Are “Trust in the COVID-19 Vaccine” and “Trust in the different Companies” Predictors of German Citizens’ Willingness to get Vaccinated against COVID-19?

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Abstract

The COVID-19 disease is a new and dangerous threat to the health of everyone around the world. One possible solution to control the disease could be reaching herd immunity through COVID-19 vaccinations. To maximize the number of people vaccinated, it is important to understand why people do not want to get vaccinated. For this study, data from German citizens (N= 195) was collected about their willingness to get vaccinated against COVID-19 and its relationship to two possible predictors called "trust in vaccine" and "trust in companies" that produce a COVID-19 vaccine. Therefore, the Vaccine Hesitancy Scale (VHS) was adapted, and five self-constructed items were added. A surprising finding was that the vaccine willingness (82.6%) was higher than in comparison to other studies. Furthermore, the study revealed that peoples' trust in the vaccine itself as well as the trust in the companies that produce the vaccines are significant predictors of citizens' willingness to get vaccinated against COVID-19. Regarding the specific companies, Germans trusted the company BioNTech most followed by Moderna, Johnson & Johnson, and AstraZeneca. Additionally, all companies differ significantly from each other regarding their trust rates except the companies AstraZeneca and Johnson & Johnson by which no difference could be detected. Based on these findings, it is now crucial to enhance peoples' trust in the vaccine and further investigate the imbalance of trust in the different companies in order to reach optimal vaccine rates.

1. Introduction

What started as small news about a virus in China, rapidly became a pandemic and developed into a worldwide threat. The outbreak of the COVID-19 disease caused by the SARS-CoV-2 virus in December 2019 changed the world as we knew it (Xu et al., 2020). A possible solution for this hazard is a large-scale vaccination, which in turn leads to herd immunity (WHO, 2020a). However, vaccine hesitancy rates are high in Germany (Neumann-Böhme et al., 2020). Thus, in order to decrease negative feelings towards the vaccine, it is essential to understand why people hesitate to get vaccinated against COVID-19. In the following paragraphs, the COVID-19 disease itself will be explained, how Germany deals with the threat, and what consequences this has on the citizens' well-being. After that, it will be clarified what concerns, that resultantly increase vaccine hesitancy, were dominating during previous pandemics.

To understand the citizens' concerns in depth, it is central to first gain knowledge about the COVID-19 disease itself and its characteristics that are different from former viruses. Generally, COVID-19 is a disease that originated in Wuhan, China, causing respiratory

infections that manifest itself through various symptoms (Lima, 2020). These range from mild flu-like symptoms and fever to serious pneumonia (Lima, 2020). Most dramatic cases also run the risk of death with an observed case-fatality ratio of 2.4% for Germany (Johns Hopkins Coronavirus Resource Center, n.d.). People who are especially likely to develop a severe course of infection belong to the at-risk group. The National Institute for Public Health and the Environment (2021) explains that those people are typically older than 60 years or individuals with underlying diseases. In contrast to that, some people do not show any signs of symptoms but are still infected with the SARS-CoV-2 virus, which leads to a continuing spread due to the person's unknowingness (Johansson et al., 2021). Like other viruses, different variants of the virus, so-called mutations, arose which spread even faster, are more contagious, and could challenge vaccine effectivity because of its changed structure (Vié, 2021).

The previously mentioned unique factors of COVID-19, such as its uncontrollability and newness, lead to difficulties in keeping the infection rates low. Governments had to impose restrictions or even partly declare lockdowns in order to stop the rising numbers of COVID-19 cases and accompanying death cases. As an example, Germany introduced restrictions such as wearing medical masks, keeping 1.5 meters distance, and social distancing from March 2020 onwards (Bundesministerium für Gesundheit, 2021). Those limitations and the threat of the virus itself led to negative consequences on the individual's wellbeing. The individual might experience physical as well as psychological problems. Physical complaints can involve bodily symptoms, such as sleeping issues as well as distorted eating behaviour due to isolation (da Silva et al., 2020). Additionally, research observed an increase in drug and alcohol abuse as well as domestic violence during the current pandemic (Leslie & Wilson, 2020; Petterson et al., 2020; Rehm et al., 2020). Individuals also suffer psychologically due to the pandemic by increased rates of for instance, stress, loneliness, anxiety, or fear (Holmes et al., 2020).

To solve this threat to citizens' health and well-being, the announcement about the invention of a COVID-19 vaccination in December 2020 arose new hope for returning to normality. The first company that came up with a vaccine is named "BioNTech" and their vaccination has been permitted in Germany on the 21st of December 2020 (Bundesministerium für Gesundheit, 2021). This vaccine development was followed by the companies "Moderna", "Johnson & Johnson" and "AstraZeneca". Whereby the latter vaccine (AstraZeneca) elicited arousal among the population by announcements about its low effectivity and high risk of side effects that contradict each other (Wise, 2021b). Because of this tumult about the AstraZeneca vaccine, it is interesting to investigate whether citizens evaluate this vaccine as less trustworthy compared to the other companies.

Despite the good news about a vaccine against COVID-19, herd immunity can only be reached if approximately 60 to 80% of the population is fully vaccinated (Tiwari & Sahu, 2021). Nevertheless, some people refuse to get vaccinated and, as a result, might prevent the aimed herd immunity threshold. Already before the COVID-19 pandemic, many people did not vaccinate against certain diseases. For Germany, only 38.8% got the influenza vaccine and 24.2 % got vaccinated against the pneumococcal disease in 2019 which is a bacterial infection causing severe fever, excessive sweating and shaking chills, or coughing (Bush, 2021; Rieck et al., 2020). Connecting this issue to the current COVID-19 vaccine, a study carried out by Neumann-Böhme et al. (2020) compared different European countries regarding their citizen's willingness to get vaccinated against COVID-19. They revealed that Germany (10%) and France (10%) have the largest proportions of citizens that are unwilling to vaccinate (Neumann-Böhme et al., 2020).

Exploring the reasons for the mentioned hesitancy rates, there appear many different barriers that might hinder an individual to get vaccinated. Firstly, there are moral, philosophical, or religious convictions that prevent people from getting a vaccine. Some examples include the Amish population in the United States of America or Orthodox Protestants in The Netherlands that oppose vaccinations (Dubé et al., 2013). Regarding the latter population, Ruijs et al. (2012) cited reasons such as that "man should not interfere with divine providence" (p. 6) or "Even if God sends a disease, he has a purpose for it" (p. 6). Secondly, a person might be biased by previous vaccination experiences like feeling pain after getting vaccinated or having adverse side effects (Dubé et al., 2013). As a third reason, Dubé et al. (2013) mention that other people in the individual's environment can influence the decision to get vaccinated through subjective norm or perceived pressure since the person wants to comply with prevalent norms and standards (Dubé et al., 2013). Another possible argument why people do not get vaccinated may be that they are simply not aware of the necessary vaccines or lack information about the process, location, or time of getting vaccinated (Dubé et al., 2013). Other than the reported determinants, Dubé et al. (2013) also note that people might hold various beliefs about the importance of a vaccine and vary in risk perception. Thus, these people weigh the perceived importance of the vaccine against how likely it is to get infected and how serious a potential infection would be. Lastly, trust in several parties such as the government, health authorities, or health institutions can affect vaccine intention too (Dubé et al., 2013). This report showed a great variability of reasons for vaccine hesitancy. Therefore, Lane et al. (2018) reviewed data from the WHO/UNICEF Joint Report Form (JRF) in the timespan of 2014 till 2016 to determine the most prevalent ones. According to this analysis, the three most mentioned arguments for

vaccine hesitancy were: (1) "risk-benefit" which is about the vaccine's safety and concerns about adverse effects, (2) lack of information, and (3) variables such as religion, culture, gender, and socioeconomic background (Lane et al., 2018).

Focusing on the most important determinant in predicting vaccine hesitancy as reported by Lane et al. (2018) namely "risk-benefit", it becomes apparent that people doubt the vaccine's effectiveness and safety. For previous vaccines, for example the influenza vaccine, there were also concerns about the effectiveness and adverse effects identified by the public as main reasons for rejection (Lehmann et al., 2014). In addition to Lehmann et al. (2014), another study found similar results and indicated that 59.9% of people who refuse to get vaccinated claim the vaccine's safety issues as the main reason (Sypsa et al., 2009). Multiple studies confirmed the citizens' concerns about the vaccine's safety across different countries (Horney et al., 2010; Lau et al., 2010; Maltezou et al., 2010; Ritvio et al., 2003).

Reading about these study results, it seems as if a huge part of the population is worried about the vaccine's characteristics. Thus, confidence in the vaccine appears to be of primary importance for peoples' willingness to get vaccinated. To understand the construct of vaccine confidence more in depth it is necessary to first investigate what factors belong to those concerns. Generally, confidence is defined as "the feeling that you can trust, believe in, and be sure about the abilities or good qualities of someone or something" (Oxford Learner's Dictionaries, n.d.). To be more concrete, vaccine confidence is composed of three subcomponents. Firstly, it is important that the individual trusts the authorities who make decisions about the vaccine which would be the government in this case (Larson et al., 2015b). Next, trust in the vaccinator, in that case the health care professional who performs the vaccination, is relevant for developing vaccine confidence (Larson et al., 2015b). Lastly, the general trust in the vaccine itself and the company that is producing it is of importance (Larson et al., 2015b). Every subcomponent requires the construct of trust, that Rousseau et al. (1998) define as ''a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or the behaviour of another" (p. 395).

Despite the fact that all of the components are important, this thesis will focus on the last concept of vaccine confidence namely the trust of the German citizens in the COVID-19 vaccine itself and in the companies that produce it. This decision is based on the previous research findings which all conclude that the safety of the vaccine itself is the most important concern and should therefore significantly influence the peoples' willingness to vaccinate. Furthermore, a specialization in the country Germany has been made since hesitance is especially high in Germany (Neumann-Böhme et al. 2020). The final research question is "*Are*

'trust in the COVID-19 vaccine' and 'trust in the different companies' predictors of German citizens' willingness to get vaccinated against COVID-19?".

All in all, understanding how vaccine confidence influences the German citizen's willingness to vaccinate against COVID-19 has several advantages. The findings of this study can enable the German government to eliminate the detected concerns, clear existing myths, and offer suitable information to the population to finally increase vaccine uptake. Another positive aspect is that government is better prepared for a possible future vaccine and how to deal with it. Meaning, they could pay attention to probable concerns from the beginning on to ensure high vaccine acceptance.

2. Methods

2.1 Design

For this study, a descriptive cross-sectional design was adopted that aimed to assess if the independent variables "Trust in the COVID-19 vaccine itself" and "Trust in the company that produces the COVID-19 vaccines" are related to the dependent variable "Willingness to vaccinate against COVID-19". Furthermore, citizens' trust regarding four different companies (BioNTech, Moderna, AstraZeneca, Johnson & Johnson), that produce a COVID-19 vaccine, was compared.

2.2 Respondents and Procedure

To investigate the aforementioned design, a self-administered online survey was developed using the "Qualtrics" online platform. Prior to starting the survey, all respondents were provided with an opening statement in which the purpose of the study is explained, the potential risks are clarified and the way their data is processed is indicated (see Appendix A).

After that, the respondents were asked to read and sign the informed consent. This was approved by the BMS Ethics Committee / Domain Humanities & Social Sciences (Requestnr.: 210304). The survey was administered in accordance with the regulations of the EU General Data Protection Regulation (GDPR) and the Code of Conduct for the use of personal data in Scientific Research by VSNU.

The survey included a total of 25 questions and was open for participation for one week during the timespan from 19th to 25th of April 2021. For the exact wording of items and answer possibilities of the survey, see Appendix B. The questions were divided into three domains: part 1 (11 questions) was about the respondent's demographic data, part 2 (6 questions) included questions about their trust in the vaccine itself, and part 3 (8 questions) concerned their

trust in the different companies. Distribution occurred via convenience sampling using media channels such as Facebook, Instagram, and WhatsApp. Characteristics of the respondents are described in the results section.

Inclusion criteria for participating in the survey were that the respondents must: (1) be at least 18 years old, (2) have German nationality, and (3) be able to read and write English.

2.3 Measures

Personal background variables

To gather general information about the respondents, they were asked to indicate several socio-demographic questions about their age, gender, and home country but also questions regarding their academic background and employment status. All questions were closed items except for the first question assessing age which had to be indicated in an open question (Appendix B).

Willingness to get vaccinated against COVID-19

After filling in the demographic items, the respondents were asked "Which of the following best describes your perspective/opinion about coronavirus (COVID-19) vaccination, when the vaccine is available for you?" to determine the person's willingness to vaccinate against COVID-19. There were five different answer possibilities that were coded into different values for later analysis (0 = I have not yet considered whether I will be vaccinated against the coronavirus, 1 = I have decided that I do NOT want to be vaccinated against the coronavirus, 2 = I am not sure yet whether I will be vaccinated against the coronavirus, but I probably will NOT, 3 = I am not sure yet whether I will be vaccinated against the coronavirus, but I probably will, 4 = I have decided that I would like to get vaccinated against the coronavirus). That has been done because the five answer possibilities were not presented in a reasonable order for scoring before and were then rearranged by sorting from not willing to get vaccinated to being willing to get vaccinated.

Trust in COVID-19 vaccine itself and company that produces it

For the next part of the online survey, the items that aim to assess the independent variables, namely trust in vaccine and trust in company, were provided. Therefore, the Vaccine Hesitancy Scale (VHS) was chosen since it assesses the peoples' vaccine attitudes (Luyten et al., 2019). Originally, it was a ten-item survey which intends to evaluate parents' attitude regarding vaccinating their children (Luyten et al., 2019). Each item is a statement that the

respondents had to rate on a five-point Likert scale to what extent they agree with it (1 = strongly disagree, 5 = strongly agree).

Several adaptions were made to make the items more applicable to the current thesis' context. Firstly, the target person was asked about their opinion towards vaccinating themselves instead of referring to their children. The second adjustment was to rephrase the term "vaccines" with "COVID-19 vaccines" to make it more specific. As an example, the first item of the VHS was changed from "Vaccines are important for my health" to "COVID-19 Vaccines are important for my health.". Another alteration was made by removing the tenth item: "I do not need vaccines for diseases that are not that common anymore." since it did load on two factors similarly and has thus been categorized as unreliable by different authors before (Luyten et al., 2019; Shapiro et al., 2018). An additional argument for removing the tenth item is that the content of this item does not fit this study's topic. Meaning, this survey was about COVID-19 exclusively and since COVID-19 is a newly developed disease this makes the item impossible to rephrase in a suitable manner.

In order to measure trust in the company that produces a COVID-19 vaccine, item seven, eight, and nine from the VHS were rewritten. Meaning, for instance item nine "All vaccines offered by the government program in my community are beneficial" was changed to "All vaccines offered by the companies are beneficial". Moreover, some items were added that are: "Overall, I trust the companies that produce the COVID-19 vaccine." and "I trust the following company that produces a COVID-19 vaccine.". The latter offers four sub-items in which the respondent had to rate the different companies that currently produce a COVID-19 vaccine, namely BioNTech, Moderna, AstraZeneca, and Johnson & Johnson.

Reliability of used scales

To measure the psychometric qualities of this survey, several methods have been applied. Firstly, the survey is suitable for factor analysis because of sufficient values according to the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (.908) and the Bartlett's Test of Sphericity shows $p < .001$. Secondly, the principal component analysis revealed that two components have an eigenvalue higher than one which proposes a two-factor structure that accounts for 60.02% of the variance. This has been justified by interpreting the scree plot and applying the elbow criterion. Looking at the rotated factor matrix that is displayed in Table 1, it seems that the first factor loads on items concerning trust in the COVID-19 vaccine itself, while the second factor rather loads on items regarding trust in the companies. However, some

items load on both factors such as items six, seven, eight, or ten. The decision to keep these items despite this outcome resulted from the intention to retain the original scale.

Next, Classical Test Theory (CTT) was used to measure the survey's reliability. Cronbach's Alpha for the Trust in the vaccine subscale (α= .85) and for the Trust in the companies (α= .89) subscale can both be interpreted as good, which indicates a good internal consistency. Furthermore, by looking at the Item-Total Statistics, it becomes apparent that Cronbach's alpha does not change significantly for both scales even when one would delete the items that load on both factors. Leading to the conclusion that all items can be perceived as relevant.

Table 1.
Factor Loadings for Exploratory Factor Analysis with Varimax Rotation

	Component[a]	
	1	2
Trust in vaccine		
1. COVID-19 vaccines are important for my health.	.81	
2. Being vaccinated against COVID-19 is important for the health of others in my community.	.77	
3. Getting the vaccine is a good way to protect myself from COVID-19.	.84	
4. COVID-19 vaccines carry more risks because they are new. *	.63	
5. COVID-19 vaccines are effective.	.73	
6. I am concerned about serious adverse effects of the COVID-19 vaccines. *	.41	.49
Trust in company		
7. Generally, I do what companies recommend about COVID-19 vaccines.	.51	.50
8. The information companies provide about vaccines is reliable and trustworthy.	.57	.56
9. All vaccines offered by the companies are beneficial.		.68
10. Overall, I trust the companies that produce the COVID-19 vaccines.	.51	.61
11. Trust company BioNTech	.61	.40
12. Trust company Moderna	.54	.50
13. Trust company AstraZeneca		.82
14. Trust company Johnson & Johnson		.85

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.
* reversed coded

2.4 Data Analysis

All analyses were carried out with the statistical package SPSS, version 26.0. The initial dataset was accordingly adjusted for analysis by removing cases that did not comply with the inclusion criteria.

Then, items number four and six were reversed coded since they were phrased negatively in comparison to the other items that were all positively formulated. Next, the independent variable that measures the citizens' willingness to get vaccinated against COVID-19 was recoded. For exact coding see Appendix B.

After that, a multiple regression analysis has been carried out in which both independent variables were taken into account simultaneously. For that, the variable "trust in vaccine" was conducted by taking the mean of items number one, two, three, four, five, and six. The mean value for "Trust in the company" is derived from the items seven, eight, nine, and ten. Also, the five respondents that answered "I have not yet considered whether I will be vaccinated against the coronavirus" were removed from the regression analysis because they did not have an opinion yet.

Lastly, trust in the specific companies was analysed by taking the mean and standard deviation of items number eleven to fourteen. To test whether the companies (BioNTech, Moderna, AstraZeneca, Johnson & Johnson) actually differ regarding the citizens' trust, a repeated measures ANOVA was conducted.

Generally, p-values lower than 0.05 were considered to be statistically significant.

3. Results

3.1 Demographics

Overall, 221 people participated in the study from which 7 were excluded as a result of missing data. Moreover, due to the reason that this study only investigates the willingness to get vaccinated of German citizens, 16 people were removed because of their nationality. Another exclusion criterion was that respondents had to be at least 18 years old, thus 3 respondents that are younger than 18 years were removed as well. Hence, a total of 195 respondents remained for the data analysis. From this sample, 141 persons (72.3%) identified themselves as female, while 53 (27.2%) were male, and one (0.5%) indicated non-binary (see Table 1). The mean age of the sample population was 23.3 years (SD=7.05, Range = 18 - 60). The majority of people indicated that their highest level of education equals a high school degree (71.3%) followed by people that already received a bachelor's diploma (17.4%). Furthermore, most of the sample population are students (N=136) which equals 69.7% of the whole sample. Other descriptive characteristics of the respondents are provided in Table 2.

Table 2.
Demographic characteristics of respondents (N = 195)

	N	%
Gender		
Female	141	72.3
Male	53	27.2
Non-binary	1	0.5
Highest educational level		
Middle school	12	6.2
High school	139	71.3
Undergraduate degree	34	17.4
Graduate degree	6	3.1
Doctorate degree/ PhD or higher	0	
Other	4	2.1
Employment		
Unemployed	8	4.1
Part-time employed	8	4.1
Full-time employed	37	19
Self-employed	5	2.6
Student	136	69.7
Retired	1	0.5

Note. N = number of respondents, % = percentage of respondents. Participants were on average 23.3 years old (SD = 7.05).

3.2 Description of Willingness to get vaccinated against COVID-19

The willingness of German citizens to get vaccinated was assessed by one item and showed that overall, most people (82.6%) decided they want to get vaccinated against COVID-19 (N=161). On the contrary, 5 (2.6%) people have made the decision that they do not want to get vaccinated. The remaining 29 (15.0%) people have either not considered that decision yet (N=5), are not sure but probably will be vaccinated (N=20) or are not sure but probably will not get vaccinated against COVID-19 (N=4) (see Table 3).

Table 3.
Willingness to get vaccinated of German citizens (N = 195)

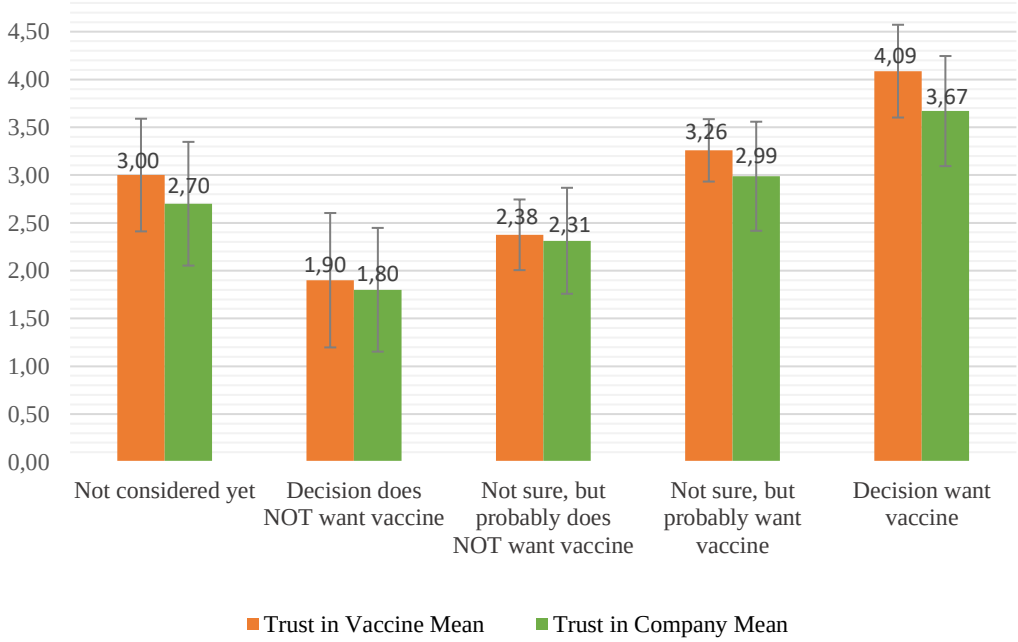
Item: Which of the following best describes your perspective/opinion about coronavirus	**N (%)**
I have not yet considered whether I will be vaccinated against the coronavirus	5 (2.6%)
I have decided that I do NOT want to be vaccinated against the coronavirus	5 (2.6%)
I am not sure yet if I will be vaccinated against the coronavirus, but I probably will NOT	4 (2.1%)
I am not sure yet whether I will be vaccinated against the coronavirus, but I probably will	20 (10.3%)
I have decided that I would like to get vaccinated against the coronavirus	161 (82.6%)

Note. N = number of respondents, % = percentage of respondents

3.3 Description of independent variables: Trust in vaccine & Trust in company

Figure 1 shows for every answer category of the dependent variable (displayed on the x-axis), the associated mean value (y-axis) of trust in the vaccine, which is highlighted in blue, and for trust in the company which is coloured in green. Regarding the first construct, which is about the citizens' trust in the COVID-19 vaccine itself, one can say that all mean values are higher than mean values for trust in the company (Fig. 1). Also, the more people are willing to get vaccinated, the higher the mean is for the trust in the vaccine as well as for company. People, who did not consider this topic at all, have a higher trust in both constructs than people who definitely do not want to get vaccinated as well as the people who are not sure yet but have the tendency to rather get not vaccinated. However, people who do not have an opinion yet also show lower means in comparison to people who want to get vaccinated or who lean towards getting vaccinated.

Figure 1.
Bar Chart displaying the Citizens' Willingness to Vaccinate



Note. This figure demonstrates the mean values of "trust in vaccine" and "trust in company" distributed per willingness to vaccinate category; Standard deviations are represented by the error bars attached to each column

3.5 Multiple regression analysis

Table 4 displays a multiple regression analysis taking the two independent variables simultaneously into account. Interpreting the findings, it becomes obvious that both variables are significant while "trust in vaccine" has a stronger effect $b = .551$, $t(195) = 8.59$, $p < .001$ than "trust in company" $b = .136$, $t(195) = 2.20$, $p = .029$ on the dependent variable. The overall

modelfit was $R^2 = .51$ which indicates that 51% of the total variance in citizens' willingness to get vaccinated can be explained by the two independent variables.

Table 4.
Multiple Regression Analysis of Trust in Vaccine and Trust in Company for predicting Citizens' Willingness to Vaccinate (N = 195)

				95% CI			
Variable	B	SE	β	Lower	Upper	t	p
Trust in vaccine	.551	0.06	0.60	.77	1.52	8.59	< .001
Trust in company	.136	0.06	0.16	.01	.26	2.20	.029

Note. Dependent variable: Willingness to get vaccinated, $R^2 = .511$

3.6 Differences in specific companies that produce a COVID-19 vaccine

Concerning the German citizens' trust towards the companies that produce COVID-19 vaccines, one can make one specific observation by looking at table 5. The citizens' trust in the specific vaccines is displayed with the mean value and SD. The respondents trusted the vaccine produced by BioNTech (M = 4.35) most, followed by the one produced by Moderna (M = 4.06), Johnson & Johnson (M = 3.40), and lastly AstraZeneca (M= 3.31). Also, the distribution of standard deviations shows that the opinion about AstraZeneca (SD = 1.05) and Johnson & Johnson (SD = .95) varies more among German citizens than compared to the other two companies (SD = .84).

The repeated measures ANOVA was used to see if there is a difference of means between the companies. Mauchly's test suggests that the assumption of sphericity is violated, $\chi^2(5) = 133.47$, $p < .001$, that is why degrees of freedom were corrected by using the Greenhouse-Geisser estimates ($\varepsilon = .53$). This revealed that there is an overall significant difference in means of trust between the different companies, $F(2.02, 391.1) = 126.51$, $p < .001$. Post hoc test using the Bonferroni correction determined that all companies differ significantly from each other except the companies AstraZeneca and Johnson & Johnson. To be more specific, pairwise comparison showed significant p-values for: BioNTech and Moderna ($p < .001$), BioNTech and AstraZeneca ($p < .001$), BioNTech and Johnson & Johnson ($p < .001$), Moderna and AstraZeneca ($p < .001$), and for Moderna and Johnson & Johnson ($p < .001$). Whereas those companies all differ regarding the trust of German citizens, the two companies AstraZeneca and Johnson & Johnson do not differ significantly ($p= .487$).

Table 5.
Mean and Standard Deviation displaying the Citizens' Trust in the Specific Companies (N=195)

Variable	Mean	SD

Trust BioNTech	4.35	.84
Trust Moderna	4.06	.84
Trust AstraZeneca	3.31	1.05
Trust Johnson & Johnson	3.40	.95

Note. Items number 11, 12, 13, and 14 from the survey

4. Discussion

This study aimed to assess the research question stated in the introduction, namely "*Are "trust in the COVID-19 vaccine" and "trust in the different companies" predictors of German citizens' willingness to get vaccinated against COVID-19?*". To conclude, both independent variables namely trust in the vaccine as well as trust in the company did predict the respondents' willingness to get vaccinated. Furthermore, this study found surprising results regarding the overall high willingness to get vaccinated compared to prior studies. In addition to that, it has been found that German citizens rated BioNTech as most trustworthy, then Moderna followed by Johnson & Johnson, and lastly AstraZeneca. However, the analysis revealed that Johnson & Johnson did not differ from each other regarding the citizens' trust-level.

Trust in the COVID-19 vaccine

For the first variable, it can be concluded that trust in the vaccine itself is a significant predictor of Germans' willingness to get vaccinated. This has been expected since many studies, investigating vaccine intention regarding other previous vaccines, revealed a link between those factors (Brown et al., 2018; Larson et al., 2015a). Studies that specified on COVID-19 vaccines also showed that individuals that have low or even no trust in the COVID-19 vaccine are more likely to refuse a vaccination (De Figueiredo et al., 2020; Fisher et al., 2020; Soares et al., 2021). Another study confirmed that people, who are hesitant in their decision to get vaccinated, mention their distrust about the vaccine in terms of its safety (Yoda & Katsuyama, 2021). Due to the newness of this topic, many studies published their results while this study was conducted which allows a comparison without meaningful time differences. This study validates the other findings which strongly highlights the importance of increasing trust in COVID-19 vaccines to maximize vaccine willingness.

Trust in the companies that produce the COVID-19 vaccine

Regarding the second construct, another significant relationship has been detected for trust in the different companies that produce a COVID-19 vaccine and peoples' vaccine willingness. Reviewing the existing literature about vaccine hesitancy linked to trust in the

brands, one can see that this research field has not been investigated yet. Nevertheless, trust in companies has been identified as a key variable in determining the success of companies in general before (Fatma et al., 2015; Gana & Koce, 2016; Ingenhoff & Sommer, 2010; Sanny et al., 2020). Therefore, the finding that peoples' trust in the specific company is related to their vaccine intention is plausible. It means that strategies to improve vaccine rates could include this factor. An example would be that advertising aims to increase trust in the companies by informing about the competence and reliability of the institutions (OECD, 2021).

Differences between companies

Another striking point was the differences in the amount of trust regarding the different companies: peoples' trust in the vaccine from BioNTech and Moderna was significantly higher than in those from AstraZeneca or Johnson & Johnson. Although there were no studies regarding this research area prior to conducting the data collection, some papers have been published during the last month with which one can compare this study's outcome. As an example, two studies carried out by Sønderskov et al. (2021) and Rzymski et al. (2021) found that people perceive the AstraZeneca vaccine as less safe compared to BioNTech or Moderna. Additionally, a study that also included the Johnson & Johnson vaccine asked Columbian participants what vaccine brand they would choose, and they found the same order of preference as this study namely: (1) BioNTech, (2) Moderna, (3) Johnson & Johnson, and (4) AstraZeneca (Lazer et al., 2021).

These observations may result from two specific reasons. Firstly, as mentioned in the introduction, AstraZeneca had a rather negative representation in the media prior to publishing the survey which could have affected the outcome for this company (Deiana et al., 2021). The first incidence with the AstraZeneca vaccine involved misinformation by a famous German newspaper ("*Handelsblatt*") in which they falsely report an effectiveness rate of 8% among the elderly population (Boytchev, 2021). A later scandal was connected to several cases of people who developed a special kind of thrombosis after taking the vaccine (Mahase, 2021). While some recent scientific articles claim that there is no causal link between the AstraZeneca vaccine and cases of thrombosis, some others explain that a thrombosis might be a consequence of getting vaccinated with AstraZeneca (Greinacher et al., 2021; Mahase, 2021). After the publication of those complications, many countries paused using AstraZeneca immediately like the Netherlands, Iceland, France, or Denmark (Wise, 2021a). Germany in specific declared that only people older than 60 years are allowed to be vaccinated with the AstraZeneca vaccine

(Bundesministerium für Gesundheit, 2021). Due to these incidences, there might have been a decline in trust regarding AstraZeneca.

Concerning the Johnson & Johnson company, the low trust from German citizens might be a result of the newness of their vaccine. To be more concrete, the survey started on the 19th of April 2021 while the official approval for the Johnson & Johnson vaccine happened only one month before that on the 11th of March 2021 (Bundesregierung, n.d.). According to Slovic and Weber (2002), people perceive risk by considering two factors called "dread" and "unknown risk" by which the latter one is important considering the risk of the Johnson & Johnson vaccine. The authors point out that if the hazard's characteristics are relatively unknown, new, and unobservable, the hazard is perceived as a risk (Slovic & Weber, 2002). Applied to the Johnson & Johnson vaccine, one can say that it scores high on each of these dimensions since it is a rather new vaccine which consequences for example possible side-effects are quite unknown and delayed in its effect of harm. Meaning, people who develop an adverse side-effect do not recognize it immediately but typically at a later point.

Overall willingness to get vaccinated

Another interesting finding is that people do not have such a negative feeling about getting vaccinated as expected. Concerning other countries, willingness to get vaccinated was surprisingly high among this sample. Percentages of people who want to get vaccinated against COVID-19 in other countries are for example: 36.1 % (Austria), 35 % (Portugal), 57.7 % (Greece), or 59% (Italy) (Kourlaba et al., 2021; Palamenghi et al., 2020; Schernhammer et al., 2021; Soares et al., 2021). These numbers are comparingly lower than the vaccine willingness of 82.6% for this study. Deviating from other European countries and concentrating on Germany, this value can be compared with the results reported by Neumann-Böhme et al. (2020). Even if the study carried out by Neumann-Böhme et al. (2020) indicated a higher willingness (70%) than the other countries, it is still below this study's value. To sum up, this study found a more positive attitude towards the vaccine among Germans than Neumann-Böhme (2020). This could be caused by differences in the timing of measuring. Neumann-Böhme's study has been published in June 2020 and therefore, the people might have been more critical than during this more recent study. This can be hypothesized because in June 2020 the invention of a successful vaccine production has not even been announced yet.

Another factor that possibly affected the willingness is the general demographic characteristics of the sample. Different studies revealed that willingness regarding the COVID-19 vaccine increased with higher education (Dorman et al., 2021; Guidry et al, 2021). To be

more concrete, a study carried out by Gan et al. (2021) showed that only 9.4% of people with a high school education or below want to get vaccinated in contrast to 53.9% of people who currently study at a university or college. Since this sample is on average highly educated this could have affected the surprisingly high vaccine intention of the sample. On the contrary, other characteristics of this sample conflicted with the high willingness rates like gender or age. Regarding the first factor, a systematic review conducted by Zintel et al. (2021) showed that men are more likely to get vaccinated against COVID than women. According to this result, this would propose a lower willingness than other studies since this sample involves a high number of females (72.3%) which is not the case. Also, the young sample (M_{age} = 23.3) should normally lead to lower willingness since multiple studies point out that vaccine willingness rises with increasing age (Bish et al., 2011; Sherman et al. 2021; Wang et al., 2021). Other possible demographic variables that could have affected this outcome are: religious conviction, political party affiliation, or pre-existing medical conditions that were identified with COVID-19 vaccine intention before but have not been taken into account in this study (Ruiz & Bell, 2021).

Strengths and Limitations

All in all, this study has brought some interesting findings for a field that is newer than any other research topic at the moment. It put light on the German citizen's vaccine intention and investigated two out of endless possible predictors for it. Since the announcement of a COVID-19 vaccine happened in December 2020 and this study started in February 2021 one strength is the newness of data and relevance to rapidly understand vaccine willingness.

Despite the previously mentioned positive points, this study has some limitations. Firstly, the sampling method is prone to biases. The distribution through social media channels probably resulted in comparably younger respondents than using other sampling methods. Another problem regarding the sample not only concerns the comparably young mean age but also overrepresentation of women which once again makes generalizability harder. As stated before, some studies point out that demographic variables influence vaccine intention. On average, vaccine willingness was highest for men, older people, and educated individuals (Freeman et al., 2020; Ruiz & Bell, 2021). The fact that the majority of this sample consists of students supports the result of high willingness. However, since this sample is rather young and has a high percentage of women, the amount of willingness to get vaccinated is contradictory to past research and leaves room for further investigation.

Regarding the scales, one could argue that this study did some adjustments in order to fit the research question better which could decrease its validity. As previously mentioned, the Vaccine Hesitancy Scale (VHS) has been changed for example with regard to the vaccine in question (Luyten et al., 2019). Also, it is not about parental willingness anymore but about the respondent's own. Additionally, this study also added one item called "Overall, I trust the companies that produce the COVID-19 vaccines.". Although reliability measurements such as KMO revealed good values, one could propose that other items should be added to extend the scale's reliability and validity.

Furthermore, this study may have been affected by unknown confounding variables. For instance, other studies showed that factors such as the respondent's current health status or if the person has a generally negative attitude towards vaccines might moderate the results (Graffigna et al., 2020; Ruiz & Bell, 2021). This research has the limitations that it can only make assumptions about the correlation but not about definite causations. This leaves room for future research to identify other possible variables that need to be considered when assessing vaccine hesitancy.

Recommendations

Looking into the future, even though willingness to get vaccinated is surprisingly high in this sample, there are still some citizens that are rather unsure and doubt their intention. Here, the German government could be a key stakeholder that is able to increase trust in the vaccine itself as well as in the companies that produce them. One example would be clearly communicating relevant information to the public because there is a chance for misinformation due to the overabundance of news and information (WHO, 2020b).

To get a better understanding of the whole vaccine hesitancy problem, increasing the number of studies and research experiments about this topic is valuable. Here, it would be a good way to vary between different strategies for example including interviews, open questions, or peer groups for qualitative research. Furthermore, studies should pay attention to the inclusion of people with multiple different features such as variation in age, gender, or cultural background to have a representative sample. Then, a reliable and valid scale to measure vaccine hesitancy is necessary. However, research about vaccine hesitancy has been mainly concerned with parental willingness to vaccinate their children which shows a need for a standardized survey assessing vaccine hesitance of the respondent itself. However, future research should focus on the COVID-19 disease as well as vaccine hesitancy, to develop better strategies to

counteract vaccine hesitancy. Furthermore, it would be interesting to do longitudinal studies to compare vaccine willingness over time to detect an eventual change in intention.

Conclusion

All in all, this study enabled valuable insights into Germans' willingness to get vaccinated and the high willingness rises hope in reaching high vaccine rates in the upcoming months. This would mean a good basis for developing herd immunity and returning to normality. Furthermore, the finding that trust in the vaccine and companies that produce them can affect the peoples' vaccine intention lays the groundwork with which the government can work. Future research should further investigate this to determine the exact effect since this study is not able to determine a causation. Also, confounding variables that were mentioned should be assessed if they influenced the outcome.

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Appendix A
Opening Statement for an Online Survey/Questionnaire

You are being invited to participate in a research study titled determinants of the population's willingness to get vaccinated against COVID-19. This study is being done by Lara Sprekelmeyer, Milena Völler, and Celine Terbeck from the Faculty of Behavioural, Management and Social Sciences at the University of Twente.

The purpose of this research study is to gain insights into how variables such as risk perception of contracting COVID-19, risk perception of the vaccination, and trust into the government influence the population's willingness to get vaccinated against COVID-19. The study will take you approximately 15 minutes to complete.

The data will be used for the bachelor thesis of Positive Psychology and to get a better understanding of the phenomenon of vaccine hesitancy.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any question.

This is an observational study with voluntary participation in the general population, with expected low risk for participants. Potential risks identified include only the nconvenience of the time taken to respond to the survey, and given the current restrictions people face, many individuals currently have more available time. The variables and information requested does not allow to identify specific ethnic or disadvantaged population groups. Due to strict data protection measures, any risk related to nonanonymous publishing of data from the survey is considered very low, and the personal harm for the individual respondent related to such unlikely event is also considered low due to the less sensitive nature of the responses provided. Benefits include the sense of contributing and being able to participate in shaping the country's pandemic response

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Appendix B
Items from Survey

Item	Answer Option
Part 1: Demographics	
What is your age?	Open question
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?	Primary school/ middle school/ high school/ undergraduate degree (Bachelor)/ graduate degree (Master)/ doctorate degree (PhD)/ other (specify)
What is your employment status?	Unemployed/ part-time employed/ full-time employed/ self-employed/ student/ retired
Willingness to get vaccinated against COVID-19	
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 (0) - I have decided that I do NOT want to get vaccinated against the coronavirus (1) - I am not sure yet if I will be vaccinated against the coronavirus, but I probably will NOT (2) -I am not sure yet whether I will be vaccinated against the coronavirus, but I probably will (3) -I have decided that I would like to get vaccinated against the coronavirus (4)
Part 2: Trust in vaccine	
To what extend do you agree or disagree with the statements below? - COVID-19 vaccines are important for my health. - Being vaccinated against COVID-19 is important for the health of others in my community. - Getting the vaccine is a good way to protect myself from COVID-19. - COVID-19 vaccines carry more risks because they are new. * - COVID-19 vaccines are effective. - I am concerned about serious adverse effects of the COVID-19 vaccines. *	Strongly disagree (1) / disagree (2)/ neither agree nor disagree (3)/ agree (4)/ strongly agree (5)
Part 3: Trust in company	
To what extend do you agree or disagree with the statements below? - Generally, I do what companies recommend about COVID-19 vaccines. - The information companies provide about vaccines is reliable and trustworthy. - All vaccines offered by the companies are beneficial.	Strongly disagree (1) / disagree (2)/ neither agree nor disagree (3)/ agree (4)/ strongly agree (5)

- Overall, I trust the companies that produce the COVID-19 vaccines.	
Trust in the different companies	
Please rate the statement below for each company separately. I trust the following company that produces a COVID-19 vaccine. - BioNTech - Moderna - AstraZeneca - Johnson & Johnson	Strongly disagree (1) / disagree (2)/ neither agree nor disagree (3)/ agree (4)/ strongly agree (5)

*= reverse-scored

Note. The numbers in brackets display the value that has been coded