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Crowdsourcing Interventions to Promote Uptake of COVID-19 Booster Vaccines

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Competing Interest Statement

RB, CB: Members of the Technical Advisory Group on Behavioral and Cultural Insights, World Health Organization Regional Office for Europe, Copenhagen, Denmark; PS, MS: Independent consultants to the Behavioral and Cultural Insights Unit, World Health Organization Regional Office for Europe, Copenhagen, Denmark; GL: Consultant to Florida Blue and Highmark Health. Academic advisory board, Level2 (a subsidiary of United Healthcare)

Abstract

We apply a novel crowdsourcing approach to provide rapid insights on the most promising interventions to promote uptake of COVID-19 booster vaccines. In the first phase, international experts proposed 46 unique interventions. To reduce noise and potential bias, in the second phase, experts and representative general population samples from the UK and the US rated the proposed interventions on several criteria, including expected effectiveness and acceptability. Sanctions were evaluated as potentially most effective but least accepted. Interventions that received the most positive evaluations regarding both effectiveness and acceptability across evaluation groups were a day off after getting vaccinated, financial incentives, tax benefits, benefit campaigns, and mobile vaccination teams. The results provide useful insights to help governments, companies, and non-governmental institutions in their decision about which interventions to implement.

JEL codes: I12, D91

Keywords: Booster vaccination, COVID-19, interventions

1. Introduction

Achieving high coverage for COVID-19 vaccination globally is the most important action to reduce hospitalizations, death, and eventually to end the pandemic. Immunity begins to wane only a few months after primary vaccination (Levin et al. 2021) and booster vaccination (i.e., additional vaccine doses after primary vaccination) is becoming routine to increase the effectiveness of the vaccines against infection and particularly severe disease (Barda et al. 2021, Patalon et al. 2021). Amidst the rapid global spread of the Omicron variant, many countries are rolling out COVID-19 booster vaccines to the general adult population, and some have announced plans or do already offer a second booster dose (e.g., Israel, Chile, England). Despite being recommended in many countries, as of March 22, 2022, only 68% of the fully vaccinated (without booster) have received a booster vaccination in the European Union, and rates are even lower in Australia (60%), North America (36%), South America (44%), Asia (33%) and Africa (8%) (Mathieu et al. 2021). While this discrepancy is in part due to insufficient supply of and access to COVID-19 vaccines, some previously vaccinated people are unwilling or hesitant to get the booster vaccination, even in countries with initially high COVID-19 vaccine uptake (Jørgensen et al. 2022, Paul and Fancourt 2022). To increase uptake of booster vaccines, most countries inform people about the benefits of boosters, and some countries also employ nudge interventions like sending personal reminders (e.g., Denmark, UK), offering incentives (e.g., Lithuania, many US states), imposing various restrictions on those who have not been boosted (e.g., Germany, France), or even imposing mandates with financial sanctions (e.g., Austria, Malaysia, Greece).

It is not only governments but also companies and other institutions which are considering and implementing ways to increase uptake of COVID-19 booster vaccines. For instance, Apple and Meta, Facebook's parent company, as well as an increasing number of universities require their employees or students to get a booster vaccine. Other institutions and companies are considering or have adopted weaker approaches, paralleling those used by most governments, such as providing incentives, educating their workforce, or increasing convenience by booking booster appointments or offering booster vaccinations on the company premises.

This heterogeneity in implemented interventions may in part be rooted in different epidemiological situations, healthcare systems, and vaccination programs. It may, however, also be due to the lack of evidence about which kind of interventions effectively increase COVID-19 booster uptake and reliance on advisors who are few in number and insufficiently versed in the behavioral science of behavior change. At present, both governments and companies, as well as other non-governmental institutions, are limited in their ability to make evidence-based decisions about which interventions are most effective for increasing uptake of the COVID-19 booster vaccine. Although it is too early to know the relative efficacity of the interventions that are presently being implemented by organizations, in general, organizational-level interventions targeted at improving employee health outcomes often fail or have only modest effects (for a review, see Nielsen et al. 2010). Not adopting any such interventions because of a lack of evidence or choosing interventions which are ineffective or unpopular have negative consequences for companies who

face a surge of sick or quarantined employees. It is estimated that companies just in the US are losing close to $1 billion per week due to costs related to employees out sick with COVID-19 (Integrated Benefits Institute, 2021). Encouraging booster uptake among the in-person labor force is especially important given the high rates of presenteeism—attending work while ill—documented in countries across the world and estimates that the costs of presenteeism exceed the costs of absenteeism (for a review, see Lohaus and Habermann 2019).

The aim of the present research is to provide rapid insights into which interventions would be most effective and acceptable (among other criteria) to increase uptake of COVID-19 boosters. A substantial evidence base is available to guide decisions about increasing vaccine uptake in general (for a review, see Brewer et al. 2018), however, relevant data on the effectiveness of interventions in the novel situation of promoting COVID-19 booster vaccination will be delayed and cannot be used when it is needed—now. In practice, governments, companies, and other institutions often consult only a small number of experts or consultants (if any), thus creating a risk of undue reliance on individual opinions when imposing nationwide or companywide interventions to increase booster uptake rates. In this study, we circumvent these challenges with a novel crowdsourcing approach using hundreds of international experts to generate and evaluate a broad range of ideas for potentially effective interventions. But effectiveness is not the only criterion for implementation; interventions also need to be accepted by the general population or the employees (Diepeveen et al. 2013, Wolf 1978), and evidence about the acceptability of different interventions to promote COVID-19 booster uptake is also often lacking. Instead of asking whether experts and people from the general population may have different expertise in judging relevant criteria, we rather assess how much both groups agree on evaluating potential interventions and whether there are some interventions that both of them regard as effective and acceptable. We therefore aimed to reduce both noise and potential bias by relying on independent evaluations from experts as well as the general population, without enforcing agreement within or between evaluation groups. The successful implementation of interventions depends on various factors, and even expert opinions may not necessarily be accurate when making single point estimates about an intervention's overall effectiveness (Milkman et al. 2021, 2022).

In a two-phase study, we first crowdsourced ideas for effective interventions to promote COVID-19 booster uptake from experts in various relevant fields, including medical practitioners and behavioral scientists. We then recruited samples from two distinct populations (experts and the general population) to evaluate each unique intervention on a number of criteria, allowing us to assess and report variation in various evaluation criteria such as effectiveness and acceptability. This approach provides a holistic perspective on which interventions may pose the largest tradeoffs between effectiveness and acceptability, as evaluated by both those who are in the position to recommend which interventions to adopt (experts) and those who will be affected by those interventions (the general population). It also allows us to investigate the misalignment of evaluations from experts and the general population with respect to the criteria that may be relevant in deciding which intervention to implement. We find that some interventions pose very large tradeoffs: interventions relying on sanctions were perceived to be most effective but least

acceptable, while interventions relying on facilitating vaccinations through environmental restructuring (e.g., making vaccinations sites easier to access) were predicted to be widely acceptable but ineffective. Moreover, we found evidence of misaligned views between the two populations. For example, despite their evaluation as highly effective by experts, sanctions were not predicted to be persuasive by respondents who have not yet received a booster.

Taken together, our results provide important and timely evidence on which organizations can base their decisions about which interventions to adopt. For example, while there is evidence that companies can significantly improve their employees' health outcome (i.e., encouraging smoking cessation) by offering large financial incentives (Volpp et al. 2009), our results will allow organizations to weigh the benefits of costly incentives against many other intervention options, as evaluated by both experts and a population representative of their employees. In addition to evaluating and comparing broad intervention categories, such as sanctions and incentives, we also provide detailed information on the 46 specific interventions proposed by the experts. By ranking them on various other criteria evaluated by experts, such as affordability, universality, and the probability of non-pharmaceutical side effects, our results provide a unique resource to help organizations to make individualized decisions about which interventions may work best in their countries and for their citizens, members, or employees.

2. Method

This study is composed of two phases, each with interrelated surveys among different samples. Figure 1 provides an overview of the overall study flow.

Ethics and Open Practices

This study received ethical clearance from the Institutional Review Board of the Department of Occupational, Economic, and Social Psychology at the Faculty of Psychology, University of Vienna, Austria (project number: 2021/W/001). All participants provided informed consent. The study was pre-registered via the Open Science Framework (https://osf.io/94ugm; original pre-registration: 2021-12-08, amendment: 2022-01-11). Anonymized data and analyses scripts as well as survey materials are also available via the Open Science Framework (https://osf.io/ab54u/).

Phase-one Survey

Sample

In December 2021—when booster vaccines were announced or made available in many countries—experts from various disciplines were invited to propose interventions that could potentially increase uptake rates of COVID-19 booster vaccines. Participants were recruited via the following email lists: Behavioral Insights Community of Practice by the World Health Organization/Regional Office for Europe, Collaboration on Social Science and Immunization (COSSI), Economic Science Association (ESA), German Association of Psychology (DGPs), and Society of Judgment and Decision Making (JDM). Invitations were sent in

calendar week 49, 2021, and and participants were asked to complete the survey within one week. Overall, *n* = 78 scientists and practitioners from the social and behavioral sciences, medical sciences, and epidemiology from 17 countries, with a mean of 17 years of professional expertise in their fields, participated in the survey (for further sample characteristics, see Table 1).

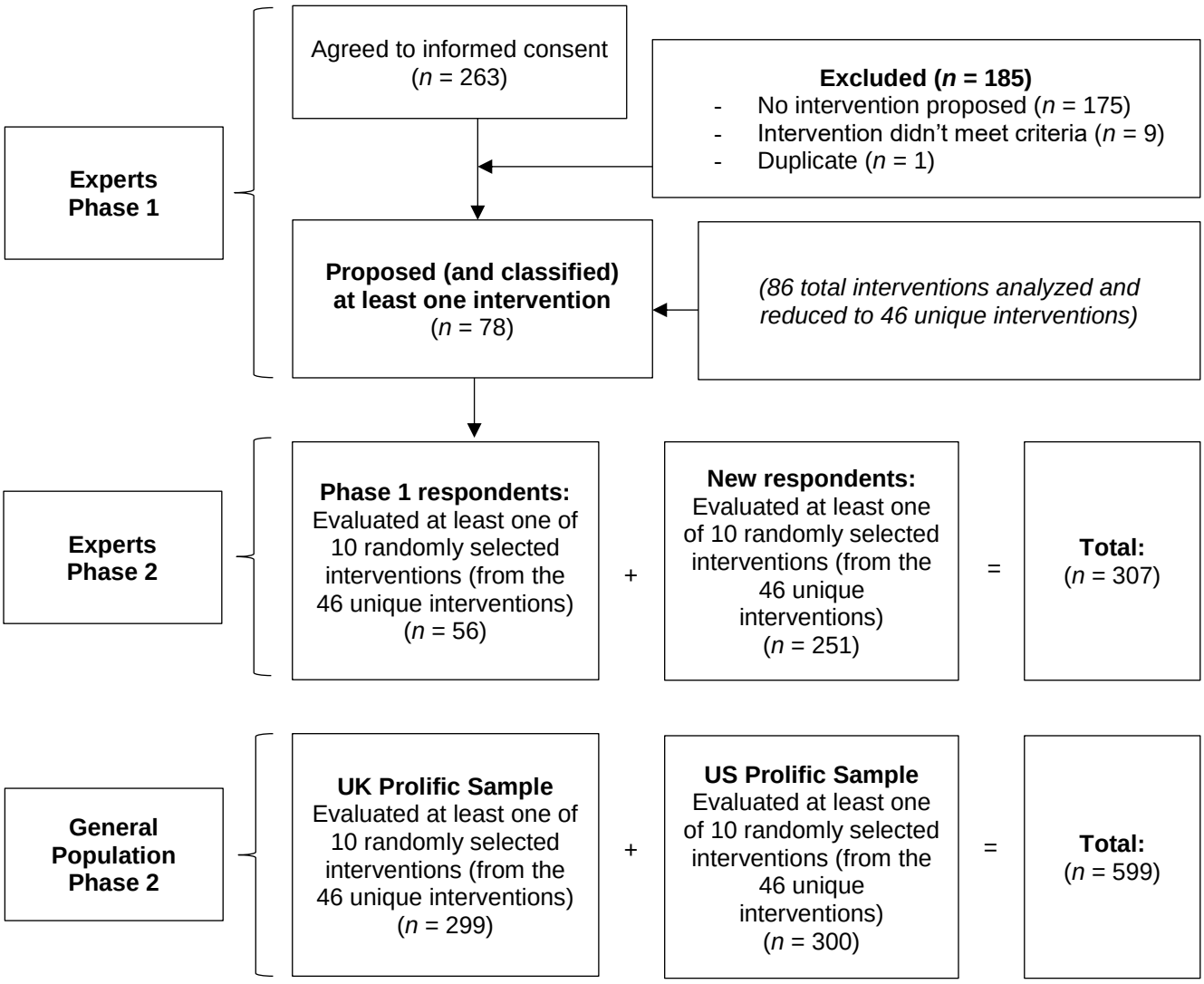

Figure 1. Flow chart of the different phases of the study, including sample types and sizes as well as tasks.

Table 1. Characteristics of Samples.

Variable	Experts (phase-one survey, *n* = 78)	Experts (phase-two survey, *n* = 307)	General population sample UK (phase-two survey, *n* = 299)	General population sample US (phase-two survey, *n* = 300)
Gender: % female	48.72%	38.11%	50.83%	51.00%
Age: mean (SD)	42.92 (12.38)	39.33 (11.2)	44.9 (15.53)	45.21 (16.17)
Disciplines: %				
Medicine or Health Care	6.41%	2.61%	NA	NA
Economics	29.49%	31.60%	NA	NA
Public Health	3.85%	3.58%	NA	NA
Psychology	46.15%	31.92%	NA	NA
Other	10.26%	12.05%	NA	NA
Experience in years: mean (SD)	17.12 (11.98)	13.66 (10.43)	NA	NA
Education: %				
Less than high school	NA	NA	0.33%	1.33%
High school or equivalent	NA	NA	26.76%	11.00%
Some college	NA	NA	37.79%	45.00%
Post-graduate education	NA	NA	35.12%	42.67%
Political attitude, mean (SD)	NA	NA	4.57 (1.49)	4.89 (1.73)
Libertarian morality, mean (SD)	NA	NA	3.20 (0.51)	3.08 (0.53)

Notes. **Gender**: female, male, non-binary, prefer not to say. **Age**: numeric response in years (18-99). **Discipline**: Listed options. **Experience in years:** Number of years working in the field (after first university diploma/degree). **Education:** Listed options. **Political Attitude:** Likert scale response: (1) Very conservative, (2) Moderately conservative, (3) Slightly conservative, (4) Neither liberal nor conservative, (5) Slightly liberal, (5) Moderately liberal, (6) Very liberal. **Libertarian Morality:** Likert Scale from (1) Strongly disagree to (5) Strongly agree used to evaluate 3 statements: (1) Society works best when it lets individuals take responsibility for their own lives without telling them what to do. (2) The government interferes far too much in our everyday lives. (3) The government should do more to advance the common good, even if that means limiting the freedom and choices of individuals. **NA:** variable was not assessed for this sample. Percentages of disciplinary affiliation do not add up to 100% because of missing values.

Procedure and Measures

Experts proposed interventions that could be implemented by governments, health organizations, companies, or other agencies, and described them in sufficient detail such that it could inform actual interventions in practice. In detail, participants were asked to propose interventions using the following instructions:

"*Please propose one intervention that can be implemented by governments, agencies, or health organizations and that is, in your view, most effective and feasible to increase uptake of COVID-19 booster vaccines in the country where you work. In this case, we define 'intervention' as a planned and focused activity aiming at increasing booster vaccine uptake, specifically: The intervention aims to increase uptake of boosters for adults. Therefore, the intervention should focus on adults (age 18+) for whom a booster is recommended in the country where you work. Please describe the intervention with key implementation information: What would the intervention look like in reality? Imagine you or your organization would be the implementers of this—provide the information necessary to make the intervention work. Examples of*

potential questions you might address include: What procedures does the intervention change compared to the status quo? How, when, and where is the intervention implemented? Who implements the intervention? What are further details that a person or organization implementing the intervention would need to know? Later in the survey, you will have the opportunity to classify and rate the likely effectiveness of the proposed intervention. Please describe only one intervention at a time. If you wish, you will be able to add more interventions later."

After participants had described their intervention proposals, they were asked to classify each intervention according to various criteria to better understand what intervention processes they aimed to address. Classification criteria were similar to those from the Behavior Change Wheel (Michie et al. 2011) (see Table 2, top panel, and Survey Materials on OSF). Next, participants were asked to evaluate the interventions they proposed on criteria adapted from the APEASE criteria by the Behavior Change Wheel (Michie et al. 2011) (Table 2, bottom panel). In contrast to the original criteria, we asked to evaluate acceptability of the intervention to both stakeholders and eligible adults. Further, we added two criteria of relevance to the present context: universality across different countries and effect on unvaccinated people. In case practicability was rated < 5 and non-pharmaceutical side effects were rated > 1, participants were asked to briefly describe potential barriers and unintended non-pharmaceutical effect, respectively (open text response). Finally, participants were also asked to provide some demographic information: gender, age, profession, discipline, country in which they work, years of experience after university degree. They were also able to leave comments, their name (to be acknowledged), and their email address to be contacted for the phase-two survey.

Selection and Classification of Intervention Proposals

Three independent raters from the author team read the proposed interventions and evaluated which proposals are sufficiently similar to be merged. Rater disagreement was solved by discussion. From the overall 86 intervention proposals we received, we identified 46 unique interventions. Descriptions were adjusted to be comparable in length and language style; we also provided a short title for each intervention. Next, two independent raters from the author team classified each unique intervention according to the evaluation criteria adapted from the Behavior Change Wheel (Michie et al. 2011). In contrast to the original classification criteria, we removed the category ‘Training’ because we saw little fit to the present context. All other criteria were adapted to the respective context, that is, interventions to promote uptake of COVID-19 booster vaccines (see Table S2, top panel). Each intervention was assigned to at least one category. Rater disagreement was solved by discussion. Table S1 in the Supplementary Material provides an overview of all unique interventions and their classification.

Table 2. Classification and Evaluation Criteria Assessed in the Surveys.

Classification criteria		
Criterion	Definition	
Education	Increasing understanding of the disease, the vaccine or how to get vaccinated	
Persuasion	Using communication to change what people think or feel	
Modeling	Providing an example for people to aspire to or imitate	
Psychological enablement	Increasing the likelihood of people turning positive intentions intro behavior (e.g., nudging)	
Environmental restructuring	Changing the physical context where vaccinations take place	
Incentivization	Providing positive reward for vaccination	
Restriction	Restrict the opportunity to engage in other desirable behaviors if unvaccinated	
Sanction	Creating expectation of punishment or financial cost if unvaccinated	
Evaluation criteria		
Criterion	Definition	Scale (1-5)
Affordability*	How costly (financially) do you think the intervention is for the implementing governments, agencies, or health organizations compared to other potential interventions?	'Very cheap' to 'Very costly'
Practicability*	Can the intervention be delivered as intended for eligible adults?	'Definitely not' to 'Definitely'
Effectiveness*‡	How much will the intervention increase uptake of COVID-19 booster vaccination in a real-world context?	'Not at all' to 'Very much'
Effectiveness for self‡	How much will the intervention increase your likelihood of getting the COVID-19 booster vaccination?	'Not at all' to 'Very much'
Acceptability to stakeholders*	How likely are the people who would implement the intervention (e.g., political decision makers, community leaders, health workers) to accept it (e.g., not protesting against it)?	'Very unlikely' to 'Very likely'
Acceptability to eligible adults*‡	How likely are adults eligible for COVID-19 vaccine boosters to accept this intervention (i.e., not protesting against it)?	'Very unlikely' to 'Very likely'
Non-pharmaceutical side effects*	Will there be any potential unintended outcomes of the intervention?	'Definitely not' to 'Definitely'

Inequities*	How will the intervention affect social and health inequalities in adult COVID-19 vaccine booster uptake?	'Definitely decrease inequalities' to 'Definitely increase inequalities'
Universality*	Please indicate whether you believe the proposed intervention is appropriate universally across different countries. With appropriateness we mean both feasibility and effectiveness.	'Specific to a certain country or region of the world' to 'Universally appropriate'
Effect on unvaccinated*	Although COVID-19 booster vaccines are for people already fully vaccinated, do you anticipate any effect of the proposed intervention on unvaccinated people?	'Definitely decrease their vaccine uptake' to 'Definitely increase their vaccine uptake'
Coerciveness‡	How coercive is this intervention?	'Not at all' to 'Very much'
Reactance‡	To what extent do you perceive the intervention as a restriction of your freedom? Would you be frustrated about the intervention? How much would the intervention annoy you? To what extent would you be offended/disturbed by the intervention?	'Not at all' to 'Very much'
Activism‡	How likely would you be to sign a petition against the intervention? How likely would you be to take part in a demonstration against the intervention? How likely would you be to join a lawsuit against the intervention? How likely would you be to encourage others to join in efforts against the intervention?	Very unlikely' to 'Very likely'

Note. * Evaluated by expert sample. ‡ Evaluated by general population samples. For all items, the midpoint (3) was pre-selected on the slider.

Phase-two Survey

Sample

In the second phase, we invited the same experts who participated in the phase-one survey and additional experts via the same mailing lists as used for disseminating the phase-one survey. Invitations were sent in calendar week 2, 2022, and participants were asked to complete the survey within one week. Overall, we received responses from *n* = 307 experts from 34 countries, with a mean of 14 years of professional expertise in their fields (for further sample characteristics, see Table 1). Among all participants, we distributed 20 $100 prizes to be given to randomly chosen participants who completed the survey (either for personal payment or donation to a charity of their choice).

Additionally, we recruited two other samples of respondents from the general population, i.e., people for whom booster vaccination had been recommended. Participants were recruited via Prolific Academic (https://www.prolific.co/). We used Prolific's build-in feature to invite samples from the UK and US general adult population, quota-representative for age, gender, and ethnicity. We recruited n = 299 participants from the UK (there was one respondent less than requested due to some technical problems) and n = 300 participants from the US (for sample characteristics, see Table 1). Each participant received remuneration of £1.50 for completion of the study.

Procedure and Measures

Each respondent evaluated a random subset of 10 interventions, leading to, on average, 57 expert ratings and 130 ratings by people from the general population per intervention. Experts were asked to evaluate the intervention proposals on 12 criteria adapted and extended from the Behavior Change Wheel's APEASE criteria (Michie et al. 2011). Respondents from the general population were asked to evaluate the intervention proposals on a subset of these criteria. Additionally, they were asked to answer additional questions regarding the perceived coerciveness, psychological reactance (four items adapted from the Salzburger State Reactance Scale (Sittenthaler et al. 2015; Cronbach's α = .95), intentions to actively engage against the intervention if it would be implemented (four items adapted from Sprengholz et al. 2021; Cronbach's α = .93), libertarian morality (three items adapted from Iyer et al. 2012; Cronbach's α = .75), and political attitude (one item). All measures and their respective items are summarized in Table 2, bottom panel. Finally, participants were also asked to provide some demographic information: gender, age, education (only general population), profession (only experts), discipline (only experts), country in which they work (only experts), years of experience after university degree (only experts).

3. Results

We first present evaluations by intervention classes, followed by a more detailed presentation of single interventions.

Evaluation of Intervention Classes

The most prevalent intervention classes among all proposed interventions in the first phase were education (50% of all interventions), persuasion (33%), modeling (30%), and psychological enablement (30%) (for a complete list, see Supplementary Material). We used mixed effects regressions to predict evaluations by intervention classes separately for each evaluation criterion. According to experts' evaluation, no intervention class was best on all evaluation criteria (Figure 2; for descriptive statistics and regression analyses with and without demographic controls; see Tables S2-S16 in the Supplementary Material for details). Perceived effectiveness was most positively predicted for interventions relying on sanctions (i.e., creating expectation of punishment of financial cost if unvaccinated; unstandardized regression coefficient: 95% CI [0.79, 1.14]). Regarding acceptability to both stakeholders (e.g., political decision makers,

community leaders, health workers; 95% CI [-1.55, -1.20]) and to the general population (95% CI [-1.77, -1.43]), however, sanctions were evaluated most negatively, closely followed by restrictions (stakeholders: 95% CI [-1.24, -0.81]; general population: 95% CI [-1.30, -0.88]). This is also captured by experts' expectations that interventions relying on sanctions, restrictions (i.e., restricting the opportunity to engage in other desirable behaviors if unvaccinated), or incentives (i.e., providing positive reward for vaccination) might cause non-pharmaceutical side effects (sanctions: 95% CI [1.20, 1.54]; restrictions: 95% CI [0.74, 1.16]; incentives: 95% CI [0.43, 0.66]) and increase health inequalities (sanctions: 95% CI [0.27, 0.56]; restrictions: 95% CI [0.57, 0.92]; incentives: 95% CI [0.02, 0.22]). Only interventions relying on environmental restructuring (i.e., changing the physical context where vaccinations take place) were expected to increase the acceptability to the general population (95% CI [0.14, 0.40]) and decrease health inequalities (95% CI [-0.39, -0.18]), but were considered relatively ineffective by the experts (95% CI [0.27, 0.54]).

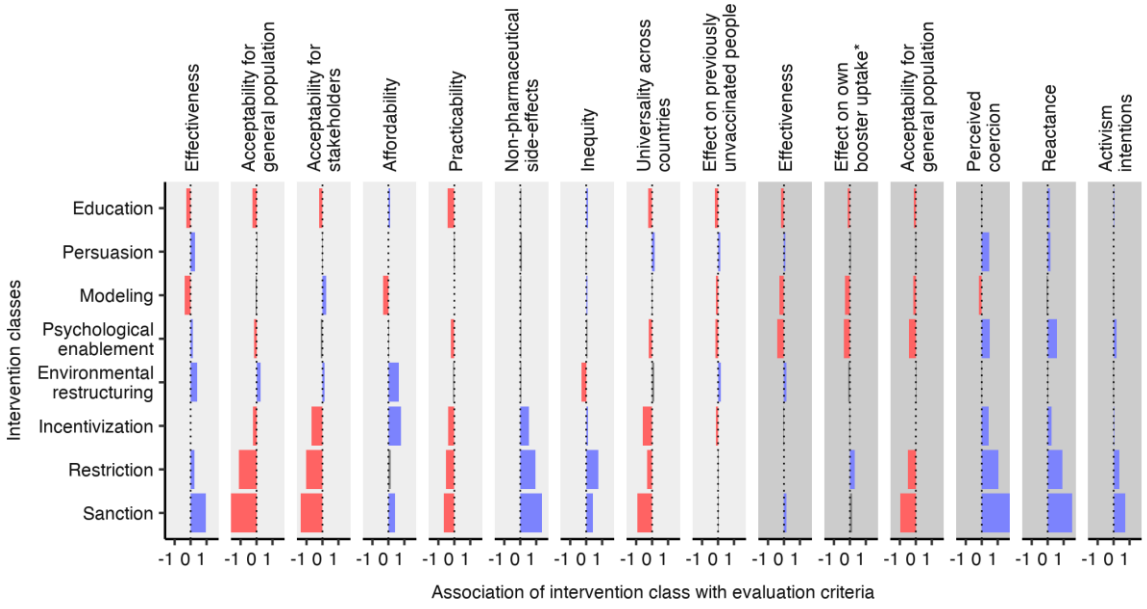

Figure 2. Evaluation of Intervention Classes. Colored bars represent unstandardized regression coefficients with a negative (red) or positive (blue) sign being different from zero ($p < .05$) by experts (n = 307; light gray) and respondents from the general population (n = 599; dark gray), respectively (see Tables S2-S16 in the Supplementary Material for details on the regression analyses). *Based on a subsample of participants who have not yet received a booster vaccine at the time of the study (n = 144).

These findings are largely mirrored by the evaluations provided by the respondents from the general population. Sanctioning interventions were evaluated, among all intervention classes, as the most likely to increase booster uptake in the general population (95% CI [0.05, 0.27]). However, among vaccinated respondents who have not yet received a booster (n = 144), only restrictions were expected to increase their own likelihood of getting a booster vaccination. Yet, sanctions (95% CI [-1.08, -0.86]) and

restrictions (95% CI [-0.65, -0.38]) were deemed as least acceptable. In turn, lower expected acceptability was associated with respondents anticipating larger psychological reactance (Pearson correlation: 95% CI [-.35, -.30]), more activism intentions against the intervention (95% CI [-.23, -.18]), and lower expected effectiveness of the intervention for own booster uptake (95% CI [.35, .44]) as well as lower expected booster uptake in the general population (95% CI [.46, .48]). Thus, lower acceptability of an intervention, such as in the case of restrictions and even more so in case of sanctions, was perceived as having potentially detrimental social effects that could undermine its effectiveness (Sprengholz et al. 2021).

Evaluation of Single Interventions

Figure 3 goes into greater detail and displays the single interventions with regard to both their expected effectiveness and acceptability, as judged by experts or respondents from the general population. While the experts expected that the introduction of vaccination mandates and different sanctions (e.g., restricted access to public spaces for people who have not received the booster vaccination) would be most effective in increasing COVID-19 booster uptake, respondents from the general population rated positive incentives such as a day off after getting vaccinated or financial incentives as most effective in increasing overall and own booster uptake. Importantly, mandatory vaccination received the lowest and the second-lowest acceptability rating by experts and respondents from the general population, respectively. Acceptability was evaluated highest by experts for a website to book appointments for booster vaccination (third place by respondents from the general population), whereas a day off after vaccination received the highest rating by respondents from the general population, both for themselves and the expected overall acceptability to the general population (third place by experts).

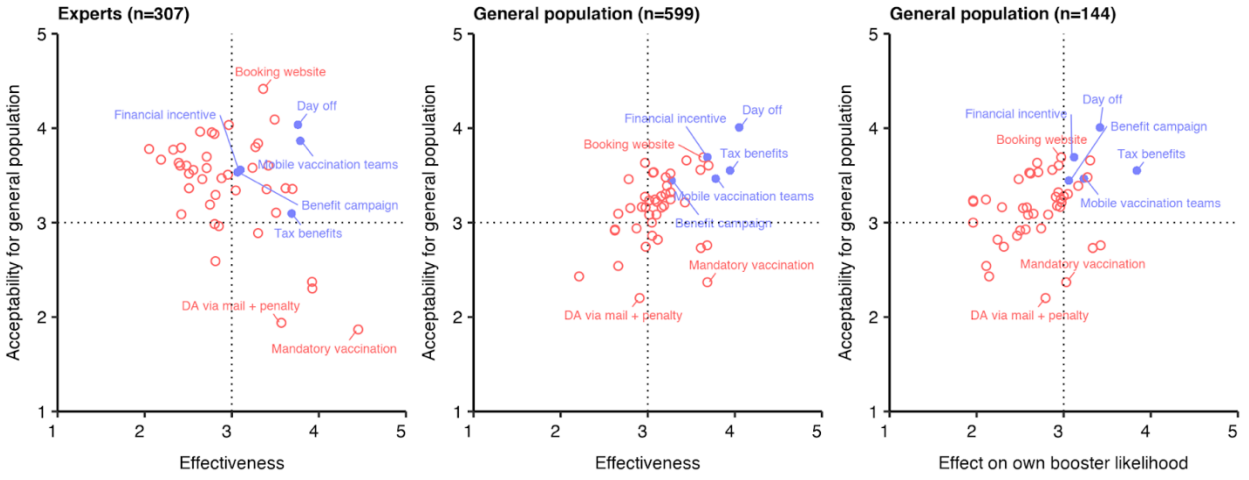

Figure 3. Relationship between Expected Effectiveness and Acceptability of Interventions as Rated by Experts and Respondents from the General Population. Blue circles indicate interventions with mean ratings above the midpoint of the scale (> 3, scale: 1-5) on both effectiveness and acceptability (upper right quadrant) for all samples. DA: Default appointment.

To quantify the level of (mis)alignment in evaluations by experts and respondents from the general population, we calculated the correlation between the mean ratings by evaluation group across all 46 interventions, separately for effectiveness and acceptability. Regarding the expected overall effectiveness of interventions, the correlation between evaluations from experts and people from the general population was medium to high (Pearson correlation: 95% CI [.29, .71]). When correlating experts' evaluations of expected overall effectiveness with the general population's own likelihood of getting the booster vaccine, however, this relationship was not statistically significant (95% CI [-.09, .47]). Experts and the general population also had high agreement regarding the interventions' acceptability (95% CI [.60, .85]). Several reasons might cause misaligned evaluations (Sunstein 2006) and cannot be disentangled here. Therefore, we took a pragmatic approach and identified those interventions that received mean ratings above the midpoint of the response scale (> 3 on a scale from 1-5; the upper right quadrants in Figure 3) across evaluation groups and evaluation criteria. Overall, 16 interventions had positive evaluations on both effectiveness and acceptability by experts, and 26 in evaluations by the general population (9 when referring to intentions of own booster uptake). Taken together, 5 out of all 46 interventions were rated positively by both experts and citizens regarding effectiveness and acceptability (Figure 3, blue dots). These interventions are: (1) a day off after getting vaccinated, (2) financial incentives (either lottery or fixed payment), (3) tax benefits (e.g., reduction of health insurance rate), (4) benefit campaigns (e.g., stressing who else can indirectly benefit from their own booster vaccination, such as vulnerable persons or healthcare personnel), and (5) mobile vaccination teams (e.g., allowing people to get vaccinated at their private and work places).

4. Discussion and Conclusion

In summary, using a novel crowd-science approach, we present insights on relevant decision criteria to implement interventions to increase uptake of COVID-19 booster vaccines in eligible adults from the general population. In times where evidence on the effectiveness of the interventions is lacking, intervention ideas and evaluations by a large number of experts and respondents from the general population may well provide the most useful insights to help governments in estimating social and financial costs and benefits of a broad range of interventions.

The results indicate that, in view of the diversity of criteria for evaluation, there is no single best intervention or intervention class to promote booster uptake, especially when expert and general population evaluations are both taken into account. In particular, some interventions that are deemed effective are deemed less acceptable (e.g., mandates) and may elicit counter behaviors such as activism. We also find that, not surprisingly, evaluations of experts and of people from the general population do not always align. Even without potentially error-prone speculations about whose perspective on what criteria might be more accurate, we can identify several interventions that are evaluated on average positively with regard to both anticipated effectiveness and acceptability by both experts and respondents from the general population.

Interestingly, three of these five interventions rely on incentives, i.e., providing some kind of positive reward for booster vaccination.

It should be emphasized that the interventions were proposed to promote COVID-19 booster vaccine uptake, not vaccine uptake of previously unvaccinated individuals (although we provide additional data on the potential effectiveness in the latter case, see Figure 2—all interventions had very small expected effects). Further, although the present investigation provides recommendations about which interventions are seen as most useful in the given context, governments and companies are advised to consider—in addition to the epidemiological situation, specificities of the healthcare system, and previous evidence of what is effective in increasing uptake—how the different criteria are weighed in their country (e.g., acceptability of certain interventions, risk of increased activism, exacerbation of inequity).

Many of the proposed interventions can be implemented by governments companies and non-governmental institutions. Indeed some interventions, like sending mobile vaccination teams to a workplace, may even be easier to implement in companies and smaller organizations with strong incentives on the company side to reduce the number of sick leaves due to COVID-19 infections. Having data not only on which interventions might be most effective, but also on which might be least likely to cause reactance among employees is also especially important for companies, who must weigh the benefits of a fully vaccinated workforce against the perils of introducing unpopular interventions that may lead to employee attrition.

The present collection of established and novel interventions, along with their evaluations by hundreds of experts and people from the general population, should therefore be seen as a relevant resource for any organization which seeks to evaluate interventions that can be used to increase COVID-19 booster uptake, now and in the future.

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SUPPLEMTARY MATERIAL:

Crowdsourcing Interventions to Promote Uptake of COVID-19 Booster Vaccines

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Contents

Table S1. Unique interventions proposed by experts.

#	Short name	Description	Classification							
			1	2	3	4	5	6	7	8
1	Vaccination festival	Widely advertised public social event with music, games, prizes, and vaccination stations. Vaccinated individuals will receive vouchers for games and other social activities (e.g., entry to a haunted house). Additional information stations with medical staff to distribute information and discuss COVID-19 booster vaccination.	x		x		x	x		
2	Free party/concert	Large social event with famous DJs/music bands, food trucks, etc. Access is granted (for free) to all people who got the booster vaccination. People could also get access when getting the booster vaccination at the entrance.			x		x	x	x	
3	Norm letter	Send weekly letters about the neighborhood's uptake rate of booster vaccination. Happy smiley if the letter recipient has already received the booster vaccination, sad smiley if s/he has not.			x	x		x		
4	Norms by time	Provide information about the share of people vaccinated in the same period (e.g., July 2020) who have already received the booster vaccination.			x	x				
5	Social media campaign	Sharing information about the benefits of booster vaccination on social media platforms (including collaboration features provided at some platforms, e.g. Instagram). Recruitment of influencers to join the campaign and spread the word.	x	x	x					

			1	2	3	4	5	6	7	8
6	Day off	People receive a paid day off after booster vaccination. This would be paid by the state.						x		
7	Restricted access	Access to public places (e.g., restaurants, airplanes, etc.) or work places will only be granted to boostered people. Vaccination status will be checked by responsible persons (e.g., owners of shops or restaurants) via official vaccination documents.							x	
8	Local role models	Recruit local role models (e.g., community leaders, local celebrities) to promote booster vaccination.		x	x					
9	Letter from doctors	Send letter from local general practitioner to inform about the value of booster vaccination.	x							
10	Mobile vaccination teams	Send mobile vaccination teams to allow people get their booster vaccination at private and work places (e.g., gym, shopping centers, company).					x			
11	Health professionals' calls	Health professionals call people who have not yet received a booster vaccination to let them know that an appointment has been scheduled for them. They provide further information and answer questions if requested. After the appointment has been scheduled, people will also receive a reminder text message 24 hours prior to the appointment.	x			x				
12	Targeted phone calls	Communities use citizen register to call persons over 60 by telephone and arrange a booster vaccination appointment if they are willing to have one.				x				

			1	2	3	4	5	6	7	8
13	Mandatory vaccination	Mandate booster vaccination with financial penalties, monitored and executed by the responsible health authority.								x
14	Booking website	Website that centralizes all available locations to get booster vaccinations and allows efficient booking of vaccination appointments (e.g., minimizing waiting and travel time for people).				x				
15	Motivational interviewing	General practitioners should ask every patient about their vaccination status. If they have not yet received the booster vaccine, they apply motivational interviewing, a patient-centered, directive approach to counseling with the goal of building intrinsic motivation to change behavior.	x	x		x				
16	DA via app	Signing up eligible people automatically for booster appointments. Appointments are shared by push notification and can be rescheduled (both time and location) via a central app. In case the recipient wants to decline the invitation, s/he will be offered to reschedule the appointment instead and receives additional information about individual and collective benefits of the booster vaccination.	x			x				
17	DA via mail	Signing up eligible people automatically for booster appointments. Appointments are shared via regular mail. Cancelation requires to explain the reasons and listen to explanation on safety/benefits of booster vaccination.	x			x				

			1	2	3	4	5	6	7	8
18	DA via mail + penalty	Signing up eligible people automatically for booster appointments. Appointments are shared via regular mail. Rescheduling or cancelation of appointment via phone. Failure to show up at appointment results in a small to medium-sized fine (e.g., 50€). Cancelation requires to explain the reasons and listen to explanation on safety/benefits of booster vaccination.	x			x				x
19	DA via mail + transportation	Signing up eligible people automatically for booster appointments. Appointments are shared via regular mail. Offer transportation to appointment to those without other transportation options. Cancelation requires to explain the reasons and listen to explanation on safety/benefits of booster vaccination.	x			x	x			
20	Vaccination stations	Easily accessible stations where people can get information about booster vaccination. In case there is already a network of testing stations, information and vaccines should be made available there too.	x				x			
21	Financial incentive	Boostered people enter a lottery for a large prize (e.g., 10.000 €) or will receive a certain but smaller prize (e.g., 5 €).						x		
22	Lottery + referral	Boostered people receive a lottery ticket for a large prize (e.g., monthly income reward for life). People receive additional lottery tickets if they recommend the booster to others, who then get vaccinated (referral), so lottery tickets increase the more others can be motivated to get vaccinated.		x				x		

			1	2	3	4	5	6	7	8
23	Decision aid + health promotion	Simplified summary of the evidence-based and legal consequences of (not) getting the booster vaccine. This includes the consequences for oneself and for others. For instance, when getting the booster vaccination (versus not getting it) you are X times less likely to develop symptoms and Y times less likely to be hospitalized if you get infected. It also includes a list of things that you will be (not) able to do with (without) the booster vaccination, such as attending a wedding party or visiting a restaurant (depending on the country's regulations). A summary of evidence includes a list of endorsers for the booster vaccination, from scientists, politicians, religious leaders, etc.	x	x	x					
24	Necessity campaign	Increase knowledge about the necessity of booster vaccination (e.g., benefits of vaccination, danger of COVID-19) via mass media, such as TV and magazine ads.	x	x						
25	Media legislation	Legislation that all media has to report responsibly and truthfully regarding the pandemic.	x							
26	Benefit campaign	Mass and social media campaign stressing who else (in addition to oneself) can be protected or helped by getting the booster vaccine, including personal stories of vulnerable persons (e.g., older persons, immunocomprised persons) or healthcare personnel (e.g., intensenive care nurses). Communication also via direct communication (e.g., doctors, trusted community leaders).	x	x	x					

			1	2	3	4	5	6	7	8
27	Personalized calculator	Public website that allows people to enter which vaccine/s they have received and when, whether they have had confirmed or suspected COVID-19 and their symptoms, their age, potential vaccine-adverse events experienced with earlier COVID-19 vaccinations, etc. The website would then provide personalized information about when to receive the booster vaccination and which vaccines are recommended.	x			x				
28	Reservation	Eligible persons are informed that a valuable vaccine dose worth X€ has been reserved for them and may be wasted if they do not claim it within a given period of time.		x		x				
29	Insurance sanction	Health insurance premium rises by X€ if booster vaccination cannot be proven within a certain time frame.								x
30	Reciprocity appeal	Mass media advertisement with young person who lost his/her grandparent during the pandemic and who is now getting the booster vaccination to protect the viewer's older loved ones, asking whether you will do the same. Includes a descriptive norm message on how many others (plan to) do the same.		x	x					
31	Free snacks	Give free snacks (e.g. burgers) after people get the booster vaccination.						x		
32	Information support for media	Website for media/journalists with up-to-date reliable information on benefits & risks of vaccination and disease (including new variants) in non-technical jargon. Information should be provided and regularly updated by scientific experts from universities.	x							

			1	2	3	4	5	6	7	8
33	Stories from suffering people	Share stories about people from the local community (e.g., people living in the same city) who describe the severe course of their COVID-19 infection after not having received the (booster) vaccination.		x	x					
34	Relative risks for hospitalization	Hospitalization rates of vaccinated versus unvaccinated people should be communicated for different population and risk groups (e.g., people over 80 years of age) to allow relative risk calculation for the own group.	x	x						
35	Help others to educate	Provide information for people about how to educate others (e.g., family members, friends) about the value of booster vaccination.	x	x	x					
36	Personalized text message	People receive personalized text message (addressing them by their name) highlighting the benefits of getting the booster vaccination.	x	x						
37	Tax benefits	Finanical benefits for boostered people, e.g., tax benefits, reduction of health insurance rate.						x		
38	Information website	Website with basic information on the benefits of booster vaccination, where and how to get it, using easy language and graphical illustrations.	x							
39	Mind-changing stories	Short videos on social media platforms of persons who explain their initial concerns before getting the booster vaccine, and their reasoning for why they eventually decided to get it. Stories should include facts but also personal reasons.	x	x	x					

			1	2	3	4	5	6	7	8
40	Q&A session	People can submit questions and concerns regarding booster vaccinations. Experts will create written and video answers which are provided online and in public Q&A events.	x							
41	Awareness ads	Short videos with famous comedians without lengthy explanations to be streamed on TV.			x					
42	Punch card	Card indicates that 2 out of 3 necessary vaccinations have already been completed, but one is still missing to achieve the protection goal.				x				
43	Mass vaccination	Weekly vaccination events (weekly at the same day and the same location) where people can go and get the booster vaccine without prior appointment.					x			
44	Donation	For every booster vaccination, there will be one dose donated to a developing country.						x		
45	Documentary	Documentary for non-experts to explain the benefits and necessity of booster vaccination, explained by trusted health experts from various disciplines. Documentary should be shown on public TV.	x	x	x					
46	Implementation intentions	Provide prompt to people that helps them plan their booster vaccination (e.g., in newspapers, flyer in supermarkets to fill in; "If X happens, I will make an appointment for booster vaccination.")				x				

Note. 1: Education. 2: Persuasion. 3: Modeling. 4: Psychological enablement. 5: Environmental restructuring. 6: Incentivization. 7: Restriction. 8: Sanction. DA: Default appointment. For definitions of classification criteria, see Table S2, top panel.

Table S2. Expert ratings: Effect on affordability.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	2.81	2.69 – 2.93	**<0.001**	2.28	1.44 – 3.12	**<0.001**
Education	0.11	0.01 – 0.20	**0.037**	0.11	0.00 – 0.21	**0.047**
Persuasion	0.01	-0.11 – 0.13	0.866	-0.02	-0.15 – 0.12	0.808
Modeling	-0.32	-0.43 – -0.21	**<0.001**	-0.29	-0.41 – -0.17	**<0.001**
Psychological enablement	0.04	-0.06 – 0.15	0.417	0.02	-0.10 – 0.13	0.770
Environmental restructuring	0.66	0.52 – 0.80	**<0.001**	0.67	0.52 – 0.82	**<0.001**
Incentivization	0.78	0.65 – 0.91	**<0.001**	0.77	0.64 – 0.91	**<0.001**
Restriction	0.13	-0.10 – 0.36	0.276	0.12	-0.12 – 0.36	0.330
Sanction	0.40	0.22 – 0.59	**<0.001**	0.35	0.15 – 0.55	**0.001**
Age				0.00	-0.01 – 0.02	0.645
Gender: Male (baseline: female)				-0.11	-0.26 – 0.04	0.139
Gender: Non-binary (baseline: female)				0.08	-0.72 – 0.89	0.842
Gender: Prefer not to say (baseline: female)				-0.24	-1.39 – 0.92	0.687
Profession: Healthcare provider (baseline: scientist)				0.45	-0.28 – 1.18	0.226
Profession: Other practitioner (baseline: scientist)				0.30	-0.23 – 0.82	0.269
Profession: Other (baseline: scientist)				0.11	-0.10 – 0.33	0.307
Education: Economics (baseline: medicine or healthcare)				0.38	-0.34 – 1.10	0.297
Education: Public health (baseline: medicine or healthcare)				0.22	-0.50 – 0.95	0.546

Education: Psychology (baseline: medicine or healthcare)		0.47	-0.23 – 1.18	0.191
Education: Other (baseline: medicine or healthcare)		0.33	-0.39 – 1.06	0.369
Participation in the first survey (baseline: no participation)		0.01	-0.17 – 0.20	0.904
Working experience (years)		0.00	-0.02 – 0.02	0.822
Random Effects				
σ^2	1.24	1.26		
τ_{00}	0.19_{ID}	0.19_{ID}		
ICC	0.13_{ID}	0.13_{ID}		
Observations	2619	2362		
Marginal R^2 / Conditional R^2	0.110 / 0.227	0.117 / 0.235		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S3. Expert ratings: Effect on practicability.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	4.04	3.93 – 4.15	**<0.001**	4.19	3.39 – 5.00	**<0.001**
Education	-0.42	-0.51 – -0.33	**<0.001**	-0.41	-0.51 – -0.32	**<0.001**
Persuasion	0.02	-0.10 – 0.13	0.780	0.02	-0.10 – 0.14	0.707
Modeling	-0.03	-0.13 – 0.07	0.604	-0.04	-0.15 – 0.06	0.421
Psychological enablement	-0.22	-0.32 – -0.12	**<0.001**	-0.20	-0.30 – -0.10	**<0.001**
Environmental restructuring	-0.10	-0.22 – 0.03	0.137	-0.10	-0.23 – 0.03	0.143
Incentivization	-0.39	-0.50 – -0.27	**<0.001**	-0.38	-0.50 – -0.26	**<0.001**
Restriction	-0.52	-0.73 – -0.32	**<0.001**	-0.53	-0.75 – -0.31	**<0.001**
Sanction	-0.66	-0.83 – -0.49	**<0.001**	-0.65	-0.83 – -0.47	**<0.001**
Age				-0.00	-0.02 – 0.01	0.663
Gender: Male (baseline: female)				-0.10	-0.24 – 0.04	0.170
Gender: Non-binary (baseline: female)				-0.57	-1.34 – 0.20	0.148
Gender: Prefer not to say (baseline: female)				-0.68	-1.79 – 0.43	0.230
Profession: Healthcare provider (baseline: scientist)				0.05	-0.65 – 0.74	0.894
Profession: Other practitioner (baseline: scientist)				0.45	-0.05 – 0.96	0.078
Profession: Other (baseline: scientist)				0.02	-0.18 – 0.23	0.829
Education: Economics (baseline: medicine or healthcare)				0.05	-0.64 – 0.73	0.892
Education: Public health (baseline: medicine or healthcare)				-0.26	-0.96 – 0.43	0.457

Education: Psychology (baseline: medicine or healthcare)		-0.03	-0.71 – 0.64	0.927
Education: Other (baseline: medicine or healthcare)		0.06	-0.63 – 0.76	0.856
Participation in the first survey (baseline: no participation)		-0.16	-0.33 – 0.02	0.081
Working experience (years)		0.01	-0.01 – 0.02	0.556
Random Effects				
σ^2	0.99	1.00		
τ_{00}	0.20_{ID}	0.19_{ID}		
ICC	0.17_{ID}	0.16_{ID}		
Observations	2615	2360		
Marginal R^2 / Conditional R^2	0.055 / 0.211	0.065 / 0.217		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S4. Expert ratings: Effect on effectiveness.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.01	2.89 – 3.12	**<0.001**	3.40	2.63 – 4.18	**<0.001**
Education	-0.26	-0.35 – -0.17	**<0.001**	-0.26	-0.36 – -0.17	**<0.001**
Persuasion	0.26	0.14 – 0.38	**<0.001**	0.27	0.14 – 0.39	**<0.001**
Modeling	-0.37	-0.47 – -0.26	**<0.001**	-0.37	-0.48 – -0.25	**<0.001**
Psychological enablement	0.14	0.04 – 0.24	**0.008**	0.15	0.04 – 0.25	**0.007**
Environmental restructuring	0.41	0.27 – 0.54	**<0.001**	0.41	0.27 – 0.55	**<0.001**
Incentivization	0.01	-0.11 – 0.13	0.825	0.00	-0.12 – 0.13	0.950
Restriction	0.25	0.03 – 0.46	**0.026**	0.23	0.01 – 0.46	**0.045**
Sanction	0.97	0.79 – 1.14	**<0.001**	0.97	0.78 – 1.16	**<0.001**
Age				0.00	-0.01 – 0.02	0.959
Gender: Male (baseline: female)				-0.29	-0.43 – -0.16	**<0.001**
Gender: Non-binary (baseline: female)				-0.66	-1.40 – 0.08	0.079
Gender: Prefer not to say (baseline: female)				-0.34	-1.40 – 0.73	0.535
Profession: Healthcare provider (baseline: scientist)				0.23	-0.44 – 0.90	0.502
Profession: Other practitioner (baseline: scientist)				-0.05	-0.53 – 0.43	0.839
Profession: Other (baseline: scientist)				0.23	0.03 – 0.43	**0.026**
Education: Economics (baseline: medicine or healthcare)				-0.25	-0.91 – 0.41	0.451
Education: Public health (baseline: medicine or healthcare)				-0.49	-1.16 – 0.17	0.146

Education: Psychology (baseline: medicine or healthcare)		-0.30	-0.95 – 0.35	0.366
Education: Other (baseline: medicine or healthcare)		-0.24	-0.91 – 0.43	0.490
Participation in the first survey (baseline: no participation)		-0.05	-0.22 – 0.12	0.548
Working experience (years)		-0.00	-0.02 – 0.02	0.964
Random Effects				
σ^2	1.10	1.11		
τ_{00}	0.18 $_{ID}$	0.16 $_{ID}$		
ICC	0.14 $_{ID}$	0.13 $_{ID}$		
Observations	2617	2362		
Marginal R^2 / Conditional R^2	0.078 / 0.206	0.104 / 0.217		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S5. Expert ratings: Effect on acceptability for stakeholders.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.74	3.63 – 3.85	**<0.001**	4.39	3.66 – 5.13	**<0.001**
Education	-0.20	-0.29 – -0.11	**<0.001**	-0.18	-0.28 – -0.08	**<0.001**
Persuasion	0.02	-0.10 – 0.13	0.772	0.06	-0.07 – 0.18	0.361
Modeling	0.22	0.11 – 0.32	**<0.001**	0.20	0.09 – 0.31	**<0.001**
Psychological enablement	-0.09	-0.19 – 0.01	0.070	-0.07	-0.17 – 0.04	0.217
Environmental restructuring	0.15	0.02 – 0.28	**0.028**	0.13	-0.01 – 0.26	0.068
Incentivization	-0.67	-0.79 – -0.55	**<0.001**	-0.61	-0.74 – -0.49	**<0.001**
Restriction	-1.02	-1.24 – -0.81	**<0.001**	-1.03	-1.26 – -0.81	**<0.001**
Sanction	-1.37	-1.55 – -1.20	**<0.001**	-1.36	-1.54 – -1.17	**<0.001**
Age				-0.00	-0.01 – 0.01	0.959
Gender: Male (baseline: female)				0.04	-0.09 – 0.17	0.536
Gender: Non-binary (baseline: female)				-0.20	-0.89 – 0.50	0.578
Gender: Prefer not to say (baseline: female)				-0.68	-1.68 – 0.33	0.185
Profession: Healthcare provider (baseline: scientist)				-0.50	-1.13 – 0.14	0.125
Profession: Other practitioner (baseline: scientist)				0.17	-0.28 – 0.62	0.457
Profession: Other (baseline: scientist)				-0.09	-0.28 – 0.10	0.353
Education: Economics (baseline: medicine or healthcare)				-0.64	-1.26 – -0.01	**0.045**
Education: Public health (baseline: medicine or healthcare)				-0.75	-1.38 – -0.12	**0.020**

Education: Psychology (baseline: medicine or healthcare)		-0.64	-1.26 – -0.03	**0.039**
Education: Other (baseline: medicine or healthcare)		-0.64	-1.27 – -0.00	**0.048**
Participation in the first survey (baseline: no participation)		0.01	-0.15 – 0.17	0.940
Working experience (years)		-0.00	-0.02 – 0.01	0.778
Random Effects				
σ^2	1.09	1.08		
τ_{00}	0.13 $_{ID}$	0.13 $_{ID}$		
ICC	0.11 $_{ID}$	0.11 $_{ID}$		
Observations	2610	2353		
Marginal R^2 / Conditional R^2	0.146 / 0.238	0.152 / 0.244		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S6. Expert ratings: Effect on acceptability for general population.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.77	3.66 – 3.88	**<0.001**	4.13	3.41 – 4.85	**<0.001**
Education	-0.27	-0.36 – -0.18	**<0.001**	-0.27	-0.37 – -0.18	**<0.001**
Persuasion	0.03	-0.08 – 0.15	0.555	0.06	-0.07 – 0.18	0.367
Modeling	-0.06	-0.16 – 0.05	0.272	-0.07	-0.18 – 0.04	0.202
Psychological enablement	-0.14	-0.24 – -0.04	**0.005**	-0.12	-0.22 – -0.01	**0.026**
Environmental restructuring	0.27	0.14 – 0.40	**<0.001**	0.25	0.11 – 0.38	**<0.001**
Incentivization	-0.21	-0.33 – -0.09	**0.001**	-0.20	-0.32 – -0.07	**0.002**
Restriction	-1.09	-1.30 – -0.88	**<0.001**	-1.09	-1.31 – -0.87	**<0.001**
Sanction	-1.60	-1.77 – -1.43	**<0.001**	-1.58	-1.76 – -1.40	**<0.001**
Age				0.00	-0.01 – 0.01	0.959
Gender: Male (baseline: female)				-0.12	-0.25 – 0.01	0.065
Gender: Non-binary (baseline: female)				-0.04	-0.73 – 0.64	0.901
Gender: Prefer not to say (baseline: female)				-0.08	-1.06 – 0.91	0.881
Profession: Healthcare provider (baseline: scientist)				-0.17	-0.79 – 0.45	0.583
Profession: Other practitioner (baseline: scientist)				0.19	-0.26 – 0.65	0.406
Profession: Other (baseline: scientist)				-0.20	-0.39 – -0.02	**0.034**
Education: Economics (baseline: medicine or healthcare)				-0.20	-0.82 – 0.41	0.513
Education: Public health (baseline: medicine or healthcare)				-0.26	-0.88 – 0.36	0.413

Education: Psychology (baseline: medicine or healthcare)		-0.32	-0.92 – 0.28	0.302
Education: Other (baseline: medicine or healthcare)		-0.23	-0.85 – 0.39	0.474
Participation in the first survey (baseline: no participation)		-0.04	-0.20 – 0.12	0.622
Working experience (years)		-0.00	-0.02 – 0.01	0.732
Random Effects				
σ^2	1.03	1.04		
τ_{00}	0.15_{ID}	0.13_{ID}		
ICC	0.12_{ID}	0.11_{ID}		
Observations	2604	2352		
Marginal R^2 / Conditional R^2	0.144 / 0.251	0.150 / 0.243		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S7. Expert ratings: Effect on probability of non-pharmaceutical side effects.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	2.19	2.08 – 2.31	**<0.001**	1.89	0.92 – 2.86	**<0.001**
Education	0.07	-0.02 – 0.16	0.107	0.07	-0.02 – 0.17	0.142
Persuasion	0.10	-0.01 – 0.21	0.082	0.07	-0.05 – 0.19	0.244
Modeling	0.07	-0.03 – 0.17	0.173	0.10	-0.01 – 0.21	0.068
Psychological enablement	0.08	-0.02 – 0.17	0.121	0.03	-0.07 – 0.13	0.559
Environmental restructuring	0.05	-0.07 – 0.18	0.416	0.02	-0.11 – 0.15	0.775
Incentivization	0.55	0.43 – 0.66	**<0.001**	0.54	0.42 – 0.66	**<0.001**
Restriction	0.95	0.74 – 1.16	**<0.001**	0.95	0.73 – 1.17	**<0.001**
Sanction	1.37	1.20 – 1.54	**<0.001**	1.32	1.14 – 1.50	**<0.001**
Age				-0.01	-0.03 – 0.01	0.367
Gender: Male (baseline: female)				-0.06	-0.23 – 0.12	0.524
Gender: Non-binary (baseline: female)				-0.07	-1.00 – 0.87	0.888
Gender: Prefer not to say (baseline: female)				0.06	-1.28 – 1.40	0.931
Profession: Healthcare provider (baseline: scientist)				0.35	-0.50 – 1.19	0.421
Profession: Other practitioner (baseline: scientist)				-0.07	-0.68 – 0.54	0.817
Profession: Other (baseline: scientist)				0.17	-0.08 – 0.42	0.178
Education: Economics (baseline: medicine or healthcare)				0.55	-0.28 – 1.39	0.193
Education: Public health (baseline: medicine or healthcare)				0.56	-0.28 – 1.40	0.191

Education: Psychology (baseline: medicine or healthcare)		0.67	-0.15 – 1.49	0.108
Education: Other (baseline: medicine or healthcare)		0.71	-0.14 – 1.55	0.101
Participation in the first survey (baseline: no participation)		0.17	-0.05 – 0.38	0.130
Working experience (years)		0.00	-0.02 – 0.03	0.686
Random Effects				
σ^2	0.99	1.01		
τ_{00}	0.32_{ID}	0.33_{ID}		
ICC	0.25_{ID}	0.25_{ID}		
Observations	2610	2359		
Marginal R^2 / Conditional R^2	0.114 / 0.332	0.125 / 0.339		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S8. Expert ratings: Effect on inequity.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	2.74	2.65 – 2.83	**<0.001**	2.71	2.13 – 3.29	**<0.001**
Education	0.13	0.06 – 0.21	**0.001**	0.12	0.04 – 0.20	**0.004**
Persuasion	-0.02	-0.11 – 0.08	0.714	-0.06	-0.16 – 0.04	0.225
Modeling	0.09	0.01 – 0.17	**0.036**	0.13	0.04 – 0.21	**0.005**
Psychological enablement	0.07	-0.01 – 0.15	0.093	0.04	-0.05 – 0.12	0.379
Environmental restructuring	-0.29	-0.39 – -0.18	**<0.001**	-0.32	-0.43 – -0.21	**<0.001**
Incentivization	0.12	0.02 – 0.22	**0.015**	0.10	-0.01 – 0.20	0.067
Restriction	0.75	0.57 – 0.92	**<0.001**	0.75	0.57 – 0.93	**<0.001**
Sanction	0.41	0.27 – 0.56	**<0.001**	0.37	0.22 – 0.52	**<0.001**
Age				-0.00	-0.02 – 0.01	0.435
Gender: Male (baseline: female)				-0.05	-0.16 – 0.05	0.298
Gender: Non-binary (baseline: female)				0.01	-0.54 – 0.56	0.969
Gender: Prefer not to say (baseline: female)				0.16	-0.63 – 0.95	0.695
Profession: Healthcare provider (baseline: scientist)				-0.06	-0.56 – 0.44	0.806
Profession: Other practitioner (baseline: scientist)				0.11	-0.25 – 0.47	0.559
Profession: Other (baseline: scientist)				-0.02	-0.17 – 0.13	0.820
Education: Economics (baseline: medicine or healthcare)				0.15	-0.34 – 0.64	0.545
Education: Public health (baseline: medicine or healthcare)				0.36	-0.14 – 0.85	0.158

Education: Psychology (baseline: medicine or healthcare)		0.21	-0.28 – 0.69	0.403
Education: Other (baseline: medicine or healthcare)		0.25	-0.25 – 0.75	0.328
Participation in the first survey (baseline: no participation)		0.05	-0.08 – 0.17	0.479
Working experience (years)		0.01	-0.01 – 0.02	0.436
Random Effects				
σ^2	0.70	0.71		
τ_{00}	0.08 $_{ID}$	0.08 $_{ID}$		
ICC	0.10 $_{ID}$	0.10 $_{ID}$		
Observations	2598	2350		
Marginal R^2 / Conditional R^2	0.045 / 0.144	0.054 / 0.149		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S9. Expert ratings: Effect on universality across countries.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.33	3.20 – 3.45	**<0.001**	3.96	2.96 – 4.97	**<0.001**
Education	-0.25	-0.34 – -0.15	**<0.001**	-0.24	-0.34 – -0.13	**<0.001**
Persuasion	0.16	0.04 – 0.28	**0.007**	0.17	0.04 – 0.29	**0.010**
Modeling	0.04	-0.07 – 0.15	0.504	0.05	-0.06 – 0.17	0.372
Psychological enablement	-0.23	-0.33 – -0.12	**<0.001**	-0.21	-0.32 – -0.10	**<0.001**
Environmental restructuring	0.12	-0.01 – 0.26	0.075	0.14	-0.01 – 0.28	0.062
Incentivization	-0.60	-0.72 – -0.47	**<0.001**	-0.60	-0.73 – -0.47	**<0.001**
Restriction	-0.32	-0.54 – -0.10	**0.005**	-0.38	-0.62 – -0.15	**0.001**
Sanction	-0.93	-1.11 – -0.74	**<0.001**	-0.90	-1.09 – -0.70	**<0.001**
Age				-0.01	-0.03 – 0.01	0.266
Gender: Male (baseline: female)				0.06	-0.12 – 0.23	0.544
Gender: Non-binary (baseline: female)				-0.35	-1.32 – 0.61	0.475
Gender: Prefer not to say (baseline: female)				-1.03	-2.42 – 0.35	0.144
Profession: Healthcare provider (baseline: scientist)				-0.21	-1.09 – 0.66	0.630
Profession: Other practitioner (baseline: scientist)				-0.04	-0.67 – 0.59	0.896
Profession: Other (baseline: scientist)				-0.05	-0.31 – 0.21	0.730
Education: Economics (baseline: medicine or healthcare)				-0.35	-1.21 – 0.51	0.422
Education: Public health (baseline: medicine or healthcare)				-0.54	-1.41 – 0.33	0.220

Education: Psychology (baseline: medicine or healthcare)		-0.43	-1.27 – 0.42	0.323
Education: Other (baseline: medicine or healthcare)		-0.30	-1.17 – 0.58	0.506
Participation in the first survey (baseline: no participation)		-0.02	-0.24 – 0.21	0.886
Working experience (years)		0.01	-0.01 – 0.03	0.296
Random Effects				
σ^2	1.14	1.17		
τ_{00}	0.35 $_{ID}$	0.34 $_{ID}$		
ICC	0.24 $_{ID}$	0.23 $_{ID}$		
Observations	2615	2363		
Marginal R^2 / Conditional R^2	0.070 / 0.290	0.078 / 0.287		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S10. Expert ratings: Effect on previously unvaccinated people.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.48	3.39 – 3.56	**<0.001**	3.70	3.06 – 4.33	**<0.001**
Education	-0.20	-0.27 – -0.14	**<0.001**	-0.20	-0.27 – -0.13	**<0.001**
Persuasion	0.13	0.05 – 0.21	**0.003**	0.13	0.04 – 0.22	**0.003**
Modeling	-0.13	-0.21 – -0.06	**0.001**	-0.14	-0.22 – -0.06	**0.001**
Psychological enablement	-0.17	-0.25 – -0.10	**<0.001**	-0.18	-0.26 – -0.10	**<0.001**
Environmental restructuring	0.16	0.07 – 0.26	**0.001**	0.17	0.07 – 0.27	**0.001**
Incentivization	-0.12	-0.20 – -0.03	**0.009**	-0.12	-0.21 – -0.03	**0.011**
Restriction	0.05	-0.11 – 0.20	0.541	0.03	-0.14 – 0.19	0.749
Sanction	0.04	-0.09 – 0.17	0.536	0.08	-0.06 – 0.21	0.266
Age				-0.01	-0.02 – 0.01	0.344
Gender: Male (baseline: female)				-0.08	-0.20 – 0.03	0.148
Gender: Non-binary (baseline: female)				0.04	-0.56 – 0.65	0.885
Gender: Prefer not to say (baseline: female)				-0.51	-1.38 – 0.36	0.250
Profession: Healthcare provider (baseline: scientist)				0.33	-0.22 – 0.88	0.238
Profession: Other practitioner (baseline: scientist)				0.04	-0.36 – 0.45	0.829
Profession: Other (baseline: scientist)				0.20	0.03 – 0.36	**0.019**
Education: Economics (baseline: medicine or healthcare)				-0.07	-0.61 – 0.47	0.801
Education: Public health (baseline: medicine or healthcare)				-0.12	-0.67 – 0.43	0.670

Education: Psychology (baseline: medicine or healthcare)		-0.14	-0.67 – 0.40	0.615
Education: Other (baseline: medicine or healthcare)		-0.20	-0.75 – 0.35	0.474
Participation in the first survey (baseline: no participation)		-0.05	-0.19 – 0.09	0.478
Working experience (years)		0.01	-0.00 – 0.02	0.174
Random Effects				
σ^2	0.55	0.56		
τ_{00}	0.14_{ID}	0.13_{ID}		
ICC	0.20_{ID}	0.18_{ID}		
Observations	2582	2333		
Marginal R^2 / Conditional R^2	0.027 / 0.218	0.049 / 0.223		

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S11. General population ratings: Effect on booster uptake.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.43	3.35 – 3.51	**<0.001**	3.39	3.09 – 3.70	**<0.001**
Education	-0.17	-0.22 – -0.11	**<0.001**	-0.17	-0.22 – -0.11	**<0.001**
Persuasion	0.08	0.00 – 0.15	**0.038**	0.08	0.00 – 0.15	**0.036**
Modeling	-0.28	-0.34 – -0.22	**<0.001**	-0.28	-0.34 – -0.22	**<0.001**
Psychological enablement	-0.44	-0.50 – -0.38	**<0.001**	-0.44	-0.50 – -0.38	**<0.001**
Environmental restructuring	0.16	0.08 – 0.24	**<0.001**	0.16	0.08 – 0.24	**<0.001**
Incentivization	-0.04	-0.12 – 0.03	0.243	-0.05	-0.12 – 0.03	0.211
Restriction	0.00	-0.13 – 0.13	0.988	-0.00	-0.13 – 0.13	0.994
Sanction	0.16	0.05 – 0.27	**0.003**	0.16	0.05 – 0.27	**0.004**
Age				-0.00	-0.01 – 0.00	0.067
Gender: male (baseline: female)				-0.12	-0.23 – -0.01	**0.032**
Country: US (baseline: UK)				-0.21	-0.32 – -0.10	**<0.001**
Education: less than high school (baseline: high school or equivalent)				-0.03	-0.64 – 0.58	0.921
Education: post-graduate education (baseline: high school or equivalent)				-0.10	-0.26 – 0.05	0.198
Education: some college (baseline: high school or equivalent)				-0.10	-0.26 – 0.05	0.187
Vaccinated (baseline: unvaccinated)				0.38	0.23 – 0.54	**<0.001**
Liberal political orientation				0.02	-0.01 – 0.06	0.224

Random Effects		
σ^2	0.90	0.90
τ_{00}	0.40 $_{ID}$	0.37 $_{ID}$
ICC	0.31 $_{ID}$	0.29 $_{ID}$
Observations	5990	5980
Marginal R^2 / Conditional R^2	0.042 / 0.336	0.072 / 0.340

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S12. General population ratings: Effect on own booster intention.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.02	2.80 – 3.24	**<0.001**	3.12	2.23 – 4.01	**<0.001**
Education	-0.14	-0.28 – -0.01	**0.032**	-0.15	-0.28 – -0.02	**0.029**
Persuasion	0.07	-0.10 – 0.24	0.445	0.07	-0.10 – 0.24	0.440
Modeling	-0.32	-0.47 – -0.17	**<0.001**	-0.32	-0.47 – -0.17	**<0.001**
Psychological enablement	-0.37	-0.51 – -0.23	**<0.001**	-0.37	-0.52 – -0.23	**<0.001**
Environmental restructuring	-0.10	-0.29 – 0.09	0.294	-0.10	-0.29 – 0.09	0.284
Incentivization	-0.02	-0.20 – 0.15	0.813	-0.02	-0.20 – 0.15	0.796
Restriction	0.32	0.00 – 0.64	**0.048**	0.32	0.00 – 0.63	**0.048**
Sanction	0.15	-0.10 – 0.40	0.239	0.15	-0.10 – 0.39	0.247
Age				-0.01	-0.02 – 0.00	0.071
Gender: male (baseline: female)				-0.09	-0.44 – 0.25	0.591
Country: US (baseline: UK)				0.20	-0.18 – 0.57	0.305
Education: less than high school (baseline: high school or equivalent)				-1.75	-3.15 – -0.35	**0.014**
Education: post-graduate education (baseline: high school or equivalent)				-0.18	-0.69 – 0.33	0.481
Education: some college (baseline: high school or equivalent)				-0.35	-0.83 – 0.12	0.144
Liberal political orientation				0.11	0.01 – 0.21	**0.031**

Random Effects		
σ^2	1.02	1.02
τ_{00}	0.87 $_{ID}$	0.80 $_{ID}$
ICC	0.46 $_{ID}$	0.44 $_{ID}$
Observations	1240	1240
Marginal R^2 / Conditional R^2	0.027 / 0.477	0.085 / 0.489

Note: Results from mixed effects regressions with a random effect of participant ID. Subsample of participants who have not yet received a booster vaccine at the time of the study (n=144).

Table S13. General population ratings: Effect on perceived coercion.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	2.21	2.12 – 2.30	**<0.001**	3.22	2.87 – 3.56	**<0.001**
Education	0.01	-0.05 – 0.08	0.691	0.01	-0.05 – 0.08	0.674
Persuasion	0.46	0.38 – 0.54	**<0.001**	0.45	0.37 – 0.53	**<0.001**
Modeling	-0.16	-0.24 – -0.09	**<0.001**	-0.16	-0.23 – -0.09	**<0.001**
Psychological enablement	0.50	0.44 – 0.57	**<0.001**	0.50	0.43 – 0.57	**<0.001**
Environmental restructuring	0.04	-0.05 – 0.13	0.421	0.04	-0.05 – 0.13	0.422
Incentivization	0.45	0.36 – 0.53	**<0.001**	0.44	0.36 – 0.53	**<0.001**
Restriction	1.04	0.90 – 1.19	**<0.001**	1.04	0.89 – 1.19	**<0.001**
Sanction	1.76	1.63 – 1.88	**<0.001**	1.75	1.63 – 1.88	**<0.001**
Age				-0.00	-0.01 – 0.00	0.127
Gender: male (baseline: female)				-0.23	-0.35 – -0.11	**<0.001**
Country: US (baseline: UK)				-0.22	-0.35 – -0.09	**0.001**
Education: less than high school (baseline: high school or equivalent)				-0.10	-0.79 – 0.59	0.777
Education: post-graduate education (baseline: high school or equivalent)				-0.09	-0.27 – 0.09	0.318
Education: some college (baseline: high school or equivalent)				0.05	-0.12 – 0.23	0.554
Vaccinated (baseline: unvaccinated)				-0.37	-0.55 – -0.19	**<0.001**
Liberal political orientation				-0.06	-0.10 – -0.02	**0.002**

Random Effects		
σ^2	1.13	1.13
τ_{00}	0.53 $_{ID}$	0.48 $_{ID}$
ICC	0.32 $_{ID}$	0.30 $_{ID}$
Observations	5990	5980
Marginal R^2 / Conditional R^2	0.121 / 0.402	0.153 / 0.404

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S14. General population ratings: Effect on reactance.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	1.43	1.35 – 1.52	**<0.001**	2.99	2.66 – 3.31	**<0.001**
Education	0.13	0.08 – 0.18	**<0.001**	0.13	0.08 – 0.18	**<0.001**
Persuasion	0.18	0.12 – 0.25	**<0.001**	0.18	0.11 – 0.24	**<0.001**
Modeling	-0.05	-0.10 – 0.01	0.090	-0.05	-0.10 – 0.01	0.092
Psychological enablement	0.59	0.54 – 0.64	**<0.001**	0.59	0.53 – 0.64	**<0.001**
Environmental restructuring	0.02	-0.05 – 0.09	0.569	0.02	-0.05 – 0.09	0.585
Incentivization	0.26	0.19 – 0.32	**<0.001**	0.25	0.19 – 0.32	**<0.001**
Restriction	0.91	0.80 – 1.03	**<0.001**	0.91	0.80 – 1.03	**<0.001**
Sanction	1.52	1.43 – 1.62	**<0.001**	1.52	1.43 – 1.62	**<0.001**
Age				-0.00	-0.01 – 0.00	0.159
Gender: male (baseline: female)				-0.15	-0.27 – -0.03	**0.013**
Country: US (baseline: UK)				-0.07	-0.19 – 0.06	0.290
Education: less than high school (baseline: high school or equivalent)				0.27	-0.39 – 0.93	0.423
Education: post-graduate education (baseline: high school or equivalent)				0.08	-0.09 – 0.25	0.371
Education: some college (baseline: high school or equivalent)				0.08	-0.09 – 0.25	0.340
Vaccinated (baseline: unvaccinated)				-0.78	-0.95 – -0.61	**<0.001**
Liberal political orientation				-0.15	-0.19 – -0.11	**<0.001**

Random Effects		
σ^2	0.71	0.71
τ_{00}	0.61 $_{ID}$	0.46 $_{ID}$
ICC	0.46 $_{ID}$	0.40 $_{ID}$
Observations	5990	5980
Marginal R^2 / Conditional R^2	0.129 / 0.532	0.230 / 0.535

Note: Results from mixed effects regressions with a random effect of participant ID. Reactance was measured with four items about how angry, frustrated, disturbed participants felt about the respective intervention and how much they perceived it as a restriction of their freedom.

Table S15. General population ratings: Effect on acceptability for general population.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	3.53	3.44 – 3.61	**<0.001**	3.31	2.99 – 3.62	**<0.001**
Education	-0.12	-0.18 – -0.06	**<0.001**	-0.12	-0.17 – -0.06	**<0.001**
Persuasion	-0.04	-0.11 – 0.04	0.333	-0.04	-0.11 – 0.04	0.333
Modeling	-0.16	-0.23 – -0.10	**<0.001**	-0.16	-0.23 – -0.10	**<0.001**
Psychological enablement	-0.44	-0.50 – -0.38	**<0.001**	-0.44	-0.50 – -0.38	**<0.001**
Environmental restructuring	0.05	-0.03 – 0.13	0.210	0.05	-0.03 – 0.13	0.218
Incentivization	0.01	-0.07 – 0.08	0.856	0.00	-0.07 – 0.08	0.896
Restriction	-0.51	-0.65 – -0.38	**<0.001**	-0.51	-0.64 – -0.37	**<0.001**
Sanction	-0.97	-1.08 – -0.86	**<0.001**	-0.97	-1.08 – -0.86	**<0.001**
Age				0.00	-0.00 – 0.01	0.137
Gender: male (baseline: female)				-0.03	-0.14 – 0.09	0.648
Country: US (baseline: UK)				-0.08	-0.19 – 0.04	0.198
Education: less than high school (baseline: high school or equivalent)				0.01	-0.62 – 0.64	0.982
Education: post-graduate education (baseline: high school or equivalent)				-0.07	-0.23 – 0.09	0.387
Education: some college (baseline: high school or equivalent)				-0.07	-0.23 – 0.09	0.379
Vaccinated (baseline: unvaccinated)				0.12	-0.05 – 0.28	0.166
Liberal political orientation				0.02	-0.01 – 0.06	0.249

Random Effects		
σ^2	0.92	0.92
τ_{00}	0.40 $_{ID}$	0.40 $_{ID}$
ICC	0.30 $_{ID}$	0.30 $_{ID}$
Observations	5990	5980
Marginal R^2 / Conditional R^2	0.067 / 0.349	0.072 / 0.352

Note: Results from mixed effects regressions with a random effect of participant ID.

Table S16. General population ratings: Effect on activism intentions.

	Base model			Extended model		
Predictors	*B*	*95 % CI*	*p*	*B*	*95 % CI*	*p*
(Intercept)	1.28	1.22 – 1.34	**<0.001**	2.52	2.25 – 2.79	**<0.001**
Education	0.04	0.01 – 0.08	**0.015**	0.04	0.01 – 0.07	**0.016**
Persuasion	0.03	-0.01 – 0.08	0.123	0.03	-0.01 – 0.07	0.137
Modeling	-0.03	-0.07 – 0.00	0.071	-0.03	-0.07 – 0.00	0.068
Psychological enablement	0.18	0.15 – 0.22	**<0.001**	0.18	0.15 – 0.22	**<0.001**
Environmental restructuring	-0.02	-0.07 – 0.03	0.388	-0.02	-0.07 – 0.03	0.380
Incentivization	0.06	0.01 – 0.10	**0.010**	0.06	0.01 – 0.10	**0.010**
Restriction	0.37	0.29 – 0.45	**<0.001**	0.37	0.29 – 0.45	**<0.001**
Sanction	0.72	0.66 – 0.79	**<0.001**	0.72	0.66 – 0.79	**<0.001**
Age				-0.00	-0.01 – -0.00	**0.002**
Gender: male (baseline: female)				-0.07	-0.16 – 0.03	0.189
Country: US (baseline: UK)				0.02	-0.08 – 0.12	0.751
Education: less than high school (baseline: high school or equivalent)				0.17	-0.38 – 0.72	0.538
Education: post-graduate education (baseline: high school or equivalent)				-0.02	-0.16 – 0.12	0.809
Education: some college (baseline: high school or equivalent)				-0.02	-0.16 – 0.12	0.760
Vaccinated (baseline: unvaccinated)				-0.57	-0.71 – -0.42	**<0.001**
Liberal political orientation				-0.10	-0.13 – -0.07	**<0.001**

Random Effects		
σ^2	0.31	0.31
τ_{00}	0.42 $_{ID}$	0.34 $_{ID}$
ICC	0.57 $_{ID}$	0.52 $_{ID}$
Observations	5990	5980
Marginal R^2 / Conditional R^2	0.051 / 0.592	0.154 / 0.594

Note: Results from mixed effects regressions with a random effect of participant ID. Activism intentions were measured with four items (signing a petition, joining a demonstration, joining a lawsuit, and mobilizing others to fight the respective intervention).

Figure S1. Mean values of expert ratings.

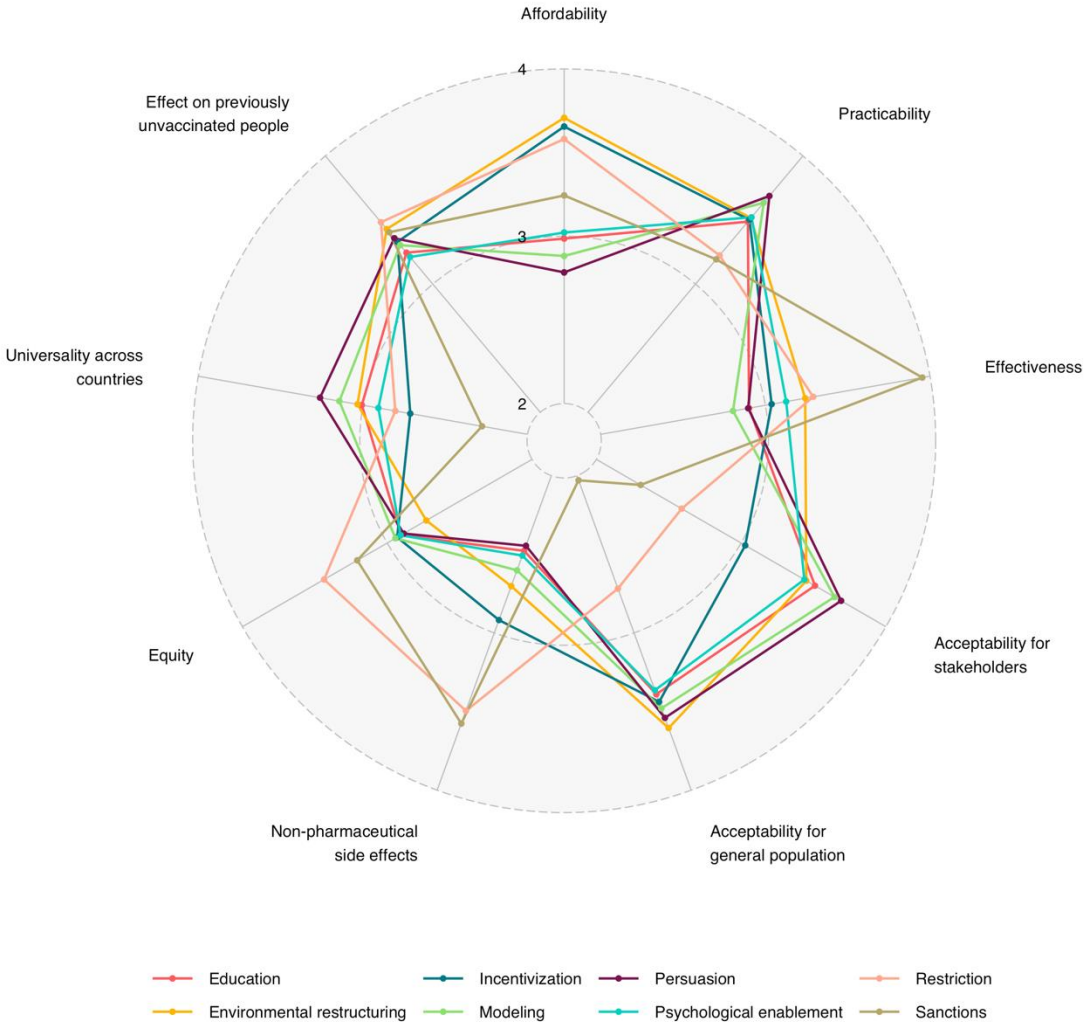

Figure S2. Mean values of general population ratings.

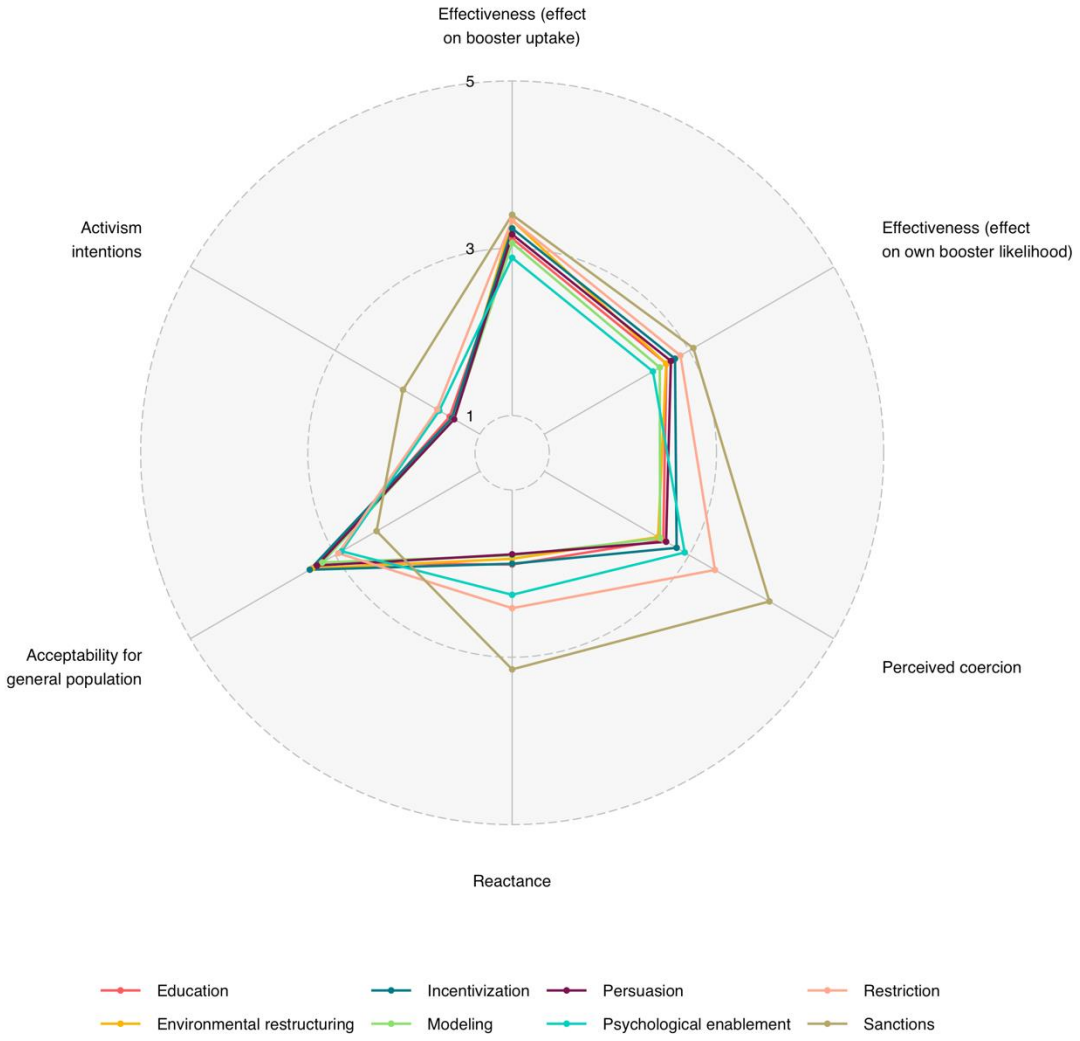

Figure S3. Correlations between expert evaluation criteria (across all interventions).

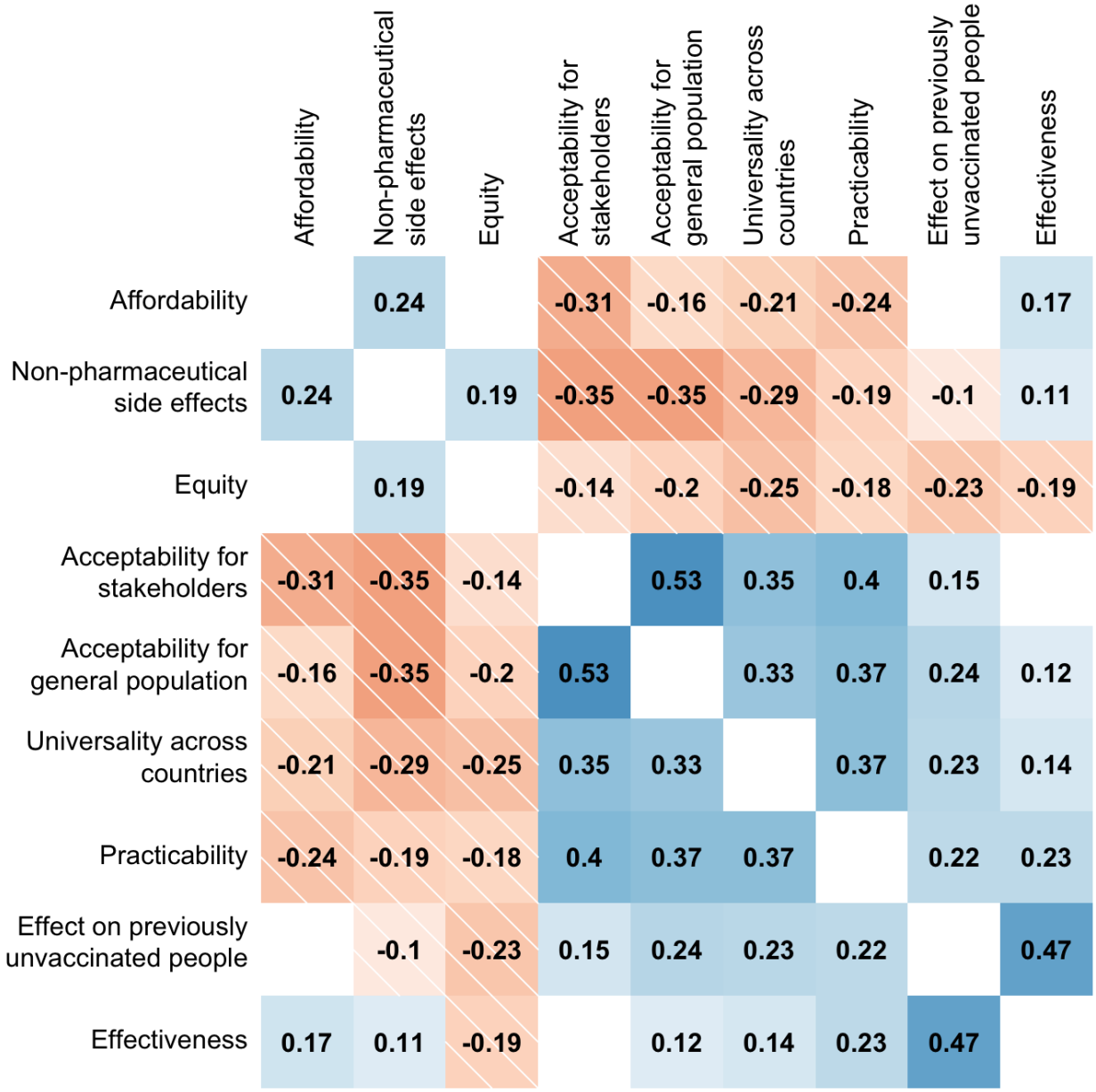

Figure S4. Correlations between general population evaluation criteria (across all interventions).

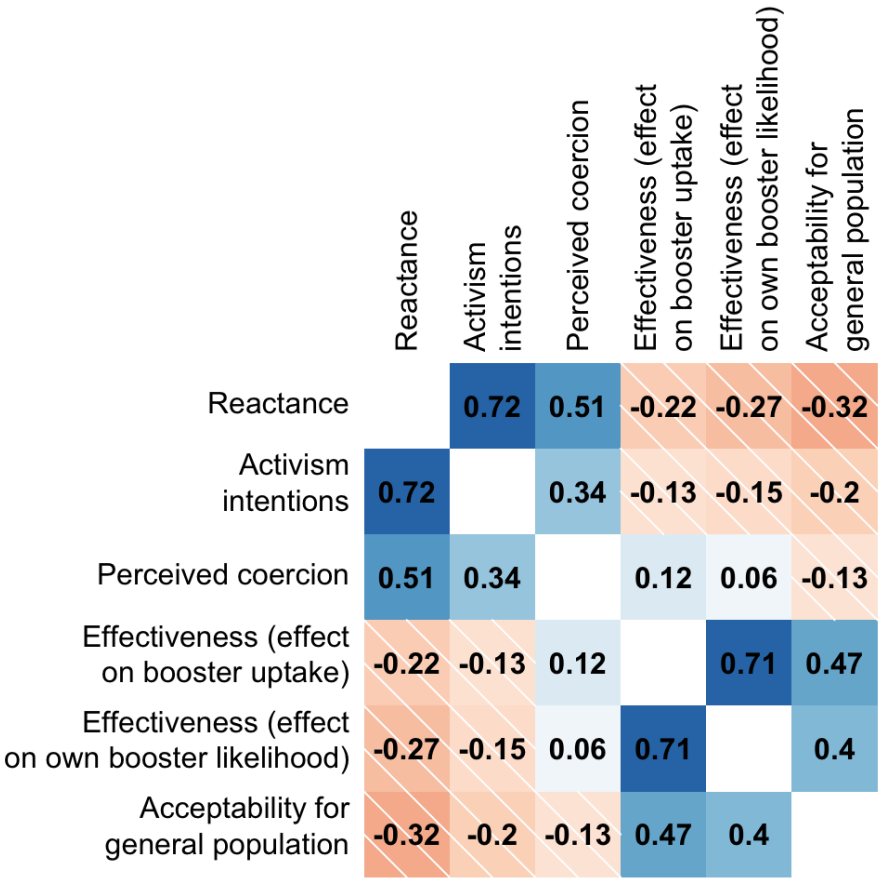

Figure S5. Expert ratings: Mean values in affordability.

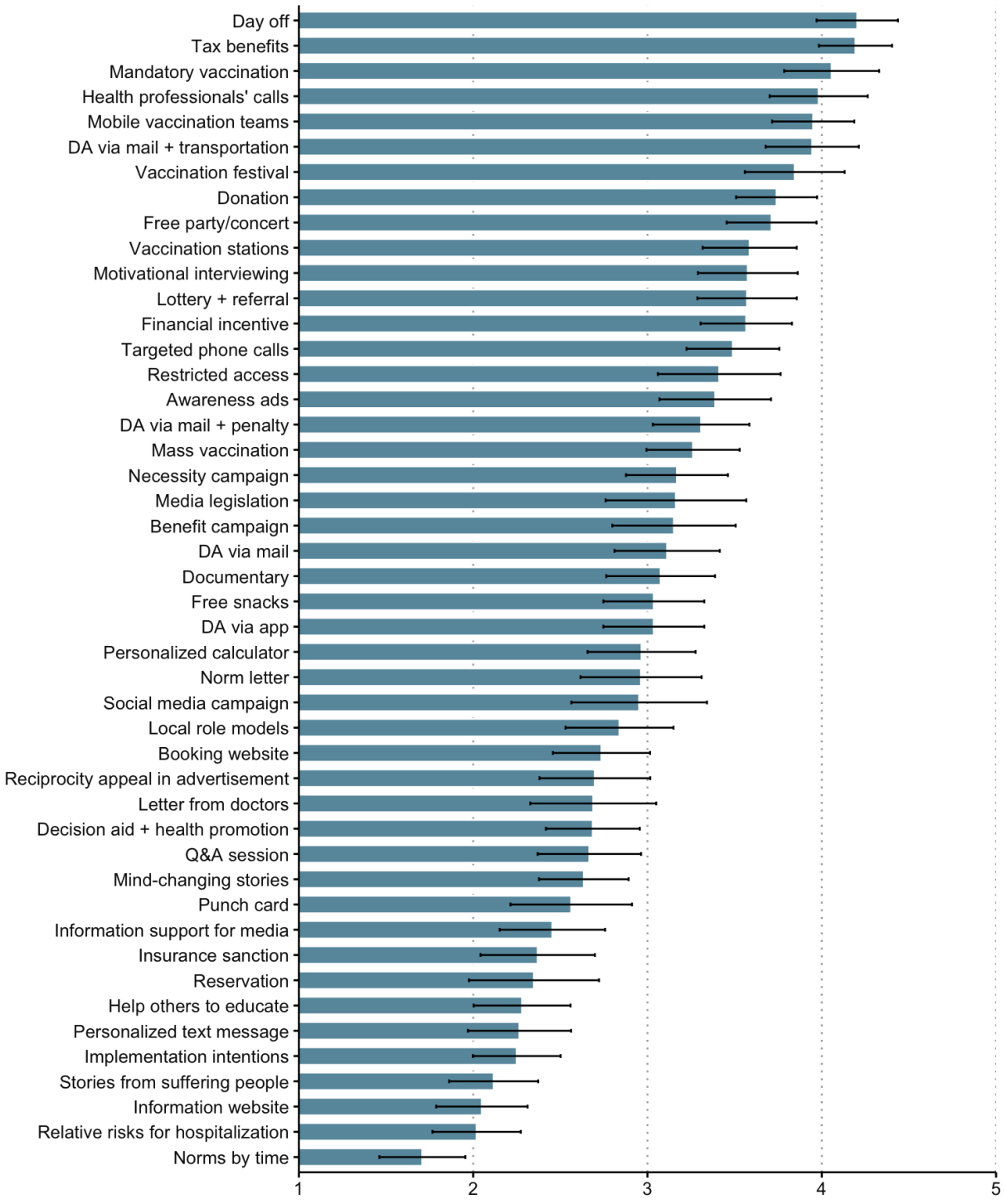

Figure S6. Expert ratings: Mean values in practicability.

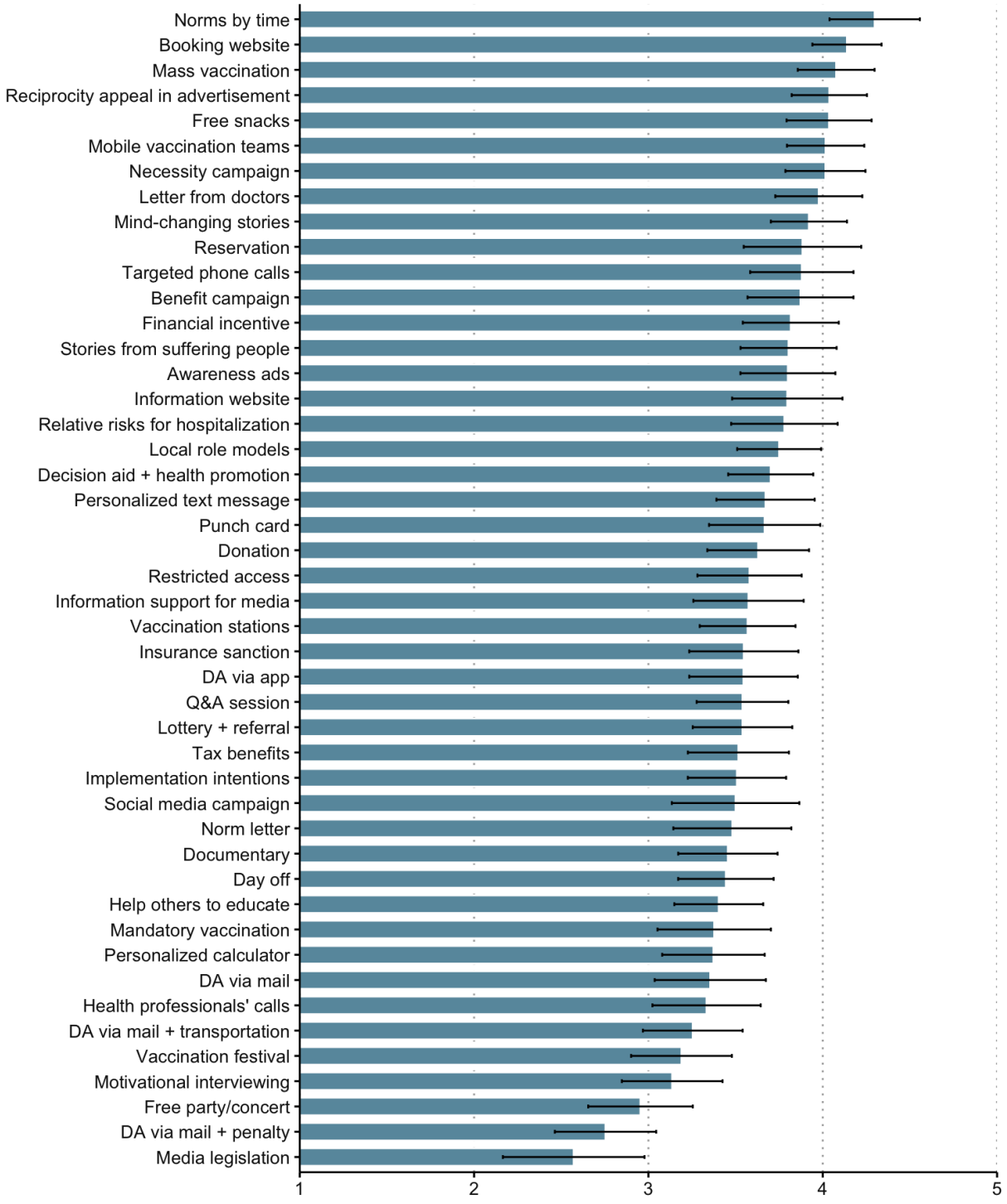

Figure S7. Expert ratings: Mean values in effectiveness.

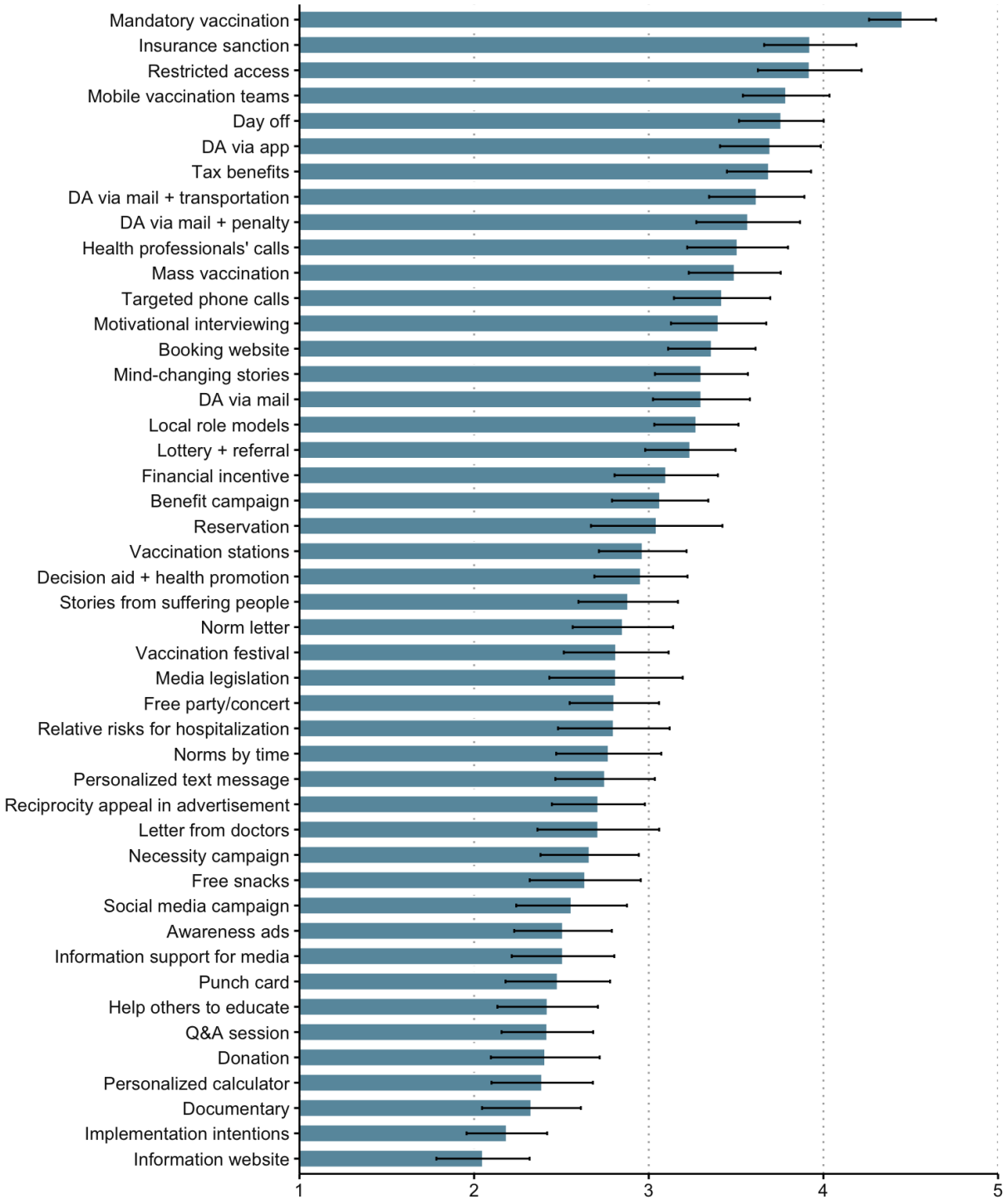

Figure S8. Expert ratings: Mean values in acceptability for stakeholders.

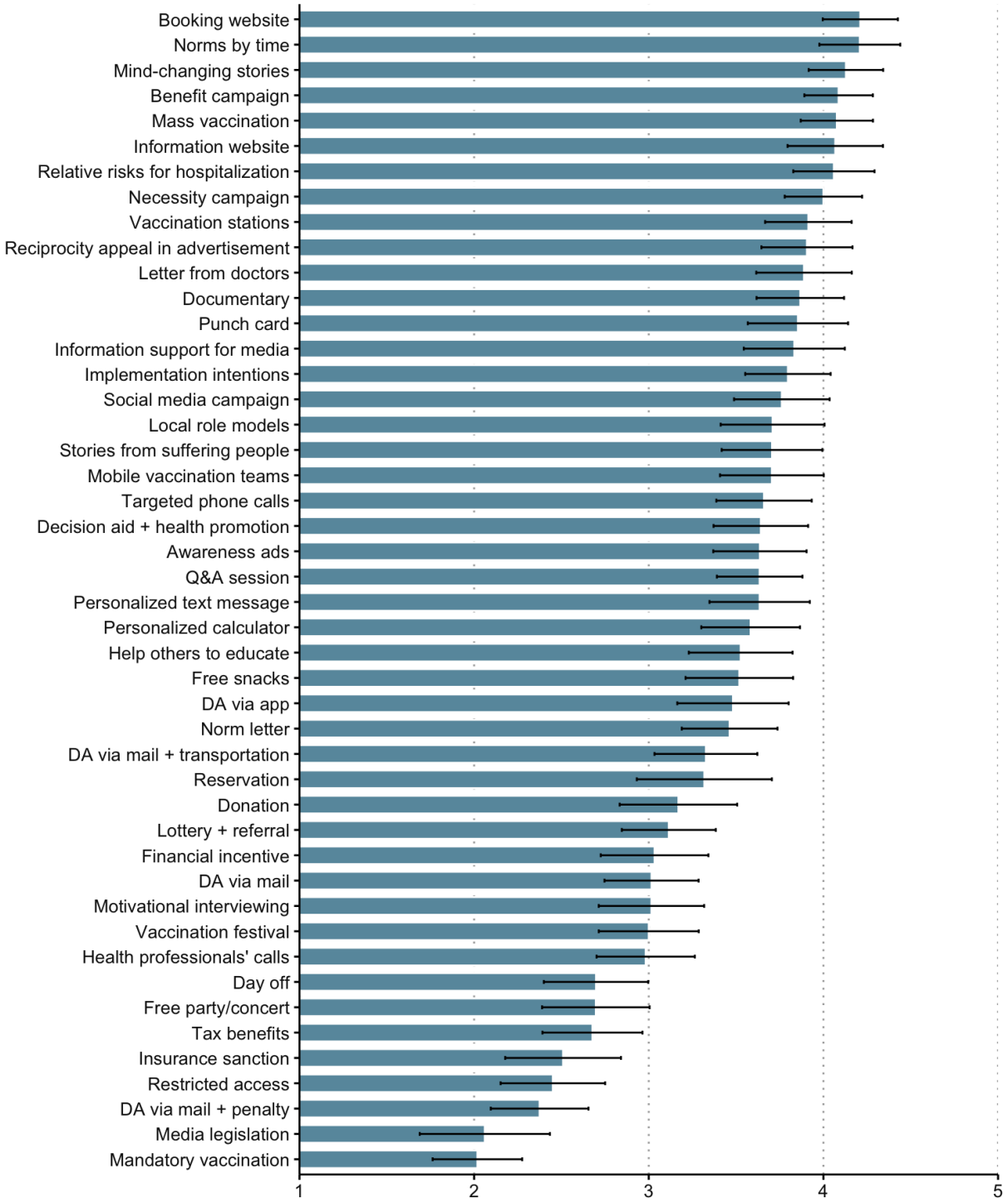

Figure S9. Expert ratings: Mean values in acceptability for general population.

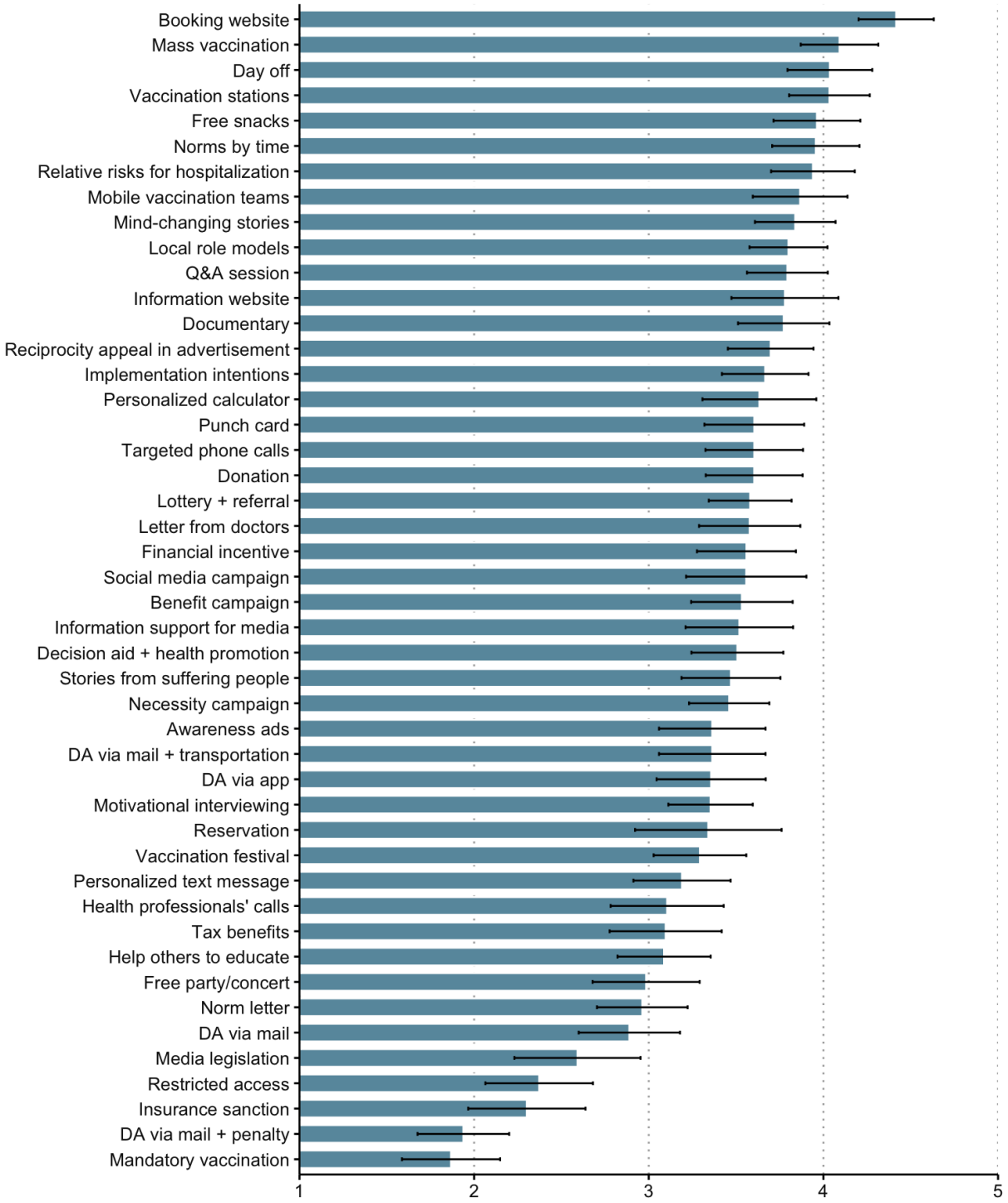

Figure S10. Expert ratings: Mean values in probability of non-pharmaceutical side-effects.

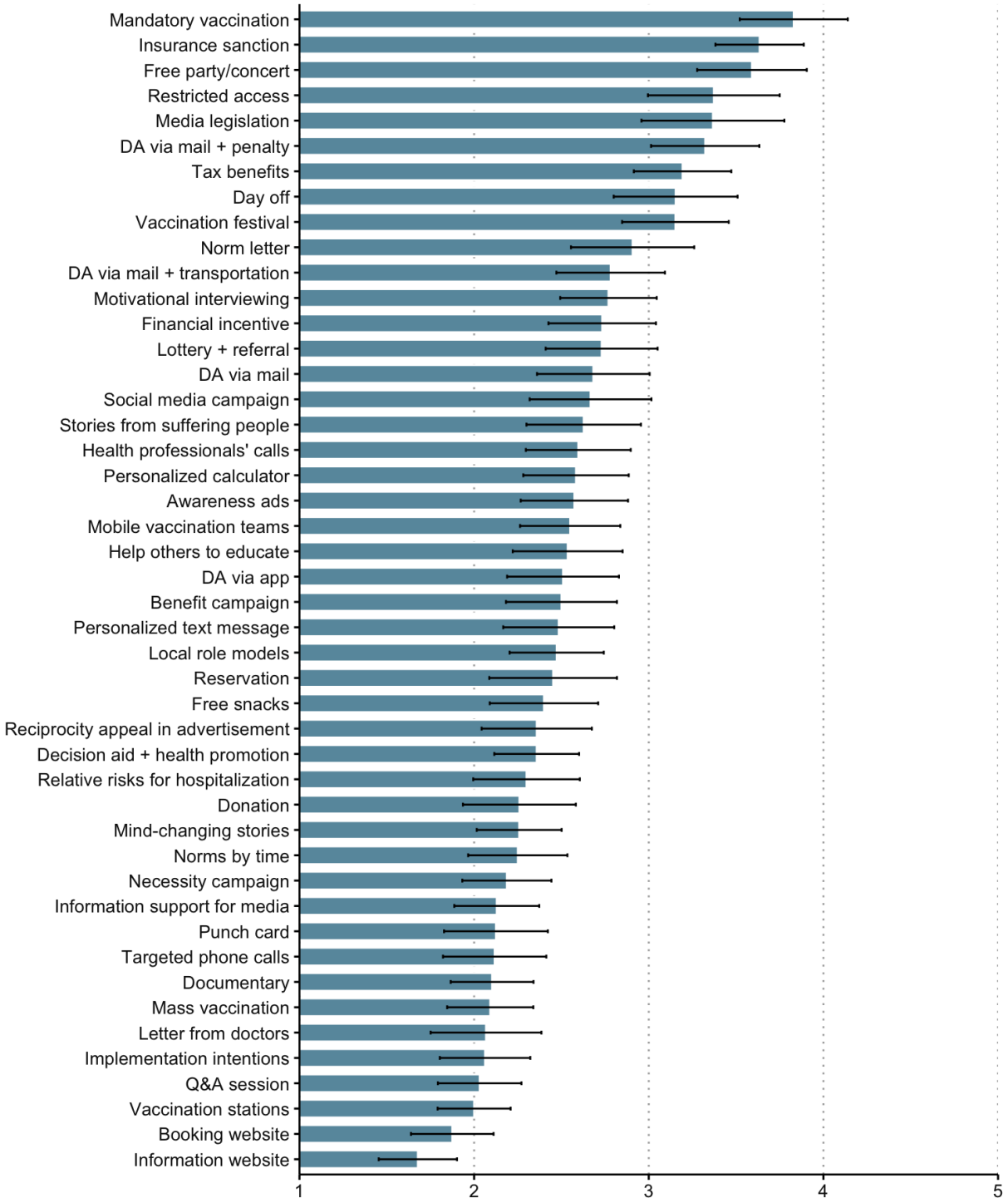

Figure S11. Expert ratings: Mean values in inequity.

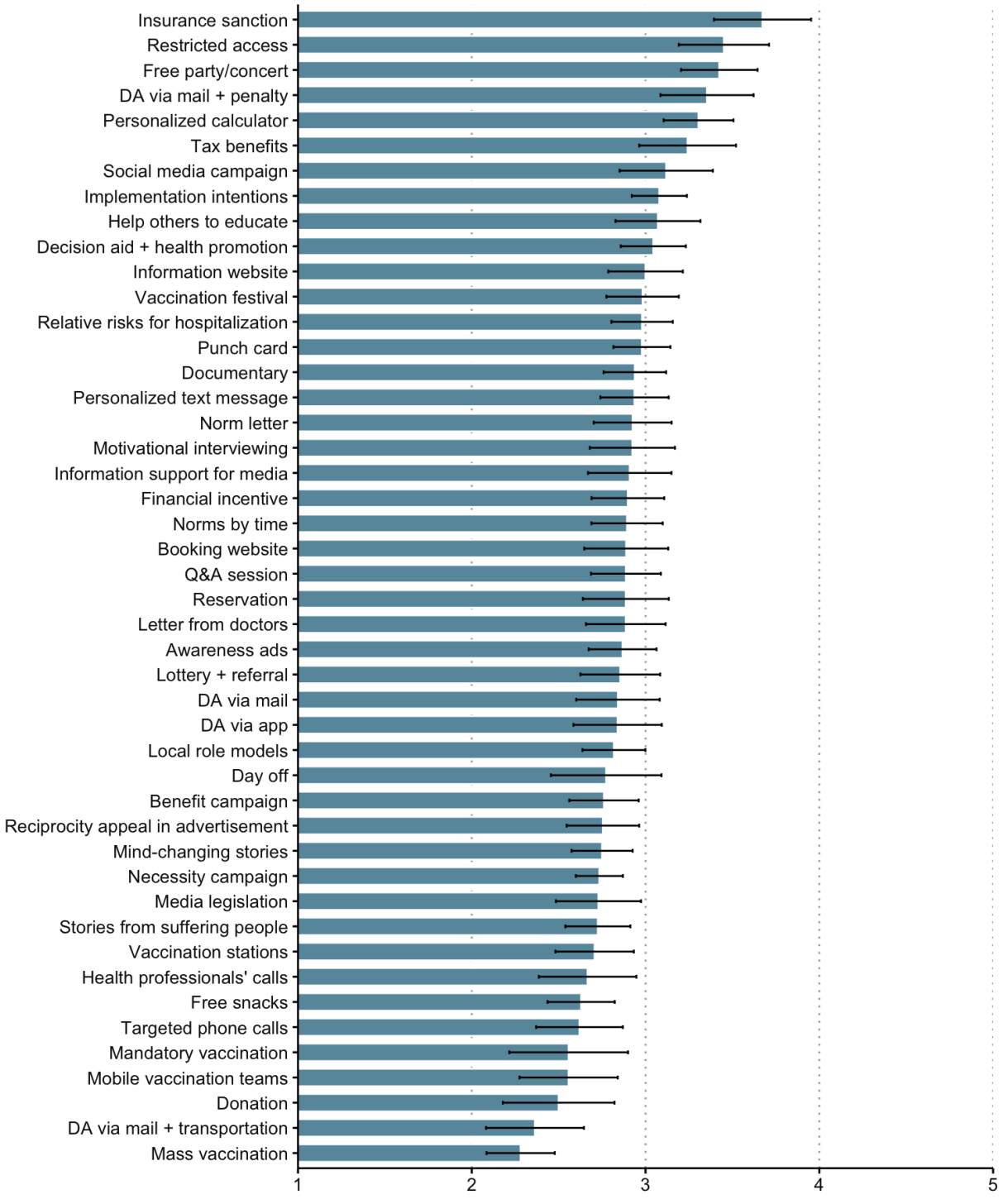

Figure S12. Expert ratings: Mean values in universality across countries.

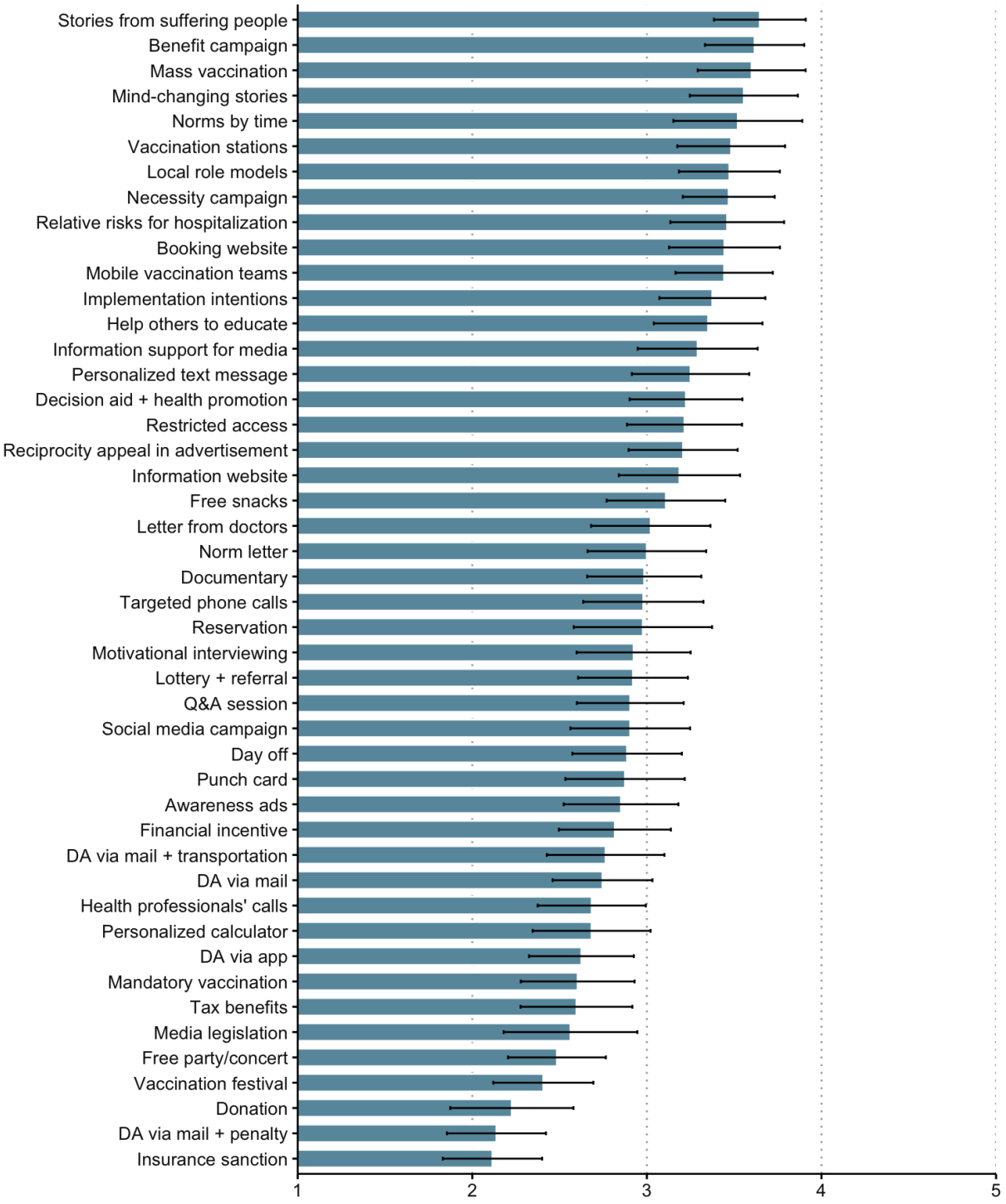

Figure S13. Expert ratings: Mean values in effect on previously unvaccinated people.

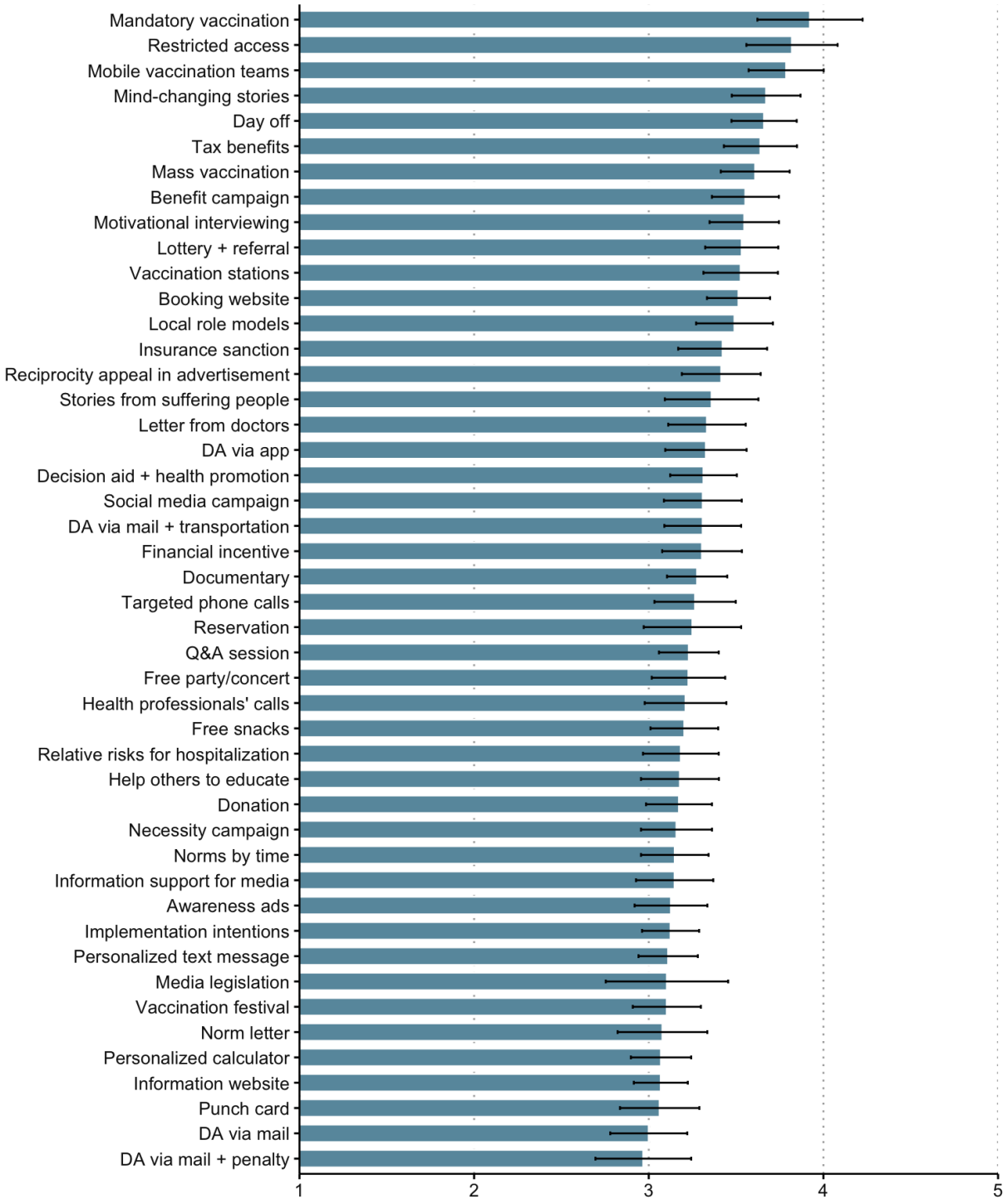

Figure S14. General population ratings: Mean values in effect on booster uptake.

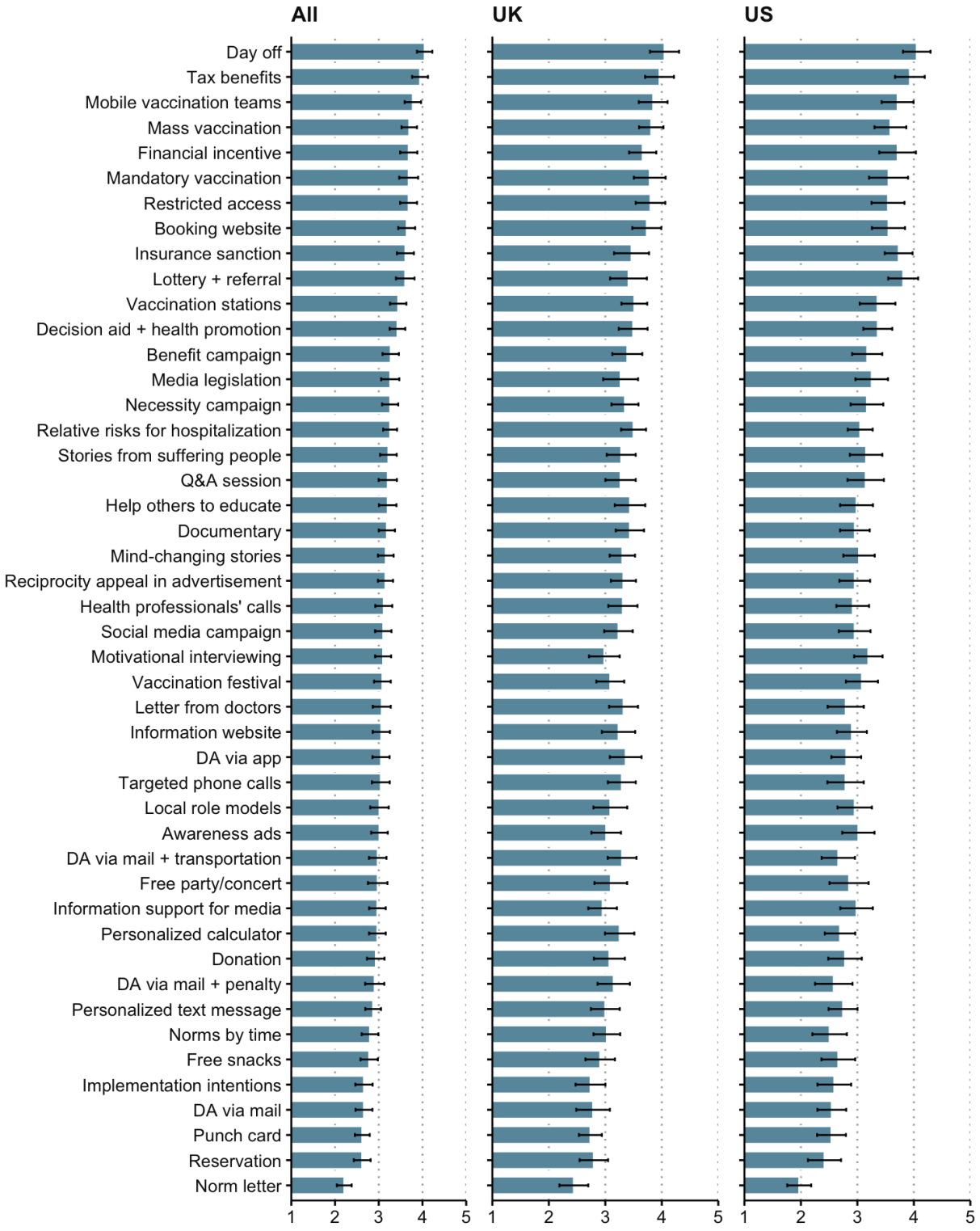

Figure S15. General population ratings: Mean values in effect on own booster intention. Based on subsample of participants who have not yet received a booster vaccine at the time of the study (n=144).

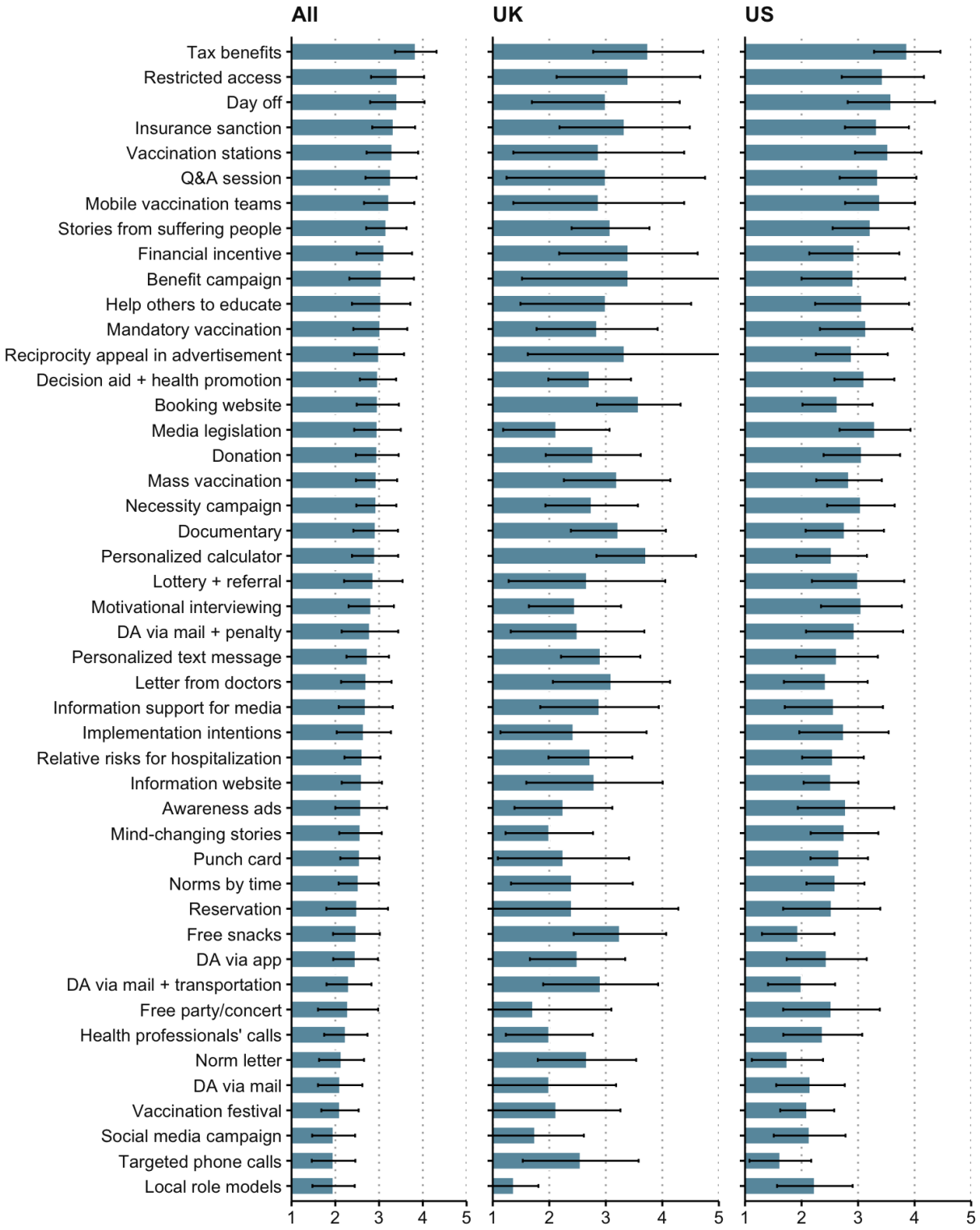

Figure S16. General population ratings: Mean values in perceived coercion.

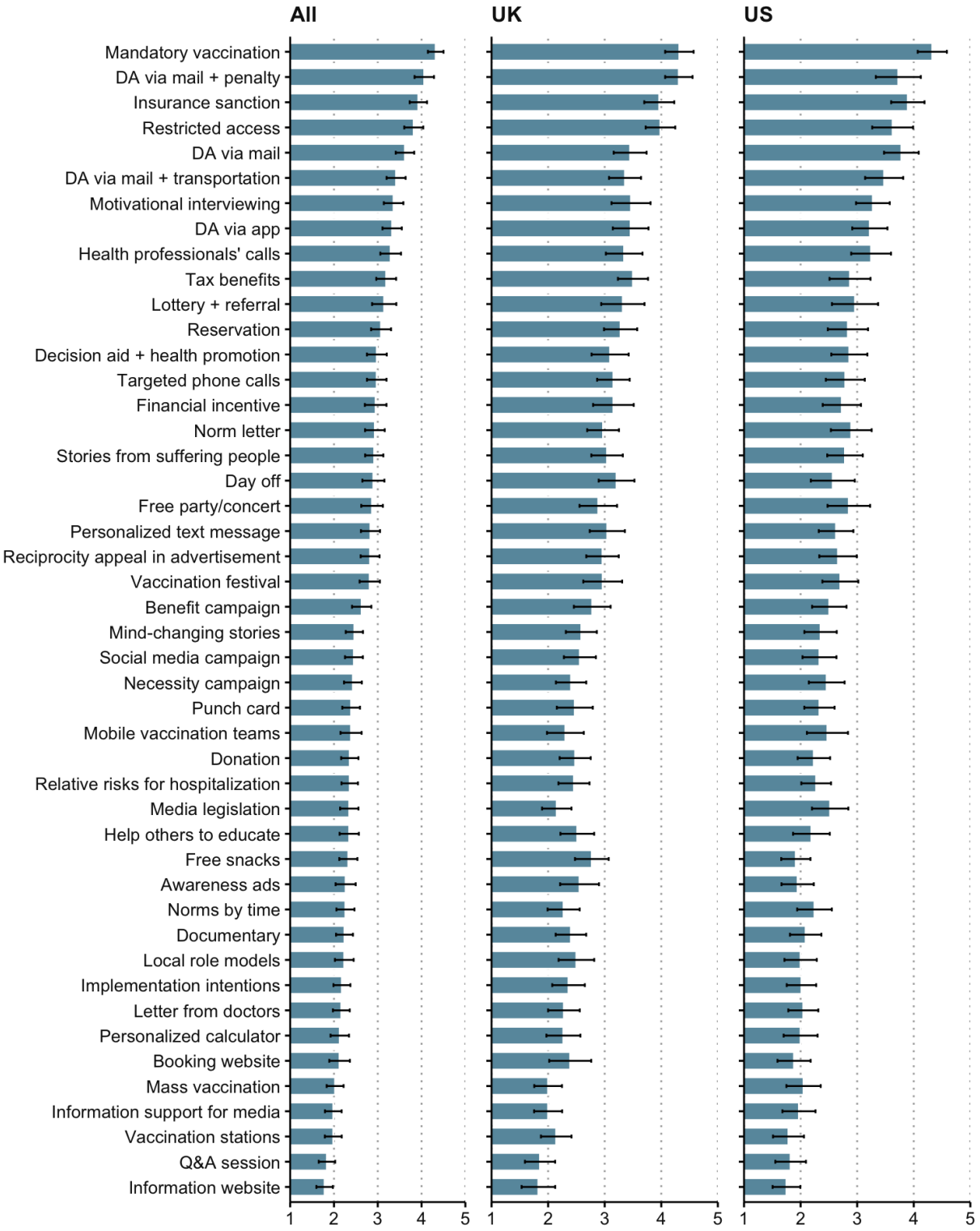

Figure S17. General population ratings: Mean values in reactance.

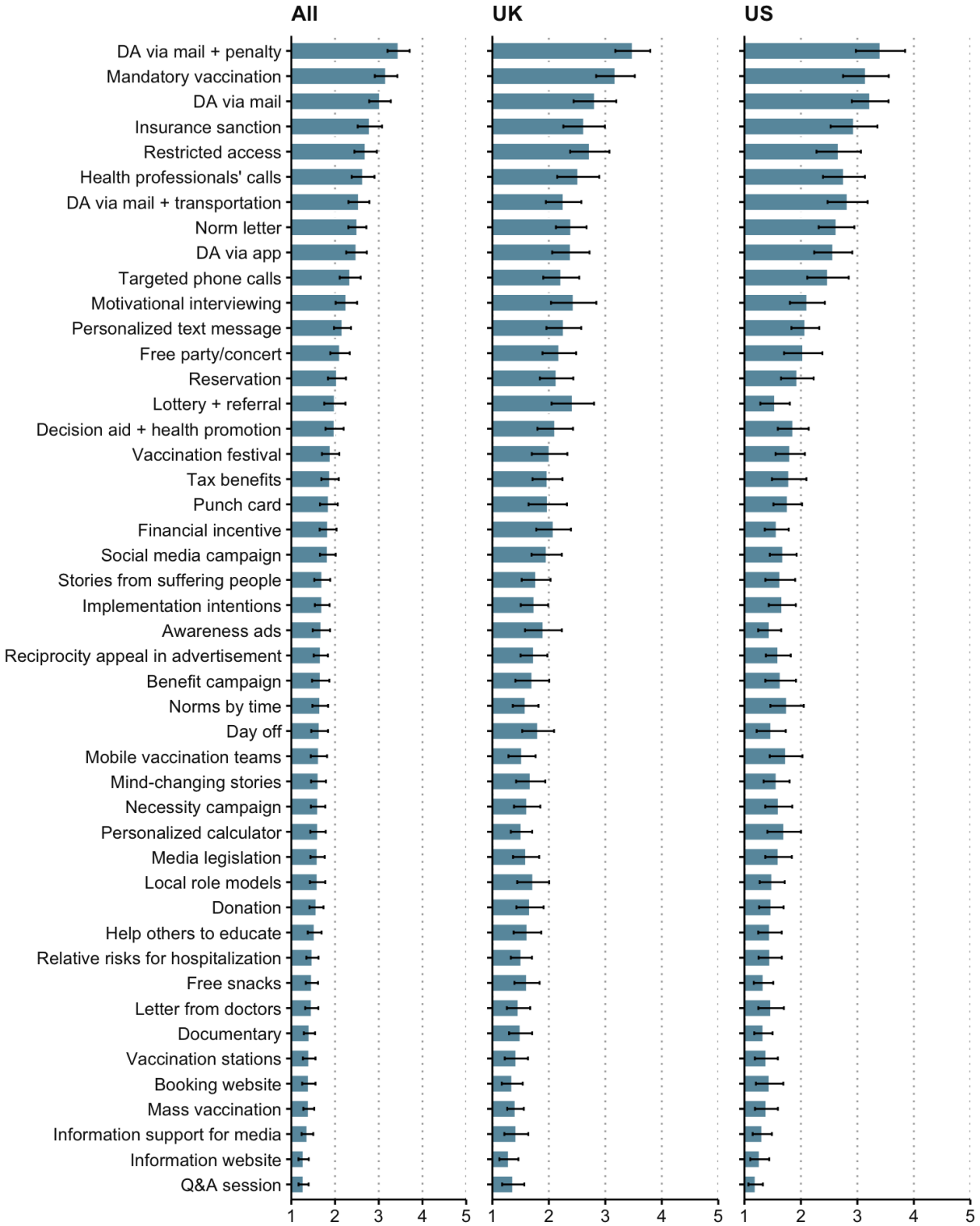

Figure S18. General population ratings: Mean values in acceptability for general population.

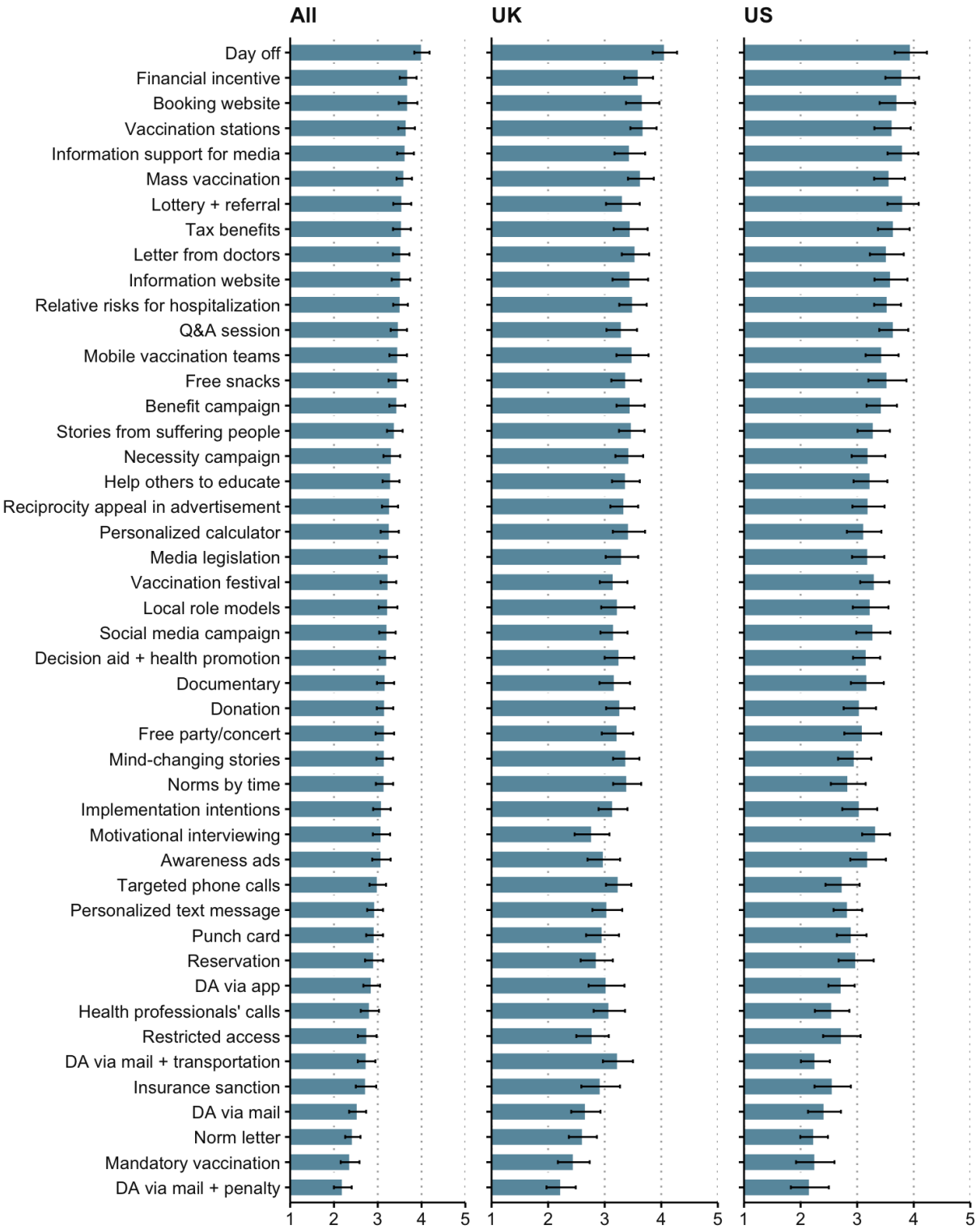

Figure S19. General population ratings: Mean values in activism intentions.

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Crowdsourcing interventions to promote uptake of COVID-19 booster vaccines

Abstract
We apply a novel crowdsourcing approach to provide rapid insights on the most promising interventions to promote uptake of COVID-19 booster vaccines. In the first phase, international experts proposed 46 unique interventions. To reduce noise and potential bias, in the second phase, experts and representative general population samples from the UK and the US rated the proposed interventions on several criteria, including expected effectiveness and acceptability. Sanctions were evaluated as potentially most effective but least accepted. Interventions that received the most positive evaluations regarding both effectiveness and acceptability across evaluation groups were a day off after getting vaccinated, financial incentives, tax benefits, benefit campaigns, and mobile vaccination teams. The results provide useful insights to help governments, companies, and non-governmental institutions in their decision about which interventions to implement.

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