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Vaccination and Discrimination: Experimental Evidence during and after the COVID-19 Pandemic

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Shusaku Sasaki, Osaka University

Hirofumi Kurokawa, Kwansei Gakuin University

Vaccination and Discrimination: Experimental Evidence during and after the COVID-19 Pandemic

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

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Abstract

The issue of receiving vaccines or not divides people: however, both the vaccinated and unvaccinated people need to live together in the same society. This study conducted financially incentivized dictator games with about 1,600 COVID-19 vaccinated or unvaccinated people residing throughout Japan and evaluate their cooperative or hostile attitudes toward each other by using *ingroup favoritism*, which is the difference in the allocated amounts between to ingroup pairs with the same vaccination status and to outgroup pairs with a different status. Our study's uniqueness is conducting the first experiment in January-February 2022 and the follow-up experiments in December 2022 and June 2023 to examine how the attitudes change toward the post-pandemic era. The first experiment suggests that the COVID-19 vaccinated people behave more discriminately toward outgroup members, when compared to the unvaccinated people. The vaccinated people show strong ingroup favoritism, which is shaped mainly by their *outgroup bias* of decreasing the allocation amount to an unvaccinated pair, their outgroup. In contrast, the unvaccinated people do not exhibit such ingroup favoritism. Their outgroup bias is found in the rather opposite direction of the hypothesis, and they tend to increase the allocation amount to a vaccinated pair, their outgroup. This tendency is found in particular from the unvaccinated people who selected as their non-vaccination reason "I would like to get vaccinated if I could, but I cannot for health or other reasons." Our follow-up experiments find that the vaccinators' ingroup favoritism is persistent over the medium term, while the non-vaccinators' favorable attitude toward their outgroup pair is temporary, and they gradually exhibit so-called ingroup favoritism.

Keywords: COVID-19, Vaccination status, Discrimination, Altruism, Online experiment

JEL classification: I12, D91, C90

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

[2] Faculty of Economics, Kwansei Gakuin University, Japan.

We obtained ex-ante approvals from the ethics committee of Center for Infectious Disease Education and Research, Osaka University, Japan (2022CRER0114, 2022CRER1115-2, 2023CRER0515). We also registered the experimental design with the AEA RCT Registry (Sasaki and Kurokawa, 2022a,b, 2023). 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

Vaccination is one of essential keys to ending the social confusion caused by pandemics and re-starting socio-economic activities. However, some people are reluctant to receive the vaccine or have negative attitudes toward the vaccination. In the COVID-19 pandemic, anti-vaccine demonstrations were held in France, Germany, Japan, and the other countries around the world, and fake news about vaccines were flooded on social media. Unvaccinated people also experienced some restrictions when going out, layoffs from work, etc.

The issue of receiving vaccines or not divides people: however, 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 crucial to empirically determine how cooperative or hostile the vaccinated and unvaccinated people are toward each other.

This experimental study measures *ingroup favoritism* of the COVID-19 vaccinated and unvaccinated people and examine the characteristics of its distribution. Compared to the literature, the uniqueness of this study is in investigating how the ingroup favoritism changes over time. 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, and vaccination status) 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). The ingroup favoritism appears also 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 in economics, there has been plenty of research on social identity since Akerlof and Kranton (2000) published their seminal paper. It reveals that social identity have significant economic consequences in the labor market (Calvo-Armengol and Jackson, 2004) and healthcare market (Centola, 2011) through ingroup favoritism.

It is known that the ingroup favoritism appears when using identities that are formed exogenously, including race and gender, as well as when using identities which are formed by people's endogenous choices (Efferson et al. 2008; Charness et al. 2014). We thus 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 vaccinated and unvaccinated people toward each other. Jagodics and Szabó (2022) also explain 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.

We conduct financially incentivized online experiments and use the responses to measure ingroup favoritism, ingroup bias, and outgroup bias among about 1,600 COVID-19 vaccinated or unvaccinated people residing throughout Japan. Specifically, we conduct one main experiment in January-February 2022 (when the program for first- and second-dose vaccinations was almost completed in Japan) and two follow-up experiments in December 2022 and June 2023. The second follow-up is conducted just after downgrading the status of the COVID-19 under the Infectious Diseases Act in Japan. That is, the current study can capture how the attitudes of vaccinated and unvaccinated individuals toward each other change, over the medium term, toward the post-pandemic era.

The main findings are as follows: The main experiment shows that vaccinated participants exhibit strong ingroup favoritism and it is shaped by outgroup bias, a hostile attitude toward unvaccinated people. The ingroup favoritism is not observed from the unvaccinated participants; rather, they allocate more to their out-group member, the vaccinated people. Their favorable attitude toward the outgroup member is found to be formed by the non-vaccinators who wanted to receive the vaccine but were not able to do so for some health reasons. Further, the two follow-up experiments show that the vaccinators' ingroup favoritism is maintained over the medium term. In contrast, the non-vaccinators' favorable attitude toward their outgroup member is temporary, and they also gradually develop so-called ingroup favoritism.

This manuscript is organized as follows: Section 2 reviews the literature on infectious diseases, vaccination, and ingroup favoritism, and specifies the position and contribution of the current study. Section 3 describes the design of the main experiment and Section 4 presents the experimental results. Section 5 introduces the two follow-up experiments and presents the results. Section 6 conducts some robustness checks. In Section 7, we develop the discussion and summarize our conclusions.

2. Literature Review and Positioning

The association between vaccination status and ingroup favoritism has been of general interest. Since before the COVID-19 pandemic, Korn et al. (2020) conducted a vaccination-framed game experiment, created hypothetical vaccinated and unvaccinated groups, used their responses in money allocations, and found the ingroup favoritism of the vaccinated group was stronger than that of the unvaccinated. Weisel (2022) reported the similar trend as Korn et al. (2020), when using the real vaccination status of whether people received the COVID-19 vaccine or not. Also, Jagodics and Szabo (2022) used a hypothetical third-party dictator game experiment and found strong ingroup favoritism among the COVID-19 vaccinators. Even when using other indicators than ingroup favoritism, Bor et al. (2022) found that the COVID-19 vaccinators' discriminating attitude toward the non-vaccinators was stronger than that of the non-vaccinators toward the vaccinators.

Economics has also been interested in the significant economic impacts of social identity through ingroup favoritism in the labor market (Calvo-Armengol and Jackson, 2004) and in healthcare market (Centola, 2011). We find economic studies of intergroup cooperation and hostility during the COVID-19 pandemic. For example, Bartos et al. (2021) conducted a one-way allocation game experiment in their financially incentivized online experiment and found emphasizing the threat of this pandemic rises the hostile attitude toward foreigners in money allocations.

Compared to previous studies, the current study has two features that can add new findings to the literature. The first feature is that we measure ingroup favoritism as well as its components, ingroup bias and outgroup bias. This feature enables us to provide one possible answer to the puzzle of why a smaller ingroup favoritism has been observed among unvaccinated individuals than among vaccinates ones. This study presents as one answer the finding that some non-vaccinators allocate generously not only to non-vaccinators (ingroup members) but also to vaccinators (outgroup members). Therefore, their ingroup favoritism, which is captured by the difference between the allocation amount to the ingroup members and that to the out-group members, is close to zero. This study further empirically explores the question of why the part of non-vaccinators behaves so generously toward vaccinators.

The second feature is that we track how the ingroup favoritism of vaccinators and non-vaccinators changes over the medium term. Capturing the change is essential in particular for prolonged pandemics. If the strong ingroup favoritism of the vaccinators is temporary, there may be little need for policy intervention. If it is maintained over the medium to long term, then policy interventions should be considered to prevent its negative social consequences. While changes in ingroup favoritism over time have been examined in controlled laboratory game experiments (Dorrough et al., 2015; Efferson et al., 2008), studies using the realistic context of a pandemic have only captured snapshots at a single point in time. This study reveals that the ingroup favoritism of vaccinated individuals remains strong over the medium term. In contrast, the unvaccinated individuals' favorable attitude toward their outgroup member is temporary, and they also develop so-called ingroup favoritism over the medium term.

This study leverages the two features to make one meaningful academic contribution of providing two possible answers to why the previous studies have observed smaller ingroup favoritism among unvaccinated individuals. The first candidate is that in the early stages of vaccination promotion, non-vaccinators tend to allocate generously to vaccinated pairs, in addition to unvaccinated pairs, and previous studies have overlooked this impact on the measurement of ingroup favoritism. The second candidate, also related to the first, is that late in the pandemic non-vaccinators will show so-called ingroup favoritism, but previous studies could have been conducted before this time.

3. Main Experiment

3.1. Overview

From January 28 to February 1, 2022, we conducted a screening survey through MyVoice.com Ltd., 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 reasons for vaccination or non-vaccination, 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.[1]

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%.[2] 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, 2022a).

3.2. Dictator Games

Our dictator game experiments have three primary conditions as follows:

- ***Anonymous condition*:** An allocator is not informed about a recipient's vaccination status.
- ***Ingroup condition*:** An allocator is informed that a recipient belongs to their ingroup.
- ***Outgroup condition*:** An allocator is informed that a recipient belongs to their outgroup.

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 further set two sub-conditions, Private and Public, respectively for the Ingroup and Outgroup conditions. In the Private condition, a recipient is not informed about the vaccination status of their

[1] The female and regional proportions and average allocations in the hypothetical dictator game experiment among the 796 vaccinators of the analysis sample are not different from those among the 5,597 vaccinations of the sample pool. Although the mean age is around 2 years higher in the analysis sample, we determine that the analysis sample captures the attitudes of a diverse group of vaccinations from all over Japan. The female and regional proportions, average age, and average allocations among the 782 non-vaccinators of the analysis sample do not differ from those among the 1,085 non-vaccinators of the sample pool.

[2] 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.

allocator. In the Public condition, the allocator's vaccination status is informed to a recipient when providing them with their money amount. Understanding whether the allocators' ingroup favoritism is stronger in the Private or Public condition is useful for predicting how it will appear in the real world and for considering policy interventions to it.

Consequently, our dictator game experiments have five conditions, including (I: Anonymous) (II: Ingroup-Private) (III: Outgroup-Private) (IV: Ingroup-Public) and (V: Outgroup-Public). We show screens for each condition in **Appendix A**. One subject participates in dictator games five times as an allocator. As shown in **Table 1**, we set 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.

[**Table 1** is Here]

In this dictator game experiment, participants are financially incentivized as follows: In each game, participants are given an endowment of 100 Japanese Yen in addition to the participation fee (90 JPY).[3] 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.

3.3. Definitions and Empirical Hypotheses

Using allocation amounts in the dictator games, *ingroup favoritism*, *ingroup bias*, and *outgroup bias* are generally defined as follows: *ingroup favoritism* is a difference between an allocation amount to an ingroup pair and an allocation amount to an outgroup pair, *ingroup bias* is a difference between an allocation amount to an ingroup pair and an allocation amount to an anonymous pair, and *outgroup bias* is a difference between an allocation amount to an outgroup pair and an allocation amount to an anonymous pair.

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

Ingroup bias and outgroup bias are the background factors of ingroup favoritism. Specifically, 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.

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.

3.4. Analytical Procedure

Our experimental design enables us to conduct both between- and within-individual comparisons. The between-analysis measures the biases, by focusing on responses in the second dictator game and comparing them across groups. The within-analysis measures 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. For robustness check, we control for covariates, address socially desirable bias and experimenter demand effect, and compare the biases between the private and public conditions. We further 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.

Second, in the within-analysis, we check the relationship between the biases and the reasons for vaccination or non-vaccination. By so doing, we enrich our discussion of exploring background factors for the biases.

3.5. 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 approximately 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. 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, which is 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 influences of attribute variables. This does not support the possibility that the vaccinated participants are more altruistic than the unvaccinated ones.

4. Main Results

4.1. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias

4.1.1. Between-Analysis

[**Figure 1** is Here]

We use the data of the main experiment, perform group comparison, and measure *ingroup favoritism*, *ingroup bias*, and *outgroup bias*.[4] 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. This effect size is large, considering that *d* of the ingroup favoritism in the meta-analysis is 0.32 (Balliet et al., 2014). 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

[4] 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.

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 similar tendencies in the biases after directly controlling for the effects of attribute variables in regression analysis. 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.[5] Furthermore, we confirm that these biases do not differ between the private and public conditions. It indicates that the vaccinators' ingroup favoritism strongly exists regardless of whether information on their vaccination status is made public or not.

4.1.2. Comparison between Vaccinators and Non-vaccinators

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.

This direct comparison also addresses the concern on the socially desirable bias and experimenter demand effect. If the experimental design of this study induces the bias and effect and these primarily

[5] 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."

form ingroup favoritism, then the ingroup favoritism must be found equally both in the vaccinated and unvaccinated participants. Differences in the attributes between both groups may produce different responses to the socially desirable bias and the experimenter demand effect: however, this possibility is directly addressed by controlling for the attributes in the regression analysis. Thus, the heterogeneity in the ingroup favoritism between both groups implies that the socially desirable bias and experimenter demand effect is not crucial for our findings.

4.1.3. Within-Analysis

We investigate the existence of *ingroup favoritism*, *ingroup bias*, and *outgroup bias* also in 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.

The vaccinated group's ingroup favoritism, ingroup bias, and outgroup bias are 7.92 (0.67), 1.29 (0.62), and -6.63 (0.79),[6] respectively. Their tendencies are 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.

The unvaccinated group's ingroup favoritism, ingroup bias, and outgroup bias are are 0.42 (0.63), 0.51 (0.66), and 0.10 (0.72), respectively. The tendencies are also 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. Heterogeneity by Reasons

Why do the vaccinated and unvaccinated people show the tendencies for the biases as observed? Here, we conduct the within-analysis and challenge the 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 captured 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,

[6] The values in parentheses are standard errors.

"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."

[**Figure 2** is Here]

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. If the vaccinated people consider the positive externality of vaccination and discriminate against the unvaccinated pairs, then ingroup favoritism should be greater in the groups that chose the second and third reasons. However, the results in Figure 2 do not support the explanation, because the vaccinated people exhibit the strong ingroup favoritism, no matter whether they received the vaccine for selfish or altruistic reason.

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.

5. Follow-up Experiments

The main experiment shows that the vaccinated participants exhibit strong ingroup favoritism and this bias is shaped by outgroup bias, which is a hostile attitude toward non-vaccinators. Ingroup favoritism is not observed among the unvaccinated participants, but rather they allocate more to their outgroup members, the vaccinators.

Is their attitude temporary or persistent? If the ingroup favoritism of vaccinators is maintained over the medium term, we will need to consider policy interventions, while taking into account how the ingroup favoritism appears as a real behavior in society. To answer this question, we conduct two follow-up experiments in December 2022 and June 2023 to investigate how the tendencies of ingroup favoritism, ingroup bias, and outgroup bias change over the medium term.

In December 2022, the infection stage more calmed down and socio-economic activities were more active, compared to January-February 2022, when the main experiment had been conducted. June 2023 was just after the Japanese government had downgraded the status of the COVID-19 under the Infectious Diseases Act and thus the society entered an after-pandemic era.

5.1. First Follow-up Experiment

We conduct the first follow-up experiment from 16 to 21 December 2022 while partially adding new sample (vaccinated sample: 606 follow-ups and 194 added ones, unvaccinated sample: 574 follow-ups and 226 added ones). The definitions of the vaccinated and unvaccinated participants are the same as in the main experiment. The vaccinated participants are defined as those who received two or more vaccinations as of the February-2022 survey, while the unvaccinated participants are defined as those who never received any vaccination. Of course, their vaccination status changes between the main experiment and the first follow-up experiment as follows: The vaccinated participants consist of 53 people who were vaccinated twice, 275 people who were vaccinated three times, 385 people who were vaccinated four times, and 87 people who were vaccinated five or more times as of December 2022. Almost all of the unvaccinated participants (792 of 800) remain unvaccinated, and only 8 are newly vaccinated. That is, the follow-up for the vaccinated sample can capture how their ingroup favoritism changes with increasing heterogeneity in the number of their vaccinations. The follow-up for the unvaccinated sample can capture how their ingroup favoritism changes while almost all of them remain unvaccinated.

In the first follow-up experiment, the financially incentivized dictator games have five conditions, including (I: Anonymous) (II: Ingroup-December2022) (III: Outgroup-December2022) (IV: Ingroup-February2022) and (V: Outgroup-February2022). Considering the increase in vaccination coverage in Japan from February to December 2022, we change vaccinated pairs in II and III conditions to those

who received three or more vaccinations as of December 2022. We keep the pairs' information of IV and V conditions the same in the main experiment. In IV and V conditions, vaccinated pairs are those who received two or more vaccinations as of February 2022, and unvaccinated pairs are those who never received a vaccination as of this timing. As shown in **Table Appendix D1**, we set the order of the five conditions so that we could prioritize capturing ingroup favoritism for pairs with updated information. The random assignment of the first follow-up experiment is completely independent of the random assignment of the main experiment. We conduct stratified randomization for the follow-up sample by the assigned group in the main experiment, while we conduct it for the added sample by age and baseline altruism. For the first follow-up experiment, we obtained approval from the research ethics committee at the Center for Infectious Disease Education and Research, Osaka University, (2022CRER1115-2).

5.2. Second Follow-up Experiment

We follow the similar procedure and conduct the second follow-up experiment from 23 to 28 June 2023 (vaccinated sample: 665 follow-ups and 135 added ones, unvaccinated sample: 686 follow-ups and 114 added ones). As of this timing, the vaccinated participants consist of 60 people who were vaccinated twice, 190 people who were vaccinated three times, 328 people who were vaccinated four times, and 222 people who were vaccinated five or more times. Still, almost all of the unvaccinated participants (791 of 800) remain unvaccinated.

In the second follow-up experiment, the financially incentivized dictator games have three conditions, including (I: Anonymous) (II: Ingroup-June2023) and (III: Outgroup- June2023). Since there exist a significant number of people who remain vaccinated three times, in II and III conditions, vaccinated pairs are defined as those who received three or more vaccinations as of June 2023, and unvaccinated pairs are defined as those who never received a vaccination as of this timing. The group assignment is shown in **Table Appendix D2**. Also for the second follow-up experiment, we obtained approval from the research ethics committee at the Center for Infectious Disease Education and Research, Osaka University (2023CRER0515).

5.3. Follow-up Results

[**Figure 3** is Here]

The upper part of **Figure 3** shows that the vaccinated participants continue to have a certain degree of strong ingroup favoritism. The size of the ingroup favoritism at the first follow-up is 7.66 JPY (*Cohen's d*=0.46), statistically significant at the 1% level. The ingroup bias remains small (1.41 JPY, *Cohen's d*=0.10) and is not statistically significant even at the 10% level. The outgroup bias is still large (-6.25 JPY, *Cohen's d*=0.37) and statistically significant at the 1% level. The direction and size of the ingroup

favoritism is almost identical to that at the time of the February's main experiment.

At the second follow-up, ingroup favoritism is almost unchanged in size, at 6.20 JPY (*Cohen's d*=0.41, $p<.01$). The size of the outgroup bias, the primary source of the ingroup favoritism, is also unchanged at -4.98 JPY (*Cohen's d*=0.34, $p<.01$).

The bottom part of **Figure 3** shows that the biases of the unvaccinated participants considerably change over time. At the first follow-up, there is no significant difference in the ingroup bias, while the favorable attitude toward the outgroup members disappears and is close to zero. Consequently, ingroup favoritism begins to exhibit a positive sign as hypothesized, although it is not statistically significant even at the 10% level.

At the second follow-up, the tendency is more pronounced, with the outgroup bias being negative (-2.41 JPY, *Cohen's d*=0.16, $p<.01$) as hypothesized. Thus, the size of the ingroup favoritism is 5.83 JPY (*Cohen's d*=0.36), which is closer to that of the vaccinated participants, and this is also statistically significant at the 1% level.

The second follow-up experiment is conducted just after the Japanese government downgraded the status of the COVID-19 under the Infectious Diseases Act. That is, the above results indicate that even if the society enters an after-pandemic era, the vaccinators' discriminating attitude toward non-vaccinators could strongly persist. On the contrary, the non-vaccinators' favorable attitude toward their outgroup member is temporary, and they also gradually develop so-called ingroup favoritism.

6. Address of Concerns

In this section, we address two concerns. The first concern is that the outgroup bias of vaccinators may be greater because many of them imagine that their anonymous pair is vaccinated. It might be possible because the vaccinators are the majority in Japanese society. If so, the outgroup bias is the difference between the allocation amounts to the unvaccinated pair and to the vaccinated pair and is almost equal to the inverse of ingroup favoritism. The ingroup bias is the difference between the allocation amounts to the vaccinated pair and to the similar vaccinator pair, which is almost zero.

As explained in Section 2.5, our analysis uses the within-individual difference in allocations for the second and first dictator games as the outcome measure. This procedure enables us to control for the effects of individuals' time-invariant unobserved characteristics, which could include what they imagine about their anonymous pair.

In addition to the above procedure, we conduct an additional validation. In the first follow-up experiment, we asked the question, "To date, what percentage of the Japanese population do you think has received three or more doses of the COVID-19 vaccine?" We divide the vaccinated group into two subgroups: those who answered that 51% or more have received the vaccines and those who answered that 50% or less have done. The former subgroup is more likely to assume their anonymous pairs as vaccinators than the latter. When estimating the ingroup and outgroup biases for each, we find that the

ingroup bias could be weakly dependent on the subjective proportion, while the outgroup bias is found to be robustly large regardless of the proportion, thereby rejecting that the first concern determines our results (See **Table Appendix E1**).

The second concern is that the results in Section 4.3 may be affected by samples that dropped out or replenished during the follow-up process. For example, many of the non-vaccinators who increased their allocations to vaccinated pairs in the main experiment did not participate in the follow-ups, which could critically affect the change in attitudes of non-vaccinators.

To address this concern, we estimate ingroup favoritism, ingroup bias, and outgroup bias for each experiment, restricting the sample to the 493 vaccinators and 495 non-vaccinators who participated in all three experiments. The estimated results are consistent with those reported in Section 4.3, rejecting the possibility that the second concern determines our results (See **Table Appendix E2**).

7. Discussion and Conclusions

We conducted financially incentivized dictator game experiments and presented the following findings. First, the COVID-19 vaccinated people have strong *ingroup favoritism*. This ingroup favoritism could be generated mainly by the *outgroup bias* of decreasing the amount allocated to the unvaccinated pairs, their outgroup members, not by the *ingroup bias* of increasing the amount allocated to the vaccinated pairs, their ingroup members. The 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.

In contrast to the vaccinated people, the unvaccinated do not show ingroup favoritism, on average. Among them, the ingroup bias is positive and consistent with the hypothesis; however, the outgroup bias is also positive in the opposite direction of the hypothesis, and they tend to allocate more money to the vaccinated pairs, their outgroup members, than to the anonymous pairs. Consequently, we do not observe ingroup favoritism, which is captured by the difference in the amounts allocated to ingroup members and outgroup members. The previous studies have also reported smaller ingroup favoritism among non-vaccinators compared to vaccinators (Jagodics and Szabo, 2022; Korn et al., 2020; Weisel, 2022), but to our knowledge, few have empirically addressed the underlying mechanisms.

Second, we further 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 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

the unvaccinated pairs, their ingroup members, than to the vaccinated pairs, their outgroup members. 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.

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.

In **Appendix F**, respectively among the vaccinated and unvaccinated groups, we find 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 group largely vary 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 socio-economic 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.

Third, we conduct two follow-up experiments in December 2022 and June 2023 to track how the ingroup favoritism of the vaccinated and unvaccinated people changes over the medium term. If the ingroup favoritism of the vaccinators is temporary, there may be little need for policy intervention. If it is maintained over the medium term, then policy interventions should be considered to prevent its negative social consequences. The second follow-up experiment is conducted just after the Japanese government downgraded the status of the COVID-19 under the Infectious Diseases Act. Our findings indicate that even if the society enters an after-pandemic era, the vaccinators' ingroup favoritism could strongly persist. In contrast, the non-vaccinators' favorable attitude toward their outgroup member is temporary, and they gradually exhibit so-called ingroup favoritism. It should be noted that the ingroup favoritism of the vaccinators is consistently shaped by the outgroup bias, while that of the non-vaccinators is largely dependent on the ingroup bias, and in this respect they differ.

The primary academic contribution of this study is that it provides two possible answers to why existing studies have observed smaller ingroup favoritism among unvaccinated individuals. The first candidate is that in the early stages of vaccination promotion, non-vaccinators tend to allocate

generously to vaccinators, and previous studies have overlooked this effect on the measurement of ingroup favoritism. The second candidate, also related to the first, is that late in the pandemic non-vaccinators will show so-called ingroup favoritism, but previous studies were conducted before this time.

This study also has policy implications when we look at the fact that the ingroup favoritism of the vaccinated people, in contrast to the unvaccinated, is characterized by their hostile attitude toward the outgroup members. This factor poses a risk to the stable management of society during a pandemic. 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, etc. 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 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 own hostile attitudes and consider diverse reasons and behaviors of the unvaccinated people to build cooperative relationships between the two groups smoothly.

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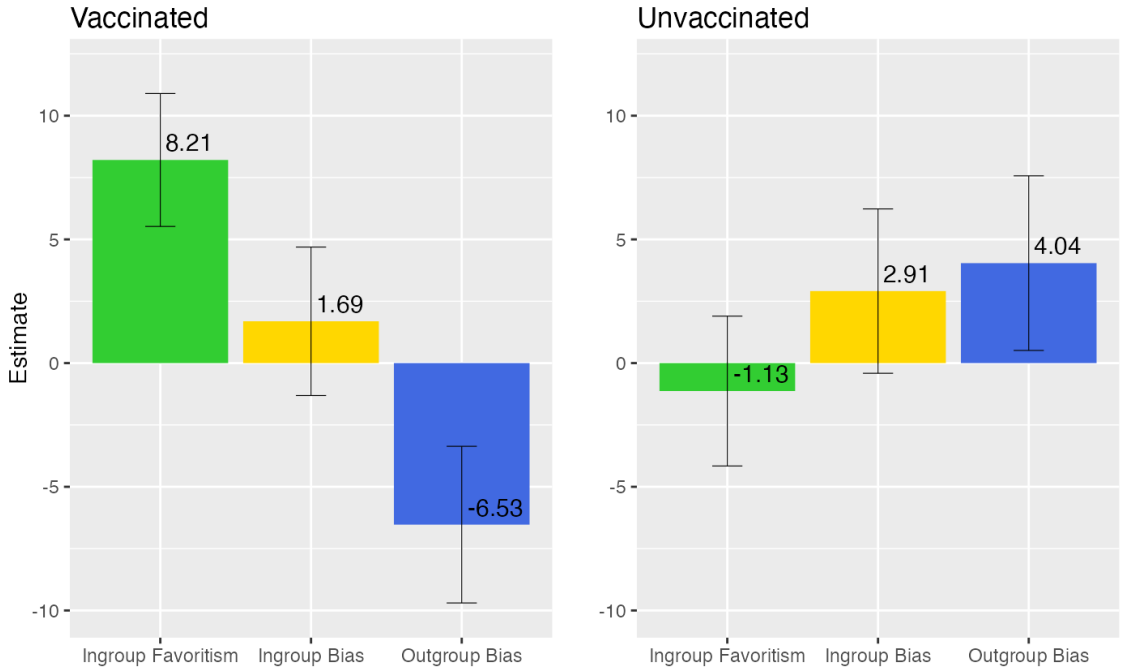
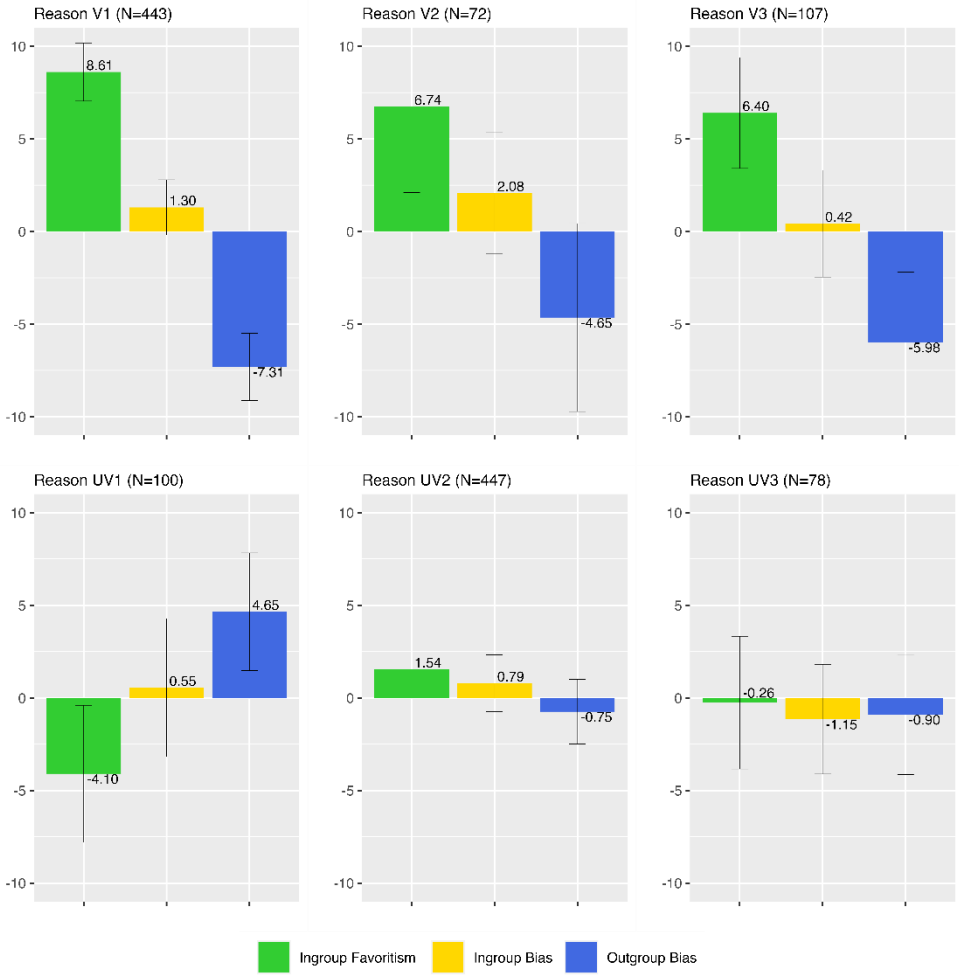
Figure 1. Ingroup Favoritism, Ingroup Bias, and Outgroup Bias



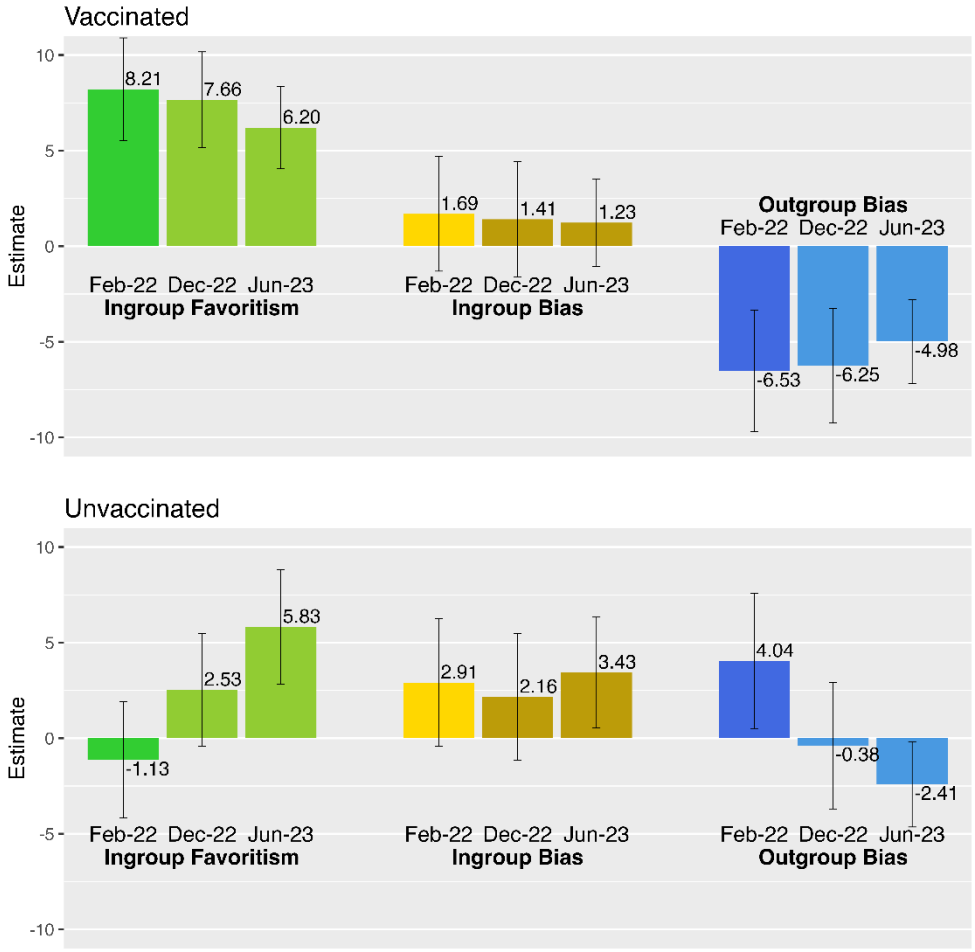
Notes: Vertical lines in the graph represent 95% confidence intervals. On the left side of Figure 1, we present the result of estimating the vaccinated group's biases by comparing the ingroup condition group, outgroup condition group, and control group. The result shows that the vaccinated group has 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. Heterogeneity by Reasons



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

Figure 3. Medium-term Transitions in Ingroup Favoritism, Ingroup Bias, and Outgroup Bias



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. Ingroup-Private (An allocator is informed that a recipient belongs to their ingroup. The allocator is anonymous for the recipient), III. Outgroup-Private (An allocator is informed that a recipient belongs to their outgroup. The allocator is anonymous for the recipient), IV. Ingroup-Public (An allocator is informed that a recipient belongs to their ingroup. The recipient is notified of the vaccination status of the allocator), and V. Outgroup-Public (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

	Tests for	(1) Ingroup Favoritism	(2) 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.

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. Ingroup-Private (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. Outgroup-Private (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. Ingroup-Public (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. Outgroup-Public (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. Ingroup-Private (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. Outgroup-Private (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. Ingroup-Public (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. Outgroup-Public (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

Table Appendix B1. With Covariates

	(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

Table Appendix B2. 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.

Appendix C. Estimation Models

Appendix C.1. Comparison between Private and Public Conditions

The estimated equation for ingroup favoritism (1) 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

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

The estimated equation for ingroup bias is as follow (2). This estimation uses the samples in the Ingroup conditions among the vaccinated and unvaccinated groups, respectively. The baseline is the Private-Ingroup condition.

$$Y = \beta_0 + \beta_1 \times Public\ Ingroup\ condition + Controls \quad (2)$$

The estimated equation for outgroup bias (3) 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.

$$Y = \beta_0 + \beta_1 \times Public\ Outgroup\ condition + Controls \quad (3)$$

Appendix C.2. Comparison between Vaccinated and Unvaccinated Groups

The estimation for ingroup favoritism uses the samples excluding the two control groups, and the estimated equation (4) is as follows:

$$Y = \beta_0 + \beta_1 \times Vaccinated\ group + \beta_2 \times Ingroup\ condition + \beta_3 \times Vaccinated\ group \times Ingroup\ condition + Controls \quad (4)$$

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 (5) is as follows:

$$Y = \beta_0 + \beta_1 \times Vaccinated\ group + \beta_2 \times Ingroup\ condition + \beta_3 \times Vaccinated\ group \times Ingroup\ condition + \beta_4 \times Outgroup\ condtion + \beta_5 \times Vaccinated\ group \times Outgroup\ condition + Controls \quad (5)$$

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 D. Follow-up Experiments: Group Assignment

Table D1. 1st Follow-up Experiment: Group Assignment

	Vaccinated people, N=800				
	(1)	(2)	(3)	(4)	(5)
Order	N=160	N=160	N=160	N=160	N=160
1	**I**	**I**	**I**	**I**	**I**
2	**II**	**II**	**III**	**III**	**I**
3	**III**	**III**	**II**	**II**	**I**
4	**IV**	**V**	**IV**	**V**	**I**
5	**V**	**IV**	**V**	**IV**	**I**

	Unvaccinated sample (N=800)				
	(6)	(7)	(8)	(9)	(10)
Order	N=160	N=160	N=160	N=160	N=160
1	**I**	**I**	**I**	**I**	**I**
2	**II**	**II**	**III**	**III**	**I**
3	**III**	**III**	**II**	**II**	**I**
4	**IV**	**V**	**IV**	**V**	**I**
5	**V**	**IV**	**V**	**IV**	**I**

Notes: We conduct dictator games in the following five conditions: I. Anonymous, II: Ingroup-December2022, III: Outgroup-December2022, IV: Ingroup-February2022, and V: Outgroup- February2022.

Table D2. 2nd Follow-up Experiment: Group Assignment

	Vaccinated people, N=800		
	(1)	(2)	(3)
Order	N=320	N=320	N=160
1	**I**	**I**	**I**
2	**II**	**III**	**I**
3	**III**	**II**	**I**

	Unvaccinated sample (N=800)		
	(4)	(5)	(6)
Order	N=320	N=320	N=160
1	**I**	**I**	**I**
2	**II**	**III**	**I**
3	**III**	**II**	**I**

Notes: We conduct dictator games in the following five conditions: I. Anonymous, II: Ingroup-June2023, and III: Outgroup- June2023.

Appendix E. Address of Concerns

Table Appendix E1. The Concern on Anonymous Pairs

Vaccinated sample	(1)	(2)
Tests for	Ingroup Bias and Outgroup Bias	
Ingroup condition	3.2746	3.3247*
	(1.9738)	(1.9593)
Outgroup condition	**-5.2166*** **	**-5.1570** **
	(1.9400)	**(1.9417)**
Subjective prop of vaccinated people is 50% or more	1.8573	2.0779
	(2.5799)	(2.5717)
Ingroup condition×Subjective prop is 50% ore more	-3.3870	-3.6018
	(2.9590)	(2.9501)
Outgroup condition×Subjective prop is 50% ore more	-1.9219	-2.0279
	(2.9145)	(2.8831)
Covariates	NO	YES
Constant term	-0.8108	0.3586
	(1.6588)	(4.1127)
Number of observations	800	800
R-squared	0.050	0.055

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. In the first follow-up experiment, we asked the question, “To date, what percentage of the Japanese population do you think has received three or more doses of the COVID-19 vaccine?” We divide the vaccinated group into two subgroups: those who answered that 51% or more have received the vaccines and those who answered that 50% or less have done.

Table Appendix E2. The Concern on Sample Selection

Vaccinated	Feb-22		Dec-22		Jun-23	
	Full	Limited	Full	Limited	Full	Limited
Ingroup Favoritism	8.21	8.23	7.66	7.20	6.20	5.81
	(1.37)	(1.28)	(1.28)	(1.61)	(1.10)	(1.10)
Ingroup Bias	1.69	0.96	1.41	0.98	1.23	0.27
	(1.53)	(1.80)	(1.53)	(1.95)	(1.17)	(1.21)
Outgroup Bias	-6.53	-7.26	-6.25	-6.23	-4.98	-5.54
	(1.62)	(1.83)	(1.53)	(1.98)	(1.12)	(1.34)
Unvaccinated	Feb-22		Dec-22		Jun-23	
	Full	Limited	Full	Limited	Full	Limited
Ingroup Favoritism	-1.13	-1.38	2.53	0.59	5.83	3.92
	(1.55)	(2.28)	(1.50)	(1.81)	(1.53)	(1.35)
Ingroup Bias	2.91	3.40	2.16	0.06	3.43	3.60
	(1.70)	(1.78)	(1.69)	(2.05)	(1.48)	(0.97)
Outgroup Bias	4.04	4.77	-0.38	-0.53	-2.41	-0.33
	(1.80)	(2.22)	(1.69)	(2.07)	(1.14)	(1.16)

Note: Standard deviations in parentheses.

Appendix F. 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 Appendix F1** is Here]

Panel A of **Table Appendix F1** 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 Appendix F1** 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 Appendix F2** is Here]

Panel A of **Table Appendix F2** 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 Appendix F1 (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 Appendix F2** 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.

Table Appendix F1. 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 Appendix F2. 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