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The politics of flu vaccines: international collaboration and political partisanship

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Abstract
While vaccine hesitancy has become a salient issue, few studies have examined the influence of international collaboration and vaccine developments on people's attitudes towards vaccines. The international collaboration especially with China has been an integral part of the field of influenza. In recent years, attitudes towards vaccines and China are both heavily politicized in the USA with a deepening partisan divide. Republicans are more likely than Democrats to be vaccine hesitant, and they are also more likely to view China negatively. At the same time, the USA has economic, security, and medical collaboration with Japan and most Americans display a very positive view of the country. Thus, does a more international collaboration or more country-specific vaccine development have an influence on US vaccine hesitancy? This study conducts a survey-embedded question-wording experiment to assess the roles of US–China and US–Japan collaboration and partisanship in people's willingness to get the flu vaccine. Despite the previously successful and effective US–China collaboration, this study finds that respondents especially Republicans are much less likely to receive a US–China flu vaccine than a US–Japan or USA alone. Interestingly, both Democrats and Republicans are as willing to receive a US–Japan vaccine as USA alone. These results point to critical roles of partisanship and international relations.

Keywords: international collaboration; partisanship; US–China relationship; vaccine hesitancy; vaccine origin

1. Introduction

While the issue of vaccine hesitancy is not new to the USA, it has become particularly salient during the coronavirus disease-2019 (COVID-19) pandemic. Despite the importance of vaccination to public health, a 2020 public opinion survey shows that about a quarter of the respondents were vaccine hesitant (Hamel *et al.*, 2020). Of course, anti-vaccine sentiments are not unique to COVID-19 vaccines. They also affect influenza (flu) vaccines (Suryadevara *et al.*, 2014; Abbas *et al.*, 2018; Quinn *et al.*, 2019) and childhood vaccines (such as measles, mumps, and rubella vaccine) (Callender, 2016; Motta *et al.*, 2018; Benecke and DeYoung, 2019; Callaghan *et al.*, 2019). In recent years, attitudes towards vaccines have become more politicized along partisan lines (Sylvester *et al.*, 2022). Republican supporters are increasingly more likely than Democrats to be vaccine hesitant (Hamel *et al.*, 2020; Jones and McDermott, 2022; Sylvester *et al.*, 2022). At the same time, both Republicans and Democrats have demonstrated significant pushback against globalization and international collaboration. Thus, how does partisanship and international collaboration influence vaccine hesitancy?

Recent studies have examined public attitudes towards international vaccines and in general the results show that citizens tend to favour vaccines developed and produced in their own country (Kreps and Kriner, 2021; Motta, 2021; Barceló *et al.*, 2022; Papp and Nkansah, 2023). National pride and trust in domestic institutions play a role in explaining vaccine nationalism, but other reasons include perceived quality of vaccines coming from countries such as China and Russia as well as trust in international institutions such as the World Health Organization (WHO) (Chiang *et al.*, 2022; Sheen *et al.*, 2023). While these studies have focused on public opinion and foreign vaccine development and production, few studies have examined the roles of international collaboration in shaping people's attitudes towards vaccines. There is a difference between foreign vaccines and international collaboration in the development of vaccines.

Historically, international collaboration has been critical to vaccine development even if the general public is unaware of foreign involvement in vaccine development. For instance, international collaboration has been an integral part of flu vaccine developments for decades (Liu *et al.*, 2018). WHO collaborating centres (CCs) in Australia, China, Japan, UK, and USA collaborate every year to determine virus strains for seasonal flu vaccines (CDC, 2021). The US Centers for Disease Control and Prevention (US CDC) Influenza Division and the Chinese National Influenza Center (CNIC) of the Chinese Center for Disease Control and Prevention (China CDC) are two of the WHO CCs partaking in the collaboration (WHO, 2023). In fact, US CDC and China CDC have a long history of international collaboration in influenza surveillance and research, dating back to 1989 (Shu *et al.*, 2019), and this collaboration has saved countless lives over the last several decades.

Given the ongoing international collaboration in the field of influenza, how does it impact people's attitudes towards flu vaccines in the USA? When it comes to impacts of international collaboration, people's sentiments towards the particular collaborative countries play a large role (Aydin *et al.*, 2021; Kobayashi *et al.*, 2022). Public attitudes towards East Asian countries vary. For example, 82% of the US public had negative views towards China in 2022 (Silver, 2022), and Republicans are more likely to have negative attitudes towards China (Silver *et al.*, 2023). However, the attitude towards Japan is more positive and bipartisan (Norman, 2018). The reasons behind these attitudes reflect both political and economic. The anti-China sentiment reveals negative responses to US–China trade war and trade deficit as well as a national security risk in East Asia and beyond. At the same time, more favourable attitudes towards Japan signal a more positive market interaction and American perceptions of high-quality products as well as East Asian security and US ally.

This study examines the influence of international collaboration on American public's attitudes towards flu vaccines among partisan individuals. We conducted a survey-embedded question-wording experiment to assess the roles of US–China/US–Japan collaboration and partisanship in willingness to get the flu vaccine. The findings suggest that people are less willing to receive a Food and Drug Administration (FDA)-approved flu vaccine developed through US–China collaboration, compared to an FDA-approved flu vaccine developed through US–Japan collaboration or the USA alone. This means that American public express more vaccine hesitancy when a flu vaccine is developed through US–China collaboration even if it is approved by the US FDA.

The results further suggest that predisposed perceptions of countries (in this case China and Japan) and partisanship influence attitudes towards vaccine collaboration. All respondents, irrespective of political affiliation, are more willing to receive a vaccine developed from Japan–US than China–US collaboration. Moreover, Republicans are significantly less likely to accept an FDA-approved flu vaccine developed through US–China collaboration than a flu vaccine developed through US–Japan collaboration or the USA alone. Among the Democrats, there is no statistically significant difference between the acceptance of an US–China collaborative vaccine and the acceptance of a vaccine developed by the USA alone. Although there is a partisan divide regarding Japan–US collaboration, it is much narrower division compared to China–US collaboration. These results point to the influence of elite cues on public opinion (Zaller, 1992).

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2. International collaboration in the influenza field

While average citizens are unaware of the positive historical vaccine collaboration between USA and other countries including China, it is important to summarize collaboration. The USA has a long history of international collaboration in the field of influenza. After WHO recommended the establishment of influenza centres globally, the USA was invited to participate in the programme in 1947 (Culbertson, 1949). The goal was to isolate new strains of virus and use them to develop vaccine before they reached other parts of the world where they had not spread (Culbertson, 1949). Currently, the CDC serves as a CC in the WHO Global Influenza Surveillance and Response System (GISRS) (Chow *et al.*, 2018). With other international partners, they monitored and characterized viruses (Chow *et al.*, 2018).

US–China collaboration dates back to 1989, when the US CDC and the CNIC of the China CDC signed a cooperative agreement (Shu *et al.*, 2019). Since the agreement, US CDC and CNIC collaborated on influenza surveillance,[1] and the staff from both agencies visited each other for collaborative research (Shu *et al.*, 2019). The collaboration deepened during the 2009 and 2013 influenza outbreaks (Shu *et al.*, 2019; Bouey, 2020). During the 2009 H1N1 flu pandemic, US CDC and China CDC worked closely together and shared data with each other to develop testing kits (Shu *et al.*, 2019) and a vaccine (Bouey, 2020). During the 2013 H7N9 flu outbreaks, they also worked together on researching the virus (Shu *et al.*, 2019; Bouey, 2020). The USA and China continued to work together on seasonal flu vaccine developments through the WHO GISRS, and these efforts resulted in the FDA-approved annual flu vaccines in the USA.

Japan is also an active participant in international collaboration on flu vaccine developments as a WHO CC. The USA and Japan established the US–Japan Cooperative Medical Sciences Program in 1965, and held an annual conference titled 'International Conference on Emerging Infectious Diseases in the Pacific Rim' to promote scientific collaboration for more than 25 years (Doi *et al.*, 2021; Lu *et al.*, 2021). The programme has facilitated international collaborations on vaccine developments for cholera, hepatitis B, and rotaviruses.[2]

3. Vaccine hesitancy and partisanship in the USA

Prior to the COVID-19 pandemic, few studies examined the influence of partisanship on vaccine hesitancy. Among the few studies, the analyses of 2009 surveys find that Democrats were more willing to get flu vaccines because they had greater trust in the Democrat government's ability to handle the 2009–2010 swine flu outbreak (Mesch and Schwirian, 2015a, 2015b). Joslyn and Sylvester (2019) analyse 2015 surveys and find a partisan effect on misbeliefs linking vaccines and autism among educated partisans. Educated Democrats are more likely to have an accurate belief because it aligns well with their partisan inclination to support government programmes and science (Joslyn and Sylvester, 2019). Yet, historically, anti-vaccine attitudes existed on both sides of the ideological spectrum (Voyles, 2020). In fact, existing studies on flu shots demonstrate that vaccine hesitancy is based on non-partisan issues such as concerns over safety and efficacy (Suryadevara *et al.*, 2014; Abbas *et al.*, 2018; Quinn *et al.*, 2019).

Vaccine attitudes have only become more politicized and a partisan issue in the recent years. During the 2016 presidential debates, the Republican presidential candidate Donald Trump promoted misinformation regarding the false link between vaccines and autism (Callender, 2016; Suryadevara *et al.*, 2019). The partisan divide intensified during the COVID-19 pandemic; a survey by the Kaiser Family Foundation finds that vaccine hesitancy was higher among Republicans (42%) than Democrats (12%) in 2020 (Hamel *et al.*, 2020). Other studies also show consistent results that

[1]See CNIC 'About CNIC', https://ivdc.chinacdc.cn/cnic/en/Aboutus/.

[2]See National Institute of Allergy and Infectious Diseases (https://www.niaid.nih.gov/research/us-japan-cooperative-medical-sciences-program-organization-and-history) and Japan Agency for Medical Research and Development (https://www.amed.go.jp/program/list/20/01/007.html).

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Republicans are more likely than Democrats to be vaccine hesitant (Jones and McDermott, 2022; Sylvester *et al.*, 2022). Sylvester *et al.* (2022) refer to this partisan divide in vaccine hesitancy as 'asymmetric vaccine hesitancy'. They find that Republicans with a moderate level of party attachment become more willing to get COVID-19 vaccines when they hear that Republican politicians have received the vaccines (Sylvester *et al.*, 2022). This suggests that elite cues impact public attitudes (Zaller, 1992).

While the partisan divide in vaccine hesitancy is clear, what remains unclear is how international collaboration in vaccine development influences partisan individuals' vaccination intentions. Current studies on the influence of international collaboration on COVID-19 vaccination intentions are not conclusive. Although many studies suggest citizens prefer domestically developed vaccines (Kreps and Kriner, 2021; Motta, 2021; Barceló *et al.*, 2022; Papp and Nkansah, 2023), there are favourable foreign vaccines. Wong *et al.* (2021) find that about 75% of survey respondents in the USA would only take a COVID-19 vaccine that is produced by certain countries. Kobayashi *et al.* (2021) find that the American survey respondents' vaccination intention does not differ between COVID-19 vaccines produced in the USA and Germany. Thus, it remains unclear how the US–China or US–Japan collaboration on flu vaccine impacts people's vaccination intention in the USA. The public perception of a bilateral relationship and partisan positions on such a relationship is key to understanding the impact of the international collaboration on vaccine hesitancy among partisan individuals.

4. Public opinion on international collaborations: China and Japan

The percentage of Americans with unfavourable views of China hits a new high of 82% in April 2022, and the shift towards unfavourable views is especially pronounced among Republicans (Silver, 2022). While the current level of negative sentiment towards China is likely fuelled by the US–China Trade War and hostile rhetoric during the COVID-19 pandemic, the partisan divide in US public opinion of China is not new. Research by Peter Gries and co-authors showed that Republicans and self-identified 'conservatives' perceive a greater threat from China and support a tougher US foreign policy towards China than Democrats and self-identified 'liberals' did in 2008 (Gries and Crowson, 2010). In a 2011 survey, Gries further establishes that this partisan divide stems from conservatives having less favorable views than liberals towards communist countries and China, combining racial prejudice with ideological antagonism (Gries, 2014). Thus, Republicans may be less likely to get the flu vaccine from a US–China collaboration than Democrats.

US–Japan collaboration can serve as a point of reference. While Japan is another East Asian country that also participates in the international collaboration in flu vaccine developments, American perceptions of Japan are drastically different from those of China. American citizens have had consistently favourable views of Japan since the late 1990s,[3] and the favourable view exceeded 80% in 2023.[4] The steadily favourable views stem from Americans' positive image of Japanese and the US–Japan bilateral allyship (Nam, 2019). This level of favourability is constant regardless of age, gender, income, education, or political views (Norman, 2018). In other words, unlike the case of China, there is no partisan divide in Americans' attitudes towards Japan (Nam, 2019). Both Republicans and Democrats view Japan positively. Thus, American citizens may prefer US–Japan collaboration over US–China collaboration with an absence of a partisan divide towards US–Japan collaboration.

Nonetheless, when it comes to vaccines, we expect strong preference for domestically developed vaccines. Barceló *et al.* (2022) suggest that 'vaccine nationalism' should be prevalent in nations that trust the quality and integrity of their own medical establishment. This includes trust in government institutions such as the CDC and FDA.

[3]Pew Global Attitudes Project survey data, accessible at https://www.pewresearch.org/question-search/.

[4]Gallup 'Canada, Britain Favored Most in U.S.; Russia, N. Korea Least', https://news.gallup.com/poll/472421/canada-britain-favored-russia-korea-least.aspx.

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This leads to three hypotheses. If respondents are averse to international collaboration due to xenophobia or nationalism alone, then respondents may feel averse to both US–China and US–Japan collaboration in flu vaccines. This international collaboration and vaccine nationalism hypothesis reflects American aversion to global or regional (East Asian) health-related collaboration and a stronger connection with American medical institutions and companies.

However, respondents may be more sensitive to specific countries rather than general international or regional collaboration. Indeed, Kobayashi *et al.* (2022) find that having a history of conflicts with a country negatively impacts attitudes towards vaccines that come from the country. An image of a country impacts public perceptions of vaccines from the country (Aydin *et al.*, 2021). Given the general public predispositions towards China and Japan, we expect less willingness to receive a vaccine through US–China collaboration than US–Japan vaccine development.

Partisanship is also an important factor that may influence vaccine hesitancy and international collaboration. Republicans tend to be less accepting of international collaboration as opposed to Democrats especially with China. The partisan hypothesis proposes a significant partisan division regarding the willingness to receive vaccines developed through international collaboration.

Vaccine nationalism (H1): The majority of respondents prefer domestically developed (USA alone) vaccines over vaccines developed through US–China *and* US–Japan collaboration.

Country-specific hypothesis (H2): Respondents are more willing to receive a US–Japan vaccine than a US–China.

Partisan hypothesis (H3): Respondents display significant partisan division regarding the willingness to receive vaccines developed through international collaboration.

5. Research design and measures

To test the hypotheses, we employ a survey-embedded question-wording experiment in which respondents were asked whether they would get the FDA-approved flu vaccine developed through different channels. Dynata implemented the survey experiment in August 2022. Dynata uses a voluntary online panel of respondents selected to match the US adult population demographics. It is a non-probability sample, but they are more representative of the broader US adult populations than other convenience samples (e.g. students). Besides, online-convenient samples are indistinguishable from population-based samples when inferring treatment effects (Coppock *et al.*, 2018). Sample demographics are available in the Supplementary materials.

In our sample of 1,334 adults, respondents were randomly assigned to one of the three questions about their willingness to get the flu vaccine that was developed by the USA alone (control group, $N = 449$), US–China collaboration ($N = 439$), or US–Japan collaboration ($N = 446$). We selected China and Japan as the country-specific examples for several reasons. First, both countries are ethnically and culturally different from the USA. For many Americans, China and Japan are very different from the USA regarding language, food, customs, and history. This reflects the foreign and international aspects of the study. Second, while both countries are Asian, they have very different political systems. Japan is much closer to the USA than China including democratic political system as well as US military presence and security interests. At the same time, political differences and tensions have defined US–China relations for decades. These similarities and differences make Japan and China critical cases for this study.

Thus, our experimental manipulation is the international collaboration/origin of the FDA-approved flu vaccine (see the Supplementary materials for more details). Survey questions have the response options of 'Yes', 'No', or 'Don't Know'. Respondents' answers to the questions about their willingness to get vaccinated constitute the dependent variable. The dependent variable,

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vaccination willingness, is coded as a categorical variable: 0 = No; 1 = Don't Know; 2 = Yes. Multinomial logistic regression models are used to test our hypotheses, as suggested by Kleinberg and Fordham (2017).[5]

As discussed earlier, partisanship affects vaccine hesitancy (Joslyn and Sylvester, 2019; Suryadevara *et al.*, 2019; Jones and McDermott, 2022; Sylvester *et al.*, 2022) and views towards China and US–China relationship (Gries and Crowson, 2010; Gries, 2014). Thus, this suggests heterogeneity in the effect of international collaboration on vaccine hesitancy across partisanship.[6] This survey assesses partisanship by a standard 7-point measure ranging from strong Democrat to strong Republican. We code partisanship as a dichotomous variable (0 = Democrat or 1 = Republican) ('leaners' is coded as partisans, those who claim Independent or other party are dropped). Supplementary materials show the results of partisanship including Independents and supporters of other parties.

A random assignment of international collaboration stimuli is used in our experimental design, but partisanship is not randomly assigned. According to Kam and Trussler (2017), control variables should be added for testing heterogeneous treatment effects if moderating variables are not randomly assigned. Thus, we control for age, gender, race, education, income, and political knowledge.

6. Results

Table 1 shows the percentage of respondents who would get the FDA-approved flu vaccine by experimental condition. Fifty-three per cent of respondents would get the vaccine developed by the US–Japan collaboration, and 48% would receive the vaccine developed by the USA alone. In contrast, only 40% would get the vaccine from the US–China collaboration. The predicted probabilities show that people who would get the vaccine from the US–Japan collaboration and the USA alone are 0.47 and 0.53. It drops to 0.40 when the vaccine is from the US–China collaboration. It shows that all respondents are less inclined to receive a flu vaccine from the US–China collaboration. The significant difference between China and Japan suggests vaccine hesitancy is county specific rather than a broader based anti-foreign attitude. This supports the county-specific hypothesis (H2).

The Z-score from difference-in-proportions tests comparing the US–China collaboration group to the USA alone is −2.54 ($P = 0.011$). It attains the $\alpha = 0.05$ level of statistical significance. This indicates that the percentage of respondents willing to receive the flu vaccine from the US–China collaboration is significantly lower than that of respondents willing to receive the vaccine developed by USA alone. However, there is no statistically significant difference between the percentages of respondents willing to receive the flu vaccine from the US–Japan collaboration and the USA alone (Z-score = 1.51, $P = 0.132$).

Since the country-specific hypothesis (H2) expects a distinction between US–China and US–Japan collaboration, there is also a need to conduct a difference-in-proportions test comparing the US–China collaboration group to the US–Japan collaboration group. The Z-score from the test is −4.03 and it attains the $\alpha = 0.005$ level of statistical significance. Combined with the results from Table 1, this means that the US–China collaboration is less preferred than both USA alone and US–Japan collaboration. Therefore, the results are consistent with the country-specific hypothesis (H2) that respondents are less willing to receive a flu vaccine from the US–China collaboration than from the US–Japan collaboration.

Table 2 shows the percentage of respondents willing to receive the FDA-approved vaccine by experimental condition and partisanship. The existing research suggests that partisanship affects vaccination rate and vaccine hesitancy (Joslyn and Sylvester, 2019; Suryadevara *et al.*, 2019; Jones and

[5]Supplementary materials show the results of vaccination willingness coded as a dichotomous variable with those who choose 'Don't Know' dropped, vaccination willingness as an ordinal variable (0 = No, 1 = Don't Know, and 2 = Yes), and vaccination willingness as a binary variable (0 = Otherwise, 1 = Yes).

[6]While we expect heterogeneity in the effect of international collaboration across partisanship, we don't assume that partisanship is necessarily the cause of this moderation. In other words, we assume the presence of 'descriptive moderation' in terms of treatment-effect heterogeneity, as opposed to 'causal moderation' (Bansak, 2021).

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Table 1. Respondents' vaccination willingness by experimental condition

Category	Group	Would you get the vaccine this year? (0 = Otherwise, 1 = Yes)			
		% Yes	Pred. Prob.	*N*	*Z*-score
All samples	Control (USA alone)	48.11	0.47 [0.43, 0.52]	216	
	US–China collaboration	39.64	0.40 [0.36, 0.45]	174	−2.54*
	US–Japan collaboration	53.14	0.53 [0.49, 0.57]	237	1.51

Note: % Yes refers to the raw percentage getting the vaccine this year; predicted probabilities are based on a logistic regression model (model 1 of Table 3-3 in the Supplementary materials) and the 95% confidence intervals are enclosed within square brackets; *Z*-scores are from difference-in-proportions tests comparing treatments to control.
*$P < 0.05$.

McDermott, 2022; Sylvester *et al.*, 2022). This study's result is in line with the previous studies' findings that Republicans are more vaccine hesitant (Jones and McDermott, 2022; Sylvester *et al.*, 2022). A higher percentage of Democrats (than Republicans) would receive the FDA-approved flu vaccine under all three conditions. For example, 59.28% of Democrats would receive the flu vaccine developed by the USA alone, but only 38.1% of Republicans would receive the same vaccine.

Table 2 also compares respondents' vaccination willingness across different conditions within each party, revealing a notable pattern of partisan responses. Among Democrats, *Z*-scores from difference-in-proportions tests comparing treatment groups (US–China collaboration and US–Japan collaboration) to the control group (USA alone) do not attain conventional levels of statistical significance. It shows that Democrats do not make a significant preferential distinction between US–China collaboration and USA alone or a distinction between US–Japan collaboration and USA alone.

However, Republicans' responses show a different pattern in Table 2. Among Republicans, 45% of them would get the vaccine from the US–Japan collaboration, and 38% of them would receive the vaccine from the USA alone, but only 27% of them would receive the vaccine from the US–China collaboration. While a higher percentage of Republicans are willing to receive the vaccine from the US–Japan collaboration than the vaccine from the USA alone, the *Z*-score is not statistically significant ($P = 0.250$). When it comes to the vaccine from the US–China collaboration, the percentage of Republicans willing to receive the vaccine from the US–China collaboration is significantly lower than the percentage of willingness to receive the vaccine developed by the USA alone (*Z*-score = −1.98, $P = 0.048$). The different patterns of partisan responses suggest that there exists heterogeneity in the effect of the indication of US–China collaboration across partisanship and support the partisan hypothesis (H3).

The multinomial regression analyses presented in Table 3 also show consistent results. The baseline comparison group is 'No' category for all models. The coefficient for US–China collaboration in model 1 'Yes' category is negative and statistically significant ($P = 0.02$). The −0.385 coefficient of

Table 2. Respondents' vaccination willingness by condition and partisanship

Category	Group	Would you get the vaccine this year? (0 = Otherwise, 1 = Yes)			
		% Yes	Pred. Prob.	*N*	*Z*-score
Democrats	Control (USA alone)	59.28	0.57 [0.50, 0.63]	131	
	US–China collaboration	54.21	0.55 [0.48, 0.62]	116	−1.07
	US–Japan collaboration	64.25	0.65 [0.59, 0.71]	142	1.08
Republicans	Control (USA alone)	38.10	0.40 [0.32, 0.48]	56	
	US–China collaboration	27.50	0.28 [0.21, 0.35]	44	−1.98*
	US–Japan collaboration	44.67	0.43 [0.36, 0.51]	67	1.15

Note: % Yes refers to the raw percentage getting the vaccine this year; predicted probabilities are based on a logistic regression model (model 2 of Table 3-3 in the Supplementary materials) and the 95% confidence intervals are enclosed within square brackets; *Z*-scores are from difference-in-proportions tests comparing treatments to control for each party.
*$P < 0.05$.

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Table 3. Multinomial logistic regression on vaccination willingness

	Model 1		Model 2	
	Yes	Don't Know	Yes	Don't Know
US–China Collaboration (UCC)	−0.385*	−0.121	−0.024	0.110
	(0.171)	(0.184)	(0.257)	(0.294)
US–Japan Collaboration (UJC)	0.347*	0.156	0.417	0.082
	(0.174)	(0.194)	(0.264)	(0.312)
Republican	−1.321***	−0.678***	−1.009***	−0.547
	(0.167)	(0.179)	(0.277)	(0.309)
UCC × Republican			−0.627	−0.356
			(0.381)	(0.417)
UJC × Republican			−0.210	0.025
			(0.385)	(0.441)
Age	0.010*	0.010*	0.007	0.013*
	(0.005)	(0.005)	(0.005)	(0.006)
Female	−0.361*	0.005	−0.357*	0.035
	(0.160)	(0.175)	(0.174)	(0.193)
Education	0.195***	−0.034	0.183***	−0.018
	(0.043)	(0.047)	(0.046)	(0.052)
Income	0.030	0.024	0.036	0.028
	(0.019)	(0.022)	(0.020)	(0.024)
Race: Black	−0.358	−0.024	−0.329	0.005
	(0.233)	(0.249)	(0.252)	(0.276)
Race: other	0.227	0.370	0.249	0.434
	(0.195)	(0.210)	(0.226)	(0.247)
Independent	−1.278***	−0.658**		
	(0.208)	(0.227)		
Other party	−1.329**	−0.235		
	(0.455)	(0.445)		
Political knowledge	0.527*	−0.345	0.410	−0.411
	(0.243)	(0.277)	(0.261)	(0.307)
Constant	−0.611	−0.194	−0.562	−0.480
	(0.367)	(0.395)	(0.420)	(0.467)
Observations	1,334		1,113	

The omitted category in the multinomial logit models is 'No'; robust standard errors in parentheses.
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

US–China collaboration under model 1 ('Yes' category) suggests that when vaccine origin increases by one unit (i.e. from 0 [USA alone] to 1 [US–China collaboration]), the expected change in the log-odds of getting vaccinated decreases by 0.385 than not getting vaccinated holding all other variables in the model constant. Thus, model 1 indicates that respondents are less willing to receive the FDA-approved flu vaccine from the US–China collaboration compared to the vaccine developed by the USA alone.

One unexpected result is the rejection of the vaccine nationalism hypothesis (H1). The H1 expected the respondents to prefer domestically developed (USA alone) vaccines over vaccines developed through both US–China and US–Japan collaboration. While the respondents evidently prefer USA alone vaccines over US–China collaborative vaccines, the distinction between USA alone vaccines and US–Japan collaborative vaccines is less clear. The results in Table 3, model 1 'Yes' category shows that the log-odds of getting vaccinated increases by 0.347 when a vaccine comes from US–Japan collaboration compared to USA alone. This increase is statistically significant at *P*-value <0.05. However, this positive relationship is not robust across different measurements of vaccination willingness (see the Supplementary materials). In fact, the result of the difference-in-proportions test in Table 1 showed that there is no statistically significant distinction between US–Japan collaboration and USA alone. Nonetheless, these results at least suggest that respondents prefer a vaccine developed from Japan–US collaboration as much as a vaccine developed by the USA alone.

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For the vaccine nationalism hypothesis (H1) to be supported, there must be a statistically significant preference for USA alone over US–Japan collaboration. Yet, this is not the case. The results from Tables 1–3 consistently suggest that there is no statistically significant distinction in vaccination willingness between USA alone and US–Japan collaboration. Accordingly, the results do not support H1. The greater support for US–Japan collaboration suggests that international vaccine collaboration is acceptable. More discussion follows in the subsequent section.

In order to further examine a heterogeneity in the effect of indicating US–China collaboration across partisanship, model 2 'Yes' category in Table 3 introduces the interaction between experimental conditions and partisanship. The interaction coefficients in model 2 'Yes' category are not statistically significant, but the lack of statistical significance in interaction coefficients does not necessarily mean that there is no interaction effect. To better interpret the interaction effect, Figure 1 plots the change in respondents' vaccination willingness by experimental condition and by the party.

Figure 1 shows that the indication of US–China collaboration reduces Republicans' willingness to get the vaccine, but US–China collaboration does not make Democrats' willingness to receive the vaccine significantly lower. With the USA alone as a reference category, an indication of a collaboration with China suppresses the vaccination willingness among both Republicans and Democrats, but the effect is statistically significant only among Republicans. An indication of a collaboration with Japan lifts the vaccination willingness for both partisans, but the effect is not statistically significant among either party supporters. In short, there exists heterogeneity in the effect of indicating US–China collaboration across partisanship.

The results of the analysis are robust across different operationalizations of vaccination willingness. The results of robustness check are available in the Supplementary materials. The results are

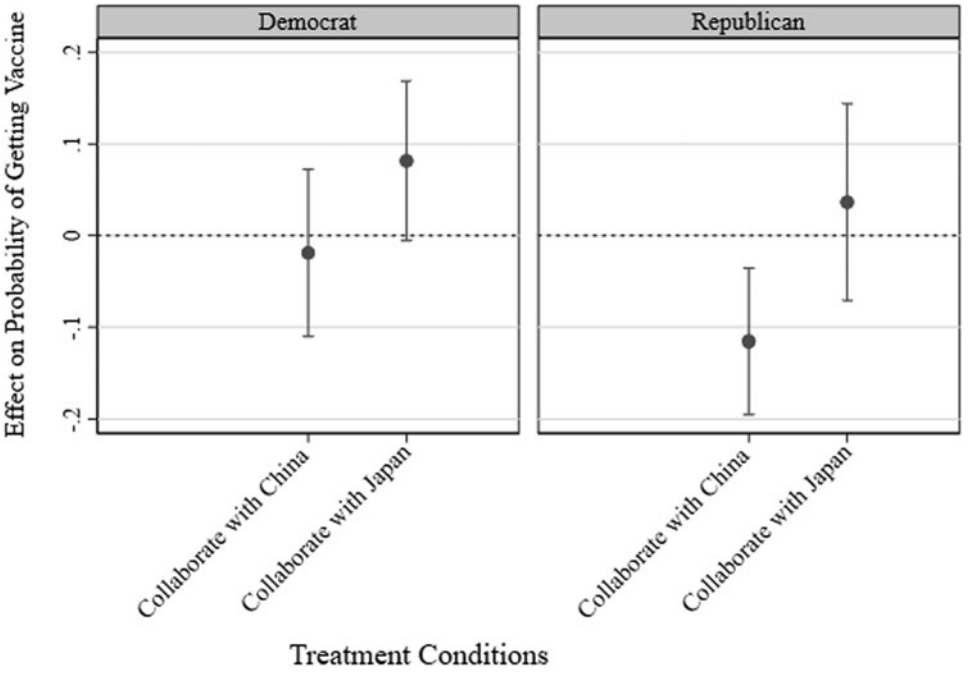

Figure 1. Effect on probability of getting vaccine.
Notes: This figure shows the change in predicted probability of getting vaccine by experimental treatments and partisanship with 95% confidence intervals. The value 0 is the control condition. Positive values indicate an increase and negative values indicate a decrease in probability. The figure is from model 2 ('Yes' category) in Table 3.

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consistent (1) when 'Don't know' is dropped, (2) when vaccination willingness is measured as an ordinal variable, and (3) when vaccination willingness is coded as a binary variable where 1 = Yes and 0 = Otherwise.

The models in Table 3 control for age, gender, race, education, income, and political knowledge. Respondents' age, race, and income do not consistently predict their vaccination willingness. Women seem less inclined to receive the flu vaccine. Those with a higher level of education and more political knowledge are more willing to accept the vaccine. Additionally, partisanship in model 1 ('Yes' category) is a categorical variable where 0 is coded as Democrat, 1 as Independent, 2 as Republican, and 3 as other party. The results in model 1 ('Yes' category) suggest that Democrats are more willing to receive the FDA-approved vaccine than non-Democrats. Models 1 and 2 'Don't Know' category suggest that respondents are not less or more likely to choose 'Don't Know' when they were exposed to the FDA-approved flu vaccines from the US–China Collaboration and US–Japan Collaboration.

7. Discussion and conclusion

This study finds that respondents are less willing to get a flu vaccine from the FDA-approved US–China collaboration than a US–Japan and USA alone. The irony is that the USA and China have collaborated for over two decades and have contributed to the annual flu shots among Americans. Indeed, most respondents acknowledged that they have received a flu vaccine in the past and these most likely were the result of US–China collaboration. However, the political landscape has changed in recent years and preconceived notions of China as well as Japan have an influence on perceptions of medical science. In addition, there are strong partisan differences in the degree of willingness. Republican respondents are less willing to receive an FDA-approved flu vaccine developed through US–China collaboration than Democrats. This partisan divide stems from politicized views of China along the partisan line.

The findings also suggest that international vaccine collaboration itself is accepted by the public, and the opposition stems from collaborations with certain countries such as China. Respondents are less willing to get a flu vaccine from US–China collaboration than US–Japan collaboration and USA alone. On the contrary, there is no obvious preference between US–Japan collaborative vaccines and USA alone vaccines. This indicates that the views of medical collaboration do not stem from vaccine nationalism, xenophobia, or general opposition against international collaboration alone. Rather, American citizens are wary of a collaboration with a certain country. Thus, the views of medical collaboration largely stem from images of collaborative countries (see also Aydin *et al.*, 2021; Kobayashi *et al.*, 2022).

For instance, public opinion survey data show that negative attitudes towards China have been deepening among American citizens. After remaining below 50% for much of the 2000s, unfavourable views towards China rose steadily since 2012, accelerating during the Trump administration to 60% unfavourable in 2018 with the launch of the US–China Trade War and attaining 79% unfavourable in 2020 after President Trump repeatedly blamed the COVID-19 on China (Silver, 2022). There is a heterogeneity in the views based on partisanship. According to a 2021 survey, 73% of Republicans support restricting US–China collaboration in scientific research, while 59% of Democrats oppose such restrictions (Kafura and Smeltz, 2021).

On the contrary, Americans have a positive view of Japanese, and the result of US–Japan collaboration more favoured than US–China collaboration follow the preconceived positive notion of Japan observed in the broader public opinion survey results. Favourable views towards Japan were 62% in 1998 and remained above 60% during the 2000s. In fact, it has increased since then, with 74% favourable in 2015. In 2019, 71% of Americans stated that the USA should cooperate more with Japan.[7] According to a 2015 Pew poll, 94% of American respondents believe Japanese are

[7]Pew Global Attitudes Project survey data, accessible at https://www.pewresearch.org/question-search/.

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hardworking, 75% said they are inventive, and 71% said the Japanese are honest.[8] Nam (2019) finds that Americans' trust in Japan is associated with their image of Japanese as honest, inventive, and hardworking.

There is also a market-driven trust based on perceived high quality of Japanese products. Economic factors play roles in building public perception of a country. In the 1980s and early 1990s, anti-Japanese sentiment was high due to the influx of Japanese imports from electronics to cars. According to Gallup polls, American attitudes towards Japan hit a low in 1994 and 1995 with only 46% respondents with a favourable view.[9] Attitudes towards Japan and Japanese products changed by the late 1990s and continue today due to the acknowledgement of affordable high-quality products. There are many stand out Japanese brands such as Honda and Toyota as well as Sony, Nintendo, and Toshiba. Although many products are made or assembled in China, there are few stand out brands and those that get attention are usually under a negative light such as Huawei. Americans are not only aware of quality Japanese products, but the USA is one of the top Japan's consumers. For example, in 2017, Japanese automakers constitute 40% of the American auto market.[10] The views of US–Japan collaboration, especially in the field of medical products such as vaccines, may be associated with American perception of Japan's high-tech and quality product reputation. It may also be motivated by the US–Japan security relationship to balance against China.

Yet, the irony is that US–China collaboration is critical to both developments of vaccines in the USA and around the world. As the COVID-19 pandemic demonstrates, public health is a global issue that transcends state borders. In fact, even greater international collaboration is needed in public health issues including vaccine developments. This is also applicable to US–China collaboration. A greater US–China collaboration is critical and beneficial to global public health regardless of the partisan divisions. However, curbing US–China collaboration efforts with vaccines for political reasons will only hurt the American public.

This study sheds light on the political nature of vaccine hesitancy in the USA. This may be contrasted to non-political sources of vaccine hesitancy in some other countries. For instance, vaccine hesitancy is largely based on practical considerations in China (Yang *et al.*, 2020). It attributes to vaccine safety concerns that stem from past vaccine-related scandals such as the violation of manufacturing standards by Changchun Changsheng Biotechnology Company in 2018 (Du *et al.*, 2020; Yang *et al.*, 2020). Future studies can further investigate the differences between political vs practical sources of vaccine hesitancy in China as well as across different country contexts or different societal groups.

The current study has three limitations. First, future studies need to further investigate other factors that underpin individuals' attitudes towards international collaboration in the medical field, including vaccine development. The factors to be further investigated include trust in government institutions and trust in the incumbent government. Second, this study is also a single-year study, and more surveys should be conducted across various time points under different incumbent governments and partisan discourses. Finally, future studies should also consider if certain modes of international collaboration and different degrees of the collaboration's publicity impact vaccine attitudes.

Finally, there are several policy implications for curtailing vaccine hesitancy in the USA. First, since there is a clear partisan effect in vaccine hesitancy, more attention needs to be paid to political roots of vaccine hesitancy including roles of politicians, political parties, and their rhetoric about vaccines. The efforts to curtail vaccine hesitancy need to consider political factors. Second, this study also sheds light on international politics and politicized views of international relations. This includes preconceived notions of other nations rather than international vs domestic perceptions. While global public health requires an even greater international collaboration, a conflation of international politics and global

[8]See https://www.pewresearch.org/global/2015/04/07/americans-japanese-mutual-respect-70-years-after-the-end-of-wwii/. In addition, the survey shows the Japanese views of Americans are not alike. For example, in the same survey, only 25% of Japanese believe Americans are hardworking and only 37% think they are honest.

[9]See https://news.gallup.com/poll/228728/americans-views-china-japan-trends.aspx.

[10]See https://asia.nikkei.com/Business/Japan-automakers-reach-for-40-American-market-share.

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health may hinder people's health around the world. State and international actors need to show a greater commitment to and raise awareness about importance and benefits of international collaboration in the fields of public health.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1468109924000021. The link to the replication data is: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/BYAFJR

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