, at 98 percent and 97 percent, respectively. In the case of subject ID 14, the posterior probabilities of the three types are similar: 29 percent for the strict egalitarian ideal, 38 percent for the libertarian ideal, and 33 percent for the liberal egalitarian ideal, such that he or she is rarely classified as a specific type. However, in Models M1 and M2, this subject is a liberal egalitarian with a probability of 78 percent and 76 percent, respectively. Finally, in the example of subject ID 24, the highest probability is shown for the libertarian ideal in all three models. However, the probability of espousing the liberal egalitarian ideal in Model P is different from the probabilities for other models, namely, only in Model P is there no probability of espousing ideals other than the libertarian ideal.

Some subjects do not show a markedly high probability of holding one ideal, such as subject ID 12, who has a similar probability of being classified

Table 4 Comparison of the distributions from posterior type probability calculation and from estimation

	Model P		Model M1		Model M2	
Type	Number of subjects	Estimated proportion	Number of subjects	Estimated proportion	Number of subjects	Estimated proportion
SE	57 (35.4%)	0.3696				
EGO			69 (42.9%)	0.3945	67 (41.6%)	0.3813
L	73 (45.3%)	0.4282	26 (16.1%)	0.1721	27 (16.8%)	0.1750
LE	31 (19.3%)	0.2022	66 (41.0%)	0.4334	67 (41.6%)	0.4436
Total	161		161		161	

as a strict egalitarian and a liberal egalitarian in Model P in Table 3. However, since we calculate the posterior type from data on six decisions, most of the subjects have the highest posterior probability for one ideal. Therefore, each subject is classified as the type with the highest probability, and its distribution is presented in Table 4.

As we see from the results in Table 4, there is not much difference between the distribution derived by posterior type calculation and the distribution estimated by log-likelihood estimation (in Table 2). In other words, the types of subjects derived by posterior type calculation have validity.

5.3 Fitness Test

By using each subject's posterior type from the three estimation models and the parameters β, $\bar{\beta}$, β^{SE}, β^{L}, and β^{LE} of the three models, we can predict each subject's optimal offer y_i in the six distribution decisions under different a_j, q_j, and X_i. In this section, the distribution of predictions derived by the three models and the distribution of observations are compared, and we identify which model's prediction is most similar to the observations.

To compare the distribution of the three models' predictions, we conduct a t-test and a variance ratio test. We find no significant difference between the three models and observations in the t-test. However, in the variance ratio test, we cannot reject that the variances between the observations and predictions of Model P are not different ($p = 0.0001$).

Figure 1 shows the histograms and the normal distribution estimated through the mean and variance of the histogram. Figure 2 describes the estimated plots using the kernel density estimator[4]. Although all models appear to have similar means, Model P shows a different variance from the observations in Figure 2. Moreover, in Figure 1, the histograms of the observations

[4]Kernel density estimators approximate the density $f(x)$ from observations on x. Unlike a histogram, a kernel density estimator assigns a weight between 0 and 1—based on the distance from the center of the interval—and sums the weighted values. The function that determines these weights is called the kernel (StataCorp, 2005). We use the Epanechnikov kernel function to estimate the plots of the observations and the predictions of the three models, Model P, Model M1, and Model M2.

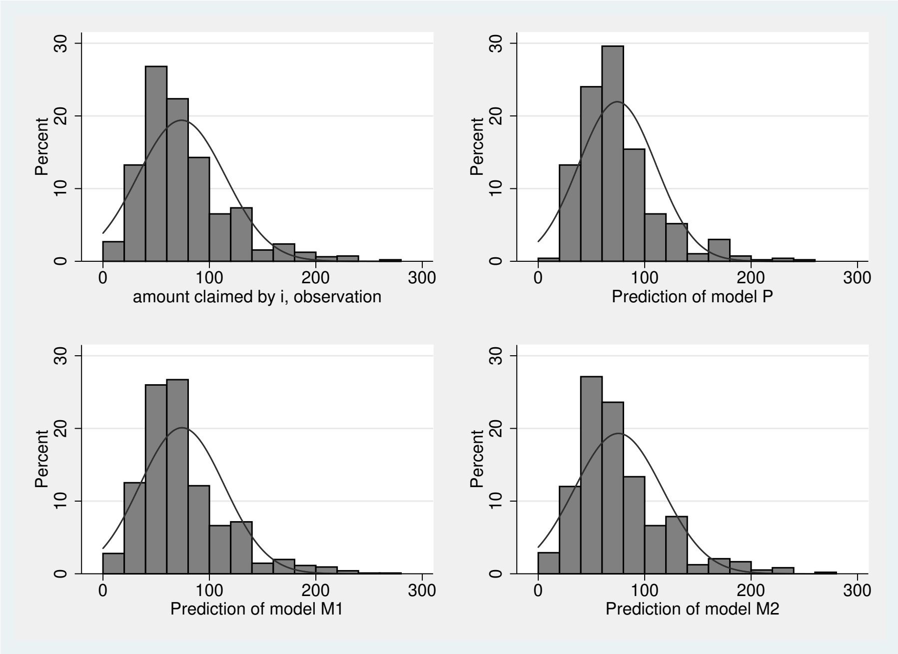

Fig. 1 Histograms of observations and predictions of three models

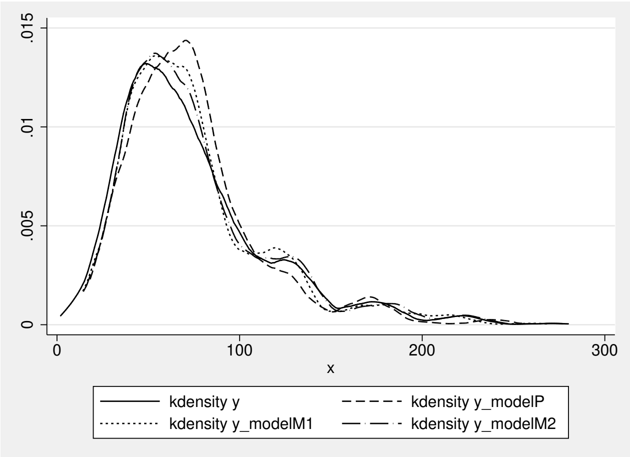

Fig. 2 Kernel density estimations of observations and predictions of three models

and the predictions of Model M2 are very similar. This implies the possibility that Model M2 is the best-fitting model.

In addition, we examine subjects' questionnaire answers to the question "What principle did you use to divide the total product points in the distribution phase? Please write briefly". The results are as follows: 57 people who are classified as type EGO in our Model M1 wrote that they distributed

Table 5 Distribution of productivity

Model M2	Number of subjects with high productivity	Number of subjects with low productivity	Total
EGO	34	33	67
L	7	20	27
LE	40	27	67
Total	81	80	161

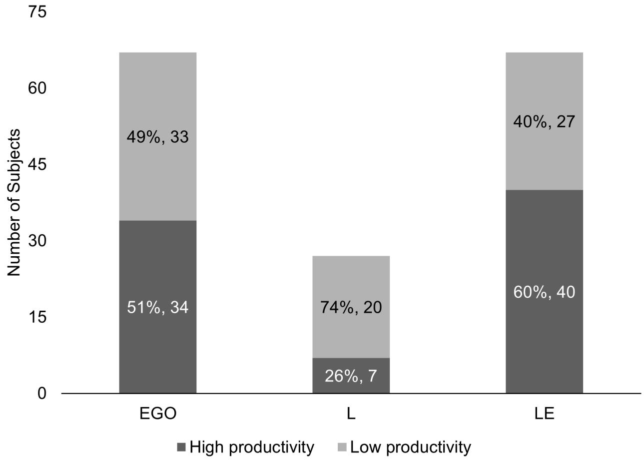

Fig. 3 The productivity distributions by fairness ideals

to maximize their own profit, for example, "I distributed it to my advantage anyway", "I distributed thinking only about myself", "If the other does not know my decision, I want to take it all", and similar responses. In other words, these answers confirm that our estimations that include type EGO fit for the subjects' distribution decisions.

In conclusion, although the prediction of Model P does not differ substantially from the observations, the predictions of Models M1 and M2 have a better fit than Model P. Therefore, the estimations using Models M1 and M2 yield the result that the strict egalitarians do not exist and that there instead is a high proportion of egoists, and these models are more suitable for explaining the pluralism of fairness ideals in the population.

5.4 Characteristics of Subjects with Different Fairness Ideals

What conditions in the experiments relate to people's fairness ideals? Are there differences in characteristics across subjects with different fairness ideals? In this section, we investigate the characteristics of subjects classified by means of the posterior types calculated using the parameters of our new Model M2. The reason for using Model M2 is that as described in Section 4.3, the assumption

Table 6 Summary statistics of effort

Model M2	EGO	L	LE
Average	15.8	18.6	16.6
Standard deviation	8.69	5.70	9.21
Minimum	0	3	3
Maximum	46	27	48

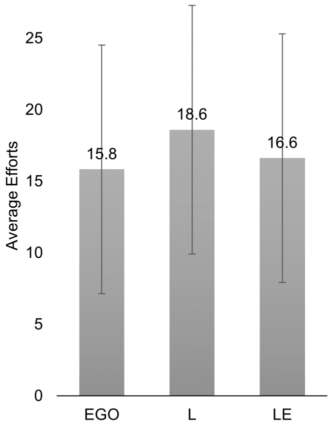

Fig. 4 The average efforts by fairness ideals (Bars depict standard deviations.)

of Cappelen et al. (2007) on β, which estimates the average value of β because each individual who has a given fairness ideal would place a different weight on his or her ideal, is more simple and offers greater interpretability, and Model M2 is based on this assumption.

First, do the factors in the experiment, namely, randomly assigned productivity and effort exerted in the task, affect an individual's fairness type? According to the choice model and fairness ideals described in Section 3, libertarians consider their own output, which includes randomly assigned productivity, to be their own fair share, while liberal egalitarians believe that only individual efforts should be reflected in the distribution. Therefore, the following two conjectures could be possible: (1) subjects who are assigned high productivity may be libertarians because the allocation corresponding to the libertarian ideal reflects productivity and may yield the dictator a higher share that the allocations corresponding to the other ideals, and (2) subjects who show higher performance in the real-effort task in the production phase may follow the liberal egalitarian ideal because this ideal reflects only individual effort.

For conjecture (1), the type distribution among the people assigned each productivity level is shown in Table 5 and Figure 3. Contrary to our conjecture, subjects who are assigned high productivity are classified as liberal egalitarians

(LEs). Figure 3 shows the productivity distribution by fairness ideal type. In each bar graph, the percentages with high and low productivity and the numbers of subjects with each productivity level of each type are shown. Figure 3 depicts that 74 percent of the libertarian type (20 subjects) have low productivity, and 60 percent of the liberal egalitarian type (40 subjects) have high productivity. In the case of egoistic subjects, the numbers of subjects with high and low productivity are similar. However, subjects with high productivity are more likely to be liberal egalitarian (40 subjects) than libertarian (7 subjects). The difference in the productivity distributions between libertarians and liberal egalitarians is significant (rank-sum test, $p = 0.0000$). This result implies that high productivity, which is assigned randomly, may be related to the liberal egalitarian ideal, which insists that the distribution should not reflect random factors (in this case productivity) but rather only individual effort.

For conjecture (2), we compare the average effort by type. Table 6 shows summary statistics of effort for each fairness ideal type, and Figure 4 shows the average effort by type. We find, contrary to conjecture (2), that liberal egalitarians do not show higher performance than other types on average. On the other hand, as shown in Table 6 and Figure 4, libertarians show a significantly higher level of effort than other types (t-test, compared with the egoist: $p = 0.0004$, and compared with the liberal egalitarian: $p = 0.0002$). This result implies that subjects who show higher performance in the real-effort task tend to be libertarians, who believe that the fair distribution should include not only individual effort but also the effect of random factors (here productivity), rather than liberal egalitarians, who believe that the fair distribution should be based only on individual effort.

In sum, these findings contradicting conjectures (1) and (2) may run contrary to the arguments of Rodriguez-Lara and Moreno-Garrido (2012) and Ubeda (2014) that people adopt different ideals depending on their situation in self-serving ways to maximize their payoffs. In other words, along with the fact that egoists exist within the population at a share of approximately 40 percent (as shown in Section 5.1), contrary to conjectures (1) and (2), the random factor (productivity) and the level of effort affect subjects' fairness ideals; that is, high productivity induces subjects to choose the libertarian ideal (L), and higher performance in the task induces subjects to follow the liberal egalitarian ideal (LE), implying that fairness ideals such as the libertarian and liberal egalitarian ideals could be considered a kind of distributional preference, not a result of self-serving bias.

The next characteristic related to fairness ideals is gender. The distribution of fairness ideals differs significantly by gender, and the results are shown in Figure 5: 51 percent of male subjects are classified as egoists, and 55 percent of female subjects are classified as liberal egalitarians.

Table 7 is the result of multinomial logistic regression analysis that indicates the difference in the effect of each factor among subjects classified by fairness ideal type. The base outcome of the comparison is the egoist.

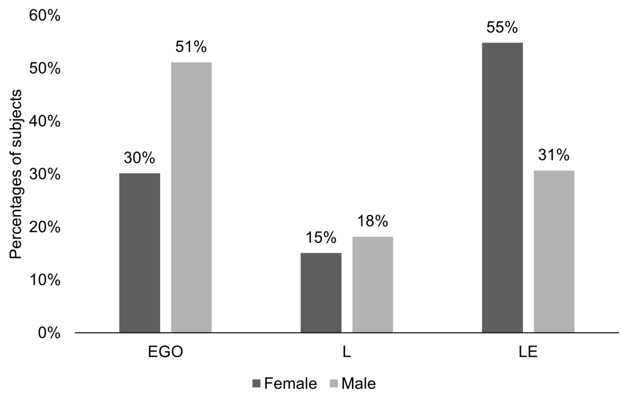

Fig. 5 Gender differences

Table 7 Multinomial logistic regression

Type	Variable	1	2
EGO	Base outcome		
L	Productivity	−0.5552***	−0.5660***
		(0.1037)	(0.1042)
	Effort	0.0396***	0.0417***
		(0.0109)	(0.0110)
	Gender		−0.4753**
			(0.1981)
	Constant	−0.0589	0.2340
		(0.3354)	(0.3594)
LE	Productivity	0.1801**	0.1485**
		(0.0712)	(0.0737)
	Effort	0.0112	0.0164*
		(0.0086)	(0.0089)
	Gender		−1.1132***
			(0.1484)
	Constant	−0.7408***	−0.1265
		(0.2695)	(0.2886)

Gender is a dummy variable: 0 for females, 1 for males. Standard errors are given in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

In Column 1 of Table 7, libertarians have a significant negative coefficient on productivity, −0.5552, and a significant positive coefficient on the level of effort in the tasks, 0.0396, compared to the egoistic type. Liberal egalitarians have a significant positive coefficient with productivity, 0.1801. These results indicate the following: First, compared to egoists and liberal egalitarians, libertarians have the highest level of effort. Second, when low productivity is assigned, subjects tend to follow the libertarian ideal more than any other ideal.

Column 2 of Table 7 shows the results of the multinominal logistic regression including the gender dummy variable. The results of this regression are similar to the results in Column 1. When we take the egoistic type as reference group, low productivity has a significant correlation with libertarian ideals based on the negative coefficient, −0.5660, and high productivity a significant correlation with liberal egalitarian ideals based on the positive coefficient, 0.1485. The level of effort has a stronger and more significant positive correlation with the libertarian ideal than the liberal egalitarian ideal since the coefficient of the libertarian type, 0.0417, is larger than the coefficient of the liberal egalitarian type, 0.0164.

In addition, male subjects prefer the egoistic ideal more than any other. The coefficients of the other types are all negative, −0.4753 for the libertarian and −1.1132 for the liberal egalitarian. This result means that male subjects (those with a dummy value of 1) are more likely to be the egoistic type than female subjects (those with a dummy value of 0). However, female subjects prefer the liberal egalitarian ideal the most, and the coefficient of liberal egalitarianism is −1.1132, which is the smallest of the types. This is supported by the results of Miller and Ubeda (2012) and Sharma (2015), who report that women tend to distribute by effort; moreover, our result that the liberal egalitarian ideal is preferred by female subjects is obtained in the same context as that considered in these studies.

6 Summary and Conclusions

The purpose of our study is to verify the finding of Cappelen et al. (2007) on the pluralism of fairness ideals—namely, that various fairness ideals coexist within the population. Cappelen et al. (2007) and previous experimental studies set endowments to be determined by the production stage before the dictator game so that an individual's luck and efforts are involved in the distribution problems. In this situation, three fairness ideals regarding what the fair distribution should be—strict egalitarianism, libertarianism, and liberal egalitarianism—correspond to different answers to the distribution problem. To demonstrate the existence of pluralism with respect to these three ideals, they suggest a choice model assuming that an individual incorporates one of the three fairness ideals into his or her utility function for the distribution problems. Based on this model, they attempt to estimate the population distributions of adherence to the three fairness ideals.

We assume that people who follow different fairness ideals also have different weights for fairness, and we separate the weight parameters of the three fairness ideals accordingly. The estimated value of the weight parameter indicates that strict egalitarians behave like egoists who take all of the total product. Therefore, we can conclude that there are no strict egalitarians, but that there are egoists. This result implies that people rarely follow the strict egalitarian ideal in this kind of dictator game with a production phase and, instead, that there is a high proportion of egoists, who take of all the total product without considering any fairness ideals. Moreover, the distribution of fairness ideals also changes considerably when we use our modified models for estimation. The estimation result using Cappelen et al. (2007)'s model without separating the parameters shows a higher proportion of libertarians than of liberal egalitarians, but the result of our modified estimation models shows a higher proportion of liberal egalitarians than of libertarians. In addition, by comparing the value of the weight parameter across the fairness ideals, we find that liberal egalitarians place slightly greater weight on their ideal than do libertarians.

We also check the fitness of our modified models and Cappelen et al. (2007)'s model. We find in the t-test that there is no significant difference in observations between Cappelen et al. (2007)'s model and our models, but in the variance ratio test, only our modified models are not significantly different from the observations. Therefore, our modified models have a better fit than the model of Cappelen et al. (2007), so the result that strict egalitarians do not exist, and that instead a high proportion of egoists exist is reliable.

In addition, subjects with high productivity are more likely to be liberal egalitarians rather than libertarians, and subjects with high effort in the task are more likely to be libertarians. The proportion of liberal egalitarians is significantly higher among women than among men, and the proportion of egoists is significantly higher for men than for women. This is supported by the results of Miller and Ubeda (2012) and Sharma (2015) that women tend to distribute based on effort rather than on luck.

In conclusion, our study provides some important clues about what is accepted as a fair distribution in society. First, individual selfishness cannot be ignored. When given authority to distribute an endowment as in the dictator game, more than a few people behave egoistically regardless of individual effort, luck, or other factors. Second, when there are several factors that affect the endowment, such as random factors and effort, a simple equal distribution does not take these factors into account at all is not supported by people. With only a small modification of the estimation model, subjects who are estimated to be strict egalitarians in previous studies behave as egoists. This result implies that simply pursuing an equal outcome without considering each individual's performance or contribution is not accepted as a fair distribution. Third, even if individual selfishness has an impact on distribution problems that cannot be ignored, fairness ideals that assert that individual performance and contributions should be considered, such as libertarianism and liberal egalitarianism, are also relevant. Although the sociocultural environment affects the arguments about whether libertarianism or liberal egalitarianism provides an fairer distribution, approximately 60 percent of people follow these two ideals without making selfish choices even though they have authority over the distribution. This implies that in distribution decisions, people have distributional preferences rather than behaving in a manner consistent with pure homo economicus model. Therefore, our study not only enables more realistic estimation by showing the existence of individual selfishness in the distribution decision but also clarifies that pluralism in fairness ideals persists, as shown in previous studies.

Appendix A Instructions

Thank you for your participation in the experiment today.

You will participate in an experiment of individual decision-making. After the instructor reads this instruction, you will make decisions to make money. All the decisions are made by inputting them into a computer in front of you. During the experiment, do not talk with others. If you have questions, let us know by raising your hand. Your mobile phone and pens should be in your bag.

Your payment is determined by the decision of you and other participants in addition to the participation fee of 800 yen. Your personal information, your decisions, and your earnings are not known to others.

This experiment consists of two stages. After finishing Stage 1, you will be given an experiment manual for Stage 2.

Stage 1

Fig. A1 Screenshot of Stage 1

You will participate in one task. Figure A1 is a screenshot of the task. In this figure, there are 48 sliders. Your work is to align the bar on 0, the left side of each slider, with 50, the center of the slider.

In other words, your goal is to move the bar from 0 to 50 more accurately within a limited time. Score 1 point for each slider that aligns with 50. First of all, you will participate in the practice task with a time limit of 120 seconds. The results of this practice task are not related to the payment. The remaining time is displayed on the screen in front of the classroom. When there are 30 seconds left, and when there are 10 seconds left, we will inform you of the remaining time verbally. Once the practice tasks are finished, the production tasks used for decision-making of Stage 2 begin. The time limit is 150 seconds.

Your output is determined by the product of the rate of return and the points you get from the task. Your rate of return, one of 2 or 4, will be randomly assigned to you after the production task is finished.

Your output = your rate of return × your points.

Check your rate of return and your output from the result screen of Stage 1.

Stage 2

The sum of the output of Stage 1 earned by you and your partner will be the product of your joint venture. In Stage 2, you will make a decision in a pair. Your payment is determined by the results of Stage 2. This stage repeats several times, each round pairing you with a new partner. You will never be paired with the same partner. After Stage 2, two rounds out of all the decision-making rounds are chosen to be the payment of this experiment.

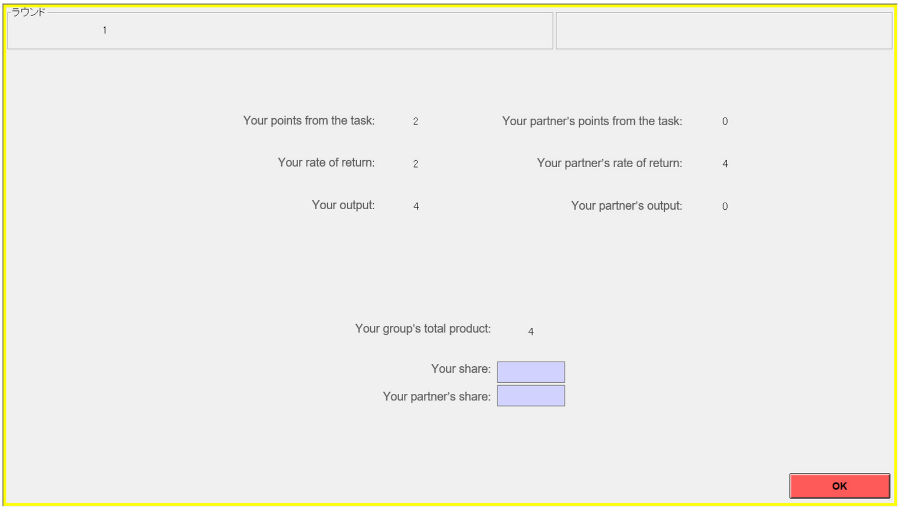

Fig. A2 Screenshot of Stage 2

In this Stage 2, you will participate decision-making to distribute the sum of the output of Stage 1 earned by you and your partner (the group's total product) between you and your partner. Figure A2 is a screenshot of Stage 2.

On the upper left side of the screen, 'your points from the task', 'your rate of return', and 'your output' are displayed. On the upper right side, 'your partner's points from the task', 'your partner's rate of return', and 'your partner's output' are displayed. At the bottom of the screen, you will see your group's total product.

Please distribute 'your share' and 'your partner's share' from your group's total production of this round and input them in integers. Please input each number so that the sum of the two numbers is your group's total product. When your distribution decision is completed, please click the OK.

This decision-making will be repeated several times. After Stage 2, two rounds are randomly chosen, and one of your decisions or your partner's decisions in those rounds is randomly chosen. The sum of your points from these two decisions will be converted into cash at the rate of 1 point = 3 yen, and your final payment is the sum of cash from the experiment and the participation fee.

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