

RISK PERCEPTION AND THE WILLINGNESS TO GET VACCINATED AGAINST
COVID-19

UNIVERSITY OF TWENTE.

Bachelor Thesis

**Getting Vaccinated or Not: The Role of Risk Perception on the Intention to Get
Vaccinated Against COVID-19**

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Abstract

Background: In March 2020, the outbreak of the coronavirus was declared a global pandemic. Its progression is linked to health-preventive behaviours, especially vaccine uptake. Previous research has identified risk perception as an important determinant in vaccine intention, but data on the willingness to get vaccinated against COVID-19 is scarce and contradictory.

Objectives/aims: The present study examined if there is a relationship between risk perception and vaccine intention among a German sample ($n = 205$). However, instead of using risk perception as construct, the two underlying constructs, perceived probability of getting infected and perceived severity of COVID-19, were used respectively. Furthermore, it was investigated if a previous corona infection influences the perception of risk, more specifically, the two concepts perceived probability and perceived severity.

Methods: A descriptive cross-sectional design was employed in the form of an online survey that the respondents could fill out during a one-week period in April 2021. The questions used assessed the participants' COVID-19 experience, vaccine intention, perceived probability to get infected, and perceived severity of COVID-19. Regression analyses were conducted to investigate if a previous infection influences risk perception and if risk perception influences vaccine intention.

Results: A previous COVID-19 infection influences the perceived probability of getting infected but not the perceived severity of COVID-19. Perceived severity was found to be a significant predictor of vaccine intention, whereas perceived probability of getting infected did not have any influence on vaccine intention.

Conclusion: The results demonstrate the importance of assessing the two underlying constructs of risk perception (perceived probability and perceived severity) independently instead of grouped together. The regression analyses showed only weak correlations, indicating that other variables than the perceived risk of COVID-19 influence vaccine intention better. Recommendations about possible interventions are presented.

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1. Introduction

In March 2020, the outbreak of the highly infectious and fast-spreading respiratory virus COVID-19 was declared as a global pandemic by the World Health Organization (WHO). As a result of the global pandemic, the governments of numerous countries enacted nationwide lockdowns, curfews, and other health restrictions to reduce the speed at which the virus was spreading worldwide. The WHO currently counts 287 (listing as of June 22nd, 2021) vaccine projects in clinical and pre-clinical development against COVID-19, from which the vaccines Pfizer/BionTech, Moderna, AstraZeneca, and Janssen Pharmaceutica NV have already been approved and are currently being used to vaccinate the population in the European Union (WHO, 2021). The population's adherence to the beforementioned policies and health restrictions as well as vaccine uptake is dependent on their perception of their own personal risk of contracting COVID-19 (Rudisill, 2013; Wiedemann, & Schütz, 2005). Therefore, it is essential to have access to a reliable and valid measure of perceived own risk concerning the COVID-19 pandemic as risk perception is likely to influence cognitions, emotions, and action concerning the pandemic, thereby affecting its prevention and management. As part of one big project that investigates the determinants of vaccine hesitancy, this thesis investigates if there is a relationship between risk perception, more specifically between perceived probability of infecting oneself as well as the perceived severity of COVID-19 and the willingness to get vaccinated against COVID-19. Based on these findings, recommendations can be made for interventions that specifically address risk perception regarding COVID-19 so that the population is provided with the correct information on which to base their decision to get vaccinated.

1.1 Perceived Risk

Risk perception can be defined as an individual's intuitive assessments of risks/hazards and the corresponding undesirable effects of that threat (Rohrmann, 2008). It affects the population's willingness to engage in health-protective and preventive behaviors (Rudisill, 2013; Wiedemann, & Schütz, 2005). In the past, it became apparent that perceived risk plays a significant role during pandemics by being one of the primary reasons people adopt health behaviours such as paying attention to increased hygiene, physical distancing and wearing face masks (Bish, & Michie, 2010; Dryhurst et al., 2020; Rudisill, 2013).

Although the previous findings demonstrate that risk perception enhances health-protective behaviours, it can also have the opposite effect. This is the case because low perceived risk can decrease health-protective behaviours (Leppin & Aro, 2009). High perceived

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risk can influence people to engage in protective behaviours, but adopting health behaviours can reduce risk perception (Brewer, Weinstein, Cuite, & Herrington, 2004). Therefore, it is essential to mention that the causality of risk perception and health behaviours is bi-directional.

A wide range of factors influence the development of risk perception. For example, in the case of COVID-19, individuals assess the risk they are exposed to amongst others based on personal experience with the virus, individualistic and prosocial beliefs, attitudes, and self-efficacy beliefs (Dryhurst et al., 2020). These findings are consistent with multiple studies showing that the risk perception of diseases, in general, not only of COVID-19, is influenced by contextual, individual, societal, social, cultural, and many other factors (Dryhurst et al., 2020; Pidgeon, 1998). Furthermore, communally created social representations of the risk, such as political policy and mass media reporting, influence an individual's perception of risk (Pidgeon, Kasperson, & Slovic, 2003). To sum up, "risk is socially negotiated based on people's experiences, values, and trust in institutions" (Dryhurst et al., 2020, p. 1003).

Risk perception includes two components. According to Rosenstock (1990), an individual perceives a risk based on (1) their perceived vulnerability and (2) the perceived severity of the consequences. In the case of COVID-19, perceived vulnerability relates to the extent to which an individual feels vulnerable to infect themselves with the virus, thus on the perceived probability of catching the disease. Perceived severity depends on the disease's course with its symptoms. In addition, it refers to beliefs about the seriousness of the consequences (Champion & Skinner, 2008).

There is evidence that people generally perceive their risk and, therefore, their susceptibility to a threat below average when they have no previous experience with that threat (Tversky, & Kahneman, 1974). Weinstein (1982) stated that individuals draw inferences based on their experience to estimate their subsequent vulnerability. Consequently, for numerous dangers, individuals appear to falsely believe that if they have not experienced the problem yet, they are unaffected or immune from the threat. Henceforth, it will also be investigated if there is a relationship between a previous COVID-19 infection and risk perception.

1.2 Perceived Risk and Vaccine Hesitancy

Vaccinations belong to the most effective health approaches to disease prevention. Yet, their effect is often undermined by vaccine hesitancy. The World Health Organization (2020a) declared vaccine hesitancy as one of the ten most crucial dangers to health in the world today. Especially during a pandemic, vaccine hesitancy can impose extreme barriers in the fight

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against the spread of highly infectious viruses. Accordingly, one of the WHO's health challenges for the next decade is stopping infectious diseases, amongst other things, the COVID-19 virus, for which vaccines provide the best and fastest solution (WHO, 2020b). Therefore, understanding the determinants of vaccine hesitancy is of uppermost significance as this can help governments and health institutions increase vaccine acceptance and thereby limit the spread of the virus.

Even though governments implemented many health restrictions, COVID-19 keeps spreading and affecting large parts of daily lives. Without the vaccines, many scientists believe that natural herd immunity would be insufficient. Research showed that the currently most widely used vaccines Moderna and Pfizer have an effectiveness of 94-95%, meaning that vaccinated people have a 95% decreased risk of COVID-19 than people who are not vaccinated (Olliaro, 2021). This low risk due to the vaccines will allow society to go back to a life without restrictions if vaccine acceptance is high. Research confirmed by the WHO further shows that the current vaccines provide partial protection against the virus's mutations and that herd immunity through vaccinations would prevent the virus from continuing to mutate and become more resistant to the currently available vaccines (Mahase, 2021). Moreover, a study conducted by Mækela et al. (2020) shows that perceived risk is highly related to emotional distress and decreased well-being, highlighting the importance of vaccinations to reduce the worrying and fear of contracting the virus.

Many scholars, such as Betsch et al. (2018) and Brewer et al. (2017), showed in their reviews that vaccine acceptance and vaccine hesitancy are highly complex processes. They are affected by a broad spectrum of factors. Next to factors such as complacency, convenience, confidence, and trust, risk perception is one of the critical determinants of vaccine acceptance and vaccine hesitancy (Stefanoff et al., 2010; Dubé et al., 2013). Since risk perception is an influential factor of vaccine hesitancy and health behaviour in general (Ferrer & Klein, 2015), it is reasonable to investigate their relationship further.

Furthermore, the relationship between a previous COVID-19 and risk perception might influence vaccine intention as well. For example, not having experienced a COVID-19 infection yet due to health restriction and minimalistic personal contact can lead people to underestimate the likelihood of contamination (Lammers, Crusius, & Gast, 2020). This can lead to lower purposes to adopt protective health behaviours, such as getting vaccinated (Maddux & Rogers, 1983). These findings demonstrate the importance of the risk perception of COVID-19 on the decision-making process to get vaccinated.

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The perceived risk of getting infected with COVID-19 is compared to the perceived costs and benefits of getting vaccinated. The stronger an individual perceives the severity and the higher they perceive their susceptibility, thus the probability, to get infected, the higher is the likelihood that the individual is motivated to avoid this situation (Janz & Becker, 1984). Empirical evidence that vaccine acceptance was observed to be higher in individuals who consider vaccination as a necessary means to counter the harmful consequences of vaccine-preventable diseases (VPDs) supports this notion (Kumar, Chandra, Mathur, Samdariya, & Kapoor, 2016). Furthermore, research shows that people who consider the risk of contracting a VPD such as COVID-19 as low, think the symptoms are mild and are unconcerned about the disease are more hesitant to get vaccinated and therefore often remain unvaccinated (Betsch et al., 2018; Brewer et al., 2007). This suggests that if their perceived risk of COVID-19 is high, individuals will be more likely to accept the vaccine. However, if it is the other way around, they might be more hesitant regarding the vaccine and eventually decide against getting vaccinated.

Until now, there are inconsistent findings regarding the relationship between risk perception of COVID-19 and vaccine intention. Some research shows that risk perception is a significant predictor, whereas other studies have contradictory results. On the one hand, studies conducted amongst others in the US, France, Australia, and Germany, suggested that people who consider the risk of COVID-19 to be high are more likely willing to get vaccinated to prevent the disease (Glöckner et al., 2020; Malik, McFadden, Elharake, & Omer, 2020; Ward et al., 2020). Opposed to these findings are the studies conducted by Karlsson et al. (2021) and Faasse and Newby (2020), showing that the perceived risk of COVID-19 on one's health is not a significant predictor of vaccine willingness. They further elaborated that even if individuals do not perceive the virus as a risk to themselves, they might still be willing to get vaccinated to protect others from the virus. These studies, however, focused either on the perceived probability of getting infected or the perceived severity of COVID-19 and took this as representative for risk perception, although multiple studies show that risk perception is multidimensional.

In order to address the inconsistent findings, this study investigated the relationship between perceived risk and vaccine intention by not taking the perceived risk as one overall variable but by measuring the relationship between the two underlying constructs of risk perception and vaccine intention, respectively, which are namely the perceived probability of getting infected with the virus and the perceived severity of COVID-19. This was done because

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the two constructs may exert different influences on vaccine intention, which might affect the overall risk perception of the virus. Since vaccine hesitancy and vaccine unwillingness in Germany are high compared to other European countries, the study will focus on the German population (Neumann-Böhme et al., 2020).

Consequently, the research question "Is one's own perceived risk of COVID-19 associated with the willingness to get vaccinated against COVID-19?" will be explored by means of the sub-questions "Does the perceived susceptibility of contracting COVID-19 influence vaccine intention?" and "Does the perceived severity of COVID-19 influence vaccine intention?". Additionally, the existing studies answering this research question often neglect to incorporate a previous infection with the coronavirus in their analyses, even though it is shown to influence risk perception significantly. Therefore, the sub-question "Does a previous COVID-19 infection have an influence on risk perception, thus on perceived susceptibility and perceived severity respectively?" will be investigated as well.

2. Methods

2.1 Design

For this study, a descriptive cross-sectional design was employed in the form of an online survey, which was created and distributed on the platform Qualtrics. It consisted of a combined study of students and therefore not only included items referring to risk perception of infecting oneself with COVID-19 but also items referring to confidence in the available vaccines as well as trust in the government. However, since these items were not used for the analyses of this thesis, the methods focused only on the items important for this research, thus referring to the risk perception of COVID-19 and vaccine intention. This research's conduction was approved by the BMS ethics committee for humanities and social sciences of the University of Twente (Request number: 210304).

2.2 Participants

The participants were approached through convenience sampling, utilizing social media and face-to-face conversations during a one-week period in April 2021, which is approximately one year after the initial outbreak of the virus. They were eligible to participate in the study if they were German, at least 18 years old, and possess a sufficient English level since the questionnaire was only available in English.

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2.3 Survey Instruments and Measures

The questionnaire started with a consent form (see Appendix A), which included information about the study's aim, inclusion criteria to take part in the study, the time it takes to take part, the right to withdraw from the study at any time, and the protection of their personal data. The questionnaire is displayed in Appendix B.

2.3.1 Demographics

The demographics included questions regarding the participants' age, gender, nationality, educational attainment, employment status, and how they would rate their general health. An example question is "How would you evaluate your overall health?" with the answer options "in good physical health", "mildly physically impaired," "moderately physically impaired," "severely physically impaired," and "totally physically impaired."

2.3.2 COVID-19 personal experience

The second part of the survey consisted of general questions about the participants' experiences with COVID-19 with questions adapted from the WHO's COVID-19 survey tool and guidance (2020c). The questions were phrased as follows: "To your knowledge, are you, or have you been infected with COVID-19?" and "Do you know people in your immediate environment who are or have been infected with COVID-19 (suspected or confirmed)?".

2.3.3 Vaccine intention

One item in the survey referred to the respondents' willingness to get vaccinated against the virus, namely: "Which of the following best describes your perspective/opinion about COVID-19 vaccination when the vaccine is available for you?". The participants were able to choose between five different answer options, amongst others "I have decided that I do NOT want to be vaccinated against the coronavirus" and "I have decided that I would like to get vaccinated against the coronavirus."

2.3.4 Perceived risk

Since the outbreak of the virus, various scales have been developed to detect the emotional dimensions of COVID-19, for example, the Fear of COVID-19 Scale (Ahorsu et al., 2020), the Coronavirus Anxiety Scale (Lee, 2020), and the COVID Stress Scales (Taylor et al., 2020), however, there was no reliable instrument to assess the perceived risk of COVID-19. Thus, the scales could not be used to evaluate risk perception. Even though the underlying

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constructs of these three scales correlate with the administration of health behaviours to reduce one's own risk, risk perception is a more reliable predictor of the administration of health behaviours (Harper et al., 2020; Witte & Allen, 2000). Since risk perception has two underlying factors, it cannot be assessed utilizing a single scale. Hence, to determine the perceived risk of COVID-19, the questionnaire included two different scales, with one scale referring to the respondents' perceived probability/susceptibility of getting infected and the other scale referring to the perceived severity of COVID-19.

Perceived probability/vulnerability. The researchers Jaspal, Fino, and Breakwell (2020) acknowledged the lack of a reliable instrument to assess perceived risk and developed the COVID-19 Own Risk Appraisal Scale (CORAS), which they state discriminates between the emotional and analytic dimensions of risk perception. Their scale focuses on the personal risk of one's own COVID-19 infection. This is an essential factor in assessing risk perception because there is a distinction between perceived risk of harming oneself or others.

The CORAS (Jaspal, Fino, & Breakwell, 2020) was adopted to measure the perceived probability of infecting oneself with the virus. As a basis for the development of the CORAS, the Perceived Risk of HIV Scale (Napper, Fisher, & Reynolds, 2012) was used because there is evidence that the development of risk perception of contracting HIV is similar to the underlying risk appraisal of COVID-19 (Breakwell & Jaspal, 2020). The CORAS included six items and was measured on a 5-point ordinal scale, which varied per question (e.g., Likert scale of likelihood, agreeableness, etc.). Questions such as 'Picturing myself getting COVID-19 is something I find: (1 = very hard to do; 5 = extremely hard to do)' and 'I feel vulnerable to COVID-19 infection' (1 = strongly disagree; 5 = strongly agree) were included in the scale. The total score of the scale is based on the sum of all scores of the six items. However, the scale only focuses on the perceived probability of infecting oneself with COVID-19 and neglects the role of perceived severity in the formation of risk perception.

Perceived severity. To cover both dimensions of perceived risk, meaning both the perceived vulnerability and the perceived severity of contracting the virus, the CORAS needed to be supplemented by items referring to the perceived severity of the infection. Farooq, Laato, and Islam (2020) modified three items from previous research about the perceived severity of influenza with the word 'coronavirus'. Their analyses showed high composite reliability ($CR = .70$), and an adequate value of average variance explained ($AVE = .52$), indicating that the scale is reliable and valid. However, due to one low factor loading, one item was removed. Therefore, the two remaining items of the perceived severity scale were adapted for this research study.

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The items were measured on a 5-point Likert scale (1= strongly disagree; 5 = strongly agree). They were phrased as follows: "The negative impact of coronavirus is high" and "The coronavirus is a serious threat for someone like me". A total score higher than the composite score indicated greater perceived severity of COVID-19.

2.4 Procedure

The participants accessed the questionnaire via a link they received over Instagram, WhatsApp, Facebook, or iMessage. Before filling out the survey, the participants needed to fill out the consent form. In case of disagreement with the consent form, the online questionnaire was closed automatically. Then, the participants were asked to indicate their demographics. After that, participants filled out the questionnaire. If they responded with 'yes' to whether they were infected with the coronavirus, they were further asked if their infection was mild or severe and if a COVID-19 test confirmed their condition. If they answered with 'no,' the questions were not presented to them. At the end of the online survey, the participants were debriefed by thanking them for their participation and providing the researchers' contact details to ensure that they could contact the researchers if questions arose.

2.5 Data Analysis

2.5.1 *Preparing the dataset*

The statistics program SPSS version 26 was used for all the analyses of this study. After transferring the data from Qualtrics to SPSS, participants who did not fulfill the inclusion criteria were removed. After filtering the age, nationality, and deletion of incomplete submissions, 205 participants were included. From the CORAS, the items "I am sure I will NOT get infected with COVID-19" and "I feel I am unlikely to get infected with COVID-19" were reverse scored and thus needed to be recoded.

2.5.2 *Demographics and basic descriptives*

Basic descriptives and frequencies were calculated for the demographic variables, the COVID-19 questions, the vaccine intention question, and the two scales for risk perception. This was done to portray the sample, display their experiences with the coronavirus, know general vaccine acceptance or hesitancy, and assess their level of risk perception.

2.5.3 Psychometric properties of the risk perception scales

Before the scales were used for subsequent analyses, their psychometric properties were tested first to ensure the adequacy of the results. This was the case because the scales are newly developed and were therefore not applied and tested in many studies so far. Therefore, their reliability and validity were checked in advance.

Reliability Analyses. For the CORAS the raw scores of each of the items were used to compute Cronbach's alpha. The reliability for the CORAS was considered acceptable with a Cronbach's alpha of 0.735. The inter-item correlations were all positive, ranging between .025 and 1, suggesting that the items were likely to measure one underlying construct.

The Spearman-Brown statistic/split-half reliability was used for the perceived severity items since it is the most appropriate reliability coefficient for a two-item scale. The Spearman Brown coefficient of .682 was considered poor. Taking a closer look, the inter-item correlation of the two questions equaled .518, suggesting that the items were so close as to be almost repetitive. However, reliability statistics are dependent on the number of items on the scale, so the low reliability for the two items is not surprising.

Validation Analyses. After assessing the scales' reliability, exploratory factor analyses were conducted to analyse the item's internal validity, that is, whether the scales indeed measure the perceived risk of COVID-19. The factor analysis for the CORAS revealed that the item "Picturing myself getting COVID-19 is something I find" does not add value to the scale since it does not have the same underlying factor as the other items and Cronbach's alpha would increase if the item was deleted. Therefore, the item was excluded in subsequent analyses to ensure the reliability of the data.

The factor analysis of the Perceived Severity Scale showed only one underlying factor of the scale: the perceived severity of a COVID-19 infection. Thus, both items are valid and were therefore used for subsequent analyses.

2.5.4 Risk perception

For the CORAS, the sum score with a minimum possible value of 5 and a maximum value of 25 was computed. For the Perceived Severity Scale, the composite scale was calculated so that participants could score a minimum value of 1 and a maximum value of 5. Although both scales are 5-point Likert scales, they were not summed together to represent the variable risk perception to detect possible differences among the perceived probability of getting infected and the perceived severity of COVID-19. Therefore, the subsequent analyses were all

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conducted with the sum score of the CORAS and the composite score of the perceived severity scale.

2.5.5 Influence of previous COVID-19 infection on risk perception

To test the hypothesis of whether a previous COVID-19 infection affects risk perception, it was necessary to statistically determine whether there exists a relationship between these two variables by means of a bivariate Pearson correlation. It was hypothesized that a previous coronavirus infection influences risk perception. Therefore, high Pearson correlations ($r > .5$) between the variable COVID-19 infection and the scores of the CORAS and the Perceived Severity scale were expected. Afterward, a multiple regression analysis was performed with perceived probability and perceived severity of COVID-19 as dependent variables, respectively, and perceived health status, previous COVID-19 infection, and course of disease as independent variables. The perceived health status was added to the regression analysis to see if health, in general, might be a predictor of risk perception as well.

2.5.6 Influence of risk perception on vaccine intention

To answer the research question, it was necessary to statistically determine whether there is a relationship between the perceived risk of COVID-19 and the willingness to get vaccinated employing a bivariate Pearson correlation. Therefore, it was assumed that there exists a correlation between the two constructs of risk perception and vaccine intention ($r \neq 0$).

3. Results

3.1 Demographics

The demographic characteristics of the sample are shown in Table 1. When looking at the table it becomes visible that more than two-thirds of the sample was female and that the sample is relatively young with a mean age of approximately 24 years. Furthermore, most of the participants chose HAVO/Gymnasium/Highschool or a Bachelor degree as their highest level of education. Consistent with the average age is the finding that most of the participants are students. Lastly, the majority of the sample considers their health to be good. However, some participants consider their health to be mildly physically impaired or moderately physically impaired. In comparison, no one considered themselves totally physically impaired, and only 1% of the participants considered themselves severely physically impaired.

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Table 1

Demographic characteristics of participants (N = 205)

	Overall
Age in years (M(SD))	23.58 (7.501)
Gender (%)	
Male	56 (27.3 %)
Female	148 (72.2 %)
Non-binary	1 (.5 %)
Nationality	
Highest level of education (M(SD))	3.73 (1.601)
Primary school	0
VMBO/Realschule/Hauptschuld/Middle school	13 (6.3 %)
HAVO/Gymnasium/Highschool	146 (71.2 %)
Undergraduate degree/Bachelor	36 (17.6 %)
Graduate degree/Master	6 (2.9 %)
Doctorate degree/PhD or higher	0
Other	4 (2.0 %)
Employment status (M(SD))	4.26 (1.178)
Unemployed	8 (3.9 %)
Part-time employed	10 (4.9 %)
Full-time employed	43 (21.0 %)
Self-employed	5 (2.4 %)
Student	138 (67.3 %)
Retired	1 (.5 %)
Health Status (M(SD))	1.47 (.711)
Good physical health	133 (64.9 %)
Mildly physically impaired	50 (24.4 %)
Moderately physically impaired	20 (9.8 %)
Severely physically impaired	2 (1.0 %)
Totally physically impaired	0

3.2 Personal Experience with COVID-19

The participants' experiences with the virus are demonstrated in Table 2. Only 8.3 % (n = 17) of the participants indicated that they are or have been infected with the coronavirus and all of them replied that a test confirmed their infection. Eleven of them indicated that their course of infection was mild, whereas six had a severe disease course. Moreover, 17 participants indicated that they do not know if they are or have been infected with the virus. Furthermore,

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most participants confirmed that they know people in their immediate environment who are or have been infected with the coronavirus.

Table 2

Participants' Personal Experience With COVID-19

	Response	N	n	%	M(SD)
To your knowledge, are you, or have you been infected with COVID-19?	Yes	205	17	8.3	2 (.408)
	No		171	83.4	
	I don't know		17	8.3	
If yes, was it confirmed by a test?	Yes	17	17	8.3	1 (.000)
If yes, was the infection mild or severe?	Mild	17	11	5.4	1.35
	Severe		6	2.9	(.493)
Do you know people in your immediate environment who are or have been infected with COVID-19 (suspected or confirmed)?	Yes	203	172	84.7	1.15 (.361)
	No		31	15.3	

3.3 Vaccine Intention

The question about vaccine willingness answered by the majority of the participants, more precisely 82 % ($n = 168$), with "I have decided that I would like to get vaccinated against the coronavirus ($M = 4.52$, $SD = 1.10$). The second most used answer option was "I am not sure yet if I will be vaccinated against the coronavirus, but I probably will" (10.2 %, $n = 21$). The remaining answer options "I have not yet considered whether I will be vaccinated against the coronavirus", "I am not sure yet if I will be vaccinated against the coronavirus, but I probably will NOT", and "I have decided that I do NOT want to get vaccinated against the coronavirus" were equally selected by 5 participants each, thus by 2.4% of participants respectively.

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3.4 Personal probability to get infected with COVID-19

The sum score of the CORAS averaged on 16.04 ($SD = 3.45$), suggesting that the participants perceive their probability to get infected with the virus as between neutral and moderately high. Indeed, the majority of participants answered the questions with 'neutral'. Moreover, there is a trend visible that more participants chose the answer option 'unlikely/disagree' than 'likely/agree' when being asked about their perceived probability of getting infected. However, for the reversed scored items it was the opposite. Thus, based on the items that did not need to be reverse scored, the perceived probability of getting infected with the virus would be lower, whereas the reverse-scored items indicate a higher likelihood of getting infected with the virus. The detailed distribution of responses is shown in Table 3.

Table 3

Perceived Probability to get Infected With COVID-19 (N = 205)

	n	%
What is your gut feeling about how likely you are to get infected with COVID-19?		
Extremely unlikely	13	6.3
Unlikely	59	28.8
Neutral	71	34.6
Likely	51	24.9
Extremely likely	11	5.4
I am sure I will NOT get infected with COVID-19*		
Strongly disagree	56	27.3
Disagree	91	44.4
Neither agree nor disagree	42	20.5
Agree	10	4.9
Strongly agree	6	2.9
I feel I am unlikely to get infected with COVID-19*		
Strongly disagree	23	11.2
Disagree	61	29.8
Neither agree nor disagree	66	32.2
Agree	49	23.9
Strongly agree	4	2.9
I feel vulnerable to COVID-19 infection		
Strongly disagree	10	4.9

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Disagree	61	29.8
Neither agree nor disagree	64	31.2
Agree	59	28.8
Strongly agree	11	5.4
I think my chances of getting infected with COVID-19 are		
Very low	4	2.0
Low	52	25.4
Neutral	100	48.8
Large	40	19.5
Extremely large	9	4.4

*= reverse-scored

3.5 Perceived Severity of COVID-19

The average score centered around 3.43 ($SD = .88$), indicating that most respondents consider COVID-19 to be moderately severe for their health. The answers of the two items show that the participant's perception of the negative impact of COVID-19 is higher than their perceived threat of COVID-19. A more accurate description of the perceived severity of the virus is shown in Table 4.

Table 4

Perceived Severity of COVID-19 (N = 205)

	n	%
The negative impact of COVID-19 is very high		
Strongly disagree	4	2.0
Disagree	25	12.2
Neither agree nor disagree	44	21.5
Agree	78	38.0
Strongly agree	54	26.3
The COVID-19 is a serious threat for someone like me		
Strongly disagree	8	3.9
Disagree	50	24.4
Neither agree nor disagree	72	35.1
Agree	61	29.8
Strongly agree	14	6.8

3.6 Influence of Previous COVID-19 Infection on Risk Perception

3.6.1 Pearson correlations

Even though the correlation is weak, there appears to be a significant relationship between the perceived probability of getting infected and previous COVID-19 infection, $r(205) = -.195, p < .01$, indicating the perceived probability of getting infected increases after a COVID-19 infection. The correlation is negative because the COVID-19 infection was coded as 'yes=1' and 'no=2'. However, there is no significant correlation between the perceived severity of COVID-19 and COVID-19 infection. Thus, previous infection with the virus does not significantly increase or decrease the perception of the severity of the virus.

Next, the results show a weak positive correlation between perceived severity of COVID-19 and overall health status, $r(205) = .214, p < .01$, suggesting that poor health status is associated with an increased perception of severity. Moreover, there is a strong relationship between health status and the course of disease, $r(205) = -.555, p < .05$, indicating that people with a poor health status tend to suffer from a more severe course of disease.

Lastly, there is a medium correlation between the perceived probability and the perceived severity, which was expected since the CORAS and the Perceived Severity Scale represent risk perception. For illustration purposes, the Pearson correlations are presented in Table 5.

Table 5

Pearson Correlations Between Health Status, COVID-19 Infection, Course of Disease and the CORAS/Perceived Severity Scale

	Health	COVID-19 infection	Course of disease	Perceived probability	Perceived severity
Health	1				
COVID-19 infection	-.051	1			
Course of disease	.555*	c	1		
Perceived probability	.104	-.195**	.275	1	
Perceived severity	.214**	-.007	.326	.434**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

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3.6.2 Multiple regression analysis

A multiple regression analysis was conducted because even though the constructs of risk perception and a previous COVID-19 infection did not show a strong bivariate Pearson correlation, they may show an association in regression. The four assumptions linearity, independence, homoscedasticity, and normality for regression analysis were met. A summary of the simple regression is provided in Table 6.

When the perceived severity was predicted, neither the course of disease nor health status were significant predictors. The overall model fit was $R^2 = 0.27$, which can be considered poor (see Figure 1). For the perceived probability to get infected, the model fit was $R^2 = 0.19$, and the independent variables did not predict probability perception (see Figure 2). Thus, the independent variables course of disease and health were not significant predictors of the dependent variables perceived probability and perceived severity.

Table 6

Summary of Simple Regression Analyses for Variables Predicting Perceived Probability of Infection and Perceived Severity of Covid-19 (N = 17)

Variable	Perceived severity					Perceived probability				
	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>Sig.</i>	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>Sig.</i>
Constant	2.523	.687		3.674	.003	17.464	2,166		8,064	,000
Course of disease	.116	.573	.056	.203	.842	,326	1,806	,052	,180	,860
Health status	.574	.323	.488	1.780	.097	1,408	1,018	,401	1,384	,188

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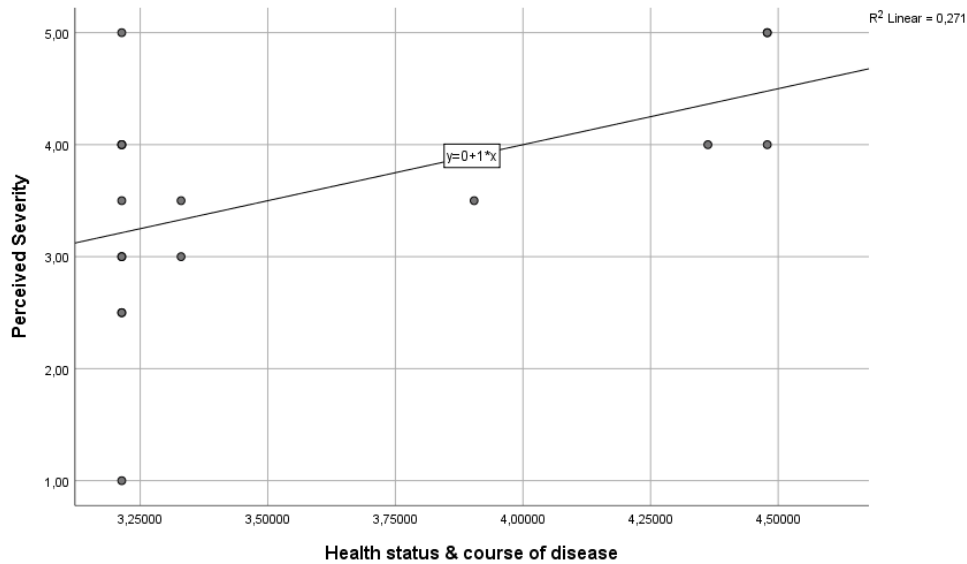


Figure 1. Scatterplot of relationship between perceived severity of COVID-19 and health status + course of disease.

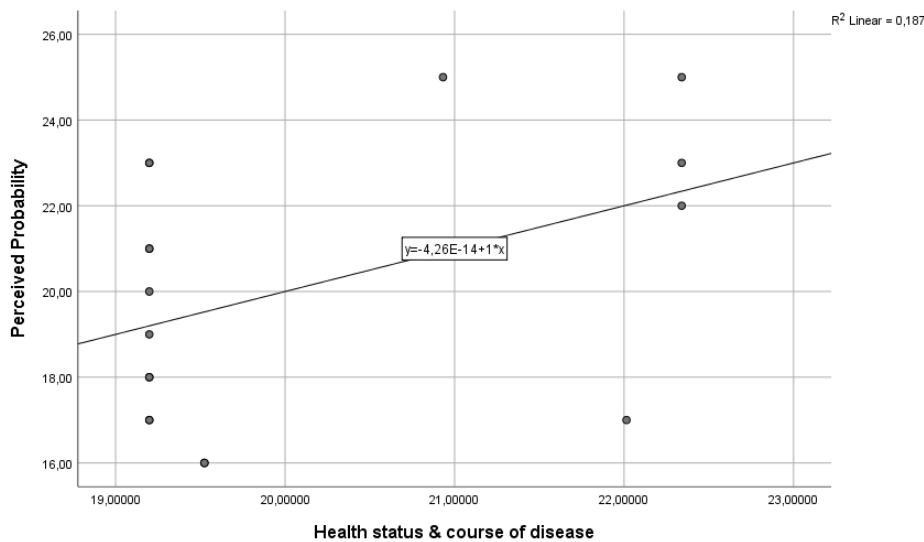


Figure 2. Scatterplot of relationship between perceived probability of getting infected and health status + course of disease.

3.7 Influence of Risk Perception on Vaccine Intention

The Pearson correlations between the total scores of the CORAS, the perceived severity scale, and vaccine intention are presented in Table 7. The correlation between the scores of the CORAS and vaccine intention is insignificant, whereas there is a significant correlation between the perceived severity of COVID-19 and vaccine intention, $r(205) = .223, p < .01$. This indicates as individuals perceive the coronavirus to be severe, their vaccine intention increases.

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The relationship between both variables of risk perception and vaccine intention are displayed in Figures 3 and 4.

Table 7

Pearson Correlations Between Risk Perception and Vaccine Intention

	Vaccine intention	CORAS	Perceived Severity
Vaccine intention	1		
CORAS	.118	1	
Perceived severity	.223**	.434**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

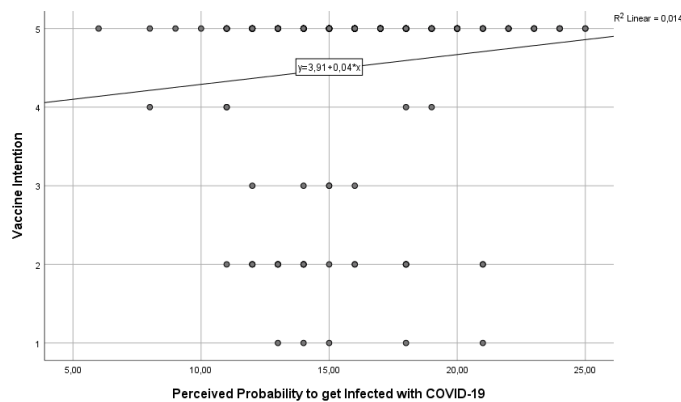


Figure 3. Scatterplot of relationship between perceived probability to get infected with COVID-19 and vaccine intention.

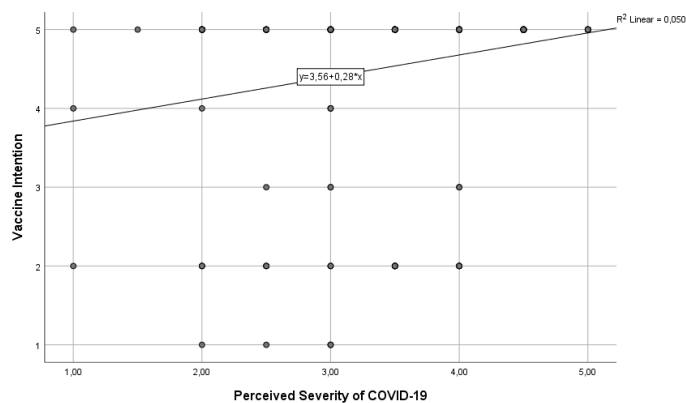


Figure 4. Scatterplot of relationship between perceived severity of COVID-19 and vaccine intention.

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4. Discussion

4.1 Summary of Results

This study aimed to investigate the relationship between the two constructs of risk perception, which are respectively "perceived susceptibility/perceived probability to get infected with the virus" and "perceived severity of COVID-19" and vaccine intention, as well as the relationship between a previous COVID-19 infection and risk perception. The study results show a relationship between the perceived severity of COVID-19 and vaccine intention. In contrast, the perceived probability of getting infected with the virus did not significantly affect vaccine intention in this sample. Consequently, this study demonstrates that there are differences in perceived probability and perceived severity, emphasizing the need to assess these constructs independently from each other. A previous COVID-19 infection moderately influenced the perceived probability of getting infected with the virus but did not affect people's perceived severity of COVID-19.

4.2 Reflection

In contrast to previous research, perceived vulnerability was not at all, and perceived severity was only marginally associated with vaccine intention (Weinstein et al., 2007; Bish and Michie, 2010). Previous research has typically focused on perceived risk overall, causing the results to neglect the differences between perceived vulnerability and perceived severity. Moreover, as far as COVID-19 is concerned, the participants showed an average perception of risk, and their health-protective behaviours might be mainly driven by their perceived risks to other people, which is not evaluated by the current study (Faasse & Newby, 2020).

The finding that the perceived vulnerability of COVID-19 plays only a minor role in predicting health-protective behaviours and vaccine intention precisely, which is a finding that Clark, Davila, Regis, and Kraus (2020) discovered in their study as well, indicates that perhaps other variables might predict vaccine intention better than perceived severity. For example, trust in the government or the trust in the vaccines themselves might be better predictors of the willingness to get vaccinated than the perceived severity of COVID-19. Consistent with this finding are the conclusions made by other scholars that interpersonal variables and variables at the level of community or health system are more important determinants of new and preventing health actions, such as the COVID-19 vaccine, as opposed to personal beliefs (Kumar et al., 2021; Vermandere et al., 2016).

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Contrary to the expectation that a previous corona infection is a significant predictor in risk perception, the regression analyses showed that there is neither an association between a prior corona infection and perceived probability nor perceived severity. However, this finding needs to be interpreted with caution because the regression analysis was conducted with a sample size of 17 respondents since this was the number of respondents infected with the virus. An argument that the findings of the regression analyses might be inadequate is the results of the Pearson Correlations. These showed that even though there was no significant relationship between perceived severity and previous COVID-19 infection, there was a significant relationship between perceived probability and previous COVID-19 infection. Therefore, people who were infected in the past consider their likelihood to catch the virus again as higher than individuals who did not get infected yet with the virus. This finding is more accountable and consistent with other studies. This phenomenon is called optimistic bias, according to which people tend to perceive their own risk of infecting themselves or passing on a disease or virus as lower than the risk of comparable others (Weinstein, 1982). It is formed through experiences, leading people to believe that they are immune or resistant to the virus if they have not contracted the virus yet (Weinstein, 1982). Consequently, if more people had been infected with the virus, the regression analysis results would likely be significant.

4.3 Limitations

The study has its limitations. A convenience sample was recruited, and as the demographics show, the sample is biased to represent female students around 24 years old. Resultingly, the sample is not representative of the German population. This could be due to the questionnaire being only distributed online which could have meant that older age groups did not have access to it. Future studies should find a way to approach all age groups to make the results more representative. Furthermore, the data were collected only at one point in time. It is not possible to observe changes in risk perceptions of the coronavirus over time and consequently no causal effects. However, the respondents' risk perception might change over time due to only short-lasting and unsteady restrictions and rules in Germany, which future studies should consider.

Another limitation is that for the CORAS, the wording of the items influenced the answers. It was noticeable that the respondent's answers were slightly inconsistent between the 'normal' items and reverse-scored items, which could indicate that the respondents either did not fully understand the items or did not take the time to read the items carefully. Similarly, for

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the item asking for the negative impact of COVID-19 in the perceived severity scale, respondents chose higher scores than for the other item of perceived severity, suggesting that they might not have understood that the item refers to their own health but moreover to the overall COVID-19 situation, for example in the social or economic context. Thus, next time, the questionnaire should include more extensive introductions to clarify what the items are referring to.

4.4 Strengths and Suggestions for Future Research

However, the study also has its strengths. First, it proved the CORAS to be a valid and reliable assessment instrument of the perceived probability of getting infected with COVID-19. Furthermore, this study highlights the need for a scale that assesses risk perception concerning the differences in perceived susceptibility/probability and perceived severity, which can be a starting point for the future development of such a scale. Future research should investigate why perceived vulnerability/probability to get infected with the virus was not associated with vaccine intention. Furthermore, scholars might build upon this study by tracking the population's risk perception and their vaccine intention over time at different points during the pandemic. In order to tailor interventions, it would be interesting to study whether there are age or gender differences in the risk perception of COVID-19 and their corresponding vaccine intention.

4.5 Recommendations

As the results have shown, does the perceived severity of COVID-19 affect vaccine intention, which is an issue that can perhaps be addressed with interventions tailored to the population's perception of severity. People turn to the media to get information, especially in uncertain situations such as COVID-19 (Anwar, Malik, Raees, & Anwar, 2020). Therefore, a mass media intervention focusing on the health consequences of COVID-19 infection and providing the population with beneficial effects of the vaccines might solve vaccine hesitancy. A mass media intervention means using multiple channels, such as social media, TV, radio, newspaper, and so on in order to reach the most people.

The intervention could include multiple elements. For instance, Diefenbach and Leventhal (1996) state that individuals assess the severity of a disease based on symptoms so that the absence of symptoms makes them believe that they are well. This is an essential factor in risk perception formation and could adversely affect reduced health-protective behaviours,

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especially vaccine hesitancy. On that account, misconceptions regarding COVID-19 and its health consequences should be addressed and corrected in public health communication initiatives. Additionally, intervention could include measures to educate the population about underestimating the fast transmissibility of the virus and overconfidence in all stages of the pandemic. If experts provide the information, the population might be more inclined to listen and to base their risk assessment based on that information. Moreover, each media source should be credible and pertain to WHO guidelines for the most effective message (Anwar et al., 2020).

Visschers, Meertens, Passchier, and De Vries (2009) identified multiple recommendations about probability information in risk communication in their literature review. They state that individuals respond best to risk communications when the information is presented both verbally and numerically since people prefer numerical data because it is more accurate. Yet, they utilize verbal statements to communicate a probability to others. Also, they recommend using graphs during risk communications because visual representations are more likely than numerical information to catch the population's attention. Another point that is worth mentioning is the risk communication of cumulative probabilities. Individuals tend to assess their risk based on a single exposure which often leads to an underestimation of the risk (Knäuper, Kornik, Atkinson, Guberman, & Aydin, 2005). There is evidence showing that providing the population with probability information in a cumulative format significantly increases their risk perception of the hazard (Greening, Chandler, Stoppelbein, & Robison, 2005). Transferred to COVID-19, communicating the cumulative risk of infection as well as the cumulative probability to suffer from adverse symptoms and long-term consequences could significantly increase the population's risk perception of COVID-19, both in terms of perceived probability and perceived severity (Keller, Siegrist, Gutscher, 2006).

Lastly, the context of information processing influences how individuals internalize the communicated risk as well as the type of processing they use, either heuristically or systematically. Accordingly, it is vital to distribute accurate health information through multiple channels, such as social media and news, so that every member of the population has access to it. Moreover, it is possible to influence the processing of risk information by tailoring the information to a specific age group, thereby motivating them to engage in systematic processing (Greening et al., 2005).

4.6 Conclusion

In conclusion, this study has relevance to both research on risk perception in general and practical application since it suggests intervention possibilities on how risk should be communicated to the population. The study's findings highlight the importance of discriminating between perceived vulnerability and perceived severity when assessing risk perception. Furthermore, the result that perceived severity plays a role in vaccine intention can be a starting point for risk communication interventions. In that regard, a mass media intervention that entails experts providing empirical information about the virus for different age groups might be most effective in forming a realistic perception of the severity of the coronavirus. If there is a link between the perceived susceptibility of getting infected with COVID-19 and vaccine intention needs to be further investigated as well as if there are perhaps other determinants that predict vaccine intention, such as trust in the government or trust in the vaccine.

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Appendix A

Opening Statement Online Survey

Dear participant,

Thank you for taking part in this study which aims to gain insight into the perceived risk of COVID-19, the COVID-19 vaccine, and people's trust in the government.

This study will approximately take 20 minutes. This study is conducted by three Psychology Bachelor students Lara Sprekelmeyer, Milena Völler, and Celine Terbeck from the Faculty of Behavioural, Management and Social Sciences at the University of Twente. Your participation in this study is entirely voluntary and you can withdraw at any time. We are looking for your personal opinions. There are no right or wrong answers!

What is this project about, and do I have to take part?

RISK PERCEPTION AND THE WILLINGNESS TO GET VACCINATED AGAINST COVID-19

This study aims to evaluate factors which might influence the COVID-19 vaccination program. You are able to participate if you are at least 18 years old and do not need any prior knowledge. Also, participating in this study is entirely voluntary.

What are the benefits and risks of taking part?

There are no foreseeable risks for you when taking part in the survey other than time spent on the survey. Should you feel uncomfortable and want to leave the study you are free to do so without any consequences.

What will happen to the information I give you?

Your data will be collected and kept anonymously according to the policy guidelines of the BMS faculty of the University of Twente and analyzed by the three researchers. The data will not be shared with anyone outside the research team. Besides, it is not possible to trace your answers back to you. This study has received ethical approval from the University of Twente, BMS Ethical Committee (BCE210304).

How long will my data be stored for?

In order to help inform future pandemic and epidemic preparedness, the data you have provided will be helpful even beyond the current COVID-19 pandemic. Your anonymous data will therefore be stored securely for up to 10 years by the BMS faculty after the end of the research for this study. At this point, the data will be reviewed, and if they are still deemed to be of public interest, they may be retained for longer. If not, your data will be permanently deleted.

Concerns

If you are concerned about this study, or how your data is being processed, or if you would like to contact us about your rights, please get in touch with the researchers via their email:

Celine Terbeck: c.terbeck@student.utwente.nl

Lara Sprekelmeyer: l.sprekelmeyer@student.utwente.nl

Milena Völler: m.voeller@student.utwente.nl

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than

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the researcher(s), please contact the Secretary of the Ethics Committee of Twente by ethicscommittee-bms@utwente.nl

Appendix B Questionnaire

Demographics	
What is your age?	
What is your gender?	Male/ female/ non-binary/third gender/ prefer not to say
What is your nationality?	German / Dutch / other (specify)
What is your highest level of education you have completed?	No formal education/ high school/ college/ undergraduate degree (Bachelor)/ graduate degree (Master)/ doctorate degree (PhD)
What is your employment status?	Unemployed/ part-time employed/ full-time employed/ self-employed/ student/ retired
How would you evaluate your overall health?	In good physical health/ mildly physically impaired/ moderately physically impaired/ severely physically impaired/ totally physically impaired
COVID-19 personal experience	
To your knowledge, are you, or have you been infected with COVID-19?	Yes/ no/ I don't know
If yes, was it confirmed by a test?	Yes/ no
If yes, was the infection	Mild/ severe
Do you know people in your immediate environment who are or have been infected with COVID-19 (suspected or confirmed)?	Yes / no
COVID-19 vaccine	
Which of the following best describes your perspective/opinion about coronavirus (COVID-19) vaccination, when the vaccine is available for you? (If you have been vaccinated already, please indicate your most fitting perspective below)	• I have not yet considered whether I will be vaccinated against the coronavirus • I am not sure yet whether I will be vaccinated against the coronavirus, but I probably will • I am not sure yet if I will be vaccinated against the coronavirus, but I probably will NOT • I have decided that I do NOT want to get vaccinated against the coronavirus • I have decided that I would like to get vaccinated against the coronavirus
Risk perception	
In the following section you will be presented about questions and statements regarding your risk perception of COVID-19. Risk perception means your personal and intuitive assessments of risks/hazards of COVID-19 and the corresponding undesirable effects of COVID-19.	

RISK PERCEPTION AND THE WILLINGNESS TO GET VACCINATED AGAINST COVID-19

Please indicate how you consider the likelihood of the following statement: - What is your gut feeling about how likely you are to get infected with COVID-19?	Extremely unlikely / unlikely / neutral / likely / extremely likely
Please indicate to what extent you agree with each of the statements: - I am sure I will NOT get infected with COVID-19* - I feel I am unlikely to get infected with COVID-19* - I feel vulnerable to COVID-19 infection	Strongly disagree / disagree/ neither agree nor disagree / agree / strongly agree
Please indicate which answer applies the most to you: - Picturing myself getting COVID-19 is something I find	Extremely hard to do / hard to do / neither easy nor hard to do / easy to do / extremely easy to do
Please indicate to what degree you rate the occurrence of the following event: - I think my chances of getting infected with COVID-19 are	Very low / low / neutral / large / very large
Perceived severity	
Please indicate how severe a COVID-19 infection would be for your health/for you personally - The negative impact of COVID-19 is very high - The COVID-19 is a serious threat for someone like me	Strongly disagree / disagree / neutral / agree / strongly agree

*= reverse-scored