

1 General information

DFG-reference number	(KO 6492/1-1, STA 1311/5-1)
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Topic	European COVID Survey ECOS
Period covered by the report / Overall funding period	Grant approval: 04.05.2021 Funding period: 01.06.2021 – 30.04.2022, extended to 31.10.2022)

- List of the most important publication resulting from the project
 - a) *Articles which, at the time of proposal submission, have been published or officially accepted by publication outlets with scientific quality assurance*
 - Hajek, A., Sabat, I., Neumann-Böhme, S., Schreyögg, J., Barros, P. P., Stargardt, T., & König, H. H. (2022). Prevalence and determinants of probable depression and anxiety during the COVID-19 pandemic in seven countries: Longitudinal evidence from the European COvid Survey (ECOS). **Journal of affective disorders**, 299, 517-524.
 - Hajek, A., Neumann-Böhme, S., Sabat, I., Torbica, A., Schreyögg, J., Barros, P. P., Stargardt T. & König, H. H. (2022). Depression and anxiety in later COVID-19 waves across Europe: New evidence from the European COvid Survey (ECOS). **Psychiatry Research**, 317, 114902.
 - Enzing, J. J., van Krugten, F. C., Sabat, I., Neumann-Böhme, S., Boer, B., Knies, S., & Brouwer, W. B. (2022). Psychometric evaluation of the Mental Health Quality of Life (MHQoL) instrument in seven European countries. **Health and quality of life outcomes**, 20(1), 1-11.
 - Neumann-Böhme S, Sabat I and Attema AE (2022) Altruism and the Link to Pro-social Pandemic Behavior. **Front. Health Serv.** 2:871891. doi: 10.3389/frhs.2022.871891
 - b) *Other publications:*
 - König HH, Neumann-Böhme S, Sabat I, Schreyögg J, Torbica A, Van Exel NJA, Barros PP, Stargardt T, Hajek A, Health-related quality of life in seven European countries throughout the course of the COVID-19 pandemic: Evidence from the European COvid Survey (ECOS), under revision at **Quality of Life Research**

- Neumann-Böhme S, Sabat I, Brinkmann C, Attema A.E, Stargardt T, Schreyögg J, Brouwer WBF, Jumping the queue. Willingness to pay for faster access to COVID-19 vaccines in seven European countries submitted to **Medical Decision-Making**
- Brinkmann C, Neumann-Böhme S, Brouwer W, Stargardt T, Timing matters - Exploring the role of health-associated information shocks in willingness to pay measurement, Working paper.
- Sabat I, Neumann-Böhme S, Barros PP, Schreyögg J, Stargardt T, Torbica A, van Exel NJA, Brouwer WBF, Shifts in the Willingness to Vaccinate Against COVID-19: a Panel Study, Working paper
- Hermanns, Kokot. Dynamics of Risk Preferences in the Context of the COVID-19 Pandemic: Experimental Evidence from seven European Countries, Working paper

2 Final progress report

2.1 Research question / objectives

The objective of this research project was to generate scientific evidence on the behavioural effectiveness and acceptability of public health interventions in the context of the COVID-19 pandemic. The research project focused on three main questions.

The first question was related to the willingness to be vaccinated against COVID-19, with a focus on the longitudinal analysis of those who switched their intention to vaccinate to being unwilling or unsure over the course of the pandemic. We found that the willingness to vaccinate against COVID-19 has been fluctuating over the course of the pandemic among Europeans, too with a great degree of heterogeneity across countries. Nevertheless, it was unclear to which state (unwilling or hesitant) the respondents moved when the willingness to vaccinate decreased. Knowing what factors caused shifts in subgroups of the population and enabled the increase in the willingness to vaccinate could prove useful for policymakers when designing vaccination programs during public health emergencies and could help to avoid threats to the effectiveness of such campaigns and increase vaccine uptakes.

The second research question of the project was to estimate the willingness to pay for access to COVID-19 vaccines to determine which value Europeans attached to immediate access to the COVID vaccines. Our findings show that 73% of respondents in our representative sample would have been willing to pay for faster access to COVID-19 vaccines in January 2021. These results highlight the benefits of providing quick(er) access to vaccines in the context of outbreaks. Furthermore, the findings may motivate policymakers to invest in production and distribution facilities to provide the population with quicker access to vaccines for future outbreaks or updated COVID-19 vaccinations.

Third, we explored the extent to which people would be willing to reduce the number of social contacts in order to reduce their risk of COVID-19. Regardless of the societal responsibility to reduce the incidence of infection through contact reductions, people faced daily situations in which they had to weigh the risk to their health. Risk trade-offs, however, not only affected themselves but could have far-reaching consequences for the health of others. Accordingly, the consequences of risk trade-offs also have a prosocial component. Meeting other people, for example, puts one at risk of infecting oneself and being the person who infects others. A resulting increase in the incidence of infection places an additional burden on the health care system.

To investigate these relationships in detail, we conducted three different experiments. These three experiments have in common that risk attitudes were surveyed in the context of the pandemic. More specifically, they were elicited as trade-offs between one's benefits from meeting others against the background of one's own risk of infection. The first experiment focused on social contact behaviour given only one's own risk of infection. The second experiment added the consequences that one's own actions have for society. In the third experiment, participants were given the opportunity to be vaccinated and thus reducing the consequences of an infection.

2.2 Project developments

The project followed the work plan as laid down in the proposal but was extended by the DFG for further data collection from April 2022 to October 2022 because of the ongoing nature of the pandemic.

- 1) **Development of survey and experiment:** As a first step, we researched current trends and relevant topics, which were added to the existing panel structure to program the survey and the experiments.
- 2) **Data collection:** In the second step, datasets were collected in four consecutive data collections; the fieldwork for wave 7 of the European COvid Survey (ECOS) was from 21.06.-05.07.2021, wave 8 from 07.09-21.09.2021, wave 9 from 23.12.2021-11.01.2022 and wave 10 from 04.05.-24.05.22 for 7 countries (UK, Germany, France, Italy, Portugal, Denmark and the Netherlands). In each data collection samples of approximately 1,000 participants per country were largely representative of the national population regarding gender, age, region, and education (n= 7.000 per data collection). Participants were recruited by the market research company Dynata. Participation depended on written consent and the anonymity and confidentiality of respondents was established in part by separating between the data collection and the recruitment of the participants. The questionnaires had been developed in English, translated into the national languages

by native speakers, and piloted in 10% of the sample. The surveys and experiments were programmed in the Qualtrics research suite. The experiments were conducted within ECOS which allowed us to link our experimental results with personal characteristics, vaccination status, and a wide range of attitudes, concerns, and confidence regarding the COVID-19 pandemic.

- 3) **Assessment of data quality and presswork:** In the third step, the involved researchers assessed the quality of each data collection. First descriptive results were shared with the press, the public and policymakers to immediately communicate findings on current issues.
- 4) **Data analysis:** Fourth, data was analysed by the research team. Depending on the research questions, various methods were used, such as two-part regression models, logistic and multinomial logistic regressions for the panel, and a hurdle model for the experiment. As planned, preliminary results were presented at national and international conferences.
- 5) **Writing of publication:** Finally, manuscripts were drafted and successfully submitted to scientific journals (please see 1a). This process is still ongoing as can be seen from the number of working papers listed in 1b).

2.3 Presentation of results and discussion

2.3.1 *Willingness to be vaccinated against COVID-19*

Main results are currently in form of a working paper:

Sabat I, Neumann-Böhme S, Barros PP, Schreyögg J, Stargardt T, Torbica A, van Exel NJA, Brouwer WBF, Shifts in the Willingness to Vaccinate Against COVID-19: a Panel Study.

Aim: This paper focused on three main states that people may be in with respect to their willingness to vaccinate (WTV) against COVID-19 – willing, unwilling and hesitant – and sought to identify the determinants of choosing these states and the channels increasing or decreasing the likelihood of shifts across these states.

Methods: We used longitudinal data from nine quarterly waves collected between April 2020 and January 2022 (sample size per wave ranging from 7 021 to 7 232) of the European COvid Survey (ECOS), a representative survey of adults in seven European countries (Germany, UK, Denmark, Netherlands, France, Portugal and Italy). First, we found out the determinants of each of the WTV

states. Then we analysed the shifts between these states and identified factors facilitating and impeding the transitions both at the aggregate and individual country levels. Logistic and multinomial logistic regressions in a panel data setting were used to analyse the relationships of interest.

Results: On average across all nine waves and seven countries, the proportion of respondents willing to get vaccinated against COVID-19 was 72.5%, the proportion of unwilling was 13% and the proportion of hesitant equaled 14.5%. Demographic characteristics were common determinants of the willingness to vaccinate both at the European and individual country levels. Aside from socio-demographic factors, following COVID-related news, trust in the information from the government, GP and the WHO, confidence in general vaccine safety and perceived COVID-19 severity for the health of one's family and community led to higher willingness to vaccinate and facilitated staying in this state as opposed to switching to hesitant or unwilling states. Living alone, being very risk-averse and not confident in general vaccine safety, perceived COVID-19 severity for the health of one's family increased the likelihood of being hesitant. Distrusting vaccine safety in general and high perceived risk of catching the coronavirus were associated with an increased probability of respondents switching from being hesitant to becoming unwilling to vaccinate against COVID-19. Meanwhile, high perceived severity of COVID-19 for the health of one's family and even a medium level of trust in government, GP and the WHO predicted a higher likelihood of initially unwilling individuals to move out of the unwilling state.

The analysis at the level of individual countries demonstrated that certain factors were more pronounced there as facilitators or impediments of shifts in the willingness to vaccinate, thereby suggesting country-specific policy implications.

Conclusion: Across seven European countries, we found factors that can facilitate or impede desired behavior patterns among people willing, not willing or hesitating to vaccinate against COVID-19. Various sociodemographic, COVID-specific and non-COVID-specific factors predicted shifts in individual willingness to vaccinate. These findings may support policy makers in designing vaccination programs during public health emergencies and facilitate effective communication with target population groups by identifying important factors allowing to avoid threats to the effectiveness of such campaigns.

2.2.2 Willingness to pay for access to Covid-19 vaccines

Main results are currently in form of two working papers:

- (a) Neumann-Böhme S, Sabat I, Brinkmann C, Attema A.E, Stargardt T, Schreyögg J, Brouwer WBF, Jumping the queue. Willingness to pay for faster access to COVID-19 vaccines in seven European countries, submitted to Medical Decision-Making.

- (b) Brinkmann C, Neumann-Böhme S, Brouwer W, Stargardt T, Timing matters - Exploring the role of health-associated information shocks in willingness to pay measurement, Working paper.

(a) Introduction: Given the initial shortage of vaccines to protect against COVID-19, many countries set up priority lists for vaccination, implying that large parts of the population had to wait to be vaccinated. We elicited the willingness to pay for immediate access to two hypothetical COVID-19 vaccines. Respondents were asked how much they would be willing to pay to get an immediate COVID-19 vaccination rather than wait for one through the public system.

Methods: We report data from the European COVID Survey (ECOS) comprising representative samples of the population in Denmark, France, Germany, Italy, Portugal, the Netherlands and the UK (N=7,068). The data presented here was collected as part of the fifth ECOS data collection conducted from January 19 until February 1, 2021. We elicited the willingness to pay for access to two hypothetical COVID-19 vaccines (100% and 60% effective).

Results: In total, 73% (68.5%) of respondents were willing to pay for immediate access to a 100% (60%) effective vaccine, ranging from 66.4% (59.4%) in the Netherlands to 83.3% (81.1%) in Portugal. We found a mean willingness to pay of 54.36 Euros (median 37 Euros) for immediate access to the 100% effective COVID-19 vaccine and 43.83 Euros (median 31 Euros) for the 60% effective vaccine. The effectiveness of the vaccine, respondents' age, country of residence, income, health state and well-being were important determinants of WTP. Willingness to be vaccinated (WTV) was also strongly associated with WTP, with lower WTV associated with lower WTP. Higher perceived risk of infection, higher health risk, more trust in the safety of vaccines, and higher expected waiting time for the free vaccination were all associated with a higher WTP.

Conclusion: We find that most respondents would have been willing to pay for faster access to the COVID vaccines (jumping the queue), suggesting welfare gains from quicker access to these vaccines. This is an important result in light of potential future outbreaks and vaccines.

(b) Introduction: Willingness to pay (WTP) is an established measure for valuing non-marketed goods, such as health care services. We analyze if unexpected events, i.e. information shocks, can cause a shift in the willingness to pay. We study the effect of health-associated information shocks (HIS) on WTP by analyzing how SARS-CoV-2 infections in the proximity of a subject alter the WTP for booster vaccinations.

Methods: We elicited the WTP for booster vaccinations against Covid-19 in representative samples in Germany, Denmark, Italy, France, Portugal, Spain, the United Kingdom and the Netherlands. The data of 8,454 individuals was collected as part of the 9th wave of the European Covid Survey (ECOS)

between 23 December 2021 and 11 January 2022. The WTP for booster shots was elicited in a three-stepped approach, asking for (1) the minimum WTP, (2) the maximum WTP, (3) the final WTP considering previous answers. We used dynamic validation to ensure the consistency and quality of answers. The setting specified that a booster vaccination is recommended but must be paid out of pocket and individual's health permits vaccination. For HIS measurement, participants were asked for the existence, proximity and severity of close Covid-19 cases in the weeks before the survey. Descriptive statistics on the sample, the WTP values and HIS were calculated. The difference in WTP depending on the occurrence of HIS was estimated using a two-part model. Average marginal effects (AME) were calculated to facilitate interpretation.

Results: Of 8,454 collected observations, we excluded 137 as careless responders and 2,508 respondents indicating protest answers. Of the final sample comprising 5,809 observations, 76.8% stated a WTP greater than €0. At least one close COVID-19 case, i.e. a HIS, was reported by 61.9% of participants. The occurrence of a HIS was associated with an increase in WTP by €14.53 ($p < 0.0001$) compared to no HIS according to a model without any covariates. Analyzing the temporal proximity, HIS was associated with an increase in WTP, which was stronger if the HIS occurred in the weeks before the survey (AME weeks 0-2: €20.05, $p = 0.0002$, weeks 3-4: €29.20, $p = 0.005$), while after more than four weeks the HIS association is still positive but no longer becomes significant, compared to no HIS. If experience of HIS was milder than expected, HIS was associated with a decrease in WTP by €-19.81 ($p = 0.0001$). Controlling for socio-demographic and COVID-19-related covariates decreases the significance and effect sizes for temporal proximity and severity of HIS.

Summary: The analysis seems to confirm HIS shifting the WTP of individuals. Timing for WTP measurement matters, and researchers should be aware of potential effects of HIS when informing decision-makers using WTP values.

2.2.3 Risk Preferences in the Context of the COVID-19

Main results from the three experiments are presented below:

- (a) Hermanns B, Kokot J, Dynamics of Risk Preferences in the Context of the COVID-19 Pandemic: Experimental Evidence from seven European Countries, Working paper
- (b) Hermanns B, Kokot J, Risk Preferences and Prosocial Behavior – Experimental Evidence in Pandemic Times, Working paper
- (c) Hermanns B, Huynh P, Kokot J, Vaccination and risk preferences in the context of the COVID-19 pandemic, Working paper

(a) Introduction: During the COVID-19 pandemic, meeting people suddenly came with a risk, and individuals had to decide how much risk of getting infected was worth the benefit from meetings. This meant that there was a trade-off between the protection of one's own health (and that of at-risk groups) and avoidance of isolation. Moreover, these decisions had to be made on an ongoing basis. As time progressed, more and more prior experience could play a role in decision-making. This study intends to investigate those dynamics, i.e., how previous events influence following decisions (reinforcement effects). Specifically, we use an experimental framework to examine how people change their risk behaviors when they have infected themselves or learned that they had met an infected person. Do they subsequently become more risk-averse? The second goal of our research is to determine how much mental accounting influences these decisions under risk (realisation effects). Third, we relate risk preferences to pandemic-specific behavior and compare this internationally.

Methods: In a preregistered online experiment, we elicit risk preferences using a modified version of the bomb risk elicitation task (ViRET). The participants decided how many persons they would like to meet. They had the choice between 0 and 25 persons and benefited financially from each meeting. One of these persons was infected with the coronavirus. If the infected person was among the contacts, the participant suffered a monetary loss and received no benefit from meeting uninfected people. In the first experiment, participants go through four rounds of decision-making. After the third round, we provided participants with their current account balance up to that point. In our treatment condition, we further induced separate mental accounting by closing the account after round 3 and opening a new one for round 4. This pure framing effect did not change the payoff structure between the two treatments. We compare the behavior from this experiment with other waves of the survey and link the experimental data to pandemic-related behavior.

Results: We find evidence for a reinforcement effect in the experimental setting: people reduce risk-taking after meeting an infected person. However, we cannot confirm this behavioral principle for the course of the pandemic. Furthermore, we find indications of mental accounting. On average, individuals are unwilling to take risks to compensate for losses after previous negative events. We identify considerable heterogeneity among the seven countries. This applies to the absolute level of risk aversion and the reaction to the meeting of risk contacts. Our study aims to investigate the dynamics of context-specific risk preferences, i.e., when meeting potentially infected individuals. We examine how people perceive the consequences of past (pandemic) behavior and whether they use different mental accounts to do so.

(b) Introduction: Every day, people face situations where they have to weigh up the risk to their health. Especially in times of a pandemic, decisions under risk do not only relate to oneself but can have far-reaching consequences for the health of others. By meeting other persons, for instance,

individuals not only risk infecting themselves but also being the one that infects others. The focus of the study is to examine how participants' risk considerations change when the consequences affect themselves and the community.

Methods: To investigate how far prosocial behavior is related to risk preferences, we conducted a preregistered online experiment with over 3,000 participants. Participants were asked to weigh the costs and benefits of risky decisions in an abstract decision-making situation (ViRET). Specifically, they were asked how many people they would like to meet if each meeting was associated with a personal benefit for them. The more people they would meet, the greater the potential benefit. On the other hand, the risk of becoming infected and thus losing the benefit increased with each person met. In this balancing of risks, one's own decision initially only had an impact on the participant itself. In a second decision, participants were asked to make another risk assessment. This time, the meeting involved not only one's own risk of infection but also the risk of incurring costs for the health care system and, thus, for the community.

Results: The results show that participants behaved as predicted: In general, they were risk-averse, as they were unwilling to meet many people. Participants increased their risk aversion when there was a likelihood of negative consequences for the community. This pattern is found in all seven European countries surveyed. The study provides insight into motives that play a role in pandemic risk considerations and social interactions. This may be particularly helpful in communicating pandemic mitigation measures.

(c) Aim: Vaccines have proven effective in many ways throughout the COVID-19 pandemic. They lower the risk of getting and spreading the virus but can also prevent severe illness and death. Thus, vaccination has brought back the possibility of meeting more contacts again, as one's and others' consequences of infection are reduced. Nonetheless, not everyone has opted for vaccination. Possible reasons could be organisational costs, fears of side effects, or omission bias.

The aim of this study is to investigate the extent to which vaccination leads to increased risk-taking behavior in the context of the COVID-19 pandemic. Furthermore, we investigate the relationship between vaccination take-up, vaccination cost, and risk preferences.

Methods: We elicit risk preferences in two rounds of decisions using the virus risk elicitation task (ViRET); see above. In the first round, no vaccination opportunity was offered. Prior to the second round, participants had the option of a vaccine. The vaccine came with organisational costs and the benefit of a smaller loss in case of meeting the infected person. We vary the level of the organisational costs and control for possible round effects.

Results: We can observe a high experimental vaccination take-up of about 80%. We also observe a change in behavior due to vaccination, i.e., an increased number of individuals met. Our variation in the level of organisational costs does not affect this result.

2.4 Statement on whether the results of the project are economically valuable and whether exploitation is already taking place or may be anticipated

Besides publications, no further exploitation of results besides is planned.

2.5 Other contributors

Co-authors of the published paper:

- Arthur Attema, Erasmus University Rotterdam
- Pedro Pita Barros, Nova School of Business and Economics
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- Werner Brouwer, Erasmus University Rotterdam
- Joost Enzing, Erasmus University Rotterdam
- Job van Exel, Erasmus University Rotterdam
- André Hajek, UKE/ University of Hamburg
- Saskia Knies, Erasmus University Rotterdam and Zorginstituut Netherlands
- Hans-Helmut König, UKE/ University of Hamburg
- Frédérique C. W. van Krugten, Erasmus University Rotterdam
- Sebastian Neumann-Böhme, University of Hamburg and Erasmus University Rotterdam
- Iryna Sabat, Nova School of Business and Economics
- Jonas Schreyögg, University of Hamburg
- Aleksandra Torbica, Bocconi University

In addition Co-authors of the papers that are work-in-progress

- Sophia Bock, MSc, University of Hamburg
- Carolin Brinkmann, MSc, University of Hamburg
- Benedicta Hermanns, MSc, University of Hamburg
- Philip Huynh, MSc, University of Hamburg

2.6 Qualification of young researchers in the context of the

- Master thesis related to the project
 - Subjective lockdown perception during the COVID-19 pandemic: Analysis of influences and drivers using the European Covid Survey and the Oxford Stringency Index
 - Der Einfluss sozioökonomischer Faktoren auf die wahrgenommene Schwere der Infektionsgefahr von Sars-CoV-2 in Europa während der Covid-19-Pandemie
 - Der Einfluss verhaltenseinschränkender Politikmaßnahmen auf den selbstwahrgenommenen Zustand von Depression und Besorgnis in Europa während der Covid-19-Pandemie
 - Einflussfaktoren der Präferenzumkehr bei der Impfentscheidung zu Sars-CoV-2 in Europa - Eine Analyse mithilfe der European Covid Survey"
 - Die psychische Gesundheit von medizinischen Fachkräften während der COVID-19-Pandemie
- *Part of PhD-works*
 - Sophia Bock, MSc, University of Hamburg, Germany
 - Carolin Brinkmann, MSc, University of Hamburg, Germany
 - Benedicta Hermanns, MSc, University of Hamburg, Germany
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