大阪大学
感染症総合教育研究拠点
CiDER
CENTER FOR
INFECTIOUS DISEASE EDUCATION
AND RESEARCH

CiDER-DP

Center for Infectious Disease Education and Research, Discussion Paper

DP001

Vaccination and Discrimination: Experimental Evidence under the COVID-19 Pandemic

Shusaku Sasaki, Osaka University

Hirofumi Kurokawa, University of Hyogo

Vaccination and Discrimination: Experimental Evidence under the COVID-19 Pandemic

Shusaku Sasaki[1] **Hirofumi Kurokawa**[2]

First Draft: October 11th, 2022

Abstract

In this study, we conduct financially incentivized dictator games with the COVID-19 vaccinated and unvaccinated people in Japan (N=1,578), and ascertain their favorable or hostile attitudes toward each other, by using *ingroup favoritism*. We measure *ingroup favoritism* as the difference in the allocated amounts between to ingroup members with the same vaccination status and to outgroup members with a different status. Our analyses suggest that the vaccinated people behave more discriminately toward outgroup members, compared to the unvaccinated people. The vaccinated people show strong *ingroup favoritism*, which are shaped mainly by their *outgroup bias* of decreasing the money amount allocated to an unvaccinated pair, their outgroup member. In contrast, the unvaccinated people do not exhibit such the ingroup favoritism, on average. Their *outgroup bias* is found in the rather opposite direction of the hypothesis, and they tend to increase the amount to a vaccinated pair, their outgroup member. We find this tendency in particular from the unvaccinated who selected as their non-vaccination reason "I would like to get vaccinated if I could, but I cannot for health or other reasons." Furthermore, we confirm significant associations between their ingroup favoritism and attitudes regarding the COVID-19 policies, suggesting that the biases would have some degree of social influence in the real world. This study's findings can contribute to discovering how to smoothly build cooperative relationships between vaccinated and unvaccinated people under the current and future pandemics.

Keywords: COVID-19, Vaccination status, Discrimination, Altruism, Online experiment
JEL classification: I12, D91, C90

---

[1] Center for Infectious Disease Education and Research (CiDER), Osaka University, Japan (*Corresponding author*: ssasaki.econ@cider.osaka-u.ac.jp).
[2] School of Economics and Management, University of Hyogo, Japan.

We obtained ex-ante approval from the ethics committee of Center for Infectious Disease Education and Research, Osaka University, Japan (2022CRER0114). We also registered the experimental design with the AEA RCT Registry (Sasaki and Kurokawa, 2022). This research is financially supported by Center for Infectious Disease Education and Research, Osaka University, and Japan Science and Technology Agency [JST PRESTO Grant Number: JPMJPR21R4 (S., Sasaki)].

1. Introduction

COVID-19 vaccination is the essential key to restarting socioeconomic activities and ending the social confusion caused by this pandemic. However, some people are reluctant to receive the vaccine or have negative attitudes toward the vaccination. Anti-vaccine demonstrations have been held in France, Germany, Japan, and other countries around the world, and fake news about vaccines have been flooded on social media.

Although the issue of receiving the vaccine or not has divided people, both the vaccinated and unvaccinated people need to live together in the same society. Since the unvaccinated people do not obtain immunity from vaccination, the vaccinated need to be careful not to spread the infection to the unvaccinated. The unvaccinated need to agree that the governments allocate taxes to investing the construction of environments in which people with vaccination intention can receive the vaccine immediately. From policy perspectives, it is quite crucial to empirically determine how cooperative or hostile the vaccinated and unvaccinated people are toward each other.

This experimental study measures *ingroup favoritism* among the vaccinated and unvaccinated people, examine the characteristics of its distribution, and determine the association between their bias and real-world attitudes. The ingroup favoritism is captured by the difference in the allocated money amount between to ingroup members who share group identities (country, religion, political party, etc.) and to outgroup members who do not.

The ingroup favoritism has been widely studied as measures of favorable attitudes toward ingroup members or hostile attitudes toward outgroup members. When experimenters artificially created a bit of identity and made explicit, based on the minimal group paradigm (Tajfel et al. 1971), people allocate more money to a paired partner with the same identity than to that with a different identity (Yamagishi and Mifune 2008; Mifune et al. 2010). It has been reported that the ingroup favoritism appears when using social identities, including country, religion, political party, race, and gender (Charness and Rustichini 2011; Fershtman and Gneezy 2001; Kranton et al. 2020). Also, the ingroup favoritism has been observed when using identities that are formed exogenously, including race and gender, as well as when using those which are formed by people's endogenous choices (Efferson et al. 2008; Charness et al. 2014).

We assume that people's endogenous choice of whether they receive the COVID-19 vaccine or not will form a group identity, and experimentally measures the ingroup favoritism of the vaccinated and unvaccinated people toward each other. Jagodics and Szabó (2022) explain, based on psychology theories, that vaccination status has conditions for shaping a social identity. For example, vaccination status is socially unneutral since regulations create distinctions based on it, and the membership makes the vaccinated people perceive that their outgroup threatens the achievement of their goals.

The ingroup favoritism is formed by two types of biases: *ingroup bias* (a.k.a. ingroup love), which is the tendency to prefer ingroup members with the same identity, and *outgroup bias* (a.k.a. outgroup

hate, outgroup derogation), which is the tendency to dislike outgroup members with different identities. The former may improve the performance of the ingroup, providing members with long-term benefits and increasing their survival probability (Brewer, 1999; Caporael, 2007). The latter may generate hostile relationships with outgroup members and stimulate competitions (Bornstein, 2003; Halevy et al., 2010; Yzerbyt and Demoulin, 2010). Whether people's ingroup favoritism emerge mainly due to ingroup bias or outgroup bias provides useful insights on how the ingroup favoritism will appear as a real-world behavior. Thus, we experimentally measure ingroup bias and outgroup bias, in addition to ingroup favoritism.

We conduct a financially incentivized online experiment to measure *ingroup favoritism*, *ingroup bias*, and *outgroup bias* among 1,578 vaccinated or unvaccinated people residing throughout Japan, as described in Section 2. For the measurement, previous studies have employed various experimental games, including the dictator game, ultimatum game, and trust game (Balliet et al. 2014; Lane et al. 2016). This study employs the dictator game, considering its advantages of being non-interactive and thus easy to implement into a nationwide online experiment. Balliet et al. (2014) note that the ingroup favoritism, which is measured by the dictator game, is relatively small. If we find significant ingroup favoritism even in such a setting, it will become strong evidence.

Under the COVID-19 pandemic, Bartos et al. (2021) conducted a one-way allocation game, like the dictator game, in their financially incentivized online experiment and found emphasizing the threat of this pandemic rises the hostile attitude toward foreigners in money allocations. In a psychological online experiment, Jagodics and Szabó (2022) captured how subjects allocate hypothetical monetary resources between two persons characterized by vaccination status. They report that the vaccinated people prefer to increase the difference in allocation between their ingroup and outgroup members to disadvantage the outgroup members.

In response to the literature, we design this experiment to be incentivized by real money to capture ingroup favoritism in situations where participants' rewards vary depending on their choices in the game, and ensure sufficient sample size to determine the biases' characteristics for the unvaccinated people, who are minorities in many societies,[1] as well as the vaccinated, respectively. Furthermore, we examine the associations between their biases and attitudes regarding the COVID-19 related policies in the real world, enrich this study's policy implications, and add new insights to the literature.

2. Experimental Design

2.1. Overview

From January 28 to February 1, 2022, we conducted a screening survey through MyVoice.com Ltd.,

[1] As of January 28, 2022, the percentage of those who received the first and second doses of COVID-19 vaccination exceeded 70.0% in many countries of Argentina, Australia, Brazil, Canada, China, France, Germany, Italy, South Korea, and the United Kingdom, in addition to Japan.

which offers online surveys and experiments, and collected a sample of around 7,934 Japanese people from its registered monitors to match the proportions of a national representative sample in terms of sex, age, and residential area. In this survey, we set up questions to ascertain their age, sex, residential area, nationality, the COVID-19 vaccination status, and future vaccination intentions, in addition to one hypothetical dictator game in the anonymous condition.

We define as "vaccinated individuals" Japanese people who have completed their first and second COVID-19 vaccinations and have the intention to receive the additional vaccine soon. The number of vaccinated individuals is 5,597. We also define as "unvaccinated individuals" those who have not received or intend to receive the vaccine. The number of unvaccinated individuals is 1,085.

From February 10 to 14, 2022, we sampled 800 vaccinated individuals and 800 unvaccinated individuals from the respondents of the screening survey and conducted the main online experiment, including financially incentivized dictator games. To compare tendencies among the vaccinated people with those of the unvaccinated, we ensured equal sample sizes for each group. Here, we adjusted the number of response requests so that the ratio of the number of respondents to the number of response requests does not differ significantly between the vaccinated and unvaccinated samples.

In the dictator game part, we first present, as priming, the COVID-19-related questions, including whether they have received the COVID-19 vaccine or not. We then present a dictator game five times (see Section 2.2). After the experiment, we set up questions to ascertain the COVID-19-related behavioral characteristics and attitudes, and socio-economic attributes. Concretely, the COVID-19-related questions include attitudes toward the COVID-19-related policies (Balancing infectious disease control and socio-economic activities, vaccination certification, and financial incentives for encouraging vaccination) and dates of the first and second COVID-19 vaccination uptakes (Vaccinated sample, only).

We followed the pre-registered procedure and excluded from the analysis 22 individuals whose vaccination status of the first and second doses in the screening survey does not match the status in this online experiment. Since the duration between the screening survey and the experiment is around two weeks, it is unlikely that "an unvaccinated individual," who did not receive the vaccine at the timing of the screening survey and had no vaccination intention, have started their vaccination during that short time. Furthermore, in reality, the vaccinated status cannot change to the unvaccinated status. Consequently, we obtained valid responses from 796 vaccinated and 782 unvaccinated individuals.

We need to note that when we conducted the screening survey and the main experiment, almost all of the Japan's first- and second-doses vaccination programs were completed. The first- and second-doses vaccinations for children and teenagers (who are outside the scope of this study) still continued, while the third-dose vaccination program started among the elderly. As of January 28, 2022, 74.8% of the Japanese population completed the first and second doses of COVID-19 vaccination; among those aged 65 and older, the percentage exceeded 92.0%. In addition, the nationwide outbreak of Omicron

strains was rapidly spreading, and many local governments requested corporations and individuals to restrict their socioeconomic activities.

Before starting this study, we obtained approval from a research ethics committee at the Center for Infectious Disease Education and Research, Osaka University (2022CRER0114). We also pre-registered our experimental design and analysis plan to the AEA RCT Registry (Sasaki and Kurokawa, 2022).

2.2. Dictator Games

We present a dictator game five times. In each game, participants are given an endowment of 100 Japanese Yen in addition to the participation fee (90 JPY).[2] They are asked to decide how much of the 100 JPY they give to a paired other person. They are also informed that (1) the paired person is not participating in this same survey, (2) the participant solely determines the allocation, (3) they are the only one who can give a share of the money to the paired person, and (4) one of the five experimental responses will be randomly selected to carry out the allocation after the experiment.

We conduct dictator games in the following five conditions:

I. **Anonymous:** A recipient is anonymous for an allocator. The allocator is also anonymous for the recipient.
II. **Private-Ingroup:** An allocator is informed that a recipient belongs to their ingroup. The allocator is anonymous for the recipient.
III. **Private-Outgroup:** An allocator is informed that a recipient belongs to their outgroup. The allocator is anonymous for the recipient.
IV. **Public-Ingroup:** An allocator is informed that a recipient belongs to their ingroup. The recipient is notified of the vaccination status of the allocator.
V. **Public-Outgroup:** An allocator is informed that a recipient belongs to their outgroup. The recipient is notified of the vaccination status of the allocator.

Here, among the vaccinated group, vaccinated people are ingroup members, and the unvaccinated are outgroup members. In contrast, among the unvaccinated group, the vaccinated are outgroup members, and the unvaccinated are ingroup members. We show screens for each condition in **Appendix A**.

[**Table 1** is Here]

One subject participates in dictator games five times as an allocator. As shown in **Table 1**, we set

[2] In February, 2022, one U.S. dollar was on average 115.24 JPY.

randomly the order of the above conditions to create eight groups in the vaccinated and unvaccinated samples, respectively (Table 1). After we first present the dictator game in the *anonymous* condition (I) in all the eight groups, we randomly set the order of the *private* (II, III) and *public* (IV, V) conditions. Then, within each of the private and public conditions, we randomly set the order of the *ingroup* conditions (II, IV) and *outgroup* conditions (III, V). Consequently, each of the vaccinated and unvaccinated samples have eight groups. Furthermore, to consider potential order effects caused by successive participation in the dictator games, we create a control group where we present the anonymous dictator game (I) five times. Totally, each of the vaccinated and unvaccinated samples have nine groups, including the control group.

2.3. Biases' Definitions and Empirical Hypotheses

We define *ingroup favoritism*, *ingroup bias*, and *outgroup bias* using allocation amounts in the dictator games as follows:

Ingroup favoritism = allocation amount to an ingroup pair – allocation amount to an outgroup pair
Ingroup bias = allocation amount to an ingroup pair – allocation amount to an anonymous pair
Outgroup bias = allocation amount to an outgroup pair – allocation amount to an anonymous pair

Ingroup bias represents a favorable attitude toward ingroup members, while outgroup bias represents a hostile attitude toward outgroups. We use the ingroup and outgroup biases to examine which attitude primarily shapes the ingroup favoritism.

Our empirical hypotheses for the ingroup favoritism and ingroup bias are that they are positive, respectively. That is, the allocations to ingroup pairs are expected to be higher than those to anonymous or outgroup pairs. In contrast, it is hypothesized that the outgroup bias is negative. The allocations to outgroup pairs are expected to be lower than those to anonymous pairs.

We further use the public and private conditions and the background factors of ingroup favoritism. This approach is based on Ockenfels and Webner (2014). Under the public condition, allocators know the vaccination status of recipients, and the recipient also knows the allocators' vaccination status. If the ingroup bias is greater in the public than in the private condition, we interpret that the allocators give higher money amounts in consideration of reputation from ingroup recipients (Guala et al. 2013; Ockenfels and Webner 2014). If the outgroup bias is greater to the positive direction in the public than in the private condition (i.e., the outgroup bias gets weakened in the public condition), we interpret this as the allocators refraining from allocating lower money amounts in consideration of reputation from outgroup recipients. If there is no difference between the two conditions, we interpret this as the ingroup favoritism based on something other than reputation mechanisms, including just preferences (Chen and Li 2009; Klor and Shayo 2010).

2.4. Analytical Procedure

Our experimental design enables us to conduct both between- and within-individual comparisons. We can measure the biases, by focusing on responses in the second dictator game and comparing them across groups. Also, we can measure the biases for each individual in the treatment groups, by using their responses from the first to fifth games and making within-individual differences.

The advantage of the between-comparison is that random assignment allows us to estimate the biases under the causal inference framework. However, since this comparison cannot directly calculate out the biases for each individual, subsample size greatly impacts estimated results when examining associations between the biases and some categories based on survey responses. The within-individual comparison can compensate for this disadvantage. However, the biases measured by using within-individual differences could be influenced by the order of the five conditions. By conducting both the between-analysis and the within-analysis, we can carefully consider the shortcomings of each analysis and investigate the direction and degree of the biases While many past studies on ingroup favoritism employed the between-analysis, an increasing number of studies have employed the within-analysis approach in recent years (Kranton et al., 2021; Bartos et al., 2021).

Specifically, first, we conduct the between-analysis and test the existence of ingroup favoritism, ingroup bias, and outgroup bias in each group of vaccinated and unvaccinated individuals. In addition, we examine how the biases differ between vaccinated and unvaccinated individuals. Also, to explore background factors for the biases, we examine how the biases change between when the vaccination status of the allocator is not informed to the recipient (the private condition) and when it is informed to them (the public condition).

Second, we conduct the within-analysis and check whether individuals' average tendencies of ingroup favoritism, ingroup bias, and outgroup bias are consistent with those observed in the between-analysis. To explore other background factors for the biases, we also check the relationship between the biases and the reasons for vaccination or non-vaccination. Furthermore, to enrich the discussion on the policy implications of this study, we examine how the biases are associated with their real-world attitudes. Specifically, in both the vaccinated and unvaccinated group, we examine the association between their biases and attitudes toward the COVID-19-related policies. In the vaccinated group, we also examine the association between their biases and the timing of COVID-19 vaccination.

2.5. Descriptive Statistics and Balance Check

Since the between-analysis basically focuses on the allocated amount in the second dictator game, the pairs of (1) and (2), (3) and (4), (5) and (6), (7) and (8), (10) and (11), (12) and (13), (14) and (15), and (16) and (17) in **Table 1** are identical in their condition, respectively. In the meta-analysis (Balliet et al., 2014), d of the ingroup favoritism is 0.32. When we calculate the necessary sample size under the condition of $power$=0.8 and $alpha$=0.05, it becomes 155 for each group. Therefore, we obtained a

sample size of around 160 for each pair.

[**Table 2** is Here]

For balance checks, we examine homogeneity between the control group and the above four pairs of treatment groups in each of the vaccinated and unvaccinated samples (**Table 2**). Using the criterion of a 5% pre-registered significance level, we test for differences across the groups in terms of age, sex, family composition, household annual income, educational years and baseline altruism (responses to the hypothetical dictator game in the screening survey and the first dictator game with the anonymous condition in the main experiment). Although we find a minor difference in marital status, the groups are homogeneous in almost all respects.

However, we need to note that when using a 10% significance level, we find a difference in the allocation amount of the first dictator game with the anonymous condition between the control and the pair of (7) and (8), the public and outgroup condition. Because we find no significant difference between the two in that of the hypothetical game in the screening survey, which is used in our stratified randomization, such a difference appears possibly by chance. However, we consider the phenomenon, use the difference between the allocation amounts of the second and first dictator games, and conduct our analysis of between-group comparisons. This procedure allows us to directly consider potentially remaining differences across groups in baseline altruism and other unobserved characteristics (e.g., socially desirable bias and experimenter demand effect). We announced the possibility of employing this procedure in our pre-registration.

Finally, we use control groups of the vaccinated and unvaccinated samples and compare their attributes. The vaccinated group shows higher average age, higher percentage of marriage, higher annual household income, longer educational years, and a larger number of family members living together compared to the unvaccinated group. Baseline altruism, captured by the allocations in the screening survey and in the first dictator game, do not differ significantly between the two groups after controlling for the effects of attribute variables.

3. Between-analysis Results

3.1. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias

[**Figure 1** is Here]

We perform group comparisons by using the allocations of the second and first dictator games and

measure *ingroup favoritism*, *ingroup bias*, and *outgroup bias*.[3] On the left side of **Figure 1**, we present the result of estimating the vaccinated group's biases by comparing the ingroup condition group (1, 2, 5, and 6 in **Table 1**), outgroup condition group (3, 4, 7, and 8), and control group (9). The result shows that the vaccinated group has the strong ingroup favoritism. The direction of their ingroup favoritism is positive as hypothesized, and its size is 8.21 JPY (*Cohen's d* = 0.46), which is statistically significant at the 1% level. The result also indicates that this ingroup favoritism may be generated by the outgroup bias rather than the ingroup bias. The size of the ingroup bias is small (1.69 JPY, *Cohen's d* = 0.11) and not statistically significant even at the 10% level, while the size of the outgroup bias is relatively large (-6.53 JPY, *Cohen's d* = 0.39) and statistically significant at the 1% level.

That is, the vaccinated people tend to increase their allocations to a paired person more when they are paired with another vaccinated person (ingroup members), compared to when they are paired with an unvaccinated person (outgroup members). This tendency is occurring as a consequence of disliking the outgroup members rather than as that of preferring the ingroup members.

On the right side of **Figure 1**, we present the result of estimating the unvaccinated group's biases by comparing the ingroup condition group (10, 11, 14, and15), outgroup condition group (12, 13, 16, and 17), and control group (18). The result does not suggest that the unvaccinated group has the ingroup favoritism, but support the hypothesis of the ingroup bias. Its size is 2.91 JPY (*Cohen's d* = 0.17) and statistically significant at the 5% level.

Despite accepting the hypothesis of the ingroup bias, we cannot observe the ingroup favoritism, because the outgroup bias has the opposite direction of the hypothesis that it is negative. Its size is 4.04 JPY (*Cohen's d* = 0.22), showing a positive sign. If we re-establish the opposite hypothesis that the out-group bias is positive, it is statistically supported at the 5% significance level. This implies that the unvaccinated people increase the amount allocated to an out-group member, a vaccinated person, compared to an anonymous paired person.

That is, the unvaccinated people increase their allocations compared to an anonymous paired person, both when they are paired with a similarly unvaccinated person, an ingroup member, and when they are paired with a vaccinated person, an outgroup member. Thus, we do not find the ingroup favoritism of favoring the unvaccinated pair compared to the vaccinated pair.

In **Appendix B**, we robustly observe the same tendencies in the biases after directly controlling for the effects of attribute variables in regression analysis. As already described in Section 2.5, our analysis considers to some degree the effects of unobserved individual characteristics, including socially desirable bias and experimenter demand effect, by using the difference between the allocations of the second game and the first game as the dependent variable. Furthermore, in **Appendix B**, we still

[3] The pairs of (1) and (2), (3) and (4), (5) and (6), (7) and (8), (10) and (11), (12) and (13), (14) and (15), and (16) and (17) are identical in their condition, respectively. In addition, the first analysis does not separate the Private and Public conditions, we regard each pair of (1)(2)(5) and (6), (3)(4)(7) and (8), (10)(11)(14) and (15), and (12)(13)(16) and (17) as identical in their condition.

observe the similar tendencies in the biases when adding variables that partially capture the socially desirable bias and experimenter demand effect to the estimation and directly controlling their effects.

3.2. Comparison between Vaccinated and Unvaccinated Groups

We statistically check how the *ingroup favoritism*, *ingroup bias*, and *outgroup bias* differ between the vaccinated and unvaccinated groups, by employing a Difference-in-Difference method and conducting regression analysis. We present the details of our estimated models in **Appendix C**.

[**Table 3** is Here]

Column 1 in **Table 3** shows the parameter for the difference in the ingroup favoritism between the vaccinated and unvaccinated groups is 9.3543 (*S.E.* = 2.3543; *p-value* = 0.0000). This implies that the ingroup favoritism is stronger among the vaccinated group than the unvaccinated group, and that the vaccinated people are more likely to favor an ingroup member over an outgroup member. Column 2 does not reject the null hypothesis that the difference in the ingroup bias between the vaccinated and unvaccinated groups is zero, but shows that their difference in the outgroup bias is -10.4841 (*S.E.* = 1.9313; *p-value* = 0.0000). We do not find differences between the vaccinated and unvaccinated groups in their favorable attitudes toward ingroup members: however, their hostile attitudes toward outgroup members are much stronger among the vaccinated group than those in the unvaccinated.

3.3. Comparison between Private and Public Conditions

We examine how the degrees of the *ingroup favoritism*, *ingroup bias*, and *outgroup bias* differ between the private and public conditions. As described in Section 2.3, if the ingroup bias is greater in the public condition than in the private condition, allocators will give a higher amount with consideration for the reputation from a recipient of the same group. Also, if the outgroup bias is larger in the positive direction in the public condition than in the private condition (i.e., the outgroup bias gets weakened in the public condition), allocators will refrain from allocating a lower amount with consideration for the reputation from a recipient of the different group. The direction of the private-public difference in ingroup favoritism will depend on which is larger, the difference in ingroup bias or the difference in outgroup bias.

[**Table 4** is Here]

In **Table 4**, we present results of estimating the models in **Appendix C**. The estimated results do not support the existence of differences between the private and public conditions for all of the ingroup favoritism, ingroup bias, and outgroup bias in both the vaccinated and unvaccinated groups. Also, the

results do not support the possibility that the reputation mechanism may shape the ingroup favoritism and outgroup bias of the vaccinated people. Their biases may arise from causes other than the mechanism.

4. Within-analysis Results

4.1. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias

From here on, we conduct the within-analysis. In our experimental design, 1,261 participants assigned to the treatment groups join the dictator games in all different conditions. Thus, we can calculate out *ingroup favoritism*, *ingroup bias*, and *outgroup bias* for each participant, by making within-individual differences.

[**Figure 2** is Here]

The left-hand side of **Figure 2** presents the average biases of the vaccinated and unvaccinated groups, which are calculated by using the within-individual differences. The tendencies in the biases of the vaccinated group are almost consistent with those in the between analysis. The existence of the ingroup favoritism is statistically significantly supported, and it could be shaped by the outgroup bias rather than the ingroup bias.

Similarly, the tendencies in the biases of the unvaccinated group are consistent with those in the between analysis, in that the existence of the ingroup favoritism is not supported and the outgroup bias is not observed in the hypothesized direction. Also, in that the ingroup favoritism and outgroup bias are greater in the hypothesized direction among the vaccinated group than among the unvaccinated group, the results in the within-analysis are consistent with those in the between-analysis. However, on average, we do not find from the within-analysis that the outgroup bias of the unvaccinated group shows a significantly positive direction, which is the exact opposite of the hypothesis.

4.2. Analysis by Reasons

Why do the vaccinated and unvaccinated people show the tendencies for the biases as observed? In Section 3.3, the between-analysis with the private and public conditions did not support the reputation mechanism. Here, we retry this question by focusing on the participants' reasons for their vaccination or non-vaccination. The advantage of the within-analysis is that this allows direct examination of the relationship between the individuals' biases and several responses in the survey, including the reasons.

In this experiment, we presented to the vaccinated group the question, "Please choose only one reason that most closely matches the reason why you received the vaccine," after the dictator games. Among 636 vaccinated people (without the control group), 443 (69.7%) selected the first reason,

"Vaccination makes it less likely that I will develop the disease even if I am infected, and thus I can avoid serious illness or sequelae." 72 (11.3%) selected the second reason, "Vaccination makes it less likely that I will develop the disease even if I am infected and thus contribute to the stability of the healthcare delivery system and the maintenance of socioeconomic activities." 107 (16.8%) selected the third reason, "Vaccination prevents me from spreading the infection to those who are at high risk of serious illness or who are not vaccinated," and only 14 (2.2%) selected the fourth reason, "others."

Similarly, we presented to the unvaccinated group the question, "Please choose only one reason that most closely matches the reason why you do not receive the vaccine." Among 625 unvaccinated people, 100 (16.0%) selected the first reason, "I would like to get vaccinated if I could, but I cannot for health or other reasons." 447 (71.5%) selected the second reason, "I do not want to get vaccinated anyway in the first place," and 78 (12.5%) selected the third reason, "others."

The remaining part of **Figure 2** shows the biases' values by reasons. We find no substantial differences in the biases of the vaccinated group across their selected reasons. Their first reason would be relatively selfish, while the second and third reasons would be altruistic. The results in Figure 2 indicates the possibility that, no matter whether the vaccinated people received the vaccine for selfish or altruistic reason, they have the strong ingroup favoritism based on the outgroup bias.

In contrast, we find quite substantial differences in the direction and degree of the biases of the unvaccinated group across their reasons. Among the subgroup selecting the first reason, as in the between-analysis, their outgroup bias has the opposite direction of the hypothesis, a positive sign. Consequently, in this within-analysis, their ingroup favoritism also has the opposite direction of the hypothesis, a negative sign. This implies that the unvaccinated people with this reason increase the allocation amount more when paired with a vaccinated person, their outgroup member, compared to when paired with an unvaccinated person, their ingroup member. We may interpret this tendency as a sign of their appreciation for those who received the vaccination on their behalf or as a sign of their perception that the vaccinated people are the *true* ingroup members for them.

Among the other subgroup selecting the second reason, their ingroup favoritism has the hypothesized direction, a positive sign. This result implies that, unlike the unvaccinated people selecting the first reason, those who selected this second reason increase the allocation amount more when paired with an unvaccinated person compared to when paired with a vaccinated person. However, the level of their ingroup favoritism (1.54) is relatively small and around one-fifth of the average level of that of the vaccinated group (7.92). In this way, our analysis by reasons allowed us to get partially closer to the background mechanism of the biases of the unvaccinated group.

4.3. COVID-19-policy Related Attitudes

We finally investigate whether and how *ingroup favoritism* is associated with opinions and behaviors regarding the COVID-19 related policies in the real world. If we find a significant association between

the two, it implies that the biases could have some degree of social influence. We look at the opinion regarding infectious disease control and socioeconomic activities, that regarding the relaxation of behavioral restrictions, that regarding measures to promote vaccination, and only for the vaccinated group, the actual timing of their vaccination.

[**Table 5** is Here]

Panel A of **Table 5** shows that the vaccinated people with stronger ingroup favoritisms are more likely to agree with relaxing the behavioral restrictions of people whose vaccination record can be verified. This association becomes statistically significant, especially when making them imagine a situation in which the number of infected people is decreasing. In addition, those with stronger ingroup favoritism are more likely to receive the vaccine at an earlier date. Although this association becomes weakened when controlling for age and other attribute variables, it remains statistically significant at the 10% level.

Panel B of **Table 5** shows that, among the unvaccinated people, negative associations exist between their ingroup favoritism and all the opinion variables. Here we need to note that the distribution of their ingroup favoritism varies for non-vaccination reasons. The ingroup favoritism is distributed in the direction that the amount allocated to an outgroup member is higher than the amount allocated to an ingroup member, among the subgroup that selected the reason, "I would like to get vaccinated if I could, but I cannot for health or other reasons." Conversely, it is distributed in the direction that the amount allocated to an ingroup member is higher than the amount allocated to an outgroup member, among the other subgroup that selected the reason, "I do not want to get vaccinated anyway in the first place."

[**Table 6** is Here]

Panel A of **Table 6** shows that, among the unvaccinated people selecting the first reason, their ingroup favoritism is negatively and significantly associated with all the three opinions regarding the COVID-19 policies. Given the distributional characteristic, the unvaccinated people who allocated more to the vaccinated than the unvaccinated tend to prioritize infectious disease control over socioeconomic activities, compared to those who do not. They also tend to agree with relaxing behavioral restrictions for people with a verifiable vaccination record and with promotional measures that provide financial rewards for vaccinators. Looking at the constant terms in the odd columns of **Table 5** (models with no covariate), we find that, compared to the unvaccinated people, the vaccinated tend to favor infectious disease control, the relaxation of behavioral restrictions, and the promotional measure with financial rewards. That is, the unvaccinated people who selected the first reason and

have ingroup favoritism in the opposite direction of the hypothesis are more likely to share the same opinions with the vaccinated.

Panel B of **Table 6** shows that, among the unvaccinated people selecting the second reason, their ingroup favoritism is negatively and significantly associated with the opinions regarding infectious disease control and socioeconomic activities and regarding measures to promote vaccination. Given the distributional characteristic, the unvaccinated people who allocated more to the unvaccinated than the vaccinated tend to prioritize socioeconomic activities over infectious disease control and disagree with the promotional measure with financial rewards. Their attitudes are completely opposite to those of the vaccinated people and the unvaccinated who selected the first reason.

5. Discussion and Conclusions

We conducted incentivized dictator game experiments and presented the following findings. First, the vaccinated people have strong *ingroup favoritism*. This ingroup favoritism could be generated mainly by their *outgroup bias* of decreasing the amount allocated to the unvaccinated people, their outgroup members, not by the *ingroup bias* of increasing the amount allocated to the vaccinated people, their ingroup members. The superficial tendency of ingroup favoritism is consistent with the hypothesis and results of previous studies, in which the ingroup favoritism was formed mainly by ingroup bias rather than outgroup bias (Balliet et al. 2014). The current results may be unique to the context of the COVID-19 vaccination. Jagodics and Szabó (2022) also use a hypothetical scenario experiment and report that the COVID-19 vaccinated people prefer to increase the difference in allocation between their ingroup and outgroup members to disadvantage the outgroup members. In contrast to the vaccinated people, the unvaccinated do not have ingroup favoritism, on average. Among them, the outgroup bias is found in the opposite direction of the hypothesis, and they tend to allocate more money to a vaccinated pair, their outgroup members, than to an anonymous pair.

Second, we take advantage of ensuring a sufficient sample size of the unvaccinated people and examine how the biases vary depending on their reason for not receiving the COVID-19 vaccine, to explore the background factors of their seemingly strange biases. The ingroup favoritism and outgroup bias are observed in the opposite directions of the hypotheses, as in the above average result, among the unvaccinated who selected the reason, “I would like to get vaccinated if I could, but I cannot for health or other reasons.” On the contrary, among those who selected the reason, “I do not want to get vaccinated anyway in the first place,” the biases are observed as hypothesized, and they tend to allocate more money amount to an unvaccinated pair, an ingroup member, than to a vaccinated pair, an outgroup member. The attitudes of the former subgroup could be interpreted as a sign of their appreciation for people who received the vaccine on their behalf or as a sign of their perception that the vaccinated people are the true ingroup members for them.

Third, respectively among the vaccinated and unvaccinated groups, the biases are associated with

their attitudes toward COVID-19-related policies, indicating that the biases would have some degree of social influence in the real world. The vaccinated people with stronger ingroup favoritism are more likely to agree with relaxing the behavioral restrictions for those whose vaccination records can be verified and have received the vaccine at an earlier date. As with the second finding, the associations for the unvaccinated people vary substantially depending on their non-vaccination reasons. Among the unvaccinated with the first reason, those who allocate more to the vaccinated are more likely to agree with prioritizing infectious disease control over socioeconomic activities, relaxing the behavioral restrictions by vaccination records, and promoting vaccination by financial rewards. In contrast, among the unvaccinated with the second reason, those who allocate more to the unvaccinated are more likely to disagree with prioritizing infectious disease control and the above vaccination promotion measure.

Favorable attitudes toward outgroup members have been observed among racial, religious, and sexual minorities in previous studies (Axt et al., 2018). The unvaccinated people are also a minority in Japan, and this study is common to the previous studies in this respect. The tendencies in the biases of the unvaccinated people are heterogeneous depending on their non-vaccination reasons, with some exhibiting hostile attitudes toward outgroup members, the vaccinated. However, their level of hostility is smaller than that of the vaccinated.

Some vaccinated people may feel as if almost all the unvaccinated people have a hostile attitude toward vaccinators, because they see lots of unvaccinated people supporting and spreading fake news about the COVID-19 vaccine through social media. However, this belief is not supported as far as we investigate by using ingroup favoritism, ingroup bias, and outgroup bias. On average, the vaccinated people, rather than the unvaccinated, behave more discriminately toward their outgroup members. In many countries and regions where the vaccinated people are the majority (e.g., Argentina, Australia, Brazil, Canada, China, France, Germany, Italy, Japan, South Korea, and the United Kingdom), it is essential for them to realize their hostile attitudes and consider diverse reasons and behaviors of the unvaccinated people to build cooperative relationships between the two groups smoothly.

References

Axt, J.R., Moran, T., and Bar-Anan, Y. (2018). Simultaneous ingroup and outgroup favoritism in implicit social cognition. *Journal of Experimental Social Psychology,* 79, 275-289.

Balliet, D., Wu, J., and De Dreu, C.K. (2014). Ingroup favoritism in cooperation: a meta-analysis. *Psychological Bulletin,* 140(6), 1556.

Bartoš, V., Bauer, M., Cahlíková, J., and Chytilová, J. (2021). Covid-19 crisis and hostility against foreigners. *European Economic Review,* 137, 103818.

Brewer, M.B. (1999). The psychology of prejudice: Ingroup love and outgroup hate?. *Journal of Social Issues,* 55(3), 429-444.

Bornstein, G. (2003). Intergroup conflict: Individual, group, and collective interests. *Personality and Social Psychology Review*, *7*(2), 129-145.

Caporael, L.R. (2007). Evolutionary theory for social and cultural psychology. *Social psychology: Handbook of basic principles,* 2, 3-18.

Charness, G., Cobo-Reyes, R., and Jimenez, N. (2014). Identities, selection, and contributions in a public-goods game. *Games and Economic Behavior,* 87, 322-338.

Charness, G., and Rustichini, A. (2011). Gender differences in cooperation with group membership. *Games and Economic Behavior,* 72(1), 77-85.

Chen, Y., and Li, S. X. (2009). Group identity and social preferences. *American Economic Review,* 99(1), 431-57.

Efferson, C., Lalive, R., and Fehr, E. (2008). The coevolution of cultural groups and ingroup favoritism. *Science,* 321(5897), 1844-1849.

Fershtman, C., and Gneezy, U. (2001). Discrimination in a segmented society: An experimental approach. *The Quarterly Journal of Economics,* 116(1), 351-377.

Guala, F., Mittone, L., and Ploner, M. (2013). Group membership, team preferences, and expectations. *Journal of Economic Behavior & Organization,* 86, 183-190.

Halevy, N., Chou, E.Y., Cohen, T.R., and Bornstein, G. (2010). Relative deprivation and intergroup competition. *Group Processes & Intergroup Relations,* 13(6), 685-700.

Jagodics, B., and Szabó, É. (2022). Is intergroup discrimination triggered by vaccination status? Exploring some social aspects of vaccinations during the COVID-19 pandemic. *The Journal of Social Psychology,* 1-15.

Klor, E.F., and Shayo, M. (2010). Social identity and preferences over redistribution. *Journal of Public Economics,* 94(3-4), 269-278.

Kranton, R., Pease, M., Sanders, S., and Huettel, S. (2020). Deconstructing bias in social preferences reveals groupy and not-groupy behavior. *Proceedings of the National Academy of Sciences,* 117(35), 21185-21193.

Lane, T. (2016). Discrimination in the laboratory: A meta-analysis of economics experiments.

European Economic Review, 90, 375-402.

Mifune, N., Hashimoto, H., and Yamagishi, T. (2010). Altruism toward in-group members as a reputation mechanism. *Evolution and Human Behavior,* 31(2), 109-117.

Ockenfels, A., and Werner, P. (2014). Beliefs and ingroup favoritism. *Journal of Economic Behavior & Organization,* 108, 453-462.

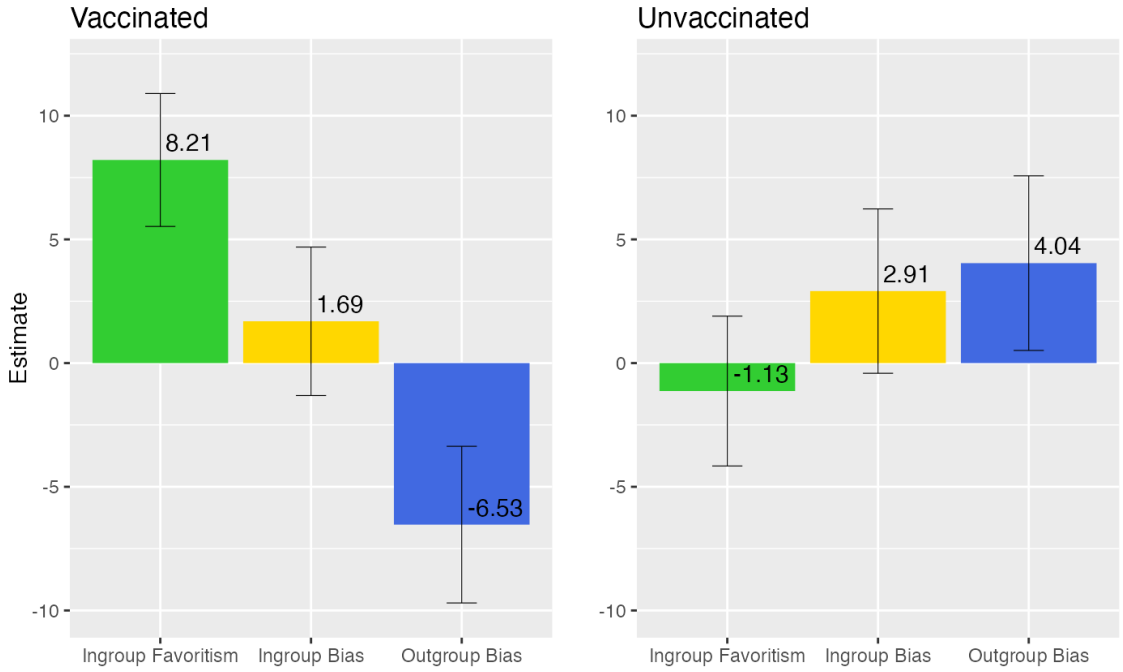
Sasaki, S., and Kurokawa, H. (2022). A Dictator Game Experiment with the COVID-19 Vaccinated and Unvaccinated People. AEA RCT Registry. https://doi.org/10.1257/rct.8951

Tajfel, H., Billig, M.G., Bundy, R.P., and Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology,* 1(2), 149-178.

Yamagishi, T., and Mifune, N. (2008). Does shared group membership promote altruism? Fear, greed, and reputation. *Rationality and Society,* 20(1), 5-30.

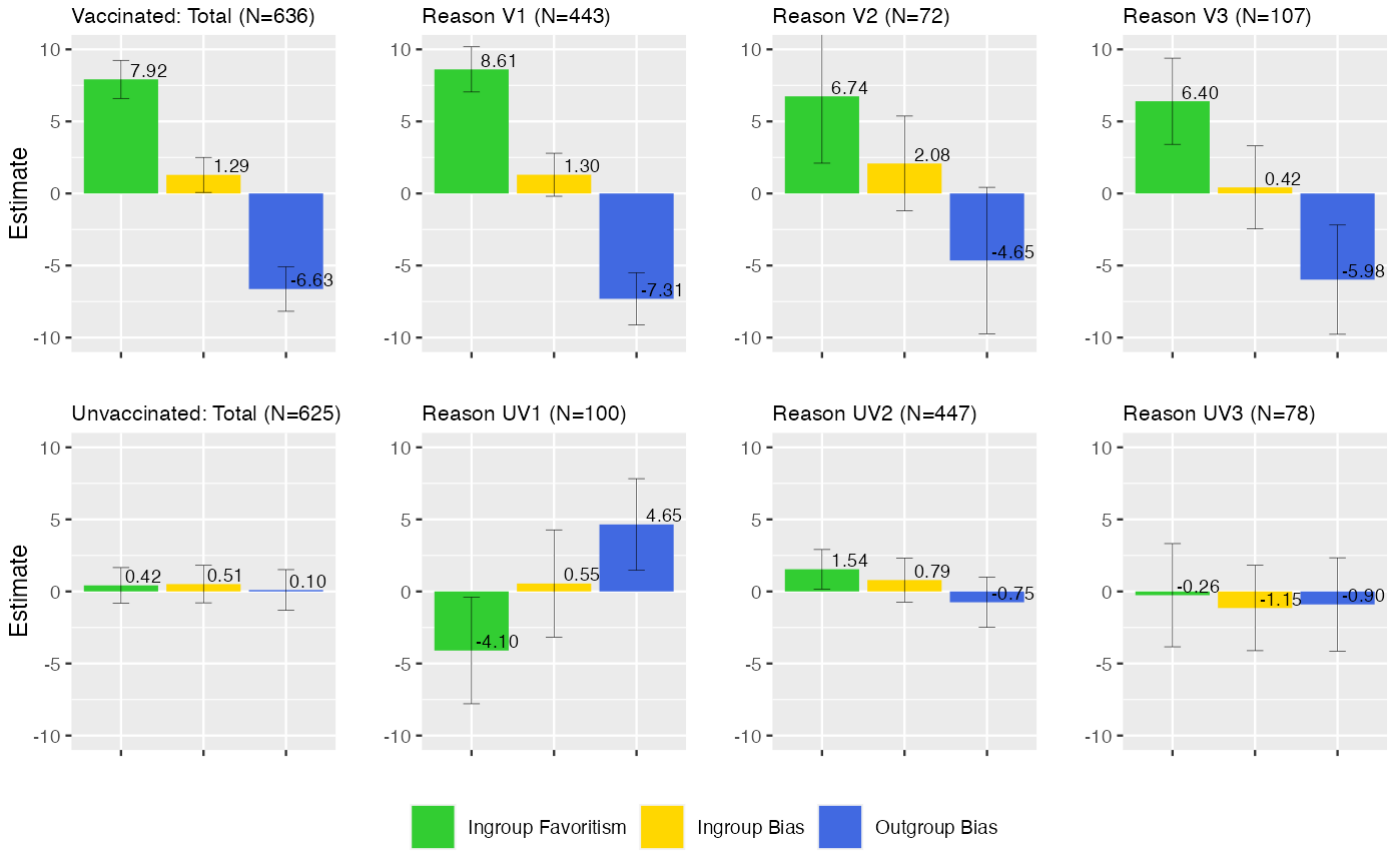
Yzerbyt, V., and Demoulin, S. (2010). Intergroup Relations. *Handbook of Social Psychology.*

Figure 1. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias (from the Between-analysis)



Notes: Vertical lines in the graph represent 95% confidence intervals. On the left side of Figure 1, we present the result of estimating the vaccinated group's biases by comparing the ingroup condition group, outgroup condition group, and control group. The result shows that the vaccinated group has the ingroup favoritism. The direction of their ingroup favoritism is positive as hypothesized, and its size is 8.21 JPY (*Cohen's d* = 0.46), which is statistically significant at the 1% level. This result also indicates that this ingroup favoritism may be generated by the outgroup bias rather than the ingroup bias. The size of the ingroup bias is small (1.69 JPY, *Cohen's d* = 0.11) and not statistically significant even at the 10% level, while the size of the outgroup bias is relatively large (-6.53 JPY, *Cohen's d* = 0.39) and statistically significant at the 1% level. Similarly, on the right side of Figure 1, we present the result of estimating the unvaccinated group's biases by comparing the ingroup condition group, outgroup condition group, and control group. The result does not suggest that the unvaccinated group has the ingroup favoritism, but support the hypothesis of the ingroup bias. Its size is 2.91 JPY (*Cohen's d* = 0.17) and statistically significant at the 5% level. Despite accepting the hypothesis of the ingroup bias, we cannot observe the ingroup favoritism, because the outgroup bias has the opposite direction of the hypothesis that it is negative. Its size is 4.04 JPY (*Cohen's d* = 0.22), showing a positive sign. If we re-establish the opposite hypothesis that the out-group bias is positive, it is statistically supported at the 5% significance level.

Figure 2. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias (from the Within-analysis)



Note: Vertical lines in the graph represent 95% confidence intervals.

Table 1. Group Assignment

	Vaccinated sample (N=800)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	N=160		N=160		N=160		N=160		N=160
Order	N=80	N=80	N=80	N=80	N=80	N=80	N=80	N=80	
1	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
2	**II**	**II**	**III**	**III**	**IV**	**IV**	**V**	**V**	**I**
3	**III**	**III**	**II**	**II**	**V**	**V**	**IV**	**IV**	**I**
4	**IV**	**V**	**IV**	**V**	**II**	**III**	**II**	**III**	**I**
5	**V**	**IV**	**V**	**IV**	**III**	**II**	**III**	**II**	**I**

	Unvaccinated sample (N=800)								
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	N=160		N=160		N=160		N=160		N=160
Order	N=80	N=80	N=80	N=80	N=80	N=80	N=80	N=80	
1	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**	**I**
2	**II**	**II**	**III**	**III**	**IV**	**IV**	**V**	**V**	**I**
3	**III**	**III**	**II**	**II**	**V**	**V**	**IV**	**IV**	**I**
4	**IV**	**V**	**IV**	**V**	**II**	**III**	**II**	**III**	**I**
5	**V**	**IV**	**V**	**IV**	**III**	**II**	**III**	**II**	**I**

Notes: We conduct dictator games in the following five conditions: I. Anonymous (A recipient is anonymous for an allocator. The allocator is also anonymous for the recipient), II. Private-Ingroup (An allocator is informed that a recipient belongs to their ingroup. The allocator is anonymous for the recipient), III. Private-Outgroup (An allocator is informed that a recipient belongs to their outgroup. The allocator is anonymous for the recipient), IV. Public-Ingroup (An allocator is informed that a recipient belongs to their ingroup. The recipient is notified of the vaccination status of the allocator), and V. Public-Outgroup (An allocator is informed that a recipient belongs to their outgroup. The recipient is notified of the vaccination status of the allocator).

Table 2. Descriptive Statistics

Vaccinated sample	Private & Ingroup		Private & Outgroup		Public & Ingroup		Public & Outgroup		Control (Anonymous)	
	II		III		IV		V		I	
	(1) (2)		(3) (4)		(5) (6)		(7) (8)		(9)	
N=796	N=160		N=159		N=160		N=157		N=160	
	Mean	S.D.	**Mean**	S.D.	**Mean**	S.D.	**Mean**	S.D.	**Mean**	S.D.
Female dummy	**0.51**	0.50	**0.49**	0.50	**0.46**	0.50	**0.48**	0.50	**0.43**	0.50
Age	**49.34**	11.97	**49.32**	12.75	**51.19**	11.85	**50.01**	12.55	**50.88**	11.47
Married dummy	**0.65**	0.48	**0.61**	0.49	**0.62**	0.49	**0.70**	0.46	**0.58**	0.49
Number of family members	**1.84**	1.30	**2.00**	1.41	**1.85**	1.33	**1.98**	1.44	**2.02**	1.49
Household income	**671.02**	424.30	**686.25**	425.91	**629.81**	412.12	**627.50**	320.06	**631.03**	408.34
No income information dummy	**0.14**	0.35	**0.14**	0.35	**0.12**	0.32	**0.13**	0.34	**0.14**	0.35
Educational years	**14.50**	1.98	**14.55**	2.17	**14.59**	1.90	**14.93**	2.09	**14.75**	1.80
Allocation in the screening survey	**40.56**	34.66	**37.80**	35.23	**43.50**	37.85	**40.38**	34.53	**39.00**	35.08
Allocation in the first dictator game	**21.50**	28.42	**22.77**	25.78	**23.69**	26.53	**26.88**	26.53	**21.56**	26.24

Unvaccinated sample	Private & Ingroup		Private & Outgroup		Public & Ingroup		Public & Outgroup		Control (Anonymous)	
	II		III		IV		V		I	
	(10) (11)		(12) (13)		(14) (15)		(16) (17)		(18)	
N=782	N=152		N=157		N=158		N=158		N=157	
	Mean	S.D.	**Mean**	S.D.	**Mean**	S.D.	**Mean**	S.D.	**Mean**	S.D.
Female dummy	**0.49**	0.50	**0.48**	0.50	**0.49**	0.50	**0.49**	0.50	**0.50**	0.50
Age	**43.32**	12.61	**42.71**	11.84	**44.16**	13.28	**44.54**	12.08	**43.26**	11.99
Married dummy	**0.39**	0.49	**0.33**	0.47	**0.40**	0.49	**0.44**	0.50	**0.39**	0.49
Number of family members	**1.73**	1.27	**1.73**	1.42	**1.74**	1.29	**1.67**	1.40	**1.94**	1.46
Household income	**525.86**	292.41	**504.54**	335.03	**487.74**	329.18	**534.83**	357.50	**509.17**	353.83
No income information dummy	**0.18**	0.39	**0.22**	0.41	**0.22**	0.41	**0.23**	0.42	**0.23**	0.42
Educational years	**14.12**	2.19	**14.11**	2.05	**13.64**	2.18	**14.20**	2.49	**14.01**	2.18
Allocation in the screening survey	**36.51**	35.33	**36.75**	36.54	**38.23**	34.63	**36.58**	37.40	**34.78**	33.18
Allocation in the first dictator game	**26.84**	31.04	**21.02**	26.68	**26.77**	30.33	**23.73**	29.07	**24.33**	27.83

Notes: Some participants did not answer annual household income. We imputed the average amount of the income for such participants, at the same time considering that they did not answer it by using the variable of no income information. For balance checks, we examine homogeneity between the control group and the above four pairs of treatment groups in each of the vaccinated and unvaccinated samples. Using the criterion of a 5% pre-registered significance level, we test for differences across the groups in terms of age, sex, family composition, household annual income, educational years and baseline altruism (responses to the hypothetical dictator game in the screening survey and the first dictator game with the anonymous condition in the main experiment). Although we find a minor difference in marital status, the groups are homogeneous in almost all respects.

Table 3. Comparison between Vaccinated and Unvaccinated Groups

	(1)	(2)
Tests for	Ingroup Favoritism	Ingroup Bias and Outgroup Bias
Vaccinated sample	-7.7650***	2.5386
	(0.7456)	(2.1227)
Ingroup condition	-1.1513	2.8943
	(1.1289)	(1.5681)
Vaccinated sample×Ingroup condition	**9.3543*** **	-1.1447
	(1.2966)	(2.8542)
Outgroup condition		4.0277***
		(1.0609)
Vaccinated sample×Outgroup condition		**-10.4841*** **
		(2.0010)
Covariates	YES	YES
Constant term	10.3841**	4.5465
	(3.6959)	(3.8168)
Number of observations	1,261	1,578
R-squared	0.046	0.040

Notes: Cluster robust standard errors at region level in parentheses. *** p<0.01, ** p<0.05, and * p<0.10. Covariates include female dummy, age, married dummy, number of family members, household income, no income information dummy, and educational years. Column 1 shows that the parameter for the difference in the ingroup favoritism between the vaccinated and unvaccinated groups is 9.3543 (S.E. = 2.3543; p-value = 0.0000). This implies that the ingroup favoritism is stronger among the vaccinated group than the unvaccinated group, and that the vaccinated people are more likely to favor their ingroup member over the outgroup member. Column 2 does not reject the null hypothesis that the difference in the ingroup bias between the vaccinated and unvaccinated groups is zero, but shows that their difference in the outgroup bias is -10.4841 (S.E. = 1.9313; p-value = 0.0000). We do not find differences between the vaccinated and unvaccinated groups in their favorable attitudes toward ingroup members, while their hostile attitudes toward outgroup members are much stronger among the vaccinated group than those in the unvaccinated group.

Table 4. Comparison between Private and Public Conditions

	3V	4V	5V	3U	4U	5U
	Vaccinated sample			**Unvaccinated sample**		
Tests for	Ingroup Favoritism	Ingroup Bias	Outgroup Bias	Ingroup Favoritism	Ingroup Bias	Outgroup Bias
Public & Ingroup condition	0.6281	-0.2031		1.1360	0.3833	
	(3.9666)	(1.4256)		(3.5341)	(1.4132)	
Public & Outgroup condition			-0.3857			-1.1570
			(3.2126)			(2.7834)
Ingroup condition	7.9155***			-1.7407		
	(1.7245)			(1.7900)		
Public condition	-0.5397			-1.0713		
	(3.1622)			(2.7790)		
Covariates	YES	YES	YES	YES	YES	YES
Constant term	-0.8084	6.3141	-1.6998	12.7715**	4.0568	20.0942
	(5.3216)	(8.2498)	(5.1400)	(4.2562)	(9.7910)	(12.4886)
Number of observations	636	320	316	625	310	315
R-squared	0.066	0.017	0.022	0.015	0.008	0.040

Notes: Cluster robust standard errors at region level in parentheses. *** p<0.01, ** p<0.05, and * p<0.10. The estimated results do not support the existence of differences between the private and public conditions for all of the ingroup favoritism, ingroup bias, and outgroup bias in both the vaccinated and unvaccinated groups. The results also do not support the possibility that the reputation mechanism may shape the ingroup favoritism and outgroup bias of the vaccinated people. Their biases may arise from causes other than the mechanism.

Table 5. Associations with COVID-19-policy Related Attitudes (1)

Panel A:

Vaccinated sample, N=636	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	I think we should prioritize infectious disease control over socioeconomic activities.		I agree with relaxing the behavioral restrictions when a vaccination record can be verified.				I agree with offering financial rewards to vaccinated people.				The period from January 1, 2021 to the vaccination date	
			In areas where the infection is spreading		In areas where the infection is shrinking		Only to newly vaccinated		Both to newly and previously vaccinated			
Scales:	0-10		1-5		1-5		1-5		1-5		Number of days	
Ingroup Favoritism	0.0015	-0.0012	0.0054	0.0055	0.0046***	0.0048**	-0.0049	-0.0036	-0.0004	0.0012	-0.2080***	-0.1230*
	(0.0082)	(0.0079)	(0.0035)	(0.0036)	(0.0014)	(0.0017)	(0.0029)	(0.0031)	(0.0016)	(0.0020)	(0.0581)	(0.0647)
Covariates	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Constant term	6.1111***	5.5520***	3.2390***	3.4002**	3.3029***	3.0753***	2.5074***	3.1294***	3.5578***	5.1891***	211.8462***	200.2294***
	(0.1142)	(1.2428)	(0.0502)	(1.0290)	(0.0625)	(0.5175)	(0.0336)	(0.4585)	(0.0309)	(0.6999)	(2.9190)	(22.2803)
R-squared	0.000	0.041	0.008	0.036	0.006	0.031	0.004	0.035	0.000	0.061	0.006	0.181

Panel B:

Unvaccinated sample, N=625	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	I think we should prioritize infectious disease control over socioeconomic activities.		I agree with relaxing the behavioral restrictions when a vaccination record can be verified.				I agree with offering financial rewards to vaccinated people.			
			In areas where the infection is spreading		In areas where the infection is shrinking		Only to newly vaccinated		Both to newly and previously vaccinated	
Scales:	0-10		1-5		1-5		1-5		1-5	
Ingroup Favoritism	-0.0284***	-0.0285***	-0.0082**	-0.0080**	-0.0089*	-0.0085*	-0.0105***	-0.0106***	-0.0116***	-0.0120***
	(0.0047)	(0.0031)	(0.0035)	(0.0032)	(0.0043)	(0.0041)	(0.0027)	(0.0022)	(0.0025)	(0.0021)
Covariates	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Constant term	4.5654***	6.1727***	2.2434***	3.1999***	2.2933***	3.7687***	2.2044***	3.8664***	2.3088***	4.4526***
	(0.0892)	(1.1976)	(0.0346)	(0.6532)	(0.0321)	(0.4133)	(0.0315)	(0.5807)	(0.0221)	(0.5598)
R-squared	0.024	0.073	0.014	0.046	0.016	0.041	0.020	0.075	0.022	0.097

Notes : Cluster robust standard errors at region level in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6. Associations with COVID-19-policy Related Attitudes (2)

Panel A:

Unvaccinated sample with Reason UV1, N=100	(1)	(2)	(3)	(4)	(7)	(8)	(11)	(12)	(13)	(14)
"Because I would like to get vaccinated if I could, but I cannot for health or other reasons."	I think we should prioritize infectious disease control over socioeconomic activities.		I agree with relaxing the behavioral restrictions when a vaccination record can be verified.				I agree with offering financial rewards to vaccinated people.			
			In areas where the infection is spreading		In areas where the infection is shrinking		Only to newly vaccinated		Both to newly and previously vaccinated	
Scales:	0-10		1-5		1-5		1-5		1-5	
Ingroup Favoritism	-0.0349**	-0.0247**	-0.0105***	-0.0129***	-0.0092**	-0.0114***	-0.0037	-0.0107**	-0.0055	-0.0125**
	(0.0115)	(0.0089)	(0.0030)	(0.0028)	(0.0032)	(0.0031)	(0.0066)	(0.0041)	(0.0081)	(0.0052)
Covariates	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Constant term	5.5469***	10.9626***	2.3969***	1.3289	2.4621***	2.4260	2.2049***	3.2280*	2.3376***	2.6191
	(0.3762)	(3.0817)	(0.0559)	(0.9781)	(0.0504)	(1.4104)	(0.1114)	(1.5150)	(0.0898)	(1.5903)
R-squared	0.058	0.174	0.046	0.147	0.031	0.075	0.004	0.176	0.007	0.173

Panel B:

Unvaccinated sample with Reason UV2, N=447	(15)	(16)	(17)	(18)	(21)	(22)	(25)	(26)	(27)	(28)
"Because I do not want to get vaccinated anyway in the first place."	I think we should prioritize infectious disease control over socioeconomic activities.		I agree with relaxing the behavioral restrictions when a vaccination record can be verified.				I agree with offering financial rewards to vaccinated people.			
			In areas where the infection is spreading		In areas where the infection is shrinking		Only to newly vaccinated		Both to newly and previously vaccinated	
Scales:	0-10		1-5		1-5		1-5		1-5	
Ingroup Favoritism	-0.0170**	-0.0180**	-0.0074	-0.0066	-0.0093	-0.0079	-0.0158***	-0.0141***	-0.0164***	-0.0147***
	(0.0059)	(0.0055)	(0.0043)	(0.0042)	(0.0054)	(0.0052)	(0.0032)	(0.0029)	(0.0031)	(0.0031)
Covariates	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Constant term	4.3082***	4.4948**	2.2172***	3.1287**	2.2895***	3.8372***	2.2100***	4.3892***	2.3027***	4.7774***
	(0.0686)	(1.5640)	(0.0484)	(1.0180)	(0.0489)	(0.6215)	(0.0225)	(0.5199)	(0.0290)	(0.5327)
R-squared	0.007	0.054	0.010	0.036	0.015	0.042	0.039	0.092	0.039	0.105

Notes : Cluster robust standard errors at region level in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Appendix A. Experimental Screens

Appendix Figure 1. Screens for Vaccinated Sample

I. Anonymous (for Vaccinated Sample)

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, An anonymous pair: 100 JPY
- Anonymous you: 10 JPY, An anonymous pair: 90 JPY
- Anonymous you: 20 JPY, An anonymous pair: 80 JPY
- Anonymous you: 30 JPY, An anonymous pair: 70 JPY
- Anonymous you: 40 JPY, An anonymous pair: 60 JPY
- Anonymous you: 50 JPY, An anonymous pair: 50 JPY
- Anonymous you: 60 JPY, An anonymous pair: 40 JPY
- Anonymous you: 70 JPY, An anonymous pair: 30 JPY
- Anonymous you: 80 JPY, An anonymous pair: 20 JPY
- Anonymous you: 90 JPY, An anonymous pair: 10 JPY
- Anonymous you: 100 JPY, An anonymous pair: 0 JPY

II. Private-Ingroup (for Vaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has already completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, A vaccinated pair: 100 JPY
- Anonymous you: 10 JPY, A vaccinated pair: 90 JPY
- Anonymous you: 20 JPY, A vaccinated pair: 80 JPY
- Anonymous you: 30 JPY, A vaccinated pair: 70 JPY
- Anonymous you: 40 JPY, A vaccinated pair: 60 JPY
- Anonymous you: 50 JPY, A vaccinated pair: 50 JPY
- Anonymous you: 60 JPY, A vaccinated pair: 40 JPY
- Anonymous you: 70 JPY, A vaccinated pair: 30 JPY
- Anonymous you: 80 JPY, A vaccinated pair: 20 JPY
- Anonymous you: 90 JPY, A vaccinated pair: 10 JPY
- Anonymous you: 100 JPY, A vaccinated pair: 0 JPY

III. Private-Outgroup (for Vaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, An unvaccinated pair: 100 JPY
- Anonymous you: 10 JPY, An unvaccinated pair: 90 JPY
- Anonymous you: 20 JPY, An unvaccinated pair: 80 JPY
- Anonymous you: 30 JPY, An unvaccinated pair: 70 JPY
- Anonymous you: 40 JPY, An unvaccinated pair: 60 JPY
- Anonymous you: 50 JPY, An unvaccinated pair: 50 JPY
- Anonymous you: 60 JPY, An unvaccinated pair: 40 JPY
- Anonymous you: 70 JPY, An unvaccinated pair: 30 JPY
- Anonymous you: 80 JPY, An unvaccinated pair: 20 JPY
- Anonymous you: 90 JPY An unvaccinated pair: 10 JPY
- Anonymous you: 100 JPY, An unvaccinated pair: 0 JPY

IV. Public-Ingroup (for Vaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has already completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"The money allocation was decided by a Japanese monitor who, like you, have completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Vaccinated you: 0 JPY, A vaccinated pair: 100 JPY
- Vaccinated you: 10 JPY, A vaccinated pair: 90 JPY
- Vaccinated you: 20 JPY, A vaccinated pair: 80 JPY
- Vaccinated you: 30 JPY, A vaccinated pair: 70 JPY
- Vaccinated you: 40 JPY, A vaccinated pair: 60 JPY
- Vaccinated you: 50 JPY, A vaccinated pair: 50 JPY
- Vaccinated you: 60 JPY, A vaccinated pair: 40 JPY
- Vaccinated you: 70 JPY, A vaccinated pair: 30 JPY
- Vaccinated you: 80 JPY, A vaccinated pair: 20 JPY
- Vaccinated you: 90 JPY, A vaccinated pair: 10 JPY
- Vaccinated you: 100 JPY, A vaccinated pair: 0 JPY

V. Public-Outgroup (for Vaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"The money allocation was decided by a Japanese monitor who, unlike you, have completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Vaccinated you: 0 JPY, An unvaccinated pair: 100 JPY
- Vaccinated you: 10 JPY, An unvaccinated pair: 90 JPY
- Vaccinated you: 20 JPY, An unvaccinated pair: 80 JPY
- Vaccinated you: 30 JPY, An unvaccinated pair: 70 JPY
- Vaccinated you: 40 JPY, An unvaccinated pair: 60 JPY
- Vaccinated you: 50 JPY, An unvaccinated pair: 50 JPY
- Vaccinated you: 60 JPY, An unvaccinated pair: 40 JPY
- Vaccinated you: 70 JPY, An unvaccinated pair: 30 JPY
- Vaccinated you: 80 JPY, An unvaccinated pair: 20 JPY
- Vaccinated you: 90 JPY, An unvaccinated pair: 10 JPY
- Vaccinated you: 100 JPY, An unvaccinated pair: 0 JPY

Appendix Figure 2. Screens for Unvaccinated Sample

I. Anonymous (for Unvaccinated Sample)

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, An anonymous pair: 100 JPY
- Anonymous you: 10 JPY, An anonymous pair: 90 JPY
- Anonymous you: 20 JPY, An anonymous pair: 80 JPY
- Anonymous you: 30 JPY, An anonymous pair: 70 JPY
- Anonymous you: 40 JPY, An anonymous pair: 60 JPY
- Anonymous you: 50 JPY, An anonymous pair: 50 JPY
- Anonymous you: 60 JPY, An anonymous pair: 40 JPY
- Anonymous you: 70 JPY, An anonymous pair: 30 JPY
- Anonymous you: 80 JPY, An anonymous pair: 20 JPY
- Anonymous you: 90 JPY, An anonymous pair: 10 JPY
- Anonymous you: 100 JPY, An anonymous pair: 0 JPY

II. Private-Ingroup (for Unvaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, An unvaccinated pair: 100 JPY
- Anonymous you: 10 JPY, An unvaccinated pair: 90 JPY
- Anonymous you: 20 JPY, An unvaccinated pair: 80 JPY
- Anonymous you: 30 JPY, An unvaccinated pair: 70 JPY
- Anonymous you: 40 JPY, An unvaccinated pair: 60 JPY
- Anonymous you: 50 JPY, An unvaccinated pair: 50 JPY
- Anonymous you: 60 JPY, An unvaccinated pair: 40 JPY
- Anonymous you: 70 JPY, An unvaccinated pair: 30 JPY
- Anonymous you: 80 JPY, An unvaccinated pair: 20 JPY
- Anonymous you: 90 JPY An unvaccinated pair: 10 JPY
- Anonymous you: 100 JPY, An unvaccinated pair: 0 JPY

III. Private-Outgroup (for Unvaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has already completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"This money allocation was decided by an anonymous Japanese monitor."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Anonymous you: 0 JPY, A vaccinated pair: 100 JPY
- Anonymous you: 10 JPY, A vaccinated pair: 90 JPY
- Anonymous you: 20 JPY, A vaccinated pair: 80 JPY
- Anonymous you: 30 JPY, A vaccinated pair: 70 JPY
- Anonymous you: 40 JPY, A vaccinated pair: 60 JPY
- Anonymous you: 50 JPY, A vaccinated pair: 50 JPY
- Anonymous you: 60 JPY, A vaccinated pair: 40 JPY
- Anonymous you: 70 JPY, A vaccinated pair: 30 JPY
- Anonymous you: 80 JPY, A vaccinated pair: 20 JPY
- Anonymous you: 90 JPY, A vaccinated pair: 10 JPY
- Anonymous you: 100 JPY, A vaccinated pair: 0 JPY

IV. Public-Ingroup (for Unvaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"The money allocation was decided by a Japanese monitor who, like you, have never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Vaccinated you: 0 JPY, An unvaccinated pair: 100 JPY
- Vaccinated you: 10 JPY, An unvaccinated pair: 90 JPY
- Vaccinated you: 20 JPY, An unvaccinated pair: 80 JPY
- Vaccinated you: 30 JPY, An unvaccinated pair: 70 JPY
- Vaccinated you: 40 JPY, An unvaccinated pair: 60 JPY
- Vaccinated you: 50 JPY, An unvaccinated pair: 50 JPY
- Vaccinated you: 60 JPY, An unvaccinated pair: 40 JPY
- Vaccinated you: 70 JPY, An unvaccinated pair: 30 JPY
- Vaccinated you: 80 JPY, An unvaccinated pair: 20 JPY
- Vaccinated you: 90 JPY, An unvaccinated pair: 10 JPY
- Vaccinated you: 100 JPY, An unvaccinated pair: 0 JPY

V. Public-Outgroup (for Unvaccinated Sample)

Again, please read the following instructions carefully and determine your choice.

You have now received another reward of **100 JPY**, in addition to the survey reward (90 JPY).

You can share some of that 100 JPY with someone who has the following characteristics:

- **He/she is another Japanese monitor registered with the same company.**
- **He/she is not participating in this experiment.**
- **He/she has already completed the first and second COVID-19 vaccinations. He/she answered to receive additional vaccinations in the future.**

You are solely responsible for deciding which allocation of 100 JPY will be divided. Also, you are the only one who can share the money with him/her, no one else.

When informing him/her of the allocation result, the following message will be attached.

"The money allocation was decided by a Japanese monitor who, unlike you, have never received the COVID-19 vaccination. He/she answered not to receive any future vaccinations."

In this situation, how will you divide the 100 JPY? Choose only one allocation that you prefer the most.

*If, as a result of a random drawing, this response is selected out of the five responses, the allocation is carried out according to the procedure described above.
*You cannot change your choice, so please make your choice after careful consideration.

- Vaccinated you: 0 JPY, A vaccinated pair: 100 JPY
- Vaccinated you: 10 JPY, A vaccinated pair: 90 JPY
- Vaccinated you: 20 JPY, A vaccinated pair: 80 JPY
- Vaccinated you: 30 JPY, A vaccinated pair: 70 JPY
- Vaccinated you: 40 JPY, A vaccinated pair: 60 JPY
- Vaccinated you: 50 JPY, A vaccinated pair: 50 JPY
- Vaccinated you: 60 JPY, A vaccinated pair: 40 JPY
- Vaccinated you: 70 JPY, A vaccinated pair: 30 JPY
- Vaccinated you: 80 JPY, A vaccinated pair: 20 JPY
- Vaccinated you: 90 JPY, A vaccinated pair: 10 JPY
- Vaccinated you: 100 JPY, A vaccinated pair: 0 JPY

Appendix B. Robustness Check

As shown in Table Appendix A, we robustly observe the same tendencies in the biases after directly controlling for the effects of attribute variables in regression analysis. As already described in Section 2.5, our analysis considers some degree of effects of unobserved individual characteristics, including socially desirable bias and experimenter demand effect, by using the difference between the allocations of the second game and the first game as the dependent variable. Furthermore, we still find the similar tendencies in the biases, when adding variables, darkness and normative consciousness, that partially capture the socially desirable bias and experimenter demand effect to the estimation and controlling their effects. We capture the participants' darkness by using their match to the behavior, "If I can never be found by others, I will do bad things (littering, violating parking laws, etc.)." In addition, we capture their normative consciousness by using their match to the behavior, "I will never interrupt someone in line."

Table Appendix 1. Robustness Check

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Vaccinated sample				**Unvaccinated sample**			
Tests for	Ingroup Favoritism		Ingroup Bias and Outgroup Bias		Ingroup Favoritism		Ingroup Bias and Outgroup Bias	
Ingroup condition	8.2258***	8.2749***	1.7803	1.8493	-1.1711	-1.1293	2.8985*	2.7039
	(1.4229)	(1.4215)	(1.5493)	(1.5570)	(1.5557)	(1.5513)	(1.6570)	(1.6603)
Outgroup condition			-6.4530***	-6.4240***			4.0232**	3.7648**
			(1.3583)	(1.3605)			(1.5077)	(1.4978)
Female dummy	-1.9075	-1.4995	-1.6687	-1.3467	-3.1992**	-3.1197*	-2.6782**	-2.4288*
	(1.7003)	(1.6307)	(1.3905)	(1.3079)	(1.5675)	(1.6312)	(1.2656)	(1.3343)
Age	-0.0970	-0.0817	-0.0810	-0.0720	-0.0800	-0.0626	-0.0558	-0.0410
	(0.0647)	(0.0632)	(0.0539)	(0.0529)	(0.0717)	(0.0689)	(0.0622)	(0.0592)
Married dummy	-1.0811	-1.2499	-0.8543	-0.9469	0.6852	0.5592	0.1933	0.0665
	(1.4539)	(1.4460)	(1.3212)	(1.3333)	(1.8156)	(1.7860)	(1.5103)	(1.4983)
Number of family members	-0.1280	-0.0779	0.0201	0.0538	-0.1593	-0.1465	-0.2086	-0.1866
	(0.4914)	(0.4776)	(0.4459)	(0.4396)	(0.6392)	(0.6579)	(0.4925)	(0.5037)
Household income	-0.0004	-0.0004	0.0000	0.0000	-0.0016	-0.0018	-0.0004	-0.0005
	(0.0018)	(0.0018)	(0.0015)	(0.0015)	(0.0034)	(0.0033)	(0.0024)	(0.0024)
No income information dummy	-2.4492	-2.2934	-1.7459	-1.6735	2.6703	2.3317	2.8361**	2.5888*
	(2.5115)	(2.5712)	(2.2149)	(2.2268)	(1.6261)	(1.6898)	(1.3522)	(1.4034)
Educational years	0.0884	0.0736	0.0001	-0.0036	-0.3760	-0.4664	-0.2927	-0.3414
	(0.3937)	(0.3943)	(0.2961)	(0.2969)	(0.3153)	(0.3165)	(0.2585)	(0.2543)
Darkness		0.8173		0.6124		-0.7517		-0.3062
		(0.5416)		(0.4967)		(0.8788)		(0.7550)
Normative consciousness		-0.4779		-0.2982		-1.6244*		-1.4196**
		(0.4865)		(0.4426)		(0.8404)		(0.6722)
Constant term	-0.9912	-1.6165	5.0251	4.2691	12.3075**	21.7177**	5.3872	12.4898*
	(5.5417)	(5.8127)	(4.6589)	(4.9188)	(5.6700)	(8.6411)	(4.7253)	(6.9922)
Number of observations	636	636	796	796	625	625	782	782
R-squared	0.065	0.069	0.058	0.060	0.015	0.023	0.018	0.024

Notes : Cluster robust standard errors at region level in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Appendix C. Estimation Models

Appendix C.1. Comparison between Vaccinated and Unvaccinated Groups

The estimation for ingroup favoritism uses the samples excluding the two control groups, and the estimated equation (1) is as follows:

$$Y = \beta_0 + \beta_1 \times Vaccinated\ group + \beta_2 \times Ingroup\ condition + \beta_3 \times Vaccinated\ group \times Ingroup\ condition + Controls \quad (1)$$

The baseline is the Outgroup condition in the unvaccinated group. β_3 captures how different the ingroup favoritism in the vaccinated group is from that in the unvaccinated group (β_2).

The estimation for ingroups bias and outgroup bias uses all samples in the vaccinated and unvaccinated groups at the same time, and the estimated equation (2) is as follows:

$$Y = \beta_0 + \beta_1 \times Vaccinated\ group + \beta_2 \times Ingroup\ condition + \beta_3 \times Vaccinated\ group \times Ingroup\ condition + \beta_4 \times Outgroup\ condtion + \beta_5 \times Vaccinated\ group \times Outgroup\ condition + Controls \quad (2)$$

The baseline is the anonymous condition in the unvaccinated group. The parameters of our interest are β_3 and β_5. β_3 captures how different the ingroup bias in the vaccinated group is from that in the unvaccinated group (β_2). Also, β_5 captures how different the ingroup bias in the vaccinated group is from that in the unvaccinated group (β_4).

Appendix C.2. Comparison between Private and Public Conditions

The estimated equation for ingroup favoritism (3) is as follow. This estimation uses the samples excluding the control groups. The baseline is the Outgroup condition, and the parameter of interest is β_3

$$Y = \beta_0 + \beta_1 \times Ingroup\ condition + \beta_2 \times Public\ condition + \beta_3 \times Public\ Ingroup\ condition + Controls \quad (3)$$

The estimated equation for ingroup bias is as follow (4). This estimation uses the samples in the Ingroup conditions among the vaccinated and unvaccinated groups, respectively. The baseline is the Private-Ingroup condition.

$$Y = \beta_0 + \beta_1 \times Public\ Ingroup\ condition + Controls \quad (4)$$

The estimated equation for outgroup bias (5) is as follow. This estimation uses the samples in the Outgroup conditions among the vaccinated and unvaccinated groups, respectively. The baseline is the Private-Outgroup condition.

$$Y = \beta_0 + \beta_1 \times Public\ Outgroup\ condition + Controls \quad (5)$$