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Vaccination decisions under risk: experimental evidence from the COVID-19 pandemic

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Abstract
We examine how risk preferences influence vaccination decisions and subsequent behavior in a pandemic context. Using data from 2,701 individuals from seven European countries, we employed an incentivized 'virus risk elicitation task', adapted from the bomb risk elicitation task, to elicit individual risk preferences in a health-related context. In the first part of the experiment, all participants faced a risk of infection without the option of vaccination. In the second part, some participants were offered a vaccination option that reduced potential losses from infection. We found that most participants were risk-averse and that there was an inverse U-shaped relationship between risk preferences and vaccination uptake: individuals with risk preferences closer to neutrality were more likely to opt for vaccination. Among participants who chose vaccination, we observed an increase in social interaction, which is consistent with risk compensation behavior. These results provide evidence on the relationship between risk preferences, vaccination decisions, and post-vaccination behavior, offering insights into the drivers of vaccine hesitancy and informing the design of future public health strategies.

Keywords Risk preferences · Covid-19 · Vaccination · Experiment

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1 Introduction

At the start of the COVID-19 pandemic, individuals faced a self-protection dilemma: maintain social interactions and enjoy their benefits, or reduce contact to lower the risk of infection. The introduction of COVID-19 vaccines added a new dimension to this decision. Vaccination reduces both the likelihood of infection and the health risks associated with contracting the virus, but it also entails costs, including the time and effort required to get vaccinated and the possibility of adverse effects. The utility of vaccination varies according to individual risk preferences, which affect how individuals weigh these protective benefits against the associated costs. For some, vaccination offers a sense of security, potentially leading to risk compensation behaviors such as increased social interactions or other risky behaviors (Aslim et al., 2024; Smart & Polachek, 2024). Such changes in behavior may lower the overall societal benefits of vaccination by increasing exposure to the virus, thereby partially offsetting the protective effects of the vaccines. For others, however, no such compensatory behaviors take place, reflecting heterogeneity in responses to risk mitigation (Hwang et al., 2024). These behavioral patterns are consistent with the theoretical framework developed by Ehrlich and Becker (1972), which examines individual decision-making under conditions of uncertainty regarding self-protection and insurance.

This raises the question of how risk preferences affect vaccination decisions. The relationship between risk preferences and vaccine uptake is complex and depends on multiple interrelated factors. On the one hand, risk-averse individuals who do not limit their social interactions may choose to be vaccinated to reduce the potential losses resulting from encountering an infected person. On the other hand, risk-averse individuals who already limit their social interactions may see vaccination as less beneficial, leading to lower vaccination uptake compared to their risk-averse but more socially active counterparts. In this study, we analyzed how different risk preferences map to vaccination decisions, which types of participants are predicted to benefit from vaccination and which are not, and how these types adjust their social behavior after choosing to vaccinate. This is relevant for understanding vaccine hesitancy in the post-pandemic period, as the motives underlying hesitancy may change, and for designing vaccination strategies in future outbreaks, including those caused by avian influenza or other emerging pathogens.[1]

We elicited risk preferences using a framed and modified version of the bomb risk elicitation task (Crosetto & Filippin, 2013; Nielsen, 2019), which we adapted to reflect pandemic conditions and henceforth refer to as the 'virus risk elicitation task' (ViRET). This approach allowed us to examine how individuals weigh the risk of encountering an infected contact against the benefits of social interaction. In this task, we introduced a vaccination option that reduced the costs associated with exposure, thereby adding an additional dimension to the standard risk elicitation

[1] Despite extensive vaccination campaigns, hesitancy remained a substantial obstacle to achieving broad population protection. Even in countries with high overall vaccination rates, a notable share of the population remained hesitant or resistant. For instance, Sabat et al. (2023) found considerable variation in vaccine acceptance across European countries, showing that hesitancy persisted as a public health challenge.

framework.[2] As a result, in addition to capturing self-protection motives (avoiding exposure through reduced social interaction), the ViRET with vaccination also captures self-insurance motives (reducing the costs associated with exposure through vaccination). We applied a classical economic model that assumes individuals care solely about their own welfare, allowing us to isolate the role of self-interest and risk preferences in COVID-19 prevention. This approach abstracts from other possible influences, such as prosocial motives or social norms (e.g., Kourtidis et al., 2024, Böhm and Betsch, 2022, Böhm et al., 2016). We employed a two-part experimental design to study the relationship between risk preferences and vaccination behavior. In the first part, we use the ViRET to elicit individual risk preferences. Based on these results, we apply a theoretical framework to predict vaccination decisions and to analyze how the risk preferences relate to vaccination uptake. In the second part, we examine how vaccination influences subsequent risk-taking behavior, focusing on the trade-off between the benefits of social interaction and the risk of exposure. In addition, we implemented two between-subject treatments to assess how varying the magnitude of organizational costs affects vaccination uptake among individuals with different risk profiles. Unlike most vaccination models (Chapman et al., 2012; Crainich et al., 2019; Courbage & Peter, 2021), which treat vaccination as reducing the probability of infection, our approach treated it as reducing the consequences of exposure.[3] This reflects conditions since the Omicron wave, when vaccines offered limited and waning protection against infection but robust protection against severe disease. The design, therefore, isolated the severity-reduction effect of vaccination by ensuring that vaccination did not affect infection probability. Vaccination solely reduced illness severity conditional on infection. By focusing on this mechanism alone, we examined how risk preferences influence vaccination decisions when the benefit lies in reducing the potential consequences of exposure rather than avoiding infection itself.[4] This approach yields novel theoretical predictions about which risk types should rationally choose vaccination when it functions as self-insurance, with the value of severity reduction varying non-monotonically across risk types. Using a sample from seven European countries and data from the European COVID Survey (ECOS), we examined the influence of socio-demographic variables on risk preferences and vaccination decisions. We also analyzed whether the risk preferences and vaccination decisions observed in the experiment were correlated with actual and past protective behaviors during the pandemic. Our main findings are:

[2] We modeled vaccination as reducing the costs associated with exposure to an infected contact, such as mandatory quarantine, lost work time, PCR testing, or psychological stress, rather than the probability of infection or transmission. This modelling choice reflects the limited and short-lived effectiveness of COVID-19 vaccines against infection and transmission during the Omicron wave, which coincided with our experiment.

[3] Though some studies incorporate both probability and severity reduction (Ibuka et al., 2014; Binder & Nuscheler, 2017).

[4] A related strand of the health economics literature examines risky treatment decisions, which have been modeled as self-insurance interventions that improve health status conditional on disease occurrence without changing disease probability (Pauker & Kassirer, 1975; Bleichrodt et al., 2003; Felder & Mayrhofer, 2014; Courbage & Rey, 2016) Our modeling of vaccination as self-insurance parallels this treatment literature while departing from the conventional vaccination modeling approach.

(1) Vaccination uptake was high and largely independent of organizational cost.
(2) The relationship between vaccination uptake and risk aversion was non-monotonic, consistent with our prediction: the likelihood of choosing vaccination increased as risk aversion moved towards risk neutrality, and then decreased again among more strongly risk-seeking participants.
(3) Among participants who choose vaccination, changes in risk-taking exhibit an inverted U shape: on average, highly risk-averse and highly risk-seeking individuals increase their social contacts less than those with near-neutral risk preferences.
(4) COVID-19-related attitudes and behaviors (e.g., stated reasons for real-world vaccination, adherence to protective measures) helped to explain both vaccination choices and post-vaccination behavior in the experiment, supporting the consistency and plausibility of our results.

This paper contributes to three strands of literature. First, it advances the growing body of research on the determinants of vaccine uptake by investigating the role of individual risk preferences. Previous experimental studies have primarily examined how vaccination intentions are influenced by factors such as defaults, social norms, monetary incentives (e.g., Serra-Garcia and Szech 2023, Klüver et al., 2021, Angerer et al., 2024), regulatory procedures (Angerer et al., 2023), and the public goods nature of vaccination (Reddinger et al., 2024). Additionally, field experiments have evaluated the effectiveness of monetary and non-monetary incentives to promote vaccination (e.g., Schneider et al., 2023, Milkman et al., 2022, Campos-Mercade et al., 2021). For flu vaccination, Nuscheler and Roeder (2016) found that greater risk aversion is associated with a higher probability of vaccination for men but not women. In a similar context, Garrouste et al. (2026) reported that individuals with greater risk aversion are more likely to get vaccinated, using data from a seasonal influenza campaign. By contrast, Angerer et al. (2024) found no significant relationship between incentivized measures of risk preferences and actual COVID-19 vaccination uptake, underscoring the heterogeneity and context dependence of such effects. Similarly, Kalwij (2023) reported that although self-reported risk attitudes are associated with higher infection rates and lower adherence to distancing rules, they do not predict vaccination uptake. Building on this work, our study offers a complementary perspective by isolating risk preferences as an influential factor in vaccination decisions within an experimentally controlled decision environment.

Second, our study contributes to the broader literature on behavioral responses to medical interventions. A recurring concern in this literature is that the availability of effective prevention or treatment can lead individuals to reduce caution, which can partially offset the intended benefits. This phenomenon has been discussed in the context of HIV, where some early studies suggested that access to antiretroviral therapy may have reduced incentives for preventive behavior (e.g., Lakdawalla et al., 2006). However, more recent meta-analyses find that such risk compensation is not universal and varies substantially across populations and settings (Traeger et al., 2018; Doyle et al., 2014). Analogous concerns about risk compensation arose during the COVID-19 pandemic. Aslim et al. (2024) and Smart and Polachek (2024) reported that vaccinated individuals increased social contacts and reduced compli-

ance with distancing measures, which is consistent with risk compensation. However, other studies point to heterogeneity in behavioral responses: Mineyama and Tokuoka (2024) found that, during the COVID-19 pandemic, vaccination increased individuals' risk aversion, particularly among those exposed to greater mortality risk. Similarly, Antonini et al. (2024) reported that individuals who refused vaccination or hesitated to get vaccinated stated a lower willingness to take risks compared to those who were fully vaccinated. We extend these findings by accounting for heterogeneity in this relationship, offering a more detailed explanation of how risk preferences interact with vaccination behavior.

Third, we contribute to the literature using controlled experimental settings to study vaccination decisions.[5] For example, Böhm et al. (2016) identified prosocial motives and concerns about potential side effects as explanations for vaccine hesitancy.[6] More directly related to our study, Binder and Nuscheler (2017) found that risk preferences influence vaccination decisions and that these effects differ by gender. In contrast to Binder and Nuscheler (2017), who elicited vaccination decisions and risk aversion separately, we elicited both within a single incentivized, health-framed decision under risk, allowing us to link vaccination choice directly to the underlying risk preference.

The remainder of this paper is organized as follows: Sect. 2 describes the experimental design and the virus risk elicitation task (ViRET), Sect. 3 develops the theoretical model and derives testable hypotheses, Sect. 4 presents the sample and procedures, Sect. 5 reports the main results, and Sect. 6 concludes with a discussion.

2 Materials and methods

2.1 General design of the ViRET

To measure risk preferences, we used the ViRET, a visual choice task adapted from the bomb risk elicitation task (BRET) (Crosetto & Filippin, 2013).[7] We departed from the standard BRET by adopting the version developed by Nielsen (2019) and adjusted it for application during the COVID-19 pandemic. This framed version aimed to capture how individuals balance the risk of infection against the benefits of social interaction. Previous work by Hermanns and Kokot (2023a) shows that the BRET and the ViRET can yield context-specific differences in elicited risk prefer-

[5] Many studies describe the decision to get vaccinated as a rational choice between the risk of infection and the risk of vaccine side effects. This view relates to the literature on self-protection (e.g., Ehrlich and Becker, 1972), which has traditionally examined financial risks (Dionne & Eeckhoudt, 1985; Eeckhoudt & Gollier, 2005; Peter, 2021a) and health risks (Peter, 2021b; Courbage & Rey, 2016). In these models, side effects and health outcomes enter the decision problem and determine the optimal level of preventive effort. In contrast, in our task, potential vaccine side effects were not included.

[6] Unlike these studies, we focus on individual risk preferences and separated them from other factors such as prosocial influences. Prosocial influences on risk preferences in the context of the pandemic are considered in detail by Hermanns and Kokot (2023b).

[7] It should be noted that the BRET is a very conservative measure, in which participants were more risk-averse than in other measures (see, e.g., Leder et al., 2024).

ences. Because the ViRET placed lower demands on numerical skills, it was well suited to our sample, which included participants from seven European countries with different educational backgrounds.[8]

In the experiment, participants are shown a grid of 25 person icons, each representing potential social contacts (see Appendix A.1 for experimental instructions). Participants are informed that exactly one of these icons represents an infected person, randomly determined for each participant and each round. The probability of encountering the infected persons is fixed at four percent for all participants and all rounds.[9] Participants then choose how many persons they are willing to 'meet' by selecting the corresponding fields (see Fig. 1). This choice represents their risk-taking behavior.

Each uninfected person they 'meet' increases their earnings by €0.04. However, if they meet the infected person, they lose €0.20, yielding no benefit from their meetings.[10] The location of the infected person is revealed only at the end of the experiment. The parameter values are comparable to similar experiments that include BRET (Nielsen, 2019) or ViRET (Hermanns & Kokot, 2023a, b).[11]

Participants' decisions regarding the number of people they choose to meet can be conceptualized as lottery choices.[12] The only non-risky outcomes occur when participants choose to meet either 0 or 25 people. Figure 2 illustrates the 26 possible options available to participants.

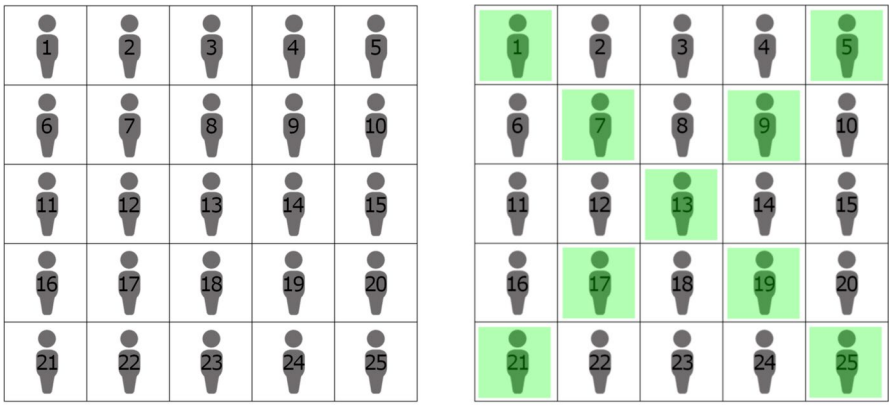


Fig. 1 User interface of choice

[8] On average, 18%, 42%, and 40% of the ECOS sample have a low, mid, or high levels of educational attainment, respectively (Sabat et al., 2024).

[9] This value slightly exceeds the reported incidence at the time of the study.

[10] For example, if none of the nine selected fields contains the infected person, the participant earns €0.36 for that round. Conversely, if one of the fields includes the infected person, they do not receive the €0.36 and incur a loss of €0.20.

[11] We doubled the reward and loss compared to Nielsen (2019)'s "high stakes" condition.

[12] We take an endowment of €0.40 as the reference point and view potential outcomes as either gains or losses.

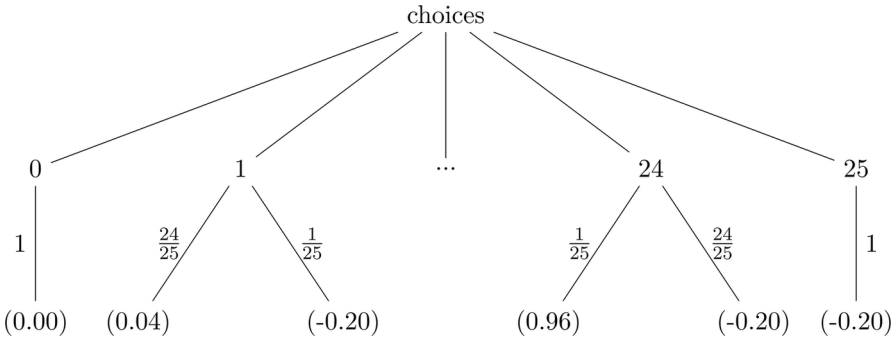


Fig. 2 Outcomes. *Notes:* Payoffs in parentheses

Table 1 Overview of experimental treatments and parameters

	LowVax	HiVax	NoVax
Part I	No vaccination	No vaccination	No vaccination
Gain per non-infected person	0.04	0.04	0.04
Loss due to risk of infection	0.20	0.20	0.20
Part II	Vaccination option	Vaccination option	No vaccination
Gain per non-infected person	0.04	0.04	0.04
Loss due to risk of infection	0.05	0.05	0.20
Vaccination costs	0.02	0.06	–
Subjects	**908**	**884**	**909**

Participants indicate their preferred number of people to meet, denoted as k, where $k \in [0, 25]$. Their decision represents their choice among the available 26 options. Thus, k reflects both the probabilities and outcomes in the following way:

$$L_{k_{NoVacc}} = \begin{cases} 0.04 * k_{NoVacc}, & \text{with } \frac{25-k_{NoVacc}}{25} \\ -0.2, & \text{with } \frac{k_{NoVacc}}{25} \end{cases},$$

Therefore, k_{NoVacc} captures the trade-off between possible outcomes and their corresponding probabilities without the vaccination option. k_{NoVacc} is negatively correlated with the degree of risk aversion. The expected value is calculated as $EV(k_{NoVacc}) = p * 0.04 * k_{NoVacc} + (1 - p) * (-0.2)$ where $p = \frac{25-k_{NoVacc}}{25}$. The expected value $EV(k_{NoVacc})$ reaches its maximum when $k_{NoVacc} = 10$, meaning that a risk-neutral participant would choose to meet $k_{NoVacc} = 10$ people. Participants selecting fewer than 10 people are classified as risk-averse, whereas those selecting more than 10 are considered risk-loving. The gray line in Fig. 10 in Appendix D.2 illustrates the expected payoff across the different values of k_{NoVacc}.

2.2 Experimental treatments

The experiment consists of two parts. In Part I, all participants complete the ViRET. In Part II, participants complete one of three versions of the ViRET: *LowVax*, *HiVax*, or *NoVax*. Table 1 provides an overview of the experimental treatments and parameters.

In *LowVax* and *HiVax* treatments, participants are presented with the option to reduce the potential loss from meeting an infected person by deciding to get vaccinated. Vaccination reduces the loss from €0.20 to €0.05, consistent with the well-established reduction in disease severity due to vaccination (e.g., Lopez Bernal et al., 2021). However, vaccination incurs a cost to the participant, which reflects barriers such as the time required to secure a vaccination appointment, travel expenses, or unpaid time off work. In the *HiVax* treatment, the cost of vaccination is €0.06, whereas in the *LowVax* treatment, it is reduced to €0.02.[13] The experimental treatments differ solely in the cost of vaccination, whereas the potential loss associated with infection remains constant. Figure 3 presents the 26 options available to participants. The *NoVax* treatment, which does not include a vaccination option, serves as a control to account for potential learning effects.

Thus k_{Vacc} indicates both the probabilities and outcomes when the vaccination option is chosen:

$$L_{k_{Vacc}} = \begin{cases} 0.04 * k_{Vacc} - c_v, & \text{with } \frac{25-k_{Vacc}}{25} \\ -(0.05 + c_v), & \text{with } \frac{k_{Vacc}}{25} \end{cases}$$

The choice of k_{Vacc} is influenced by the availability and the cost of the vaccination option. The expected value with vaccination can be calculated as $EV(k_{Vacc}) = p * 0.04 * k_{Vacc} + (1-p) * (-0.05) - c_v$ where $p = \frac{25-k_{Vacc}}{25}$ and c_v is the vaccination cost, set at 0.02 in the *LowVax* treatment and 0.06 in the *HiVax* treatment. The expected value $EV(k_{Vacc})$ reaches its maximum when $k_{Vacc} = 12$. Vaccination becomes cost-effective (solid line in Fig. 10 in Appendix D.2) when participants choose at least 4 people in the *LowVax* treatment and at least 10 people in the *HiVax* treatment. This threshold is represented by the intersection between the vaccination and *NoVax* treatments in Fig. 10.

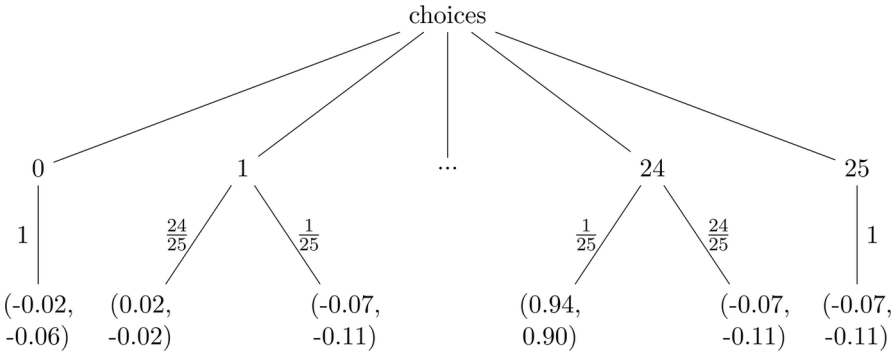


Fig. 3 Outcomes with vaccination. *Notes:* Outcomes in parentheses: Payoffs with vaccination

[13] For example, in the *LowVax* condition, if a participant chooses vaccination and decides to meet four people, that participant would incur a loss of €0.05 if one of these people is infected, resulting in a total loss of €0.07 for that round. Conversely, if none of the four icons represents the infected person, the participant earns €0.16 minus the vaccination cost of €0.02, resulting in a total of €0.14 for that round.

3 Model and predictions

3.1 Theoretical framework

We modeled the vaccination decision of expected utility-maximizing participants who face the risk of exposure to a contagious disease. Individuals derive benefits $B(k)$ from social interactions, where k denotes the number of social contacts. The probability of exposure p (where $0 \leq p \leq 1$) is proportional to both the number of contacts and an exogenous prevalence rate: $p = k * Pr$.

Without vaccination, participants face a trade-off between the benefits of social interaction and the risk of incurring a loss L from exposure to an infected person.[14] Figure 4a illustrates this decision: with probability $(1 - p)$, the participant receives benefit $B(k)$; with probability p, they incur loss L. The participant chooses the number of contacts k^*_{NoVacc} that maximizes their expected utility.

Vaccination offers the option to reduce the loss from exposure (from L to $L_{reduced}$) but requires an organizational cost c_v.[15] As Fig. 4b shows, with vaccination, a participant incurs cost c_v upfront but faces only $L_{reduced}$ if exposed. The participant will choose vaccination if it yields higher expected utility than remaining unvaccinated. The formal derivations, utility functions, and vaccination treatments are provided in Appendix D.1.

3.2 Predicted behavior

To derive concrete predictions about who should vaccinate and how they should adjust behavior, we characterized optimal vaccination decisions based on risk preferences elicited in Part I of our experiment. We employed a constant relative risk aversion (CRRA) utility function of the form $u(k) = k^r$. This approach allowed us

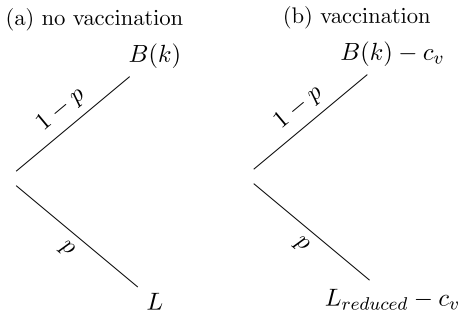


Fig. 4 Choice between no vaccination and vaccination in case of risk encounter

[14] Our model focused on the risk of exposure rather than the direct risk of infection. We frame the consequences of exposure as potential monetary losses (e.g., the cost of PCR testing or lost working hours due to mandatory quarantine after learning about the exposure) rather than as health losses.

[15] Importantly, vaccination does not decrease the probability p of exposure but rather reduces the loss incurred in the event of exposure. Although COVID-19 vaccines can reduce infection risk, during the Omicron wave (available data indicated that this effect was small and waned quickly, whereas protection against severe disease remained stronger and more durable (Andrews et al., 2022; UK Health Security Agency, 2022) Our experiment was administered during this period, and we therefore modelled vaccination as reducing the loss conditional on infection rather than the probability of infection.

to estimate the risk aversion parameter r for each participant and predict their optimal vaccination decision and contact choices in Part II.[16]

Under the CRRA specification, the analysis showed a non-monotonic relationship between risk preferences and optimal vaccination uptake. This pattern emerged because the risk aversion parameter r influences both exposure levels and the valuation of loss reduction. Highly risk-averse participants (choosing few contacts in Part I) have low exposure probability, making vaccination less cost-effective despite their aversion to losses. For highly risk-seeking participants (choosing many contacts), the CRRA framework implies that they place less weight on potential losses, reducing the benefit of vaccination despite greater exposure. Risk-neutral participants who choose a moderate number of contacts face enough exposure risk that vaccination offers a clear reduction in expected losses. This implies an inverse U-shaped pattern: participants who are either risk-averse or highly risk-seeking types are not expected to vaccinate, whereas those with moderate levels of risk-aversion or risk-seeking are expected to vaccinate.

Figure 5a illustrates these predictions across risk types. In the *LowVax* treatment (low organizational cost, $c_v = 0.02$), vaccination is optimal for participants who choose between 3 and 18 social contacts in Part I. When vaccination costs are higher, as in the *HiVax* treatment ($c_v = 0.06$), the advantageous range narrows to those who select 9 to 14 contacts. Solid lines indicate risk types for whom vaccination yields higher expected utility than no vaccination, while dotted lines identify those for whom vaccination is not favorable. A comprehensive mapping from contact choices to predicted utilities is provided in Appendix D.5 (Table 6).

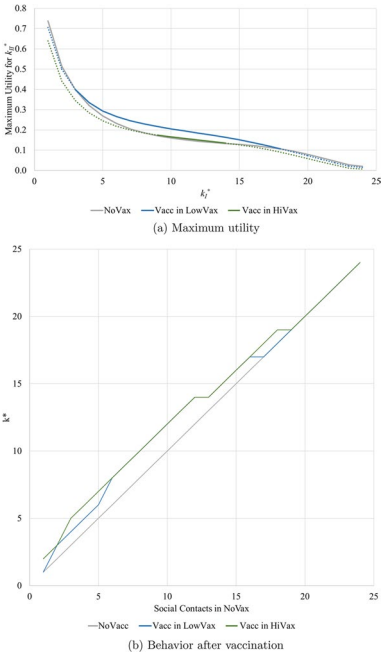


Fig. 5 Predicted utility and behavior after vaccination. *Notes*: (**a**) shows the maximum utility that is possible in Part II for each risk preference type k_I^*. (**b**) shows the corresponding number of social contacts in Part II, k_{II}^*, with which the maximum utility in (a) can be reached. The dashed line in (a) indicates that no vaccination would be optimal in *LowVax* or *HiVax* for the respective k_I^*

[16] A detailed description of the process can be found in Appendix D.4.

Beyond identifying who is expected to vaccinate, the model also predicts how vaccination changes subsequent behavior.[17] In particular, it suggests that the size and even direction of changes depend on individual risk preferences. For participants whose choices in Part I indicate low to intermediate risk-taking (k_I^* between 2 and 16 in *LowVax* and between 1 and 18 in *HiVax*), vaccination is expected to increase the chosen number of social contacts by one or two, as participants take advantage of the lower expected losses from exposure. By contrast, for very risk-averse participants (low k_I^*) and for highly risk-seeking participants (high k_I^*), maintaining their previous contact level remains utility-maximizing even after vaccination.

Figure 5b visualizes these predicted behavioral responses. It shows an inverse U-shaped relationship between risk preferences and the optimal adjustment in the number of social contacts.

3.3 Hypotheses

Building on the implications of our model, we derived three hypotheses and tested them experimentally.[18]

Hypothesis 1 *Treatment comparison*

We have demonstrated that changes in organizational costs influence the benefits of vaccination. Therefore, if vaccination becomes available at a lower cost, it should be advantageous for a broader range of risk preferences. As a result, we hypothesize:

1) *Higher vaccination uptake if costs are lower*.

Hypothesis 2 *Risk preferences and the vaccination decision*

As we have shown, the benefits of vaccination vary across different risk preferences, with vaccination offering the greatest utility for participants with non-extreme risk preferences (i.e., those closer to risk neutrality). Therefore, we hypothesize:

2) *An inverse U-shaped relationship between vaccination uptake and risk-taking, with lower uptake among participants who are either highly risk-averse or highly risk-seeking*.

Hypothesis 3 *Behavior following the vaccination decision*

The decision to vaccinate affects subsequent behavior, particularly the chosen number of social contacts. Based on the CRRA model, we predict that participants

[17] These behavioral predictions describe changes conditional on vaccination and are independent of the predicted vaccination uptake itself.

[18] Note that our hypotheses in the paper were partly restructured from the pre-registration to align with our theoretical model, but all pre-registered hypotheses are addressed: Pre-H1 (contact increase) was differentiated into Hypotheses 3a and 3b (see Fig. 6); Pre-H2 (organizational costs) correspond to Hypothesis 1; Pre-H3 (cross-country heterogeneity) is reflected in Fig. 14 and the regression results (particularly Fig. 8d). Hypothesis 2 in the manuscript (U-shaped relationship) follows from our pre-registered intention to examine "which risk types opt for vaccination".

with moderate risk aversion, risk neutrality, or moderate risk-seeking preferences are most likely to increase their social interactions following vaccination. In contrast, individuals who choose not to vaccinate are not expected to change their contact behavior. Accordingly, we hypothesize:

3a) *No change in behavior for participants who decide against vaccination.*

3b) *An inverse U-shaped relationship between increases in social contacts after vaccination and risk-taking, with smaller increases among participants who are highly risk-averse or highly risk-seeking.*

4 Sample and procedure

Our study involved a large sample of participants from seven European countries: Denmark, France, Germany, Italy, the Netherlands, Portugal, and the United Kingdom.[19] The experiment, integrated within the European COVID Survey (ECOS),[20] allowed for the combination of our experimental findings with a comprehensive dataset on COVID-19-related attitudes and behaviors. The survey wave was conducted between December 2021 and January 2022. At that time, 80 percent had received a first and 50 percent a second dose (European Centre for Disease Prevention and Control. COVID-19 vaccine tracker, 2024).

Participants were randomly assigned to one of the three experimental treatments (*LowVax*, *HiVax*, or *NoVax*). They received instructions regarding the task, the presence of an infected person, and the associated gains and losses. The experiment was pre-registered on aspredicted.org and programmed using Qualtrics.[21] Participants were recruited via the market research company Dynata and were provided with an initial endowment of €0.40.[22] Payouts consisted of a participation fee for completing the survey and additional earnings based on their decisions during the experiment, with payouts received as panel points.[23] To ensure comprehension, participants were required to answer four control questions before starting the task (see Appendix A.2).

We conducted power calculations before launching the experiment, assuming an effect size of 0.30.[24] Based on these calculations, we determined that at least 176 par-

[19] All written materials were translated into the respective languages by native speakers.

[20] See Sabat et al. (2024) for more details about the survey.

[21] Registration-ID: 83933. https://aspredicted.org/mq2h-9z3j.pdf. Note that the pre-registered data collection for control treatment 4 could not take place as planned. As a result, 150 fewer observations were targeted. The condition with neutral framing was included in the subsequent ECOS wave, see Hermanns and Kokot (2023a).

[22] For participants in Denmark and the UK, incentives were presented in equivalent Danish Kroner and Pound Sterling, respectively. Participants were informed that the experiment comprised two rounds, but details of the second round were not provided until they had completed the first one.

[23] Panel points are Dynata's internal credit system used for compensating participants. Points can be converted into cash or vouchers. Thus, they are equivalent to direct monetary payouts.

[24] The effect size was derived using data from Hermanns and Kokot (2023b). We compared the average number of people met by participants who reported a willingness to get vaccinated (mean = 6.27, s.d. = 5.22) and those who did not (mean = 6.34, s.d. = 6.00). Under the assumption of risk neutrality, we estimated that vaccination would lead to an optimal increase of two additional contacts. Weighting this increase by the observed willingness-to-get-vaccinated rates yielded an expected effect size of 0.30.

ticipants per treatment and country were required to achieve 80% statistical power at a 5% significance level. To ensure robust results, we registered a target of recruiting a minimum of 1,260 participants for each experimental treatment. To improve data quality, we restricted our analytic sample to participants who had the instruction page open on their screen for at least 15 seconds. This reduced the size of our sample from n = 3,780 to n = 2,701, leading to 908 participants in the *LowVax*, 884 participants in the *HiVax*, and 909 participants in the *NoVax* treatment. The experiment was designed to last approximately five minutes, with payouts ranging from €0 to €1.80.

From the ECOS survey, we also collected detailed sociodemographic background information. Table 2 reports descriptive statistics for age, gender, and vaccination status. The average age was 37.7 years, 57% of participants were female, and 87% had received at least one vaccine dose.

5 Results

5.1 Risk preferences

Figure 6 shows the number of social contacts per treatment and part. Based on participants' choices in Part I, we measured risk preferences and found that participants were, on average, risk-averse, with a mean score of 6.05 (s.d. 5.62). We also observed cross-country variation in baseline risk preferences: the average number of chosen contacts varied from 4.86 (s.d. 4.56) in France to 7.31 (s.d. 6.99) in Denmark (see Fig. 14 in Appendix E for an overview). As shown in Fig. 12 in Appendix E, nearly 80% of participants displayed risk-averse preferences. As expected, there were no significant differences between the experimental treatments, either in the mean (t-tests: $p > 0.655$) or for the distribution (Kolmogorov-Smirnov tests: $p > 0.548$), suggesting that the random assignment to treatment groups was effective.

These elicited risk preferences formed the basis for predicting the vaccination decisions and contact behavior in Part II at the individual level.

Table 2 Sample

	LowVax		HiVax		NoVax	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Age	39.88	9.71	39.69	10.02	39.69	9.77
Female	0.57	0.50	0.58	0.49	0.57	0.50
Countries						
DE	15.09%		13.91%		13.86%	
DK	14.98%		15.84%		14.74%	
FR	13.11%		12.78%		13.53%	
IT	13.11%		11.88%		13.97%	
NL	15.42%		16.06%		15.40%	
PT	16.52%		16.40%		15.84%	
UK	11.78%		13.13%		12.65%	
Vaccinated	0.87	0.34	0.87	0.34	0.86	0.35
N	908		884		909	

Vaccinated refers to the first dose of vaccination. See Table 5 in Appendix C for further details

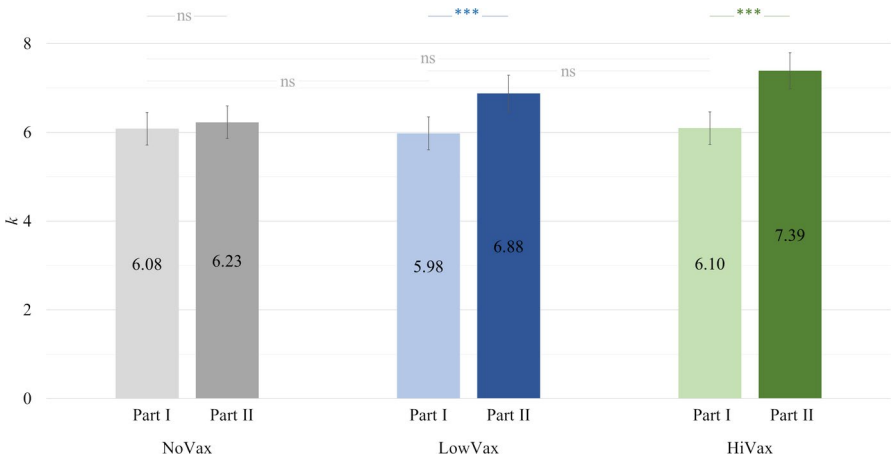


Fig. 6 Social contacts by treatment and part. *Notes:* p-values from t-tests: *ns* not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; confidence intervals at the 95% confidence level

5.2 Vaccination uptake

Based on the distribution of risk preferences, we anticipated an overall vaccination uptake rate of 43% given our prediction in Sect. 3.2. This expectation stemmed from a 64% anticipated uptake among participants in the *LowVax* treatment, contrasting with a significantly lower rate of 21% among those in the *HiVax* treatment. However, the actual overall experimental vaccination uptake was 82%, which was much higher than predicted. Figure 7a shows a rate of 82% in the *LowVax* and 81% in the *HiVax* treatment. Hence, in contrast to Hypothesis 1, we did not observe differences in vaccination uptake between the two treatments ($p < 0.753$).

Result 1: The observed experimental vaccination rates exceeded the predicted rate. We did not find that lower organizational costs led to significantly higher vaccination rates.

Despite the organizational costs, we expected risk preferences to play a role in the decision to get vaccinated. To test this relationship, we conducted probit regressions to determine the likelihood of deciding in favor of vaccination based on risk preferences (k_I^*). As we expected an inverted U-shape relationship, we also included the quadratic term of the number of social contacts (k_I^{*2}) in the model.

The results in Table 3 indicate a non-monotonic relationship between risk preferences and vaccination uptake. Individuals who chose more social contacts in Part I (indicating lower risk-aversion) had a significantly higher probability of opting for vaccination. However, as the number of social contacts increased further (reflecting increasingly risk-seeking behavior), the likelihood of vaccination began to decline. This finding is in line with Hypothesis 2.

Result 2: We observed a non-monotonic relationship between risk preferences and vaccination uptake. Both highly risk-averse and highly risk-seeking participants appeared to be less likely to choose the vaccination compared to those closer to risk neutrality.

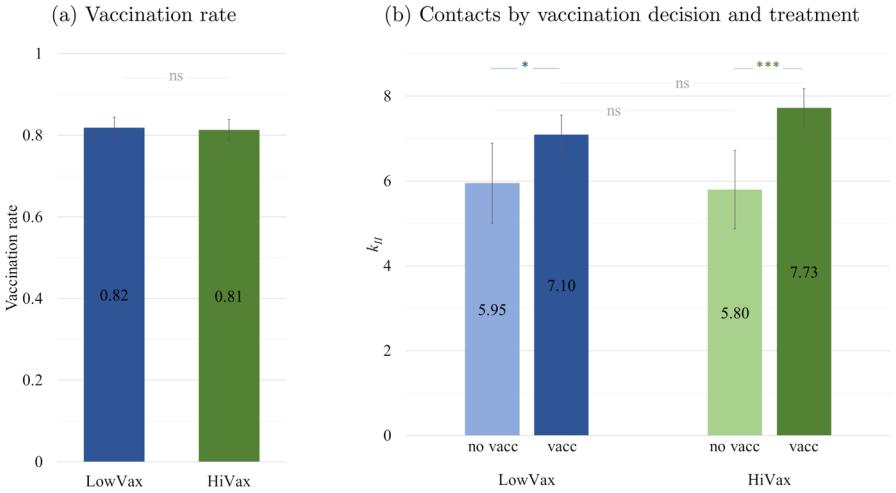


Fig. 7 Vaccination decision and contacts after vaccination decision. *Notes:* *p*-values from t-tests: *ns* not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; confidence intervals at the 95% confidence level

For Models (4) to (6), we extended the regressions by adding demographic controls (age, gender, and country), and an indicator for having received at least one COVID-19 vaccination. The estimated coefficients for female participants were negative, but we did not find that females were significantly less likely to choose vaccination than males. The *LowVax* treatment showed a significant effect in relation to age. With each additional year of age, the probability of choosing vaccination increased by 0.2 percentage points. We did not observe a significant age effect in the *HiVax* treatment.

Figure 8 shows the marginal predictions for vaccination uptake. Figure 8a displays the inverse U-shaped pattern from model (6): vaccination probability peaks at $k_I^* = 11$, which is consistent with our theoretical prediction (see Table 6 in Appendix D.5).[25] This relationship was robust across all regressions, also for the subsamples of *LowVax* and *HiVax* treatments. As shown in Fig. 8b, both treatments exhibit the predicted non-monotonic pattern. The curves are similar in height and curvature, indicating that organizational costs had no clear effect on aggregate vaccination uptake and did not change the relationship between risk preferences and vaccination uptake.

This non-monotonic relationship was robust across treatments. As shown in Fig. 8b, both *LowVax* and *HiVax* treatments exhibit the predicted inverse U-shaped pattern with similar curvature, level, and peak location. This similarity indicates that organizational costs had no clear effect on aggregate vaccination uptake and did not change how vaccination uptake relates to risk preferences.

We observed country-specific variation: Italy showed the highest likelihood of vaccination in the *LowVax* treatment, and Portugal in the *HiVax* treatment, whereas

[25] Please note, due to the highly right-skewed distribution of the number of contacts, we lack a sufficiently large amount of a high number of social contacts to be able to precisely estimate the relationship for more severe risk-seekers.

Table 3 Probit regression results: Experimental vaccination uptake

Experimental vaccination uptake	(1) LowVax	(2) HiVax	(3) Total	(4) LowVax	(5) HiVax	(6) Total
k_I^*	0.052***	0.071**	0.062***	0.058*	0.088*	0.072**
	(0.015)	(0.026)	(0.016)	(0.027)	(0.034)	(0.026)
k_I^{*2}	−0.003***	−0.003*	−0.003***	−0.003*	−0.004*	−0.003**
	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
HiVax			−0.028			−0.040
			(0.084)			(0.095)
Female				−0.190	−0.091	−0.135
				(0.127)	(0.140)	(0.076)
Age				0.015*	0.004	0.009*
				(0.007)	(0.005)	(0.004)
Country						
DE				0.000	0.000	0.000
				(.)	(.)	(.)
DK				0.199***	−0.195***	−0.019
				(0.017)	(0.034)	(0.023)
FR				0.195***	−0.097***	0.049***
				(0.017)	(0.021)	(0.009)
IT				0.610***	0.120***	0.361***
				(0.015)	(0.021)	(0.009)
NL				−0.182***	−0.009	−0.083***
				(0.018)	(0.012)	(0.008)
PT				0.427***	0.224***	0.333***
				(0.011)	(0.015)	(0.008)
UK				0.043*	0.215***	0.132***
				(0.019)	(0.031)	(0.020)
Vaccinated (COVID-19)				2.248***	2.037***	2.126***
				(0.093)	(0.092)	(0.077)
Constant	0.791***	0.690***	0.753***	−1.673***	−1.120***	−1.336***
	(0.059)	(0.085)	(0.089)	(0.271)	(0.243)	(0.159)
N	906	878	1,784	906	878	1,784
Pseudo R^2	0.009	0.012	0.010	0.352	0.294	0.316

Results from probit regressions. Dependent variable: experimental vaccination uptake. Model (1) and Model (4) include only participants from *LowVax*; Model (2) and Model (5) only from *HiVax*. Model (3) and Model (6) include all participants from *LowVax* and *HiVax* treatments. The number of social contacts in Part I, k_I^*, measures risk preferences. Robust standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the Netherlands had the lowest uptake in *LowVax* and Denmark in *HiVax*. To explore this heterogeneity, we estimated separate regressions by country (see Table 8 in Appendix F). Figure 8c shows cross-country variation in level and curvature, but most countries still exhibit the predicted inverse U-shaped relationship between risk preferences and vaccination uptake. This pattern is most pronounced in Denmark and Portugal.

The effect of having been vaccinated against COVID-19 in real life was particularly noticeable. Participants who had already received at least one dose of a COVID-19 vaccine were significantly more likely to choose the vaccine in the experiment.

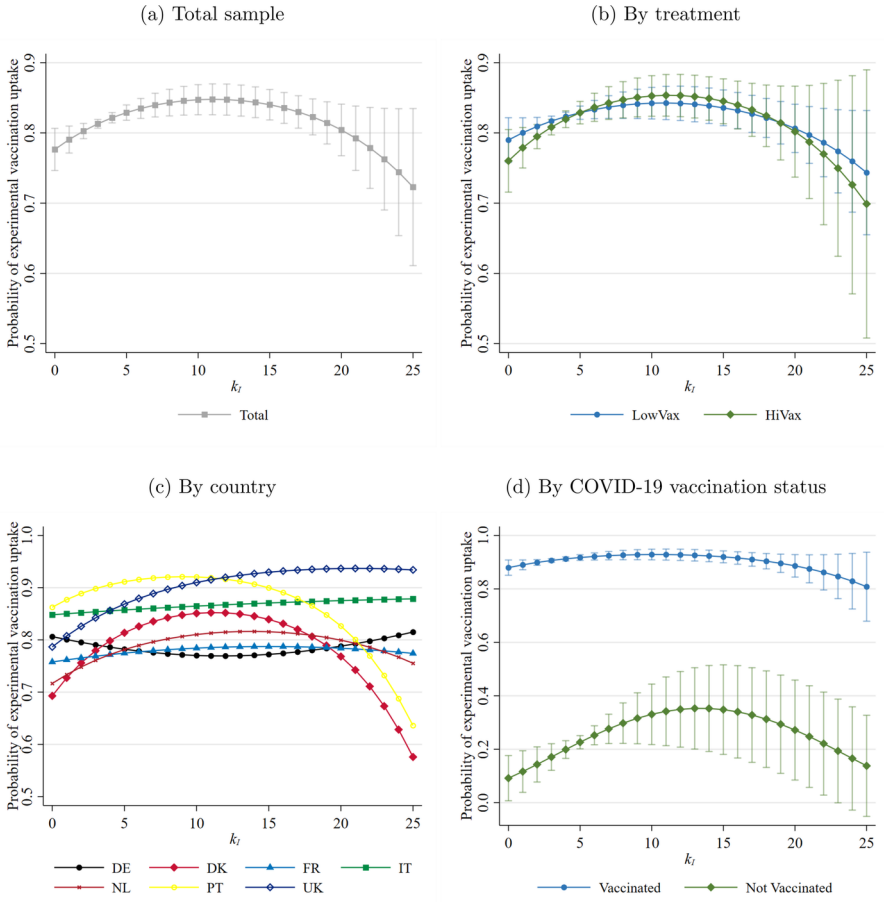


Fig. 8 Marginal predictions of vaccination uptake. *Notes:* Marginal predictions of the experimental vaccination uptake by k_I^*, the number of social contacts in Part I (**a**) from the total sample (model 6), (**b**) comparing *LowVax* (model 4) and *HiVax* (model 5) treatments, (**c**) comparing cross-country differences (regressions from Table 8 in Appendix F), and (**d**) comparing those with and without COVID-19 vaccinated participants (regressions from Table 7 in Appendix F); confidence intervals at the 95% confidence level

In the *LowVax* treatment, the probability of choosing vaccination in the experiment was 37.4 percentage points higher than that of participants who were not vaccinated in real life. In the *HiVax* treatment, the difference was 37.8 percentage points. We also ran separate regressions by COVID-19 vaccination status (see Table 7 in Appendix F). Figure 8d shows the different levels of vaccination uptake by real-life vaccination status. It also shows that the inverse U-shaped pattern appears both among participants who had already been vaccinated and among those who had not.

To further examine the impact of real-life vaccination, we used the detailed data from ECOS on attitudes and beliefs regarding COVID-19 vaccinations and vaccinations in general. The corresponding results can be found in Appendix F in Tables 9, 10, 11 and 12.

Table 9 in Appendix F shows that individuals with strongly negative views toward vaccination were significantly less likely to choose vaccination in the experiment. In particular, participants who strongly disagreed with the statements that vaccines are important for children, are safe, or are effective were 21-22 percentage points less likely to choose vaccination than those who strongly agreed with these statements. Table 10 in Appendix F shows that a higher likelihood of getting vaccinated against COVID-19 in real life was positively associated with the likelihood of choosing vaccination in the experiment. In contrast, we found no significant association between experimental vaccination uptake and the share of vaccinated peers. Participants who reported higher adherence to protective measures such as mask wearing or social distancing were significantly more likely to choose vaccination in the experiment.

Table 11 in Appendix F reports the results for the subsample of participants who were vaccinated against COVID-19. We analyzed how different stated reasons for real-world vaccination (self-protection, protecting family members, ability to travel, reducing the severity of illness if infected, reducing the economic impact on oneself, and returning to pre-COVID-19 life) were related to experimental vaccination choices. In general, the more strongly a participant agreed with one of these reasons, the more likely that participant was to choose vaccination in the experiment.

For unvaccinated participants, we explored the following reasons against vaccination using the regressions in Table 12 in Appendix F: the need for more data, feeling pressured, distrust in global vaccine manufacturers, low vaccination rates among peers or family, a perception that COVID-19 does not pose a threat to one's own health, the opinion that vaccines are not safe, and concerns about complications. In particular, we found that participants who justified their being unvaccinated by stating that they did not want to financially support the global vaccine manufacturers with a COVID-19 vaccination were significantly less likely to choose the vaccination in the experiment than those for whom this was not a reason. Aside from this, we found few significant results, although it must be mentioned that the number of unvaccinated people in our sample was small, making it difficult to draw definitive conclusions about the non-significance of findings.

Overall, these results indicate that, in addition to risk preferences, other factors such as attitudes, beliefs, and motivations may also have played an important role in vaccination decisions during the experiment. Therefore, as detailed in the following Sect. 5.3, we evaluated behavior in Part II based on the vaccination decision made in Part I, treating the vaccination decision as exogenous. For this purpose, the optimal number of social contacts in Part II was evaluated using the predictions in Sect. 3.2, which were based on risk preferences from Part I under the assumption that vaccination had been chosen.

5.3 Behavior change after vaccination

In examining the *NoVax* treatment, we observed no significant differences between Part I and Part II, as illustrated in Fig. 6. This contrasts with the results from the *LowVax* and *HiVax* treatments. In the *LowVax* treatment, the number of social contacts increased by 15% in Part II, whereas in the *HiVax* treatment, there was a 21% increase. To explore these differences further, we investigated the social contact

behavior of participants who chose vaccination compared to those who did not. Figure 7b shows that those without the vaccination had significantly fewer social contacts in Part II than those with vaccination. They maintained a similar level of social contacts in Part II as they did in Part I, with no significant deviations ($p > 0.308$, t-tests), and their social contact levels resembled those in Part II of the *NoVax* treatment ($p > 0.376$, t-tests). This supports Hypothesis 3a, which posits that contact behavior remains unchanged for those who did not receive the vaccination.

Consequently, the variations between Parts I and II in the vaccination treatments can be attributed to those who chose vaccination, as depicted in Fig. 7b. Based on the distribution of risk preferences, we expected an increase in the number of social contacts of 1.01 in the *LowVax* treatment and 1.43 in the *HiVax* treatment for those who chose vaccination. In the *LowVax* treatment, the number of social contacts among participants who chose vaccination increased significantly by 1.12 from Part I to Part II (s.d. 6.30), reaching 7.10, a statistically significant increase compared to those who did not choose vaccination (t-test: $p = 0.035$). Similarly, in the *HiVax* treatment, the number of social contacts for vaccinated participants increased by 1.63 from Part I to Part II, reaching 7.73 (s.d. 6.15). This was also a significant increase for vaccinated individuals compared to their non-vaccinated counterparts (t-test: $p < 0.001$).

Result 3a: Participants who decided against vaccination maintained their previous number of social contacts, showing no meaningful change in behavior once the vaccination option became available. In contrast, participants who chose to vaccinate increased their number of social contacts on average after vaccination.

Up to this point, our analysis has focused on aggregate behavior change among participants who chose vaccination. However, as predicted in Sect. 3.2, we expected that variation in this behavior to be affected by individual risk preferences. In particular, we predicted that participants with very high risk aversion or very high risk seeking would not substantially adjust their contact behavior, and that the observed increase in social contacts in Part II would be driven mainly by participants with less extreme risk preferences.

To explore this, we first examined the data graphically. Figure 9 presents the Part II decisions for each treatment as a function of the corresponding Part I decisions, with 95% confidence intervals. For reference, the dashed line represents the theoretical prediction outlined in Sect. 3.2. In addition to the decisions made after vaccination, we include a comparison of decisions and predictions without prior vaccination.[26]

For both *LowVax* and *HiVax*, the decisions made after vaccination did not appear to deviate strongly from the theoretical prediction. In *LowVax*, the decisions of participants who chose $k_I^* = 1 - 5$ in Part I closely matched the prediction. For $k_I^* = 6 - 12$, the predicted increase in contacts was not fully reached, but the Part II contact levels among more risk-tolerant participants still matched the predicted pattern.[27] In *HiVax*, the observed decisions were consistent with the predictions across

[26] Due to the limited number of decisions made without vaccination in Part II, and to maintain clarity in the visualization, we opted not to display confidence intervals for the decisions in Part II without prior vaccination.

[27] However, it should be noted that the number of observations becomes very small in this range, so no strong conclusions can be drawn.

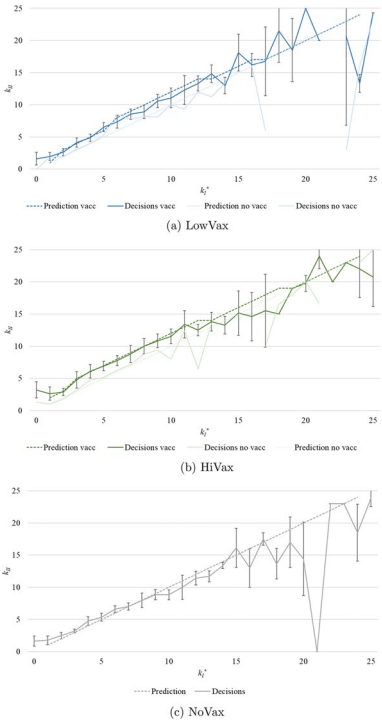


Fig. 9 Behavior change after vaccination compared to prediction. *Notes:* Graphs show k^*_{II}, the optimal number of social contacts in Part II for each k^*_I following the prediction in Sect. 3.2 as dashed line. They also show k_{II}, the mean value of the number of social contacts in Part II, for each k^*_I as a solid line. Confidence intervals at the 95% confidence level

most of the range; visible deviations occurred mainly among the most risk-seeking participants, for whom the estimates were also less precise. Figure 9 further shows that, in both *LowVax* and *HiVax*, post-vaccination decisions generally led to higher numbers of social contacts in Part II than in the corresponding no-vaccination scenarios. Taken together, these results are consistent with Hypothesis 3b.

For *NoVax*, we would not expect a change in the number of social contacts from Part I to Part II, because the decision environment did not change. In other words, the situation corresponds to *LowVax* or *HiVax* if vaccination had not been chosen. Figure 9c shows that the Part II decisions in the *NoVax* treatment were very similar to those in Part I. This matches our prediction.

In the next step, we analyzed changes in behavior after the vaccination decision using an endogenous switching regression. By jointly modeling the vaccination decision[28] and the subsequent change in behavior, this approach allowed us to account for potential selection bias. We again predicted an inverted U-shaped relationship, this time between risk preferences and the increase in social contacts among participants who chose to vaccinate. In these regressions, we included both the linear and quadratic terms of the number of social contacts in Part I.[29] Table 4 reports the switching regression results.

[28] The independent variables in the selection equation were chosen based on the results of the probit regressions (see Table 3).

[29] We reduce the risk of endogeneity bias from unobserved factors affecting social contacts in Part I and Part II through the experimental design and the inclusion of a comprehensive set of control variables.

The positive coefficient for k_I^* combined with the negative coefficient for ${k_I^*}^2$ indicates a non-linear relationship between risk preferences and changes in social contact behavior after vaccination.[30] Participants who chose a higher number of social contacts in Part I, indicating lower risk aversion, tended to further increase their contacts in Part II. However, as the number of chosen contacts in Part I increased further, the additional increase in Part II became smaller. This inverse U-shaped pattern is consistent with our Hypothesis 3b.[31]

The regression results from the total sample indicate that the change in social contacts was significantly larger in the *HiVax* treatment than in the *LowVax* treatment ($p = 0.014$). This suggests that higher vaccination costs were associated with stronger behavioral changes after vaccination.

Beyond this treatment heterogeneity, the switching regression also indicates demographic variation in behavior change. Among vaccinated participants, females increased their number of social contacts significantly less after vaccination ($p = 0.001$), suggesting more cautious post-vaccination behavior. In addition, the increase in social contacts declined significantly with age ($p = 0.001$), suggesting that older individuals maintained more cautious behavior despite vaccination.[32]

We also observed country differences. Using Germany as the reference category (which showed the smallest change), vaccinated participants in Italy displayed the largest increases in social contacts, followed by Denmark and the United Kingdom.

Result 3b: We found evidence of a non-linear relationship between risk preferences and changes in behavior after vaccination. Participants with very high risk aversion and very high risk seeking increased their number of social contacts less after vaccination than participants who were more risk-neutral.

These findings provide evidence that individuals' vaccination decisions and their subsequent behavior, despite involving different potential outcomes, can largely be explained by the risk preferences assessed before the opportunity for vaccination. This suggests a level of consistency in individuals' risk preferences across different decision-making contexts.

Nevertheless, we acknowledge that residual endogeneity from unmeasured individual traits cannot be ruled out.

[30] The switching regression results confirm our earlier finding that behavioral change is specific to those who obtained the benefits of vaccination. All risk-preference coefficients in the unvaccinated regime remained statistically non-significant, consistent with Hypothesis 3a.

[31] When we restricted the analysis to treatment-specific subsamples, the negative quadratic term remained statistically significant, confirming the curvature of the relationship. The linear term remained positive in sign but was no longer statistically significant in the smaller subsamples, likely due to reduced power.

[32] These demographic effects are absent in the unvaccinated regime, where neither gender nor age significantly predict behavioral changes.

Table 4 Switching regression results: Change in behavior in Part II

Change in social contacts from Part I to Part II	(1) LowVax		(2) HiVax		(3) Total	
	NoVacc	Vacc	NoVacc	Vacc	NoVacc	Vacc
k_I^*	−0.011	0.136	−0.184	0.085	−0.088	0.121*
	(0.139)	(0.071)	(0.133)	(0.083)	(0.094)	(0.037)
k_I^{*2}	−0.008	−0.010*	0.001	−0.014**	−0.004	−0.012***
	(0.009)	(0.005)	(0.007)	(0.005)	(0.006)	(0.003)
Female	0.502	−0.085	−0.028	−0.968**	0.304	−0.510***
	(0.655)	(0.145)	(0.284)	(0.327)	(0.364)	(0.152)
Age	0.044	−0.029*	−0.012	−0.036***	0.021	−0.028***
	(0.035)	(0.013)	(0.021)	(0.006)	(0.020)	(0.008)
Country						
DK	−0.289	0.642***	1.105***	1.018***	0.451**	0.881***
	(0.339)	(0.095)	(0.224)	(0.058)	(0.160)	(0.045)
FR	−0.582**	0.534***	−0.133**	−0.084	−0.423**	0.336***
	(0.222)	(0.024)	(0.043)	(0.124)	(0.143)	(0.042)
IT	−0.416***	1.146***	0.637***	0.671***	0.165	1.133***
	(0.107)	(0.035)	(0.111)	(0.093)	(0.159)	(0.073)
NL	0.643***	0.503***	0.013	0.362***	0.411***	0.342***
	(0.098)	(0.041)	(0.047)	(0.085)	(0.041)	(0.013)
PT	1.324***	0.260***	0.790***	0.590***	1.050***	0.608***
	(0.188)	(0.052)	(0.084)	(0.123)	(0.055)	(0.072)
UK	−0.313***	1.020***	−0.032	0.518***	−0.219***	0.693***
	(0.094)	(0.035)	(0.053)	(0.097)	(0.051)	(0.051)
HiVax					0.200	0.375*
					(0.343)	(0.153)
Constant	−1.357	1.692**	1.252	2.610***	−0.432	1.442***
	(2.153)	(0.536)	(1.048)	(0.431)	(1.104)	(0.432)
Selection equation (Vaccination decision)						
	LowVax		HiVax		Total	
k_I^*	0.058*		0.062		0.067*	
	(0.028)		(0.036)		(0.028)	
k_I^{*2}	−0.003*		−0.002		−0.002	
	(0.001)		(0.002)		(0.002)	
Age	0.016*		0.001		0.006	
	(0.007)		(0.005)		(0.005)	
Country						
DK	0.205***		−0.250***		−0.011	
	(0.016)		(0.045)		(0.013)	
FR	0.220***		−0.192**		0.033*	
	(0.020)		(0.068)		(0.013)	
IT	0.643***		−0.114		0.295***	
	(0.019)		(0.092)		(0.032)	
NL	−0.158***		−0.072		−0.028	
	(0.018)		(0.063)		(0.022)	
PT	0.442***		0.118		0.319***	
	(0.012)		(0.071)		(0.016)	
UK	0.057*		0.116**		0.163***	

Table 4 (continued)

Selection equation (Vaccination decision)			
	LowVax	HiVax	Total
	(0.025)	(0.044)	(0.021)
Vaccinated (COVID-19)	2.250***	1.580***	1.803***
	(0.091)	(0.183)	(0.183)
HiVax			−0.025
			(0.093)
Constant	−1.835***	−0.652*	−1.113***
	(0.273)	(0.304)	(0.276)
ρ_0 (NoVacc)	0.098	0.039	0.050
ρ_1 (Vacc)	−0.116***	1.222***	0.887***
Wald test	13.81	21.88	17.99
Observations	906	878	1,784

Results from endogenous switching regressions. Dependent variable: change in number of social contacts from Part I to Part II. Model (1) includes only participants from *LowVax*; Model (2) only from *HiVax*. Model (3) includes all participants from *LowVax* and *HiVax* treatment. Reference country is Germany. The number of social contacts in Part I, k_I^*, measures risk preferences. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Discussion and conclusion

In this study, we examined how risk preferences influence vaccination decisions and subsequent behavior in a controlled experimental setting designed to reflect pandemic conditions. Using a 'virus risk elicitation task' (ViRET), which incorporated a vaccination option with varying organizational costs, we aimed to identify which risk types should optimally choose vaccination, who actually opts for vaccination, and how vaccination affects subsequent risk-taking behavior.

First, we found that the majority of participants displayed high levels of risk aversion. This is consistent with previous studies using the BRET or its adaptations (e.g., Hermanns and Kokot 2023a, b, Costa-Gomes and Schoenegger, 2022, Nielsen, 2019, Crosetto and Filippin, 2013). Moreover, our results indicate that health-related risk contexts, especially those framed in terms of potential infections, further reinforce risk-averse decision-making (Hermanns & Kokot, 2023a).[33]

Second, from a theoretical perspective, we anticipated an inverse U-shaped relationship between risk preferences and vaccination uptake, predicting that individuals close to risk neutrality would be most likely to choose vaccination, whereas those with very high or very low risk aversion would benefit less from vaccination. Empirically, our results support this non-monotonic relationship: individuals who were extremely risk-averse or strongly risk-seeking were less likely to get vaccinated compared to those closer to risk neutrality.

Third, although our theoretical predictions suggested that the vaccination uptake would be highly sensitive to the organizational costs of vaccination, the observed vaccination rates were nearly invariant across the different cost treatments. This suggests that factors beyond standard economic rationales, such as trust in vaccine

[33] We observed similar results to those of Hermanns and Kokot (2023a), who found that participants met fewer people in the ViRET (5.54) compared to the classical BRET (6.36).

efficacy, policy pressures, past experiences, and perceived social norms, may play a more important role (e.g., Sabat et al., 2023, Keser and Rau, 2023). The country-specific differences in vaccine uptake that we found in the experiment are consistent with real-world vaccination decisions (European Centre for Disease Prevention and Control. COVID-19 vaccine tracker, 2024).

Finally, participants who opted for vaccination, on average, increased their number of social contacts. This behavior change supports the notion of 'risk compensation': by reducing the potential severity of infection through vaccination (reduced loss), individuals allowed themselves more social interaction. This result contributes to mixed evidence on risk compensation, with some studies finding no such effect (e.g., Hwang et al., 2024) and other identifying indicators of increased mobility due to vaccination (e.g., Aslim et al., 2024).[34] Moreover, we found some evidence for a U-shaped relationship between risk preferences and the increase in social contacts following vaccination.

Thus, our study provides a behavioral view of why people become more mobile after receiving the vaccine. As predicted, the magnitude of this behavior change showed an inverse U-shaped pattern: Those individuals closer to neutral risk preferences increased their contacts after vaccination more than those who were highly risk-averse or highly risk-seeking. Moreover, our findings provide evidence that individuals' vaccination decisions and subsequent changes in social contact behavior, despite involving different potential outcomes, can largely be explained by the risk preferences assessed prior to the vaccination. This suggests a level of consistency in individuals' risk preferences across different decision-making scenarios.

Our construction of the vaccination decision has limitations. First, our findings are not directly transferable to infectious diseases in which vaccination reduces the probability of infection and thereby protects others. Earlier in the pandemic, vaccines against SARS-CoV-2 were shown to reduce transmission by lowering viral load and shortening the infectious period, particularly for variants such as Alpha and Delta (e.g., Lyngse et al., 2022, Braeye et al., 2023). However, during the Omicron wave (the context of our experiment), these effects were found to be much weaker (e.g., UK Health Security Agency, 2022, Andrews et al., 2022, Braeye et al., 2023, Zhou et al., 2025). On that basis, we modeled vaccination as reducing the costs associated with infection rather than the probability of infection or onward transmission. It also means that our results apply most directly to settings in which vaccination mainly reduces the consequences of infection, and they may not generalize to settings in which vaccination strongly prevents infection and contagion.

Second, in our experimental setting, we abstract from potential vaccination side effects to isolate the direct influence of organizational costs. However, we acknowledge that real-world vaccination decisions can involve weighting two types of risks: the potential side effects of the vaccine versus the risk of infection if one remains unvaccinated (e.g., Binder and Nuscheler, 2017, Nuscheler and Roeder, 2016). However, our approach considers risk aversion solely in the context of assessing the risk of contracting the virus, modeling organizational costs rather than the costs asso-

[34] This reflects behavior observed in the study by Barro (2022), who found that the influence of vaccination on deaths diminished by early 2022 and disappeared in the period from February to May 2022.

ciated with potential vaccine side effects. Additionally, time preferences may also influence vaccination decisions because vaccination can be viewed as an investment with immediate costs and delayed benefits (e.g., Guillon et al., 2024, Nuscheler and Roeder, 2016, Chapman and Coups, 1999). In this study, we focus only on short-term effects, leaving the role of time preferences for future exploration. Third, we abstract from higher-order risk preferences, such as prudence, which has been shown to be associated with adherence to preventive measures (e.g., Courbage and Rey, 2006). Finally, real-world vaccination decisions were often influenced by pro-social considerations, such as helping to avoid overburdening the healthcare system or protecting vulnerable groups. Because our model does not include externalities of individual vaccination decisions, participants had no incentive to act on such motives, even though these are known to influence vaccine uptake in both pandemic and non-pandemic contexts (e.g., Kourtidis et al., 2024, Böhm and Betsch, 2022).

Furthermore, our design is also subject to limitations related to the size of the incentives. The relatively low stakes in each round of the experiment may have reduced the perceived salience of cost differences, which could partly explain the limited variation in vaccination uptake across experimental treatments. This interpretation is consistent with previous evidence indicating that moderate, real monetary incentives can increase vaccination uptake, whereas weaker or non-monetary incentives tend to have only minor effects (Campos-Mercade et al., 2021). In addition, the pronounced differences in vaccination uptake between participants with and without prior real-world vaccination suggest that persistent individual attitudes, social norms, and identity-related motivations likely exerted a stronger influence on participants' vaccination choices than marginal financial costs in this context (e.g., Neumann-Böhme et al., 2023, Sabat et al., 2023).

Overall, our study contributes to the understanding of how risk preferences influence preventive health measures, such as vaccination. Contrary to previous findings (e.g., Antonini et al., 2024, Binder and Nuscheler, 2017, Nuscheler and Roeder, 2016), we demonstrate that the relationship between risk aversion and vaccination uptake is non-monotonic and influenced by the interaction between risk preferences and the perceived benefits and costs of vaccination. In a post-pandemic world, understanding these drivers is essential for designing public health strategies to prevent risk compensation from undermining the protective effects of vaccination campaigns.

Appendix A: Instructions and comprehension questions

Appendix A1: Instructions

LowVax, HiVax, NoVax

At the end of the survey, we would like you to participate in a short experiment. With your participation, you can receive an additional payment in form of panel-points which will be added to your account within 5 weeks after closing this study.

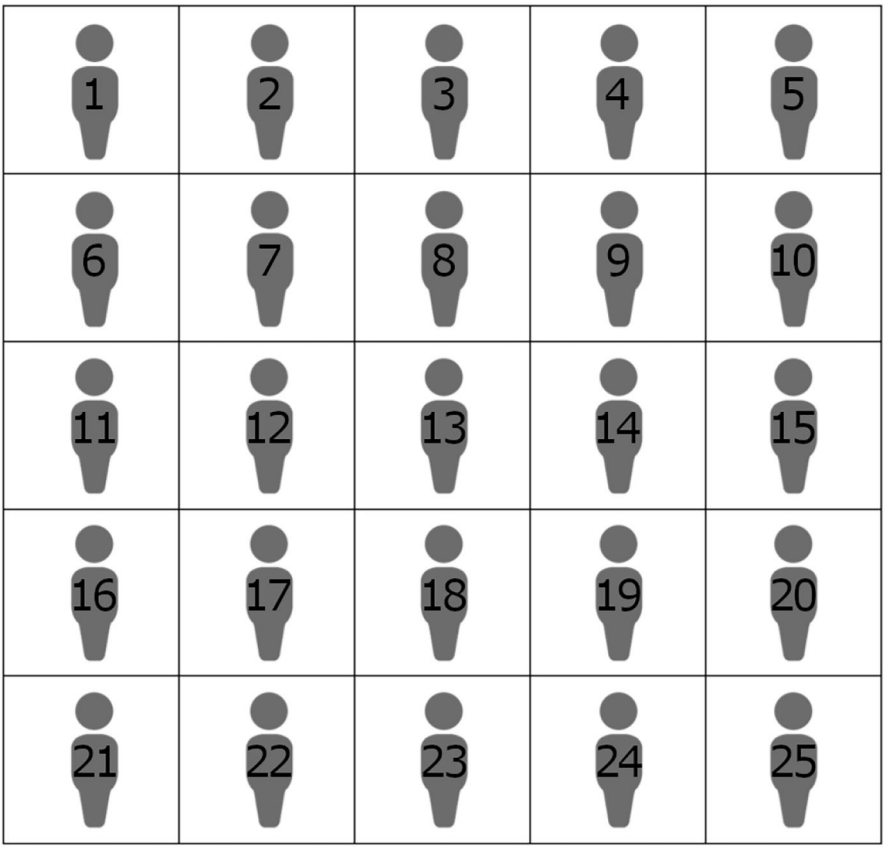
Experiment rules

You now receive a starting balance of 0.40 Euro. The experiment involves 2 decisions. After you have made decision 1, we will explain the second decision situation.

Decision 1

You see a box containing a total of 25 people (see below). Exactly 1 person is infected with the coronavirus, the others are not. You do not know which person is infected. The placement of the infected person is completely random.

Your task will be to decide how many people you are willing to meet. You will be able to meet between 0 and 25 people.



The following 2 situations can occur - leading to the following effects:

1) You have only met people without infection or no people at all: You receive 0.04 Euro per person met in addition to your starting balance because you benefit from meeting people who are not infected with the coronavirus.
2) Among your met people is the person who is infected with the coronavirus: You will have 0.20 Euro deducted from your starting balance because you may be infected yourself. In this case, you will not receive 0.04 Euro per person you met. Click on all people you are willing to meet. Then continue to go to decision 2.

Note: You will only find out who the infected person is after finishing decision 2 and not immediately after clicking on the person. Only click on as many people as you are willing to meet.

Decision 2

You will now begin decision 2

LowVax + [HiVax]

Also, in decision 2, your task is to decide how many people you want to meet.

Before you make your second decision, you have the possibility to get a vaccination. The vaccination is associated with an organisational cost of 0.02 Euro [0.06 Euro], which will be directly deducted from your balance. With a vaccination, only 0.05 Euro would be deducted from your balance if you meet the infected person.

Overview: With vaccination, 0.02 Euro [0.06 Euro] will be directly deducted from your balance. The following 2 situations can occur - leading to the following effects:

1) You have only met people without infection or no people at all: You receive 0.04 Euro per person met in addition to your balance.
2) Among your met people is the person who is infected with the coronavirus: You will have 0.05 Euro deducted from your balance. You will not receive 0.04 Euro per person met.

Without vaccination, the 2 situations are identical to decision 1:

1) You have only met people without infection or no people at all: You receive 0.04 Euro per person met in addition to your balance.
2) Among your met people is the person who is infected with the coronavirus: You will have 0.20 Euro deducted from your balance. You will not receive 0.04 Euro per person met.

NoVax

Decision 2 is identical to decision 1. The following 2 situations can occur - leading to the following effects:

1) You have only met people without infection or no people at all: You receive 0.04 Euro per person met in addition to your balance.
2) Among your met people is the person who is infected with the coronavirus: You will have 0.20 Euro deducted from your balance.

Appendix A2: Comprehension questions

Before you begin, we ask you to answer a few questions to test your understanding of the experiment rules.

Reminder: starting balance of 0.40 Euro if no infected person was met: additional 0.04 Euro per person met if infected person was met: 0.20 Euro deducted from starting balance .

1. Let's assume you meet 2 people (highlighted in green) Person 1, and 3. Person 2 was infected. What impact would that have on you?

(a) receiving additional 0.04 Euro
(b) receiving additional 0.08 Euro
(c) losing 0.20 Euro from starting balance and receiving no additional benefit from meeting people

2. Let's assume you meet 12 people (highlighted in green) Person 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, and 23. Person 2 was infected. What impact would that have on you?

(a) receiving additional 0.24 Euro
(b) receiving additional 0.48 Euro
(c) losing 0.20 Euro from starting balance and receiving no additional benefit from meeting people

3. Again, let's assume you meet people 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, and 23 (highlighted in green). This time, the infected person is person 1. What impact would that have on you?

(a) losing 0.20 Euro from starting balance and receiving no additional benefit from meeting people
(b) losing 0.48 Euro from starting balance and receiving no additional benefit from meeting people
(c) receiving additional 0.28 Euro

4. This time, let's assume you meet ALL 25 people. What impact would that have on you?

(a) losing 0.20 Euro from starting balance and receiving no additional benefit from meeting people
(b) receiving additional 0.40 Euro
(c) receiving nothing in addition but keeping starting balance

Appendix B: Pre-registration

ASPREDICTED

Wharton CREDIBILITY LAB
University of Pennsylvania

CONFIDENTIAL - FOR PEER-REVIEW ONLY

Vaccination and risk preferences in the context of the COVID-19 pandemic (#83933)

Created: 12/23/2021 04:06 AM (PT)

This is an anonymized copy (without author names) of the pre-registration. It was created by the author(s) to use during peer-review.
A non-anonymized version (containing author names) should be made available by the authors when the work it supports is made public.

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
We examine whether and to what extent risk attitudes change when the option of vaccination has been given. We also investigate whether this effect depends on organisational costs associated with vaccination. We would also like to study the selection effect, i.e. which risk types opt for vaccination. We investigate our research questions with a sample from seven European countries.
How individual risk assessment and a vaccination option will interact is not clear. On the one hand, we expect that risk-averse participants will opt for vaccination because it reduces the consequences of meeting a person infected with the coronavirus. On the other hand, we assume that vaccination could be not worthwhile for risk-averse people who do not plan to meet many people anyhow. That would result in this group getting vaccinated less often than the less risk-averse group.
We hypothesise that, on average, participants will increase the number of contacts when vaccination is offered.
We expect that the lower the organisational costs, the more likely vaccination will be chosen.
We hypothesise that individuals' risk preferences and the effects of vaccination are heterogeneous across European countries.

3) Describe the key dependent variable(s) specifying how they will be measured.
People play two rounds of a stylised and framed version of the Bomb risk elicitation task (BRET). In both rounds, they choose how many persons to meet with the goal of not meeting a person with a COVID-19 infection. Decisions are individually incentivised.

4) How many and which conditions will participants be assigned to?
(1) Vaccination opportunity
Part 1: Risk elicitation without the option of vaccination; Part 2: Risk elicitation with the option of vaccination.
(2) Vaccination opportunity with low vaccination costs
Part 1: Risk elicitation without the option of vaccination; Part 2: Risk elicitation with the option of vaccination and low vaccination costs
(3) No vaccination opportunity
Part 1: Risk elicitation without the option of vaccination; Part 2: Risk elicitation without the option of vaccination.
(4) Neutral framing (Germany only)
Part 1: Risk elicitation with BRET framing; Part 2: Risk elicitation with BRET framing.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
On a within-subject level, we study the risk behaviour when vaccination is introduced. On a between-subject level, we plan to test the effects of the height of organisational costs of vaccination. We plan to describe who opts for vaccination. Furthermore, we plan to analyse selection effects, i.e., how risk aversion differs in Part 1 of the experiment between those who later chose vaccination and those who did not.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
We exclude speeders (those below one-fifth of the median time duration taken to complete the experiment).

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
We plan to collect approximately 3930 observations, aged 18 to 55.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
We plan to link the data to the European COvid Survey (ECOS). We aim to investigate whether risk preferences and the preference for vaccination depend on socio-demographic variables. We also plan to test whether risk preferences and the preference for vaccination can be related to actual and past protective behavior during the pandemic. Furthermore, we want to link our results to the acceptability of public health interventions in response to the COVID-19 pandemic. With treatments (3) and (4), we plan to control for learning and framing effects.

Version of AsPredicted Questions: 2.00

Available at https://aspredicted.org/SM9_SJ8

Notes: Note that the data collection for the control treatment 4 (risk elicitation with BRET framing) could not take place as planned. Therefore, 150 fewer observations were targeted. The condition with neutral framing was included in the following ECOS wave, see Hermanns and Kokot (2023a). Note further that our hypotheses in

the paper were partly restructured from the pre-registration to align with our theoretical model, but all pre-registered hypotheses are addressed: Pre-H1 (contact increase): differentiated to Hypotheses 3a/3b, visible in Fig. 6; Pre-H2 (organizational costs): Hypothesis 1; Pre-H3 (cross-country heterogeneity): in Fig. 14 and regression results (especially Fig. 8d). Hypothesis in the manuscript 2 (U-shaped relationship) follows from our pre-registered intention to study "which risk types opt for vaccination."

Appendix C: Supplementary materials: variable description

See Table 5.

Table 5 Variable description
Source: ECOS Survey. For more details, see Sabat et al. (2024)

Variable	Description
Age	Age of participant.
Gender	Sex of the participant.
Country	Country from which the participant originates. DE (Germany), DK (Denmark), FR (France), IT (Italy), NL (Netherlands), PT (Portugal), UK (United Kingdom)
Vaccinated	"Have you already received a vaccination against COVID-19?" [Yes, the first shot; yes, both shots; yes, three shots (booster); not yet, but I intend to; no]
Likelihood of getting vaccinated next week	"Suppose there is a vaccine available for you next week. How likely would you be to get vaccinated against COVID-19 (with any officially approved vaccine)?" [Definitely will not (0); probably will not, might or might not, probably will, definitely will (100)]
Vaccination of peers	"Thinking about your close friends and family, how many people from your close environment have received vaccination against COVID-19?" [None; just a few; about half; most]
Reasons for vaccination	"You stated earlier that you want or have been vaccinated against COVID-19. We would be very interested in the reasons for your decision. To what extent do agree or disagree with the following statements?" [Strongly disagree,..., strongly agree; I don't know] (i) Own protection, "To protect myself against an infection with the coronavirus." (ii) Family's protection, "To protect family members from getting infected." (iii) Vacation/travel, "To be able to go on vacation/travel." (iv) Milder disease, "To have a milder course of the disease, if I get infected." (v) Reducing econ. impact, "To reduce the economic impacts of the pandemic for myself (worse chances on the job market, unemployment etc.)." (vi) Returning to pre-covid life, "To return to my pre-covid life with the liberties I'm used to (e.g. going out to concerts, theatres, restaurants etc.)."
Reasons against vaccination	"You stated earlier that you don't want to be vaccinated against COVID-19. We would be very interested in the reasons for your decision. To what extent do you agree or disagree with the following statements?" [Strongly disagree,..., strongly agree; I don't know] (i) More data, "I want to see more data on the risk/effectiveness relation of vaccines." (ii) Too pressured, "I feel too much pressured by expectation of politicians/society." (iii) Not supp. manufact., "I don't want to support the profit-striving of global vaccine manufacturers." (iv) Few friends & family, "I think that few of my friends and family members are getting vaccinated." (v) No threat, "I don't think that COVID-19 is dangerous to my health." (vi) Vaccine not safe, "I think COVID-19 vaccine may not be safe enough." (vii) Worries complications, "I'm worried about complications because of a previous health condition."

Table 5 (continued)

Variable	Description
Opinion regarding vaccines	"Next, we would like to ask you about your confidence in vaccines in general."
	[Strongly agree, tend to agree, tend to disagree, strongly disagree; don't know]
	(i) Important for children, "Overall, I think vaccines are important for children to have."
	(ii) Safe, "Overall, I think vaccines are safe."
	(iii) Effective, "Overall, I think vaccines are effective."
Adherence to protective measures	"Do you intend to adhere to the protective measures recommended by the WHO?"
	[No; yes, a bit; yes, quite strongly; yes, fully]

Appendix D: Theoretical model and predictions

Appendix D.1: Formal model setup

We model the vaccination decision of expected utility-maximizing individuals who face a risk of exposure to a contagious disease with probability p, where $0 < p \leq 1$. This probability is endogenous, as it depends on the number of social contacts k maintained by the individual, while also incorporating an exogenous prevalence rate Pr of the disease. We express the probability of exposure as: $p = k \cdot Pr$.

Individuals derive benefits from social interactions, represented by the benefit function $B(k)$, which depends on the number of social contacts k.

Decision without vaccination:

When a decision-maker faces exposure risk (i.e., at least having one social contact), they face potential loss L. With probability $(1 - p)$, the individual enjoys benefit $B(k)$ from social interactions; with probability p, they incur loss L. The individual chooses the number of contacts k^*_{NoVacc} that maximizes their expected utility:

$$EU_{NoVacc} = (1 - p) \cdot u(B(k_{NoVacc})) + p \cdot u(-L) \tag{1}$$

where $u(\cdot)$ represents the individual's utility function.

Decision with vaccination:

Vaccination is available at organizational cost c_v. For simplicity, we assume no side effects from vaccination. Crucially, our model focuses on exposure risk rather than direct infection risk. Vaccination does not reduce the probability p but rather reduces the loss incurred upon exposure to $L_{reduced}$, with $L > L_{reduced}$.

With vaccination, the individual chooses contacts k^*_{Vacc} to maximize:

$$EU_{Vacc} = (1 - p) \cdot u(B(k_{Vacc}) - c_v) + p \cdot u(-L_{reduced} - c_v) \tag{2}$$

The expected utility-maximizing individual will choose to vaccinate if:

$$(1 - p) \cdot u(B(k^*_{Vacc}) - c_v) + p \cdot u(-L_{reduced} - c_v) > (1 - p) \cdot u(B(k^*_{NoVacc})) + p \cdot u(-L) \tag{3}$$

This condition captures the trade-off between paying upfront cost c_v to reduce potential losses versus accepting higher losses while avoiding organizational costs.

Appendix D.2: Application to the experimental design

In our experiment, participants face a grid of 25 potential social contacts, exactly one of which represents an infected person. The infection risk is uniformly 4% across all choices. Participants decide how many people *k* they wish to meet.

Payoff structure without vaccination:

If only meeting uninfected persons, each person met yields a gain of €0.04. Meeting the infected person results in a loss of €0.20, with no benefit from any meetings in that part. Taking an endowment of €0.40 as the reference point, the lottery for choosing k_{NoVacc} contacts can be expressed as:

$$L(k_{NoVacc}) = \begin{cases} 0.04 \cdot k_{NoVacc}, & \text{with probability } \frac{25-k_{NoVacc}}{25} \\ -0.20, & \text{with probability } \frac{k_{NoVacc}}{25} \end{cases} \tag{4}$$

The expected value is:

$$EV(k_{NoVacc}) = p \cdot (0.04 \cdot k_{NoVacc}) + (1-p) \cdot (-0.20) \tag{5}$$

where $p = \frac{25-k_{NoVacc}}{25}$. The light gray curves in Fig. 10 (a) and (b) show that the expected value reaches its maximum at $k_{NoVacc} = 10$, meaning a risk-neutral individual would choose 10 contacts. Participants choosing fewer than 10 are classified as risk-averse; those choosing more than 10 are risk-seeking.

Payoff structure with vaccination:

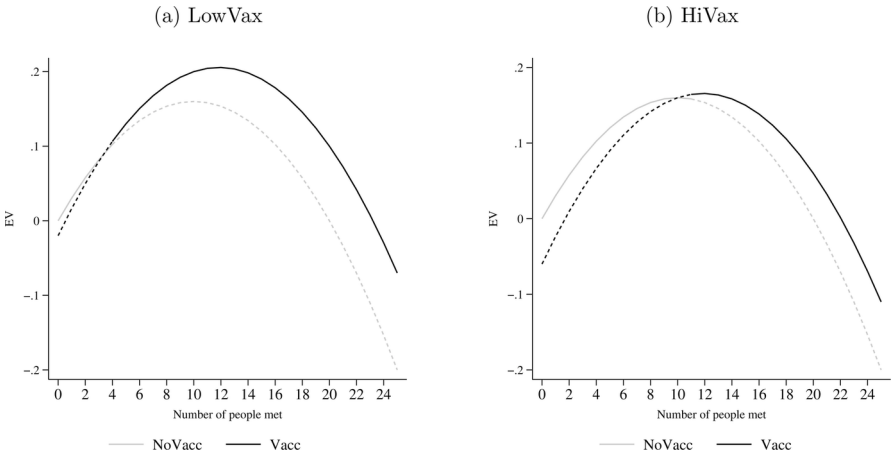


Fig. 10 Expected values. *Notes:* Expected values for every possible number of persons met *k* from 0 to 25 by treatment condition. In light gray the EV of no vaccination and in black the EV of vaccination for (a) *LowVax* and (b) *HiVax*. The curve is solid for the EV-maximizing choice of a given *k*

Vaccination reduces the loss from €0.20 to €0.05 but incurs cost c_v. In the *LowVax* condition, $c_v = €0.02$; in the *HiVax* condition, $c_v = €0.06$. With vaccination, the lottery becomes:

$$L(k_{Vacc}) = \begin{cases} 0.04 \cdot k_{Vacc} - c_v, & \text{with probability } \frac{25-k_{Vacc}}{25} \\ -0.05 - c_v, & \text{with probability } \frac{k_{Vacc}}{25} \end{cases} \tag{6}$$

The expected value with vaccination is:

$$EV(k_{Vacc}) = p \cdot (0.04 \cdot k_{Vacc}) + (1-p) \cdot (-0.05 - c_v) \tag{7}$$

where $p = \frac{25-k_{Vacc}}{25}$. The black curves in Fig. 10a and b show that the expected value maximizes at $k_{Vacc} = 12$. Vaccination becomes cost-effective when $k_{NoVacc} \geq 4$ in *LowVax* and $k_{NoVacc} \geq 10$ in *HiVax*. These thresholds represent where the vaccination and no-vaccination expected value curves intersect.

Appendix D.3: CRRA utility specification

To map choices to risk preferences, we employ the constant relative risk aversion (CRRA) utility function $u(x) = x^r$, where r is the risk aversion parameter. For $r < 1$, the individual is risk-averse; $r = 1$ indicates risk neutrality; $r > 1$ indicates risk-seeking preferences.

An expected utility maximizer chooses k_I^* to maximize:

$$EU_{NoVacc}(k) = \frac{25-k}{25} \cdot (0.04k)^r + \frac{k}{25} \cdot (-0.20)^r \tag{8}$$

For each observed choice k_I in Part I, we can infer the range of r values for which that choice is optimal. Appendix D.5 (Table 6) presents these ranges. For example, choosing $k_I = 5$ implies $0.449 \leq r < 0.548$, with mean $r = 0.499$. Choosing $k_I = 10$ (risk-neutral) corresponds to $0.947 \leq r < 1.055$, with mean $r = 1.001$.

Appendix D.4: Prediction procedure

For each risk type (identified by k_I from Part I), we characterize optimal behavior in Part II under expected utility maximization as follows:

Step 1: Extract the range of r consistent with the observed choice k_I.

For a given choice $k_I \in \{1, 2, \ldots, 24\}$ in Part I, we determine the range of risk aversion parameters $[r_{min}, r_{max}]$ for which this choice maximizes expected utility as specified in Appendix D.3. Specifically, k_I is optimal if:

$$EU(k_I; r) > EU(k; r) \quad \forall k \neq k_I \tag{9}$$

where $EU(k; r) = \frac{25-k}{25} \cdot (0.04k)^r + \frac{k}{25} \cdot (0.20)^r$. This defines a continuous interval $[r_{min}(k_I), r_{max}(k_I)]$ for each k_I, as shown in Appendix D.5 (Table 6).

Step 2: Calculate the representative risk preference.

For computational tractability and to generate point predictions, we calculate the mean value of *r* within the identified range:

$$\bar{r}(k_I) = \frac{r_{min}(k_I) + r_{max}(k_I)}{2} \tag{10}$$

This representative value $\bar{r}(k_I)$ characterizes the typical risk preference of individuals who chose k_I contacts in Part I. For example, individuals choosing $k_I = 10$ have $\bar{r} = 1.00$, close to risk neutrality.

Step 3: Calculate expected utility for all possible Part II choices.

For each possible choice $k_{II} \in \{0, 1, \ldots, 25\}$ in Part II, we calculate expected utility under three conditions:

(a) Without vaccination (NoVax or NoVacc in LowVax/HiVax):

$$EU_{NoVax}(k_{II}; \bar{r}) = EU_{NoVax}(k_I; \bar{r}) = \frac{25 - k_{II}}{25} \cdot (0.04 \cdot k_{II})^{\bar{r}} + \frac{k_{II}}{25} \cdot (-0.20)^{\bar{r}} \tag{11}$$

(b) With vaccination in LowVax ($c_v = 0.02$):

$$\begin{aligned} EU_{LowVax}(k_{II}; \bar{r}) = & \frac{25 - k_{II}}{25} \cdot (0.04 \cdot k_{II} - 0.02)^{\bar{r}} \\ & + \frac{k_{II}}{25} \cdot (-0.05 - 0.02)^{\bar{r}} \end{aligned} \tag{12}$$

(c) With vaccination in HiVax ($c_v = 0.06$):

$$\begin{aligned} EU_{HiVax}(k_{II}; \bar{r}) = & \frac{25 - k_{II}}{25} \cdot (0.04 \cdot k_{II} - 0.06)^{\bar{r}} \\ & + \frac{k_{II}}{25} \cdot (-0.05 - 0.06)^{\bar{r}} \end{aligned} \tag{13}$$

These calculations are performed for all 26 possible values of k_{II}, generating the complete utility landscape for each risk type, treatment condition, and conditional on each vaccination decision. We show in Fig. 11 the predicted expected utilities for the choices k_{II} in Part II for the various risk preferences that are based on the choice in Part I.

Step 4: Identify optimal choices in each condition.

For each condition, we identify the contact choice that maximizes expected utility:

$$k^*_{NoVax} = \arg \max_{k_{II} \in \{0,\ldots,25\}} EU_{NoVax}(k_{II}; \bar{r}) = k^*_I \tag{14}$$

$$k^*_{LowVax} = \arg \max_{k_{II} \in \{0,\ldots,25\}} EU_{LowVax}(k_{II}; \bar{r}) \tag{15}$$

$$k^*_{HiVax} = \arg \max_{k_{II} \in \{0,\ldots,25\}} EU_{HiVax}(k_{II}; \bar{r}) \tag{16}$$

In the vaccination conditions, the optimal choice k^*_{Vacc} assumes the individual has already decided to vaccinate. This represents the contact level that maximizes utility conditional on vaccination.

Step 5: Determine vaccination optimality.

Vaccination is optimal if the maximum utility achievable with vaccination exceeds the maximum utility without vaccination. We compare the highest expected utility values:

$$\text{Vaccinate in } LowVax \text{ if: } \max_k EU_{LowVax}(k;\bar{r}) > \max_k EU_{NoVax}(k;\bar{r}) \tag{17}$$

$$\text{Vaccinate in } HiVax \text{ if: } \max_k EU_{HiVax}(k;\bar{r}) > \max_k EU_{NoVax}(k;\bar{r}) \tag{18}$$

For each risk type k_I, Appendix D.5 (Table 6) indicates whether vaccination is optimal (shown in bold) by comparing these maximum utilities. When vaccination is optimal, the solid line in Fig. 5a shows the higher utility trajectory.

Step 6: Calculate predicted behavioral change.

For individuals for whom vaccination is optimal, we predict the change in social contacts:

$$\Delta k = k^*_{Vacc} - k_I \tag{19}$$

This difference represents the optimal adjustment in behavior after vaccination. Appendix D.5 (Table 6) displays Δk for each risk type where vaccination is beneficial, with the direction indicator ($\nearrow$ for increase, $\bullet$ for no change). For individuals for whom vaccination is not optimal, we predict no behavioral change ($\Delta k = 0$), as their Part I decision remains optimal in Part II without the vaccination option.

These six steps generate the complete set of predictions presented in Appendix D.5 (Table 6) and visualized in Fig. 5, forming the basis for our three experimental hypotheses.

Appendix D.5: Predictions under CRRA

See Table 6 and Fig. 11.

Table 6 Predictions based on estimates of r from k_I^*, assuming CRRA $u(k) = k^r$

					NoVax		Vac in LowVax			Vac in HiVax		
k_I^*	$[r_{min}, r_{max}]$			$\bar{r}$	k_{II}^*	EU	k_{II}^*	EU	Δ	k_{II}^*	EU	Δ
1	0	$\leq$ r $\leq$	0.134	0.067	1	0.738	1	0.705		2	0.639	
2	0.135	$\leq$ r $\leq$	0.239	0.187	2	0.514	3	0.499		3	0.441	
3	0.240	$\leq$ r $\leq$	0.345	0.293	3	0.398	**4**	**0.399**	↗	5	0.345	
4	0.346	$\leq$ r $\leq$	0.448	0.397	4	0.321	**5**	**0.335**	↗	6	0.285	
5	0.449	$\leq$ r $\leq$	0.548	0.499	5	0.269	**6**	**0.294**	↗	7	0.245	
6	0.549	$\leq$ r $\leq$	0.647	0.598	6	0.232	**8**	**0.266**	↗	8	0.218	
7	0.648	$\leq$ r $\leq$	0.745	0.697	7	0.205	**9**	**0.245**	↗	9	0.199	
8	0.746	$\leq$ r $\leq$	0.844	0.795	8	0.186	**10**	**0.230**	↗	10	0.185	
9	0.845	$\leq$ r $\leq$	0.946	0.896	9	0.171	**11**	**0.217**	↗	**11**	**0.174**	↗
10	0.947	$\leq$ r $\leq$	1.055	1.001	10	0.160	**12**	**0.206**	↗	**12**	**0.166**	↗
11	1.056	$\leq$ r $\leq$	1.172	1.114	11	0.151	**13**	**0.195**	↗	**13**	**0.158**	↗
12	1.173	$\leq$ r $\leq$	1.303	1.238	12	0.144	**14**	**0.184**	↗	**14**	**0.150**	↗
13	1.304	$\leq$ r $\leq$	1.452	1.378	13	0.138	**14**	**0.174**	↗	**14**	**0.143**	↗
14	1.453	$\leq$ r $\leq$	1.626	1.540	14	0.133	**15**	**0.163**	↗	**15**	**0.135**	↗
15	1.627	$\leq$ r $\leq$	1.837	1.732	15	0.128	**16**	**0.151**	↗	16	0.126	
16	1.838	$\leq$ r $\leq$	2.101	1.970	16	0.123	**17**	**0.138**	↗	17	0.116	
17	2.102	$\leq$ r $\leq$	2.445	2.274	17	0.116	**17**	**0.123**	•	18	0.104	
18	2.446	$\leq$ r $\leq$	2.914	2.680	18	0.106	**18**	**0.107**	•	19	0.090	
19	2.915	$\leq$ r $\leq$	3.581	3.248	19	0.094	19	0.090		19	0.075	
20	3.582	$\leq$ r $\leq$	4.584	4.083	20	0.079	20	0.073		20	0.058	
21	4.585	$\leq$ r $\leq$	6.184	5.385	21	0.062	21	0.055		21	0.042	
22	6.185	$\leq$ r $\leq$	9.121	7.653	22	0.045	22	0.038		22	0.026	

Table 6 (continued)

					NoVax		Vac in LowVax			Vac in HiVax		
k_I^*	$[r_{min}, r_{max}]$			$\bar{r}$	k_{II}^*	EU	k_{II}^*	EU	Δ	k_{II}^*	EU	Δ
23	9.122	$\leq$ r $\leq$	16.286	12.704	23	0.028	23	0.021		23	0.012	
24		r $\geq$	16.287	16.287	24	0.021	24	0.015		24	0.007	

For each k_I^*, the selected social contacts in *NoVax* the implied range of $[r_{min}, r_{max}]$ assuming the CRRA function $u(k) = k^r$ is stated. Taking the mean value $\bar{r}$ of this range for *r*, the EU value refers to the optimal amount of social contacts k_{II}^* for *NoVax* (which is similar to k_I^*), as well as in *LowVax* and *HiVax* if the vaccination would be chosen. If k_{II}^* and *EU* is written in bold, the possible EU value in *LowVax* or *HiVax* is larger than in *NoVax*, meaning an expected utility maximizer should get vaccinated. In this case, in Δ, the difference between the k_{II}^* in *NoVax* and in *LowVax* or *HiVax* is indicated. The symbol shows whether the behavior should change after the vaccination. If $\nearrow$ is displayed, it is optimal to increase social contacts after vaccination, given the risk preference. If $\bullet$ is displayed, keeping the amount of social contacts constant is optimal

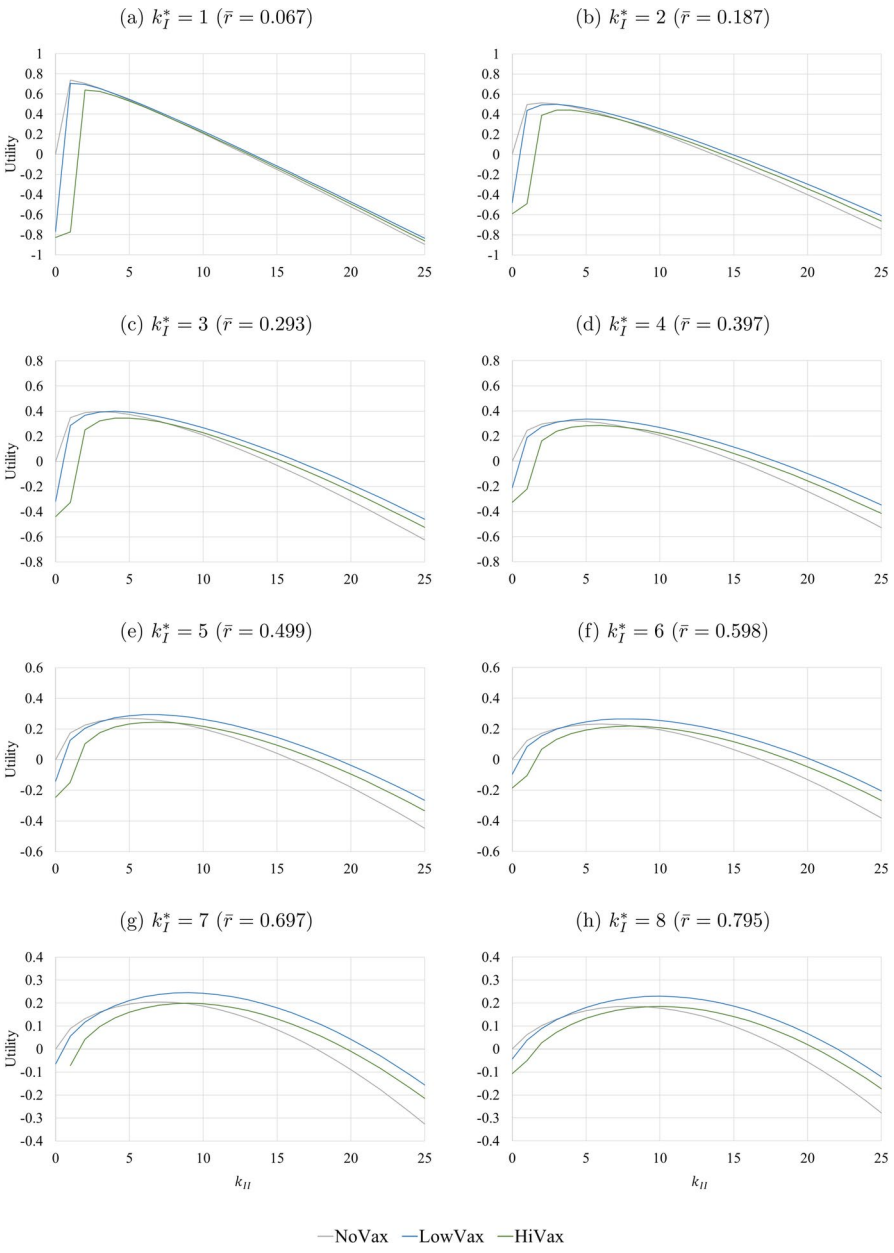


Fig. 11 Predicted expected utility for k_{II} measured by k_I^*. *Notes:* For each level of risk preference, from $k_I^* = 1 - 24$, we show separately for each treatment what benefit the choice of social contacts would lead to in Part II, for a k of $0 - 25$. For *LowVax* and *HiVax*, we show the utility that would be possible with vaccination. If no vaccination is chosen, then the possible utility corresponds to that in *NoVax*

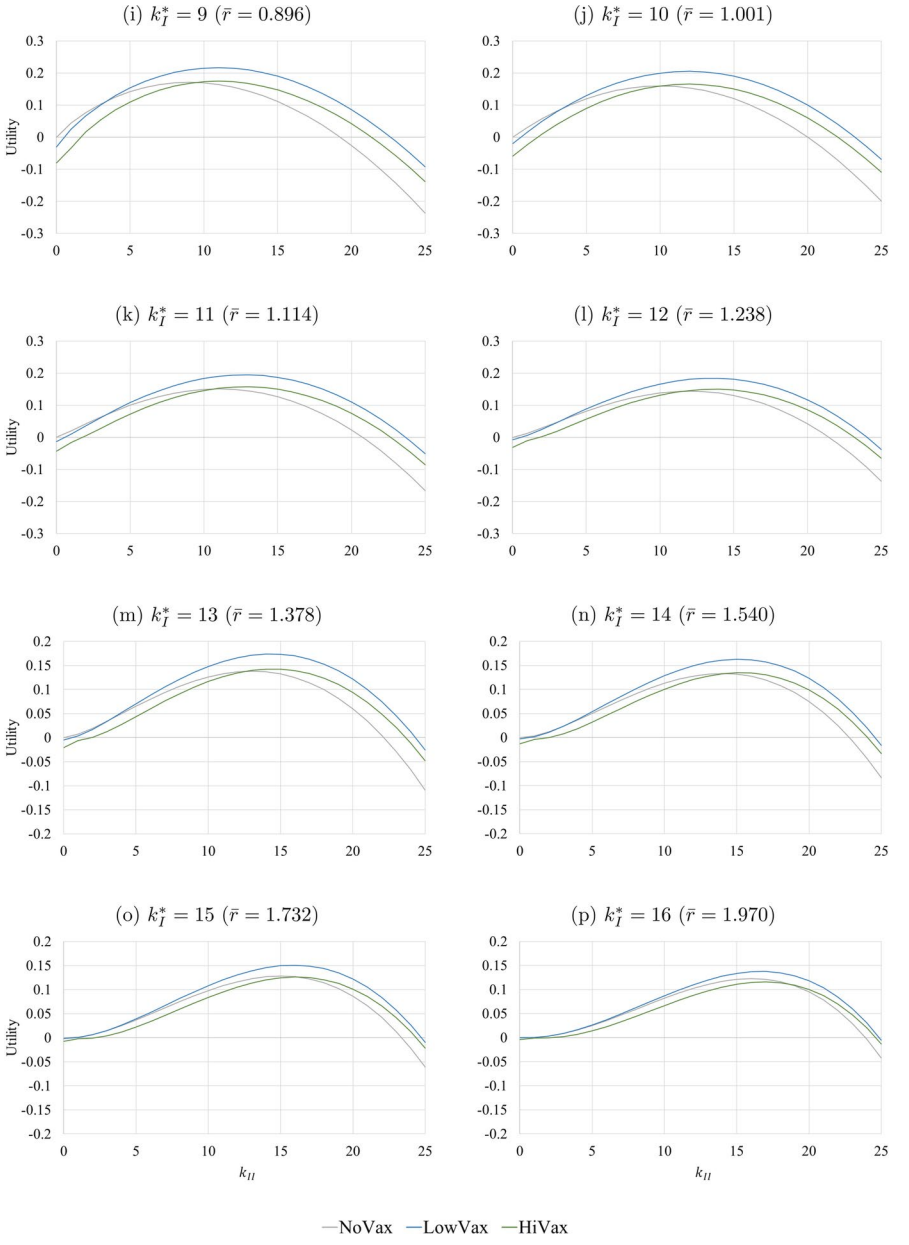


Fig. 11 (continued)

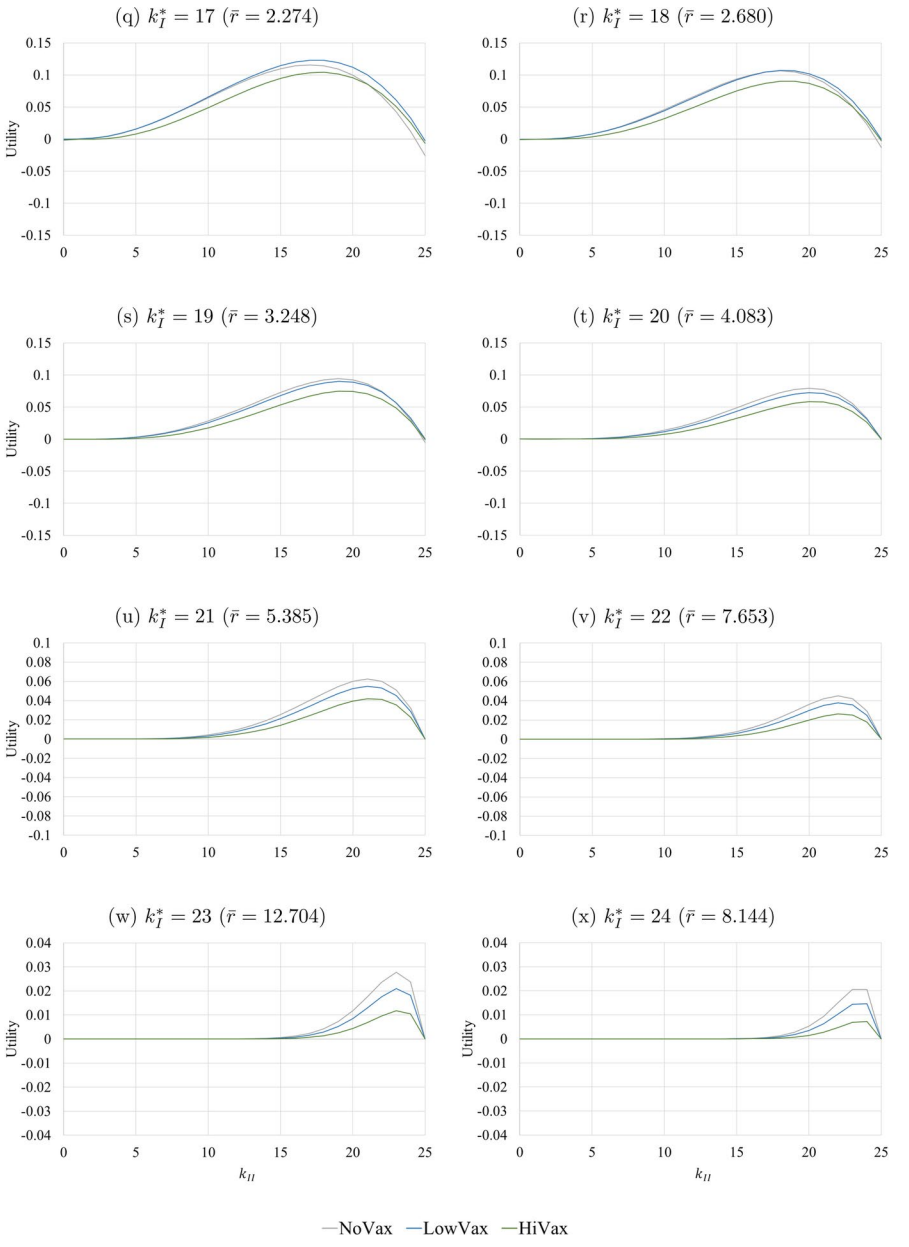


Fig. 11 (continued)

Appendix E: Descriptive statistics

See Figs. 12, 13, 14 and 15.

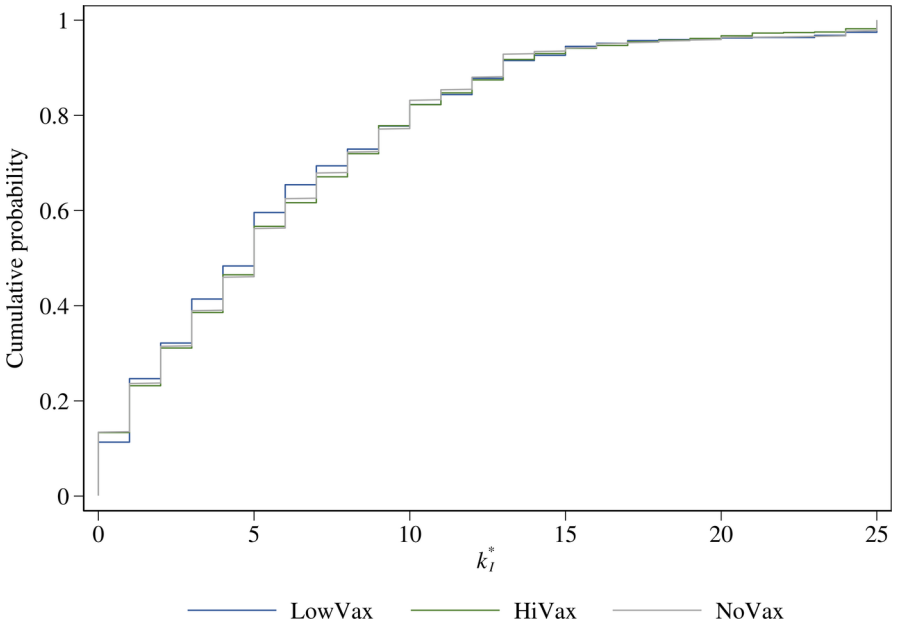


Fig. 12 Distribution of social contacts in Part I. *Notes:* Distribution of social contacts in Part I, k_{II}^*, separated by treatment

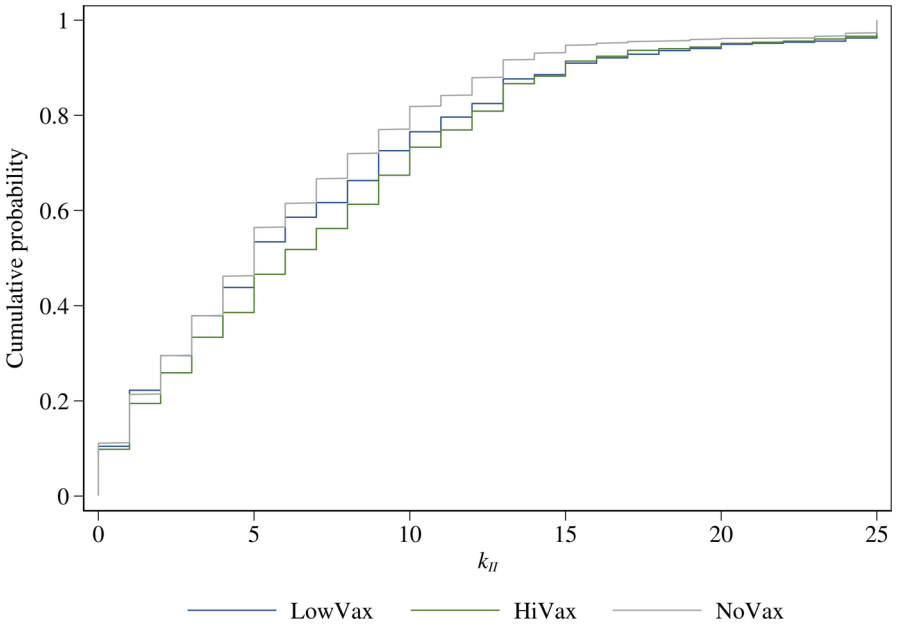


Fig. 13 Distribution of social contacts in Part II. *Notes:* Distribution of social contacts in Part II, k_{II}, separated by treatment

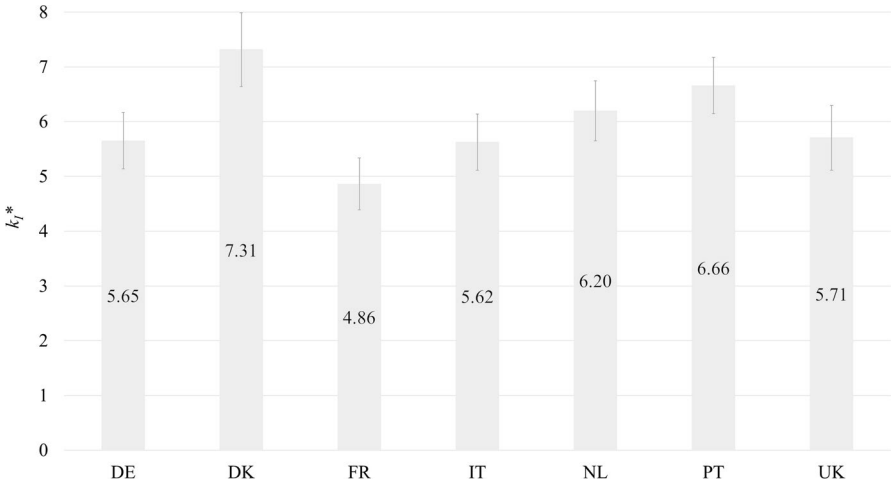


Fig. 14 Social contacts in Part I by country. *Notes:* Confidence intervals at the 95% confidence level

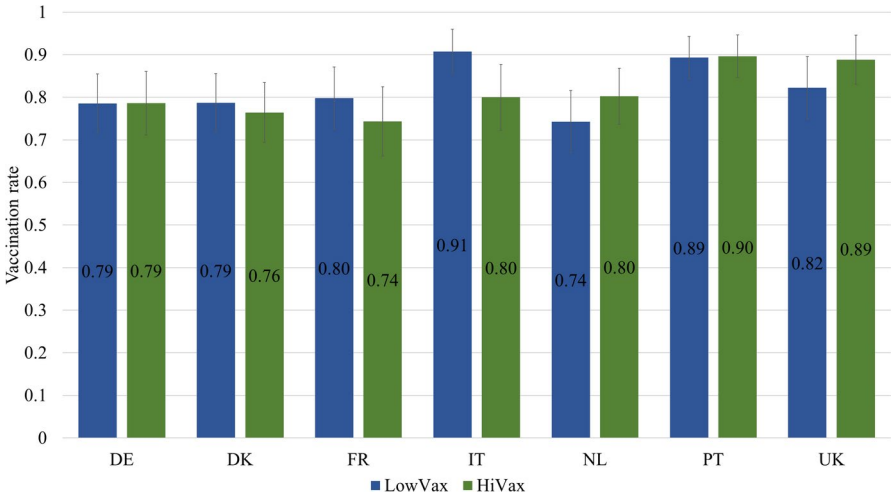


Fig. 15 Vaccination decision by country and treatment. *Notes:* Confidence intervals at the 95% confidence level

Appendix F: Further analyses

See Tables 7, 8, 9, 10, 11 and 12.

Table 7 Probit regression results by COVID-19 vaccination status

Experimental vaccination uptake	Vaccinated	Not vaccinated
k_I^*	0.058*	0.153*
	(0.026)	(0.067)
k_I^{*2}	−0.003*	−0.006*
	(0.001)	(0.002)
HiVax	−0.070	0.105
	(0.099)	(0.104)
Female	−0.068	−0.443*
	(0.069)	(0.197)
Age	0.012*	−0.011*
	(0.006)	(0.005)
Country		
DE	0.000	0.000
	(.)	(.)
DK	−0.045	−0.122*
	(0.037)	(0.056)
FR	0.017	0.027
	(0.012)	(0.040)
IT	0.400***	0.179***
	(0.009)	(0.027)
NL	−0.036*	−0.541***
	(0.015)	(0.059)
PT	0.304***	0.541***
	(0.013)	(0.068)
UK	0.072*	0.413***
	(0.031)	(0.047)
Constant	0.683***	−0.761
	(0.157)	(0.510)
N	1,552	232
Pseudo R^2	0.030	0.107

Results from probit regressions. Dependent variable: experimental vaccination uptake. Full sample includes all participants from *LowVax* and *HiVax* treatments. Each column represents a separate regression for participants with the respective COVID-19 vaccination status. The number of social contacts in Part I, k_I^*, measures risk preferences. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8 Probit regression results by country

Experimental vaccination uptake	DE	DK	FR	IT	NL	PT	UK
k_I^*	−0.035	0.146**	0.020	0.014	0.079	0.093	0.094
	(0.047)	(0.045)	(0.063)	(0.065)	(0.048)	(0.052)	(0.062)
k_I^{*2}	0.001	−0.006***	−0.001	−0.000	−0.003	−0.005*	−0.002
	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
HiVax	0.090	−0.300	−0.157	−0.354	0.288	−0.156	0.192
	(0.219)	(0.203)	(0.212)	(0.252)	(0.203)	(0.245)	(0.233)
Female	−0.395	0.049	−0.292	−0.185	−0.186	−0.151	0.271
	(0.240)	(0.211)	(0.222)	(0.255)	(0.206)	(0.227)	(0.242)
Age	0.033**	0.012	0.009	−0.005	0.008	0.004	−0.005
	(0.011)	(0.009)	(0.011)	(0.014)	(0.010)	(0.012)	(0.012)
Vaccinated	2.352***	2.200***	2.036***	2.219***	2.571***	1.990***	2.102***
(COVID-19)	(0.292)	(0.273)	(0.252)	(0.294)	(0.279)	(0.305)	(0.356)
Constant	−2.033**	−1.703***	−0.951	−0.178	−1.985***	−0.622	−1.130
	(0.638)	(0.501)	(0.557)	(0.686)	(0.498)	(0.638)	(0.600)
N	252	276	232	224	282	295	223
Pseudo R^2	0.355	0.321	0.324	0.396	0.376	0.250	0.239

Notes: Results from country-specific probit regressions. Dependent variable: experimental vaccination uptake. Full sample: includes all participants from *LowVax* and *HiVax* treatments. Each column represents a separate regression for the indicated country. The number of social contacts in Part I, k_I^*, measures risk preferences. Robust standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9 Probit regression results - Influence of general opinion about vaccines

Experimental vaccination uptake	Opinion: vaccines are		
	Important for children	Safe	Effective
k_I^*	0.072**	0.068**	0.069**
	(0.023)	(0.024)	(0.023)
k_I^{*2}	−0.003**	−0.003**	−0.003**
	(0.001)	(0.001)	(0.001)
Vaccinated (COVID-19)	1.879***	1.890***	1.879***
	(0.033)	(0.060)	(0.053)
Opinion regarding vaccines			
Strongly agree	0.000	0.000	0.000
	(.)	(.)	(.)
Tend to agree	−0.017	−0.225**	−0.159
	(0.136)	(0.082)	(0.085)
Tend to disagree	−0.321*	−0.561***	−0.558***
	(0.150)	(0.158)	(0.112)
Strongly disagree	−0.940***	−0.928***	−0.947***
	(0.131)	(0.132)	(0.147)
Don't know	−0.429*	−0.318*	−0.081
	(0.181)	(0.152)	(0.186)
HiVax	−0.044	−0.060	−0.047
	(0.093)	(0.098)	(0.094)
Demographics	✓	✓	✓
Constant	−0.779***	−0.753***	−0.698***
	(0.099)	(0.109)	(0.077)
N	1,784	1,784	1,784
Pseudo R^2	0.353	0.342	0.344

Results of probit regressions. Dependent variable: experimental vaccination uptake. Full sample: includes all participants from *LowVax* and *HiVax* treatments. Models differ by one covariate, in which the type of opinions about vaccines varies. The number of social contacts in Part I, k_I^*, measures risk preferences. Demographics comprise gender, age, and country indicators. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10 Probit regression results - Influence of pandemic situation

Experimental vaccination uptake	Getting vaccinated	Vaccination of peers	Adherence to protective measures
k_I^*	0.075*	0.068*	0.071**
	(0.030)	(0.027)	(0.026)
k_I^{*2}	−0.003*	−0.003*	−0.003*
	(0.001)	(0.001)	(0.001)
Vaccinated (COVID-19)	1.445***	2.048***	2.055***
	(0.061)	(0.106)	(0.069)
Likelihood of getting vaccinated next week	0.013***		
	(0.002)		
Vaccination of peers			
None		0.000	
		(.)	
Just a few		−0.273	
		(0.262)	
About half		−0.155	
		(0.178)	
Most		0.002	
		(0.223)	
Adherence to protective measures			0.317***
			(0.054)
HiVax	−0.050	−0.037	−0.021
	(0.102)	(0.089)	(0.098)
Demographics	✓	✓	✓
Constant	−1.578***	−1.151***	−2.069***
	(0.206)	(0.298)	(0.257)
N	1,714	1,784	1,784
Pseudo R^2	0.372	0.319	0.343

Results of probit regressions. Dependent variable: experimental vaccination uptake. Full sample: includes all participants from *LowVax* and *HiVax* treatments (Exception: Due to a small error in the programming of the survey when recording the "likelihood of getting vaccinated next week", the answer for 70 participants is missing.). Models differ by one covariate on pandemic-specific behavior or circumstances. The number of social contacts in Part I, k_I^*, measures risk preferences. Demographics comprise gender, age, and country indicators. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11 Probit regression results - Reasons for vaccination against COVID-19

Experimental vaccination uptake	Reason for vaccination:					
	Own protection	Family's protection	Vacation/ travel	Milder disease	Reducing econ. impact	Returning to pre-covid life
k_I^*	0.047	0.051	0.050	0.051	0.058*	0.055*
	(0.026)	(0.027)	(0.029)	(0.028)	(0.024)	(0.026)
k_I^{*2}	−0.002	−0.002*	−0.003	−0.002*	−0.003*	−0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Vaccinated (COVID-19)	1.069***	0.929***	1.154***	1.074***	1.215***	1.169***
	(0.238)	(0.246)	(0.213)	(0.281)	(0.190)	(0.217)
Reason for vaccination						
Strongly disagree	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Disagree	−0.051	−0.239	0.218	0.289	0.329	0.640
	(0.338)	(0.269)	(0.120)	(0.259)	(0.225)	(0.451)
Indifferent	0.674	0.564***	0.363	0.267	0.505**	0.523
	(0.407)	(0.170)	(0.191)	(0.376)	(0.186)	(0.383)
Agree	0.847**	0.596*	0.309*	0.725*	0.496***	0.519**
	(0.269)	(0.266)	(0.136)	(0.292)	(0.144)	(0.191)
Strongly agree	1.046***	0.824***	0.606***	0.927***	0.747***	0.585*
	(0.253)	(0.196)	(0.173)	(0.189)	(0.127)	(0.251)
I don't know	1.130*	0.873	0.494	0.902	0.907***	0.332*
	(0.444)	(0.477)	(0.273)	(0.548)	(0.240)	(0.363)
HiVax	−0.076*	−0.056	−0.053	−0.034	−0.047	−0.041
	(0.104)	(0.093)	(0.102)	(0.102)	(0.096)	(0.097)
Demographics	✓	✓	✓	✓	✓	✓
Constant	−0.862	−0.592*	−0.708*	−0.819	−0.929**	−0.869
	(0.451)	(0.281)	(0.311)	(0.461)	(0.342)	(0.468)
N	1,530	1,530	1,530	1,530	1,530	1,530
Pseudo R^2	0.087	0.076	0.057	0.073	0.063	0.048

Results of probit regressions. Dependent variable: experimental vaccination uptake. Subsample: includes all vaccinated participants from *LowVax* and *HiVax* treatments. Models differ by one covariate in which the reasons for vaccination against COVID-19 differ. The number of social contacts in Part I, k_I^*, measures risk preferences. Demographics comprise gender, age, and country indicators. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12 Probit regression results - Reasons against vaccination against COVID-19

Experimental Vaccination Uptake	Reason against vaccination:						
	More data	Too pressured	Not supp. manufact.	Few friends & family	No threat	Vaccine not safe	Worries complications
k_I^*	0.184**	0.172**	0.181***	0.166**	0.179**	0.176*	0.147*
	(0.069)	(0.066)	(0.049)	(0.057)	(0.063)	(0.070)	(0.063)
k_I^{*2}	−0.007**	−0.006**	−0.006***	−0.006**	−0.006**	−0.006*	−0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Vaccinated (C-19)	1.913***	1.640***	1.807***	1.681***	1.773***	1.648***	1.658***
	(0.189)	(0.197)	(0.205)	(0.179)	(0.188)	(0.205)	(0.216)
Reason against vaccination							
Strongly disagree	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Disagree	−0.243	0.283	−0.857	−0.066	0.483*	−1.144*	0.362*
	(0.619)	(0.792)	(0.486)	(0.426)	(0.489)	(0.561)	(0.529)
Indifferent	0.360	0.341	−1.177**	−0.021	0.782*	−0.670	0.201
	(0.305)	(0.317)	(0.367)	(0.299)	(0.368)	(0.457)	(0.423)
Agree	0.971	0.279	−0.982*	0.159	−0.086	−0.696	0.101
	(0.509)	(0.512)	(0.407)	(0.328)	(0.293)	(0.512)	(0.326)
Strongly agree	0.283	−0.168	−1.597***	−0.069	−0.062	−1.594***	−0.427
	(0.516)	(0.442)	(0.290)	(0.468)	(0.338)	(0.417)	(0.294)
I don't know	−0.819	−0.141	−1.487*	−0.077	0.070	−1.102*	−0.252
	(0.575)	(0.784)	(0.752)	(0.277)	(0.501)	(0.454)	(0.395)
HiVax	0.083	−0.017	−0.000	0.003	−0.004	−0.010	−0.045
	(0.205)	(0.158)	(0.235)	(0.193)	(0.206)	(0.208)	(0.184)
Demographics	✓	✓	✓	✓	✓	✓	✓
Constant	−2.002***	−1.536	−0.187	−1.417*	−1.525	−0.608	−1.268
	(0.596)	(0.786)	(0.830)	(0.653)	(0.817)	(0.794)	(0.696)

Table 12 (continued)

Experimental Vaccination Uptake	Reason against vaccination:						
	More data	Too pressured	Not supp. manufact.	Few friends & family	No threat	Vaccine not safe	Worries complications
N	254	254	254	254	254	254	254
Pseudo R^2	0.276	0.246	0.288	0.231	0.276	0.295	0.256

Results of probit regressions. Dependent variable: experimental vaccination uptake. Subsample: includes all unvaccinated participants from *LowVax* and *HiVax* treatments. Models differ by one covariate in which the reasons against vaccination against COVID-19 differ. The number of social contacts in Part I, k_I^*, measures risk preferences. Demographics comprise gender, age, and country indicators. Standard errors clustered on country level in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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