Judgment and Decision Making (2024), **vol. 19**:e29 1–16
doi:10.1017/jdm.2024.13

EMPIRICAL ARTICLE

Applying the sour grapes/sweet lemons rationalization to change beliefs and preferences: Reducing public concerns about vaccine safety and enhancing their willingness to get vaccinated

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Received: 10 September 2023; **Revised:** 1 April 2024; **Accepted:** 2 April 2024

Keywords: 2019-nCoV vaccine; safety concerns; wait-and-see approach; the sour grapes/sweet lemons rationalization; Chinese population

Abstract

This study examined the sour grapes/sweet lemons rationalization through 2 conditions: 'attainable' (sweet lemons) and 'unattainable' (sour grapes), reflecting China's 2019-nCoV vaccination strategy. The aim was to find ways to change people's beliefs and preferences regarding vaccines by easing their safety concerns and encouraging more willingness to get vaccinated. An online survey was conducted from January 22 to 27, 2021, with 3,123 residents across 30 provinces and municipalities in the Chinese mainland. The direction of belief and preference changed in line with the sour grapes/sweet lemons rationalization. Using hypothetical and real contrasts, we compared those for whom the vaccine was relatively unattainable ('sour grapes' condition) with those who could get the vaccine easily ('sweet lemons'). Whether the vaccine was attainable was determined in the early stage of the vaccine roll-out by membership in a select group of workers that was supposed to be vaccinated to the greatest extent possible, or, by being in the second stage when the vaccine was available to all. The attainable conditions demonstrated higher evaluation in vaccine safety, higher willingness to be vaccinated, and lower willingness to wait and see. Hence, we propose that the manipulation of vaccine attainability, which formed the basis of the application of sour grapes/sweet lemons rationalization, can be utilized as a means to manipulate the choice architecture to nudge individuals to ease vaccine safety concerns, reducing wait-and-see tendencies, and enhancing vaccination willingness. This approach can expedite universal vaccination and its associated benefits in future scenarios resembling the 2019-nCoV vaccine rollout.

1. Introduction

The coronavirus disease 2019 (COVID-19) is a highly contagious viral illness caused by SARS-CoV-2, emerging as the most consequential global health crisis since the 1918 influenza pandemic (Cascella et al., 2022). The COVID-19 pandemic has had a catastrophic impact on the world's populations,

causing significant social and economic upheaval, and the majority of the world's countries even have enforced societal-level lockdowns (Lancet, 2020; Ma et al., 2022). Fortunately, vaccines have been rapidly developed and are currently being deployed (Koff and Berkley, 2021). People worldwide then are facing the choice of whether to be vaccinated or not. Getting vaccinated comes with the uncertainty of the benefits versus the potential harm, leading to an approach-avoidance conflict. Numerous behavioral models have been proposed to elucidate decision-making processes under both certain and uncertain circumstances (Li et al., 2012; Wang et al., 2012). People tend to avoid making decisions amidst uncertainty (Morton et al., 2011). Uncertainty intensifies the approach-avoidance conflict and exacerbates the reluctance to make decisions, subsequently diminishing individuals' willingness to undergo vaccination. Due to concerns about the effectiveness and potential side effects of the vaccine, some individuals adopt a wait-and-see approach toward vaccination. Nonetheless, such behavior can impede vaccination promotion efforts and has detrimental effects on public health and safety (Bhattacharyya and Bauch, 2011; Zhang et al., 2021).

How do people's beliefs and preferences change when facing the choice of whether to get vaccinated or not? According to Jois (2009), the sour grapes/sweet lemons analogy helps explain how humans rationalize situations by bringing 'preferences into line with expectations'. In Aesop's classic fable,[1] the grapes are initially attractive. However, once the grapes are unattainable, they 'become' sour. Of course, the character of the grapes has not changed at all; we merely rationalize the fact that we know we cannot get the grapes by making ourselves believe the grapes are sour. More interesting, however, is the 'sweet lemons' phenomenon. In this situation, an initially less favored outcome (the lemon) becomes more favorable as the likelihood of such an outcome becomes greater—the lemons become sweeter if they are more attainable (Kay et al., 2002).

In Jois' words (Jois, 2009), if we already have lemons, we are likely to justify our possession of lemons by believing they are sweet rather than try to get grapes which are more unattainable, and therefore we believe them to be sour.

Vail et al. (2023) also suggested that the 'sour grapes' and 'sweet lemons' effects help people to live with what would otherwise be an undesirable status quo that seems extremely likely (Laurin et al., 2012) and inescapable (Laurin et al., 2010).

We thus employed the 'sour grapes/sweet lemons rationalization' concept, as discussed in Vail et al. (2023), to explain and predict people's concerns about vaccine safety and their willingness to get vaccinated. Specifically, when the fruit is attainable (i.e., the vaccination is attainable), people's attitude toward the fruit (vaccination) resembles the sweet lemons effect (Nagler, 2023; Parker, 1995): the fruit 'becomes' something sweet (the vaccine is perceived as safe, and I am willing to get vaccinated and not to wait); conversely, when the fruit is unattainable (i.e., the vaccination is unattainable), people's attitude toward the fruit (vaccination) aligns with the sour grapes effect (Elster, 2016): the fruit 'becomes' something sour (the vaccine is perceived as unsafe, and I am unwilling to get vaccinated and opt to wait).

The following are the specific facts about whether the COVID-19 vaccination (the fruit) is attainable in China.

2. Three factors aligning with China's 2019-nCoV vaccination strategy and our working hypotheses

On December 19, 2020, China's State Council Joint Prevention and Control Mechanism held a press conference (https://www.gov.cn/xinwen/2020-12/20/content_5571320.htm). The head of the COVID-19 vaccine development task force under the State Council Joint Prevention and Control

[1]In Aesop's fable about the fox and the grapes, the fox is drawn to a bunch of grapes hanging from the vine and tries to leap up and grab them. But he fails to reach the grapes and soon realizes they are hanging too high above the ground. Finally, the fox changes his mind and concludes that the grapes were probably sour (Elster, 1983; Sjåstad et al., 2020).

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Mechanism announced that China's current vaccination strategy is being implemented nationwide in a '*two-step*' approach.

The first step involves primarily vaccinating specific key groups, including high-risk workers engaged in tasks such as cold-chain importation, port quarantine, maritime piloting, aviation services, working in fresh food markets, public transportation, medical and disease control, as well as individuals traveling to and from medium to high-risk countries or regions for work or study. This step aims to alleviate the pressure of preventing and controlling imported cases and reduce the risk of local infections and domestic outbreaks. *The second step* will see an increase in vaccine production as vaccines receive conditional or formal approval for marketing. This will lead to the deployment of more vaccines. By carrying out vaccinations in an organized manner, the individuals who should be vaccinated to the greatest extent possible will have the opportunity to be vaccinated, ensuring that everyone meeting the criteria can be vaccinated as much as possible.

Against the backdrop of the aforementioned press conference and the practical considerations required for the vaccine, we have identified 3 factors or variables that determine whether the COVID-19 vaccination (the fruit) is attainable in China's 'two-step' approach: (1) *the vaccination status of individuals*, which refers to whether an individual has actually received the COVID-19 vaccination; (2) *the inclusion of individuals who should be vaccinated to the greatest extent possible group* (literally 应接尽接[2]; hereinafter referred to as *the SBV group*), leading to a distinction between those who are recommended, though not required, by the government to get vaccinated and those who do not fall into this category; (3) *the vaccination process*, in which the deployment of vaccines increases progressively as the vaccination process progresses from the early stage to the intermediate stage, and finally to the late stage of the vaccination process.

Our research is then grouped based on the following hypotheses, which are tailored to the 3 factors or variables discussed above. These hypotheses are formulated assuming that the perception of fruit (vaccination) attainability will determine whether the effect is a sour grapes effect or a sweet lemons effect.

2.1. Vaccination status and related hypothesis

Hypothesis 1 (H1) centers on the condition where the vaccination is attainable, depending on whether responses have received the vaccine or not. The hypothesis is as follows:

H_1. In the unvaccinated group, the vaccination is perceived as unattainable, people's attitude toward the vaccination aligns with the sour grapes effect: the fruit (vaccination) 'becomes' something sour (i.e., the vaccine is perceived as unsafe, and I am unwilling to get vaccinated, opting to wait). That is, we merely rationalize the fact that we know we cannot get the grapes (vaccination) by making ourselves believe the grapes are sour (vaccine is unsafe).

Conversely, in the vaccinated population, the vaccination is perceived as attainable, people's attitude toward the vaccination resembles the sweet lemons effect: the fruit (vaccination) 'becomes' something sweet (i.e., the vaccine is perceived as safe, and I am willing to get vaccinated, without waiting). That is, we are likely to rationalize our possession of lemons (vaccination) by believing they are sweet (vaccine is safe).

2.2. SBV/non-SBV group and related hypothesis

Hypothesis 2 (H2) focuses on the condition where the vaccination is attainable, depending on whether respondents are identified as part of the SBV/non-SBV group. The hypothesis is as follows:

[2]The Chinese version shall always prevail in case of any discrepancy or inconsistency between the Chinese version and its English translation.

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H_2. In the 'non-SBV group' condition, the vaccination is perceived as unattainable, leading people to exhibit the sour grapes effect in their attitude toward the vaccine. The fruit (vaccination) 'becomes' something sour (i.e., the vaccine is perceived as unsafe), and individuals are unwilling to get vaccinated, choosing to wait instead. This is a rationalization of the fact that they know they cannot get the vaccination (grapes) by convincing themselves that the grapes are sour (vaccine is unsafe).

Conversely, in the 'SBV group' condition, the vaccination is perceived as attainable, leading people to exhibit the sweet lemons effect in their attitude toward the vaccine. The fruit (vaccination) 'becomes' something sweet (i.e., the vaccine is perceived as safe), and individuals are willing to get vaccinated without waiting. This is an attempt to justify their possession of the vaccination (lemons) by convincing themselves that the lemons are sweet (vaccine is safe).

2.3. Vaccination process and related hypothesis

Hypothesis 3 (H3) deals with the vaccination process and is developed based on the early, intermediate, and late stages of the vaccination process as reflected in China's 2019-nCoV vaccination strategy. The hypothesis is as follows:

H_3. During the early stage of the vaccination process, characterized by a low number of vaccinations, the likelihood of vaccination is perceived as unattainable, leading people to exhibit the sour grapes effect in their attitude toward the vaccine. The fruit (vaccination) 'becomes' something sour (i.e., perceived as unsafe), and individuals are unwilling to get vaccinated, choosing to wait instead. This is a rationalization of the fact that they observe a low vaccination (grapes) rate by convincing themselves that the grapes are sour (vaccine is unsafe).

Conversely, in the late stage of the vaccination process, marked by a high number of vaccinations, the likelihood of vaccination is perceived as attainable, leading people to exhibit the sweet lemons effect in their attitude toward the vaccine. The fruit (vaccination) 'becomes' something sweet (i.e., perceived as safe), and individuals are willing to get vaccinated without waiting. This is a rationalization of the fact that they observe a high vaccination (lemons) rate by convincing themselves that the lemons are sweet (vaccine is safe).

Regarding the 3 factors or variables that were shaped by China's 2019-nCoV vaccination strategy, it is assumed that the perception of the degree of vaccine attainability is highest for 'vaccination status', followed by 'SBV/non-SBV group' and/or the 'vaccination process'.

The primary objective of this study was to assess and compare individuals' evaluations of their willingness to be vaccinated, their inclination to adopt a wait-and-see approach, and their perceptions of vaccine safety based on the sour grapes/sweet lemons rationalization. Moreover, this study aimed to investigate the direction of attitude change trends in line with the expectation of the sour grapes/sweet lemons rationalization. By pursuing these objectives, this research endeavored to contribute to the promotion of universal vaccination and facilitate the achievement of this crucial goal.

3. Methods

3.1. Participants

This study involved an online questionnaire survey on Sojump (http://www.sojump.com), a popular and widely used online survey website in China, across 30 provinces, cities, and autonomous regions (except Tibet) in the Chinese mainland. The survey was conducted from January 22 to 27, 2021. After eliminating unqualified samples through questionnaire quality control, a final dataset comprising responses from 3,123 respondents was used for analysis. Table 1 shows the demographic variables of the respondents.

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Table 1. *Demographic variables of the respondents (N = 3,123).*

Variable	Group	Number of respondents	Percentage
Gender	Male	1,707	54.7
	Female	1,416	45.3
Age (years)	18–24	781	25.0
	25–34	1,454	46.6
	35–44	628	20.1
	≥45	260	8.3
Education	Primary school and below	4	0.1
	Middle school	27	0.9
	High school/technical secondary school/vocational high school	177	5.7
	Junior college	467	15.0
	Undergraduate	2,198	70.4
	Graduate and above	250	8.0
Family economic status (self–assessment compared to surrounding people)	Far below average	58	1.9
	Below average	479	15.3
	Average	1,940	62.1
	Above average	629	20.1
	Far above average	17	0.5
Physical health status	Poor	10	0.3
	Relatively poor	90	2.9
	Fair	1,017	32.6
	Good	1,581	50.6
	Great	425	13.6
Self–health concern	Very little concern	9	0.3
	Little concern	82	2.6
	Fair concern	575	18.4
	Good concern	1,802	57.7
	Great concern	655	21.0

3.2. Measures

3.2.1. Consent to vaccination

To assess respondents' inclination toward consenting to vaccination, a 5-point scale developed by Lazarus et al. (2021) was adapted and modified to suit China's 2019-nCoV vaccination strategy. The original scenarios of Lazarus et al. (2021), 'If a COVID-19 vaccine is proven safe and effective and is available to me, I will take it' and 'I would follow my employer's recommendation to get a COVID-19 vaccine once the government has approved it as safe and effective', were revised to: 'The COVID-19 vaccine (2019-nCoV vaccine) is currently available in your area as per government allocation. Please evaluate the extent to which you agree with the following statement: I will get vaccinated myself'.

This scale allowed participants to express their level of agreement or disagreement regarding vaccination consent. The rating options within the scale were defined as follows: (A) 'completely agree', (B) 'somewhat agree', (C) 'neutral/no opinion', (D) 'somewhat disagree', and (E) 'completely

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disagree'. During the data analysis, we assigned scores to indicate the degree of consent for vaccination, with higher scores reflecting a stronger level of consent for vaccination.

3.2.2. Vaccine safety

To assess the perceived vaccine safety, a scale ranging from 0 to 100 was employed (0 = the vaccine is completely unsafe while 100 = the vaccine is completely safe). Respondents could convey their responses by dragging a slider or inputting numbers.

3.2.3. Willingness to be vaccinated

In this study, we utilized a scale ranging from 0 to 100 to evaluate individuals' willingness to receive vaccination. Here, 0 represents completely unwilling to receive vaccination (the lowest level of willingness), and 100 represents completely willing to receive vaccination (the highest level of willingness). Respondents could express their willingness by dragging a slider or inputting numbers.

3.2.4. Willingness to wait and see

To evaluate the inclination toward adopting a 'wait-and-see' approach regarding vaccination, which offers insight into the level of caution and the potential requirement for extra information or reassurance that could impact future vaccination decisions (e.g., Alsharawy et al., 2022; Kekeh et al., 2022), we utilized a scale that ranged from 0 to 100. In this case, 0 signifies complete unwillingness to wait and see, while 100 indicates complete willingness. Respondents had the opportunity to express their stance by moving a slider or entering numerical values.

3.3. Procedure

Considering the constraints imposed by the requirement to conduct a large-scale survey and a rigorous laboratory experiment within a limited time frame, we utilized (1) practical comparisons and (2) imaginative/hypothetical manipulations to manipulate the aforementioned 'vaccination process' and 'SBV/non-SBV group' that determine whether the COVID-19 vaccination is attainable in China.

In the first part of the questionnaire, we first ask participants to answer questions related to *consent to vaccination* ('The COVID-19 vaccine [2019-nCoV vaccine] is currently available in your area as per government allocation. Please evaluate the extent to which you agree with the following statement: "I will get vaccinated myself"'.) and *vaccine safety* ('Please drag the slider below or directly enter a number in the text box to rate the safety of the vaccine'). We then categorize the participants into (1) those who belong to the unvaccinated population group and the vaccinated population group (for detailed categorization criteria, please see Appendix A) and (2) those who belong to the SBV group and those who do not (for specific categorization issues, refer to Appendix B). These classifications enable us to perform practical comparisons.

It is worth noting that our survey was conducted shortly after the vaccine was developed, which might result in uneven distribution of participants among the 'vaccination status' and 'SBV/non-SBV' groups, such as having many people in the unvaccinated group and only a few in the vaccinated group. To address this problem, we employed imaginative/hypothetical manipulations and a within-subjects design to distribute the participants evenly across groups.

Therefore, in the second part of the questionnaire, (1) we initially ask participants to envision themselves as belonging to both the SBV group and the non-SBV group (for a detailed imagined scenario, refer to Appendix C), regardless of their actual eligibility. Subsequently, we assess their *willingness to be vaccinated* ('Please drag the slider below or directly enter a number in the text box to rate your willingness to get vaccinated'.), *willingness to wait and see* ('Please drag the slider below or directly enter a number in the text box to rate your willingness to wait and see'.), and *perception of vaccine safety* ('Please drag the slider below or directly enter a number in the text box to rate the safety of the vaccine'.), respectively. (2) We initially ask participants to envision themselves as belonging to one of the 3 stages of the vaccination process (5% of people have been vaccinated (early stage), 30% of

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people have been vaccinated (intermediate stage), or 55% of people have been vaccinated (late stage)) (for the specific imagined scenario, refer to Appendix D), regardless of their actual stage. Participants are then asked to answer questions related to their *willingness to be vaccinated* and their *willingness to wait and see*. This imaginative/hypothetical manipulation allows us to assess changes in people's beliefs and preferences within a limited time frame.

The study was approved by the institutional review board of the Institute of Psychology, Chinese Academy of Sciences. Further details on the materials and data are available at https://www.scidb.cn/en/s/VN7Vvm.

4. Results

4.1. Results for practical comparisons

This section of the statistical analysis can be divided into 2 parts based on whether the participants are truly vaccinated and whether they truly belong to the SBV group. The first part (Section 4.1.1) tests Hypothesis 1, focusing on vaccination status, while the second part (Section 4.1.2) tests Hypothesis 2, focusing on the SBV/non-SBV group.

4.1.1. Vaccination status

Our respondents were separated into 2 distinct groups based on their actual vaccination status: vaccinated individuals and unvaccinated individuals. Specifically, 180 of our respondents had received the vaccine, while 2,943 had not been vaccinated.

The descriptive statistics for the responses to the questions of 'consent to vaccination' and 'evaluation of vaccine safety' from the 2 groups are presented in Figure 1, which shows the mean 'consent to vaccination' and 'vaccine safety' evaluation when respondents were informed that a vaccine was available.

4.1.2. SBV/non-SBV group

Our respondents were divided into 2 separate groups according to whether their actual occupation qualified them as part of the 'population who should be vaccinated to the greatest extent possible' or 'individuals who are not required to be vaccinated to the greatest extent possible' groups. Specifically, 577 of our respondents were categorized as SBV, while 2,546 were classified as non-SBV.

The descriptive statistics for the responses to the questions of 'consent to vaccination' and 'evaluation of vaccine safety' from the 2 groups are displayed in Figure 2, indicating the mean consent to vaccination and vaccine safety evaluation.

4.1.3. The main effects and two-by-two ANCOVA results

To examine the main effects of vaccination status and SBV/non-SBV group, an Analysis of Covariance (ANCOVA) for *consent to vaccination* without interaction was conducted. Taking into account that various factors may influence the effects, the following variables were controlled for gender, age, education, economic status, self-health status, and self-health concern. Table 2 represents the table of correlations.

Since the scales used were different, we standardized the variables to ensure uniformity in size and variability and reduce multicollinearity (Milligan and Cooper, 1988; Sneath and Sokal, 1973) using the scale function from base R. The procedures concerning control variables remained consistent throughout. The results showed that the main effect of vaccination status was significant (F [1, 3114] = 35.88, $p < 0.001$, $\eta_p^2 = 0.011$), indicating that individuals who had vaccinated expressed higher consent to vaccination ($M = 4.72$) compared to those who remained unvaccinated ($M = 4.00$) (Figure 1, left panel). On the other hand, the main effect of SBV/non-SBV group also was significant (F [1, 3114] = 20.09, $p < 0.001$, $\eta_p^2 = 0.006$), indicating that individuals who belong to the group that should be vaccinated to the greatest extent possible expressed higher consent to vaccination ($M = 4.33$) compared to those who do not belong to that group ($M = 3.97$) (Figure 2, left panel).

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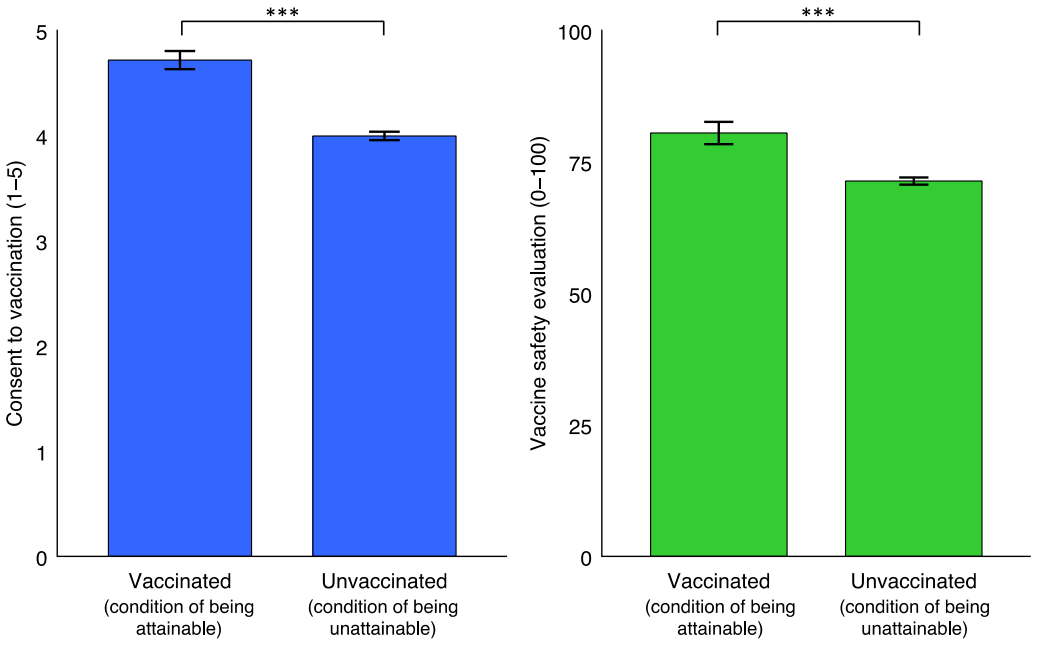

Figure 1. *Mean consent to vaccination and vaccine safety evaluation for the vaccinated and unvaccinated groups. The figure shows the consent to vaccination (left panel; score: 1–5; a higher score indicates a higher level of vaccination consent) and the evaluation of vaccine safety (right panel; score: 0–100; a higher score represents a higher safety evaluation). Dashes represent 95% confidence intervals; ***p < .001.*

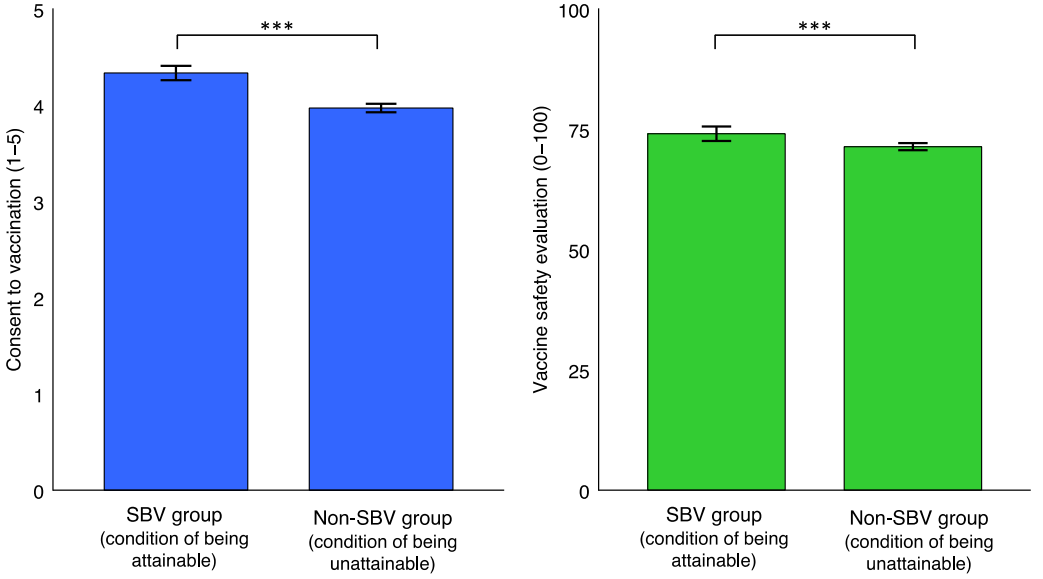

Figure 2. *Mean consent to vaccination and vaccine safety evaluation for the SBV and non-SBV groups. The figure shows the consent to vaccination (left panel; score: 1–5; a higher score indicates a higher level of vaccination consent) and the vaccine safety evaluation (right panel; score: 0–100; a higher score indicates a higher safety evaluation). Dashes represent 95% confidence intervals; ***p < .001.*

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Table 2. *Correlations among vaccination status, SBV/non-SBV group, demographic variables, and other variables (N = 3,123).*

Variable	1	2	3	4	5	6	7	8	9	10
1. Gender	—									
2. Age (years)	−.05**	—								
3. Education	.05**	−.04*	—							
4. Family economic status	−.01	.02	.21***	—						
5. Physical health status	−.06**	.01	.15***	.27***	—					
6. Self–health concern	−.04*	.04*	.14***	.22***	.32***	—				
7. Consent to vaccination	−.07***	−.03	.02	.10***	.16**	.17**	—			
8. Vaccine safety evaluation	−.12***	.03	.06**	.14***	.20***	.18**	.56***	—		
9. Vaccination status	.08***	.00	.00	−.07***	−.06**	−.07***	−.15***	−.11***	—	
10. SBV/non–SBV group	.06**	.01	.01	−.06***	−.02	−.06***	−.13***	−.06**	.29***	—

*$p < .05$,
**$p < .01$,
***$p < .001$.

Then, an ANCOVA for *vaccine safety* without interaction was conducted, while controlling for respondents' gender, age, education, economic status, self-health status, and self-health concern. The main effect of vaccination status was significant (F [1, 3114] = 20.84, $p < 0.001$, $\eta_p^2 = 0.007$), indicating that individuals who had vaccinated evaluated the vaccine was safer ($M = 80.48$) than those remained unvaccinated ($M = 71.35$) (Figure 1, right panel). Individuals who belong to the group that should be vaccinated to the greatest extent possible expressed higher safety evaluation ($M = 74.06$) compared to those do not belong to that group ($M = 71.38$) (Figure 2, right panel). However, this main effect of SBV/non-SBV group did not reach a significant level (F [1, 3114] = 0.44, $p = 0.506$).

Considering that the SBV group includes vaccinated individuals (for whom vaccine attainability is presumably at its highest) and these 2 variables (SBV/non-SBV group and vaccination status) are not perfectly correlated, we then conducted a two-by-two ANCOVA.

Respondents were therefore divided into 4 groups based on their actual vaccination status and SBV/non-SBV group: two (vaccination status: vaccinated vs. not vaccinated) × two (SBV/non-SBV group: SBV vs. non-SBV), which served as between-subject variables. Specifically, 116 of our respondents belonged to the SBV population and had received the vaccine, 64 belonged to the non-SBV population and had received the vaccine, 461 belonged to the SBV population and remained unvaccinated and 2,482 belonged to the non-SBV population and remained unvaccinated. An ANCOVA for *consent to vaccination* involving vaccination status by SBV/non-SBV group interaction was conducted. The results showed that there was a significant vaccination status by SBV/non-SBV group interaction (F [1, 3113] = 4.92, $p = 0.027$, $\eta_p^2 = 0.002$). Among individuals who remained unvaccinated, those belongs to the SBV group (vs. non-SBV group) expressed higher consent regarding vaccination. However, this difference disappeared among individuals who had vaccinated (Figure 3).

In addition, an ANCOVA for *consent to vaccination* involving the same interaction was conducted. The results showed that the vaccination status by SBV/non-SBV group interaction was not significant (F [1, 3113] = 0.10, $p = 0.748$) (Figure 3).

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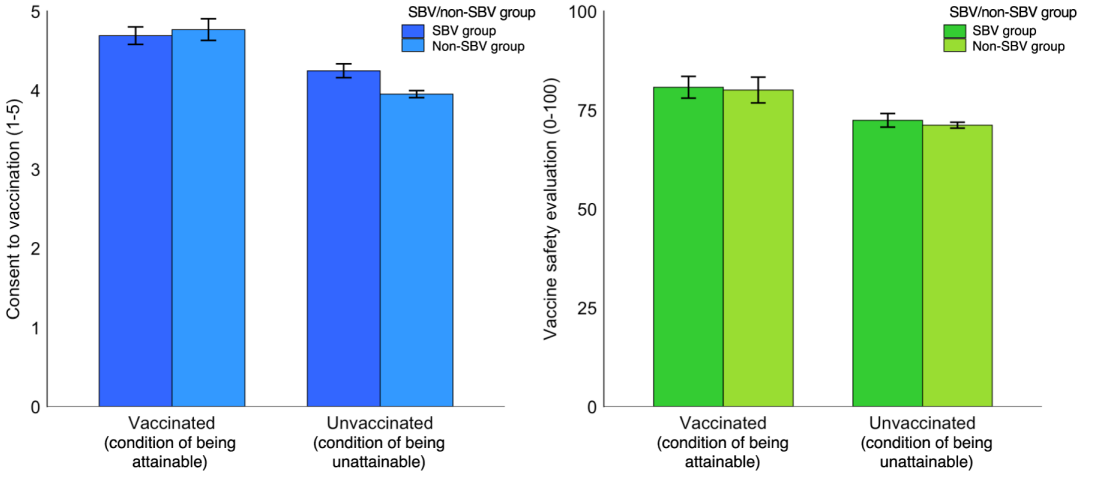

Figure 3. *Mean consent to vaccination and vaccine safety evaluations among various groups according to their actual vaccination status and eligibility. This figure shows the consent to vaccination (left panel; score range: 1–5; higher scores indicate a greater level of vaccination consent) and vaccine safety evaluation (right panel; score range: 0–100; higher scores represent a higher safety evaluation) for the 4 population groups. Dashes represent 95% confidence intervals.*

The aforementioned analyses for 'vaccination status' group provide corroborating evidence for our Hypotheses 1 (H1), which propose that when vaccination is perceived as unattainable (unvaccinated), people exhibit the sour grapes effect, perceiving the vaccine as unsafe and being unwilling to get vaccinated. Conversely, when vaccination is perceived as attainable (vaccinated), people exhibit the sweet lemons effect, perceiving the vaccine as safe and being willing to get vaccinated.

With regard to the aforementioned analyses for the SBV/non-SBV group, the results are not as straightforward as for the 'vaccination status' group. Notably, the main effect of SBV/non-SBV group, as depicted in Figure 2, vanishes in the two-by-two ANOVA presented in Figure 3, thus failing to support our Hypothesis 2 (H2). This discrepancy is likely due to 2 factors: (1) participants in the SBV group perceive *vaccine attainability* as lower compared to those who have already been vaccinated, and (2) given the early stage of the vaccine rollout when the questionnaire was distributed, the number of individuals who had received the vaccine was restricted (i.e., out of our respondents, 180 had received the vaccine, whereas 2,943 had not been vaccinated), which may have resulted in uneven participant proportions in the actual input data.

4.2. Results for imaginative (hypothetical) manipulations

The statistical analysis of this section could be divided into 2 parts according to the groups that the participants were asked to imagine themselves belonging to the SBV/non-SBV group and the hypothetical stages of the vaccination process. The first part (Section 4.2.1) tests Hypothesis 2, focusing on the SBV/non-SBV group, while the second part (Section 4.2.2) tests Hypothesis 3, focusing on the vaccination process.

4.2.1. SBV/non-SBV group with hypothetical manipulation

For some reason, we were unable to detect a significant difference in the main effect of SBV/non-SBV group using a between-subject design in our practical comparisons. We now turn to the data obtained from hypothetical manipulations using a within-subjects design, wherein each participant was presented with 2 hypothetical scenarios: they belong to the group that should be vaccinated to the greatest extent

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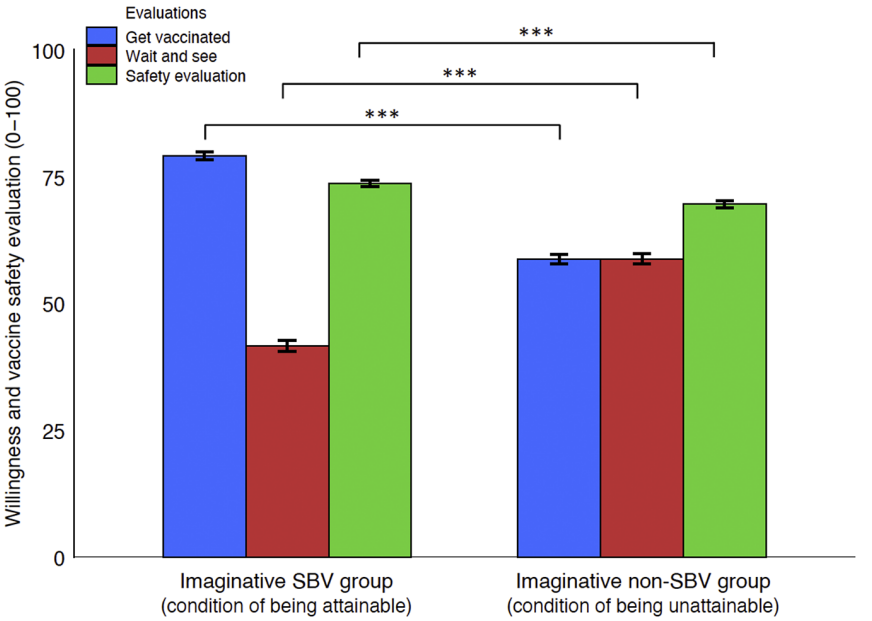

Figure 4. *Mean willingness to be vaccinated, vaccine safety scores, and willingness to wait and see for the imaginative SBV and non-SBV groups. Dashes represent 95% confidence intervals. ***p < .001.*

possible or they do not belong to this group. They then assessed their willingness to be vaccinated, willingness to wait and see, and vaccine safety under each hypothetical scenario.

We utilized repeated measures ANOVA to investigate these 3 measures while controlling for respondents' gender, age, education, economic status, self-health status, self-health concern, actual SBV/non-SBV group, and actual vaccination status as covariates. The continuous control variables were standardized. The results showed that in the SBV condition, the average score for willingness to be vaccinated was 79.14, whereas in the non-SBV condition, it was 58.72, and the difference between the 2 groups was statistically significant (F [1, 3114] = 47.15, $p < 0.001$, $\eta_p^2 = 0.015$). In addition, in the SBV condition, the average score for willingness to wait and see was 41.63, whereas in the non-SBV condition, it was 58.77 and the difference between the 2 groups was statistically significant (F [1, 3114] = 22.81, $p < 0.001$, $\eta_p^2 = 0.007$). Furthermore, the vaccine safety score in the SBV condition was 73.65, whereas in the non-SBV condition, it was 69.53 and the difference between the 2 groups was statistically significant (F [1, 3114] = 20.28, $p < 0.001$, $\eta_p^2 = 0.006$). That is, when comparing the SBV and non-SBV conditions, it was found that willingness to be vaccinated was higher, willingness to wait and see was lower, and the evaluation of vaccine safety was higher in the SBV condition (Figure 4).

These findings from hypothetical manipulations support our Hypothesis 2 (H2). This hypothesis states that when vaccination is perceived as unattainable (individuals belong to the non-SBV group), people exhibit the sour grapes effect, perceiving the vaccine as unsafe and choosing to wait rather than getting vaccinated. Conversely, when vaccination is perceived as attainable (individuals belong to the SBV group), people exhibit the sweet lemons effect, perceiving the vaccine as safe and willing to get vaccinated without waiting.

4.2.2. Vaccination process

Participants were randomly allocated to 1 of the 3 hypothetical stages, and their willingness to get vaccinated and their willingness to adopt a 'wait-and-see' approach during the hypothetical stage were measured and assessed. In total, 1,079 of our respondents were allocated to the early condition, 1,007 to the intermediate condition, and 1,037 to the late condition. We conducted an ANCOVA while

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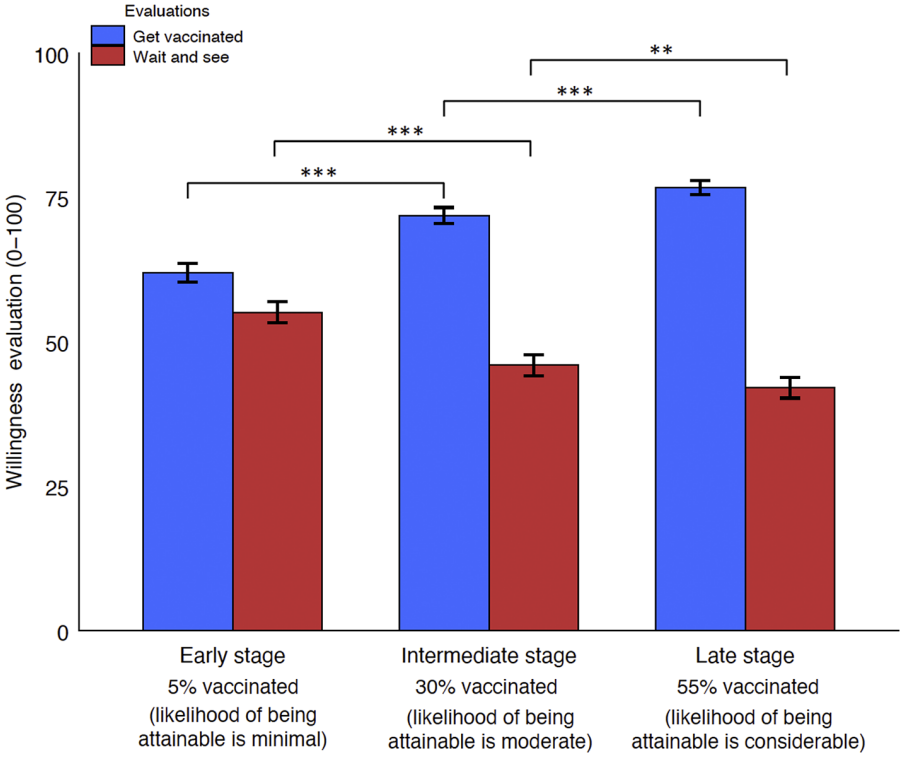

Figure 5. *Mean willingness to be vaccinated and willingness to wait and see in the early, intermediate, and late stages of the vaccination process. Dashes represent 95% confidence intervals. **p < .01; ***p < .001.*

controlling for respondents' gender, age, education, economic status, self-health status, self-health concern, actual SBV/non-SBV group, and actual vaccination status as covariates. The continuous control variables were standardized. The results revealed significant differences in willingness to be vaccinated (F [2, 3112] = 111.58, p < 0.001, η_p^2 = 0.067) and willingness to wait and see (F [2, 3114] = 55.60, p < 0.001, η_p^2 = 0.035) among the early, intermediate, and late stages of the vaccination process. The scores for willingness to be vaccinated were 61.99 in the early stage (5% vaccinated) condition, 71.87 in the intermediate stage (30% vaccinated) condition, and 76.69 in the late stage (55% vaccinated) condition. Post-hoc tests revealed that respondents' willingness to be vaccinated was significantly lower in the early stage condition than intermediate stage (p < .001, d = −0.422) and late stage (p < .001, d = −0.638) and respondents' willingness to be vaccinated was significantly lower in the intermediate stage than late stage (p < .001, d = −0.216). In addition, the scores for willingness to wait and see were 55.10 in the early stage condition, 45.97 in the intermediate stage condition, and 42.03 in the late stage condition. Post-hoc tests revealed that respondents' willingness to wait and see was significantly higher in the early stage condition than intermediate stage (p < .001, d = 0.310) and late stage (p < .001, d = 0.447), and respondents' willingness to wait and see was significantly higher in the intermediate stage than late stage (p = .006, d = 0.137). These findings indicate that willingness to be vaccinated increased progressively throughout the 3 stages, while willingness to wait and see declined (Figure 5).

These findings support our Hypothesis 3 (H3), which posits that when the perceived probability of vaccination is unattainable (early stage of the vaccination process), people exhibit the sour grapes effect in their attitude toward the vaccine, and individuals are reluctant to get vaccinated, opting to wait instead. Conversely, when the perceived probability of vaccination is attainable (late stage of the

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vaccination process), people exhibit the sweet lemons effect in their attitude toward the vaccine, and individuals are willing to get vaccinated without waiting.

In summary, our results from both practical comparisons and imaginative (hypothetical) manipulations provide supportive evidence for the 3 hypotheses proposed, except that Hypothesis 2 did not receive anticipated support in the practical comparisons.

5. Discussion

The main objective of this research is to investigate and identify an effective outcome in China's situation that aligns with the predictions and explanations of the sour grapes/sweet lemons rationalization (Elster, 1982; Henderson et al., 2010; Jois, 2009; Sjåstad et al., 2020).

Our online survey, conducted with 3,123 participants across 30 provinces and municipalities in the Chinese mainland, revealed that, in contrast to individuals in the early stage of the vaccination process, the unvaccinated and non-SBV population groups (i.e., those who fit the sour grapes effect's description of 'unattainable') showed lower evaluation in vaccine safety, lower willingness to be vaccinated, and higher willingness to wait and see tendencies. On the other hand, those in the late stage of the vaccination process, the vaccinated, and SBV population groups (i.e., those who align with the sweet lemons effect's description of 'attainable') exhibited higher evaluation in vaccine safety, higher willingness to be vaccinated, and lower willingness to wait and see tendencies.

Therefore, we suggest that the manipulation of vaccine attainability, which forms the foundation of the sour grapes/sweet lemons rationalization application, can be employed as a method to manipulate the choice architecture to 'nudge' individuals into making better decisions (Benartzi et al., 2017; He et al., 2018; Thaler and Sunstein, 2008). Specifically, this involves making better decisions on easing vaccine safety concerns, reducing wait-and-see tendencies, and enhancing vaccination willingness.

We believe that manipulating vaccine attainability can be an efficient strategy to promote universal vaccination and encourage broader acceptance. Based on these discoveries, we suggest the specific actions outlined below.

Inform people about vaccine progress in a timely manner. It is essential to regularly update the public on the vaccination progress, particularly when it enters the late stage with a high vaccination rate. By keeping people informed at this stage, they are more likely to experience the 'sweet lemons' effect, where the vaccination seems attainable, which leads to increased awareness of vaccine safety, a decreased willingness to wait and see, and a higher likelihood of getting vaccinated.

Expand the scope of SBV group. Broadening the SBV individuals group to include more occupations can contribute to a greater number of individuals experiencing the 'sweet lemons' effect's 'attainable' state. This expansion would lead to increased vaccine safety awareness, a decreased willingness to wait and see, and a higher likelihood of getting vaccinated.

Select the appropriate vaccine recommender. When identifying individuals to recommend or promote vaccination, it is advisable to target the group of individuals who should be vaccinated to the greatest extent possible. This group is more prone to experiencing the 'sweet lemons' effect's 'attainable' state and is more likely than those who do not belong to that group to view the vaccine as safe. Therefore, leveraging this group as vaccine recommenders can enhance the effectiveness of vaccination promotion.

Considering the pressing circumstances surrounding vaccine inoculation at that time (i.e., our online survey commenced approximately 1 month after China's State Council Joint Prevention and Control Mechanism conducted the press conference), it was of paramount importance to ascertain a viable and effective approach. As a result, there was a constraint on time and resources allocated to thoroughly verify (1) if our manipulation effectively led to the sour grapes/sweet lemons rationalization and (2) how people's responses to the baseline consent for vaccination and vaccine safety evaluation questions altered. For future research, 2 key areas warrant investigation: firstly, evaluating the efficiency of manipulating vaccination timing for various population groups in alternative countries; secondly, it is

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essential to investigate whether the manipulation of various processes among vaccinated individuals genuinely elicits sets of conditions, namely 'attainable' and 'unattainable', along with their respective baselines.

Lastly, considering that some of our comparisons (particularly those concerning true vaccination status) in this study did not involve random assignment and are not susceptible to the same confounds, it is crucial to acknowledge potential confounds affecting the interpretation of our data. We encourage further research using more rigorous methods to validate and expand upon our findings.

Acknowledgments. The authors are grateful to Li-Lin Rao, Rui Zheng, and Ming-Xing Xu for their contributions to the initial ideas behind this article, and Yi Kuang and Yuan-Na Huang for their help with survey question design and data collation. All the valuable suggestions provided have made significant improvements to this study.

Author contributions. S.-Y.D. analyzed and interpreted the respondent's data regarding safety concerns about the vaccine and wait-and-see vaccination behavior. Y.Z., Y.-X.D., C.Z., J.-T.M., M.N., P.-W.L., and N.Z. participated in survey question design and data collation and were contributors in writing the manuscript. S.L. and Y.Z. were the directors of the fund and designed ideas of research. S.L. was a major contributor to writing the manuscript. All authors read and approved the final manuscript.

Funding statement. This research was supported by the National Natural Science Foundation of China (Grant No. 72074236) and Major Program of the National Social Science Foundation of China (Grant No. 19ZDA358).

Competing interest. The authors declare that they have no competing interests.

Ethical standards. This study was approved by the ethics review committee of the Institute of Psychology, Chinese Academy of Sciences, to protect the rights and welfare of the research participants (project identification code: H20029). Informed consent was obtained from all participants. All methods were carried out in accordance with relevant guidelines and regulations.

References

Alsharawy, A., Dwibedi, E., Aimone, J., & Ball, S. (2022). Vaccine hesitancy and betrayal aversion. *Annals of Biomedical Engineering*, *50*(7), 794–804.

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., Tucker-Ray, W., Congdon, W. J., & Galing, S. (2017). Should governments invest more in nudging? *Psychological Science*, *28*(8), 1041–1055.

Bhattacharyya, S., & Bauch, C. T. (2011). "Wait and see" vaccinating behaviour during a pandemic: A game theoretic analysis. *Vaccine*, *29*(33), 5519–5525.

Cascella, M., Rajnik, M., Aleem, A., Dulebohn, S., & Di Napoli, R. (2022). *Features, evaluation, and treatment of coronavirus (COVID-19)*. Treasure Island, FL: StatPearls.

Elster, J. (1982). Sour grapes utilitarianism and the genesis of wants. In A. Sen & B. Williams (Eds.), *Utilitarianism and beyond* (pp. 219–239). Cambridge: Cambridge University Press.

Elster, J. (1983). *Sour grapes: Studies in the subversion of rationality*. Cambridge: Cambridge University Press.

Elster, J. (2016). *Sour grapes*. Cambridge: Cambridge University Press.

He, G. B., Li, S., & Liang, Z. Y. (2018). Behavioral decision-making is nudging China toward the overall revitalization. *Acta Psychologica Sinica*, *50*(8), 803–813.

Henderson, M., Hillygus, D. S., & Tompson, T. (2010). "Sour grapes" or rational voting? Voter decision making among thwarted primary voters in 2008. *Public Opinion Quarterly*, *74*(3), 499–529.

Jois, G. U. (2009). *Stare decisis is cognitive error* (p. 75). New York: Social Science Electronic Publishing.

Kay, A. C., Jimenez, M. C., & Jost, J. T. (2002). Sour grapes, sweet lemons, and the anticipatory rationalization of the status quo. *Personality and Social Psychology Bulletin*, *28*(9), 1300–1312.

Kekeh, M., Lucero, L., & Akpinar-Elci, M. (2022). COVID-19 vaccine hesitancy the United States. In *Coronavirus (COVID-19) outbreaks, vaccination, politics and society: The continuing challenge* (pp. 357–368). Cham: Springer International Publishing.

Koff, W. C., & Berkley, S. F. (2021). A universal coronavirus vaccine. *Science*, *371*(6531), 759–759.

Lancet, T. (2020). India under COVID-19 lockdown. *Lancet (London, England)*, *395*(10233), 1315.

Laurin, K., Kay, A. C., & Fitzsimons, G. J. (2012). Reactance versus rationalization: Divergent responses to policies that constrain freedom. *Psychological Science*, *23*(2), 205–209.

Laurin, K., Shepherd, S., & Kay, A. C. (2010). Restricted emigration, system inescapability, and defense of the status quo: System-justifying consequences of restricted exit opportunities. *Psychological Science*, *21*(8), 1075–1082.

Lazarus, J. V., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K. S., & El-Mohandes, A. (2021). A global survey of potential acceptance of a COVID-19 vaccine. *Nature Medicine*, *27*(2), 225–228.

https://doi.org/10.1017/jdm.2024.13 Published online by Cambridge University Press

Li, S., Jiang, C.-M., Dunn, J. C., & Wang, Z.-J. (2012). A test of "reason-based" and "reluctance-to-think" accounts of the disjunction effect. *Information Sciences*, *184*(1), 166–175.
Ma, J. T., Ding, Y., Shen, S. C., Kuang, Y., Yang, S. W., Xu, M. X., & Li, S. (2022). Long-term orientation and demographics predict the willingness to quarantine: A cross-national survey in the first round of COVID-19 lockdown. *Personality and Individual Differences*, *192*, 111589.
Milligan, G. W., & Cooper, M. C. (1988). A study of standardization of variables in cluster analysis. *Journal of Classification*, *5*, 181–204.
Morton, T. A., Rabinovich, A., Marshall, D., & Bretschneider, P. (2011). The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications. *Global Environmental Change*, *21*(1), 103–109.
Nagler, M. G. (2023). Thoughts matter: A theory of motivated preference. *Theory and Decision*, *94*(2), 211–247.
Parker, P. M. (1995). "Sweet lemons": Illusory quality, self-deceivers, advertising, and price. *Journal of Marketing Research*, *32*(3), 291–307.
Sjåstad, H., Baumeister, R. F., & Ent, M. (2020). Greener grass or sour grapes? How people value future goals after initial failure. *Journal of Experimental Social Psychology*, *88*, 103965.
Sneath, P. H., & Sokal, R. R. (1973). *Numerical taxonomy. The principles and practice of numerical classification*. San Francisco: Freeman.
Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven: Yale University Press.
Vail, K. E., Harvell-Bowman, L., Lockett, M., Pyszczynski, T., & Gilmore, G. (2023). Motivated reasoning: Election integrity beliefs, outcome acceptance, and polarization before, during, and after the 2020 US Presidential Election. *Motivation and Emotion*, *47*(2), 177–192.
Wang, Z. J., Li, S., & Jiang, C. M. (2012). Emotional response in a disjunction condition. *Journal of Economic Psychology*, *33*(1), 71–78.
Zhang, H. J., Ding, L. L., Pan, X. J., Shen, L. Z., Zhu, Y., Chen, F. X., & Lv, H. (2021). Willingness to receive novel coronavirus vaccine and factors influencing willingness among healthcare workers in Zhejiang province. *Chinese Journal of Vaccines and Immunization (Chinese Version)*, *1*, 1–7.

Appendix A

The following questions, presented in Chinese, are designed to determine whether respondents belong or do not belong to the 'vaccinated population' group.

您是否已经接种过新冠病毒疫苗?
- ∘ 是
- ∘ 否

Have you been vaccinated against COVID-19?
- ∘ Yes
- ∘ No

Appendix B

The following questions, presented in Chinese, are designed to determine whether respondents belong or do not belong to the group of individuals who should be vaccinated to the greatest extent possible.

我国目前接种的策略是按照"两步走"方案,第一步是推进重点人群疫苗接种,确保应接尽接,第二步是其他人群的接种。明确新冠病毒疫苗接种的重点人群主要包括从事进口冷链、口岸检疫、船舶引航、航空空勤、生鲜市场、公共交通、医疗疾控等感染风险比较高的行业人员;前往中高风险国家或者地区工作、学习等人员。请问您属于上述哪一类人群:

- ∘ 属于应接尽接的人群
- ∘ 不属于应接尽接的人群

China's current vaccination strategy is in accordance with the 'two-step' approach, the first step is to promote the vaccination of key groups to ensure all individuals who should be vaccinated to the greatest extent possible have access to it, the second step is the vaccination of other groups. The key

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groups for COVID-19 vaccination mainly include high-risk workers engaged in tasks such as cold-chain importation, port quarantine, maritime piloting, aviation services, working in fresh food markets, public transportation, medical and disease control, as well as individuals traveling to and from medium to high-risk countries or regions for work or study. Which of the above categories do you belong to:

- ○ Belong to the group of individuals who should be vaccinated to the greatest extent possible.
- ○ Do not belong to the group of individuals who should be vaccinated to the greatest extent possible.

Appendix C

The following scenarios, presented in Chinese, are designed to inform respondents about the vaccination eligibility they are presumably belongs to. This section follows Appendix B and is presented on its next page.

假设您属于应接尽接的接种人群

Assume that you are belong to the group of individuals who should be vaccinated to the greatest extent possible.

Next page:

假设您不属于应接尽接的接种人群

Assume that you are not belong to the group of individuals who should be vaccinated to the greatest extent possible.

Appendix D

The following scenario, presented in Chinese, is designed to inform respondents about which vaccination process they are presumably in. Respondents are randomly assigned to one of the following 3 conditions):

Scenario 1: 假定目前本地区新冠病毒疫苗接种已进入5%的人接种完毕的阶段(初期阶段)
Scenario 2: 假定目前本地区新冠病毒疫苗接种已进入30%的人接种完毕的阶段(中期阶段)
Scenario 3: 假定目前本地区新冠病毒疫苗接种已进入55%的人接种完毕的阶段(后期阶段)

Scenario 1: Assuming that the current COVID-19 vaccination in your region has entered the stage where 5% of people have been vaccinated (early stage of the vaccination process).

Scenario 2: Assuming that the current COVID-19 vaccination in your region has entered the stage where 30% of people have been vaccinated (intermediate stage of the vaccination process).

Scenario 3: Assuming that the current COVID-19 vaccination in your region has entered the stage where 55% of people have been vaccinated (late stage of the vaccination process).

Cite this article: Du, S-Y., Zhang, C., Ma, J-T., Nharen, M., Dai, Y-X., Li, P-W., Zhao, N., Zheng, Y., and Li, S. (2024). Applying the sour grapes/sweet lemons rationalization to change beliefs and preferences: Reducing public concerns about vaccine safety and enhancing their willingness to get vaccinated. *Judgment and Decision Making*, e29. https://doi.org/10.1017/jdm.2024.13