

Key Issues in Social Policy and Public Health

# MASTER THESIS

An explorative qualitative research

**PRO- AND ANTI-VACCINATION  
ARGUMENTS IN THE ONLINE  
VACCINATION DISCOURSE ON TWITTER**

Jacintha Merts - 4225422  
Under supervision of Dr. Marijn Stok  
June 2021

## Abstract

**Background.** Vaccinations help prevent the spread of diseases and save healthcare costs. Herd immunity exists at a high level of vaccine coverage and improves individual and community health and can be jeopardized by anti-vaccination movements. According to literature, anti-vaccination proponents generally base their arguments on beliefs and mistrust while pro-vaccination proponents rely on science. Both pro- and anti-vaccination movements impact the online vaccination discourse and can influence vaccine-related decisions. Understanding the arguments used by Twitter users can combat the online anti-vaccination movement and increase willingness to vaccinate, resulting in herd immunity and improved health outcomes.

**Methodology.** A vaccination decision-making framework is created to visualize various arguments used in vaccination debates. This framework is based on qualitative studies from literature and used as a coding scheme for vaccination tweets. Prior to this research, a selection of 2,000 tweets was gleaned from database containing 85,000 tweets. These selected tweets were coded manually in Excel by six coders in various categories including pro-vaccination, anti-vaccination and hesitant. Any doubts were discussed among the coders. Then, these pro-, anti- and hesitant vaccination tweets were coded top-down on content, substantiated by bottom-up codes. Solely the pro- and anti-vaccination tweets were coded in NVivo based on the aforementioned vaccination decision-making framework. Finally, in data analysis the pro- and anti-vaccination arguments were compared to each other.

**Results.** In pro-vaccination, the most mentioned themes were preventive health beliefs, risk, health freedom, media, reliability, vaccine effectiveness and social experiences. In anti-vaccination, the most mentioned themes were vaccine safety, trust in government and social experiences. As expected, pro-vaccination arguments are more based on science while anti-vaccination arguments are more focused on beliefs and mistrust. Several themes were unmentioned, implying that Twitter users value them less than expected in literature studies.

**Discussion.** Differences in outcomes between this research and the literature can be explained by country, tweet selection, the time period of the tweets and study population. Strengths of this research include the representation of reality, inter-coder reliability in Excel, an interdisciplinary approach and the jointly analysis of pro- and anti-vaccination tweets. Limitations of this research include the lack of inter-coder reliability in NVivo, little variation and validity in the (amount of) tweets, the difficulty of interpretation of tweets and the fact that the current COVID-19 pandemic might have changed the attention, willingness and hesitancy towards vaccines. Further research would include a more explorative analysis on the influence of Twitter on vaccine decision-making.

**Conclusion.** In line with the literature, the arguments in pro-vaccination tweets are majorly based on science and the anti-vaccination tweets are more based on beliefs, attitudes and mistrust.

**Key words.** Vaccine, vaccination, anti-vaccination, anti-vaxx, pro-vaccination, pro-vaxx, proponent, vaccine hesitancy, herd immunity, vaccine damage, Twitter, tweets, belief, attitude, health, freedom

# 1. Introduction

## 1.1 Problem statement

The Dutch National Institute for Public Health and the Environment [Rijksinstituut voor Volksgezondheid en Milieu; RIVM] describes that vaccinations prevent the spread of diseases and that herd immunity exists at a vaccine coverage of at least 95%. Herd immunity can be decreased by a lower vaccine coverage, which harms overall immunity and community benefits, as well as individuals. Therefore, several policy interventions worldwide aim to contribute to high vaccine coverage with increased vaccination rates (Omer et al., 2009). The World Health Organization [WHO] (2018) describes vaccination as the process in which a person is made resistant or immune for a specific infectious disease. The vaccine stimulates one's body to make the immune system fight against the infection. The WHO estimates 2 to 3 million avoided deaths per year, due to vaccination. Therefore, the WHO is in favour of vaccinating people to protect them from vaccine preventable diseases. Advantages of preventive vaccination include a cost-effective health investment and no needed extensive lifestyle change to uptake vaccinations (WHO, 2018).

The RIVM provides informative statistics on vaccination in the Netherlands and according to this institute, the majority of the Dutch parents, 92-99%, allow their child(ren) to get vaccinated. Vulnerable children, e.g. with cancer or autoimmune diseases, cannot get vaccinated. They will also be protected when others get the vaccine coverage up. The RIVM offers the opportunity to discuss vaccination questions and doubts at vaccination consultations (2020).

Herd immunity is jeopardized because vaccination is under pressure as a societally relevant topic for years. This stems from the belief that certain diseases have disappeared, because as a result of vaccination, their incidences have dropped (Chen & DeStefano, 1998; McCarthy et al., 2018). Over the years, the concerns about vaccines and their potentially negative side effects have increased, leading to more increased vaccine hesitancy. This leads to a lower vaccination coverage (Chen & Hibbs, 1998). However, Hinshaw et al. (2013) described that the Institute of Medicine has done many vaccine safety studies and have confirmed no evidence to be concerned about vaccine safety as well as confirming that vaccination indeed decreases the risk of certain diseases. Besides, vaccination is needed to maintain high global vaccine coverage which is vital in preventing global disease outbreaks (Mendel-Van Alstyne et al., 2018).

Vaccine hesitation can have devastating effects on (global) communities, because, as stated before, preventive vaccination is estimated to avoid millions of deaths per year (WHO, 2018). In total, vaccines are estimated to have prevented 103 million cases of disease since 1924 (Van Panhuis et al., 2013). In the Netherlands, 6,000 to 12,000 deaths were prevented between 1953 and 1992 due to vaccinations (Van Wijhe, 2018). Furthermore, national vaccination programmes reduced the number of reported cases of diseases.

Anti-vaccination movements mostly disregard scientific facts (Smith & Graham, 2019). Just like every other population group, not everyone with an anti-vaccination sentiment is the same and various types of anti-vaccination proponents exist for various reasons like personal, moral or religious ones (Hussain et al., 2018). Berman (2020) describes some types of anti-vaccination proponents. This includes those who ignore the vaccines, those who are actively against it, those who actively refuse the vaccine and those who challenge healthcare professionals by looking for infectious diseases to see what happens if one gets infected.

Pro-vaccination movements on the other hand are being evaluated strictly by anti-vaccination proponents, which poses a new threat to pro-vaccination arguments because this could influence the opinion of people who are vaccine hesitant into anti-vaccination thoughts. Research shows that pro-vaccination arguments might take the form of evaluation of anti-vaccination arguments to be persuasive and effective. Besides, not all pro-vaccination arguments are formulated positively, which makes them vulnerable for counter-arguments (Jenkins & Moreno, 2020).

All in all, both pro- and anti-vaccination movements impact the online vaccination discourse and can influence vaccine-related decisions. Therefore, research must be done on the type of arguments to provide insight in debate and to provide opportunity to create understandability. An

online vaccination debate takes place on social media platform Twitter. Based on an analysis of this online discourse, the types of arguments of pro- and anti-vaccination will be categorized. This interdisciplinary research aims to improve public health outcomes by drawing attention to the importance of vaccinations and to understand the anti-vaccination movements on the Internet. Also, so that it can be combatted by creating trust in professionals and health authorities and promoting vaccination (Hussain et al., 2018). It turns out that social networks are an important factor to influence parents' vaccination decisions (Brunson, 2013). Unfortunately, the role of the Internet on social identity, discourse, sentiments and vaccination decision is to be left unclear, leaving a knowledge gap. It is clear though that social media have changed healthcare (Hors-Fraile et al., 2016) and healthcare research (Sinnenberg et al., 2017). Research is needed to understand Internet mechanisms that influence vaccination decisions so that public health information can also be properly spread on the Internet and in echo chambers (Meyer et al., 2019).

Besides preventing diseases and suffering, vaccines save money with regard to health care. Vaccination programmes cost money, but this is only a small part of the spending of the government on national health care (Van Wijhe, 2018). Lee and Pichichero (2000) studied the costs to families in New York during an outbreak of pertussis in 1995-1996. Recalculated to USD in 2014, these costs range from \$278 to \$4.331 (Moser, Reiss & Schwartz, 2015). However, lifetime medical costs would be even higher. In addition, it turns out that public health departments in the US do not get funded in case of unexpected events, meaning that an outbreak of an infectious disease could lead to the reassignment of staff and funds, leading to higher costs (Ortega-Sanchez et al., 2014). Understanding the arguments which influence Twitter users vaccination decisions, is paramount, to combat the online anti-vaccination movement.

## 2. Vaccination movements and attitudes

It is important to reflect on anti-vaccination movements to identify trends and to combat them. Anti-vaccination movements are as old as vaccinations themselves (Bazin, 2001; Hussain et al., 2018; Massey, 1722). Also in the so-called "New World" religious oppositions were seen (Storm, 2011). These movements are not likely to disappear in the present (Wolfe & Sharp, 2002). New vaccines are developed, vaccines are adjusted and combined and this enhances the anti-vaccination movement on the Internet and social media (Chatterjee & O'Keefe, 2010). In addition, the Dutch immunization programme is changeable, which could each time lead to new doubts on vaccines. For example, since 2009 the HPV vaccine has been included in the national immunization programme for female young adults, but from 2021 on, male young adults will also be offered this HPV vaccine (RIVM, 2019). This might raise new concerns leading to vaccine hesitancy.

Mnookin (2011) wrote a book about how vaccination nowadays is a source for fear and a target for misinformation. In addition, the media has been proven to have a negative effect on vaccine uptake (Smith et al., 2007), while the Internet has given anti-vaccination proponents a voice (Scullard et al., 2010; Wolfe et al., 2002), which has been strengthened by Web 2.0 functions (Betsch et al., 2012). These anti-vaccination movements show common characteristics (Kata, 2012) such as vaccination uselessness and unsafety (Kata, 2010).

The transition of vaccine-neutral people to vaccine hesitation or anti-vaccination movements has been proven (Jolley & Douglas, 2014). However, while anti-vaccination proponents base their arguments mostly on discourse, pro-vaccination proponents focus on the misinformation and try to reduce the spreading of this and to correct it (Kata, 2012). According to research, people who are in favour of vaccines can even be confused by the vaccination debate, which could lead to vaccine hesitancy (Hussain et al., 2018).

Over time, multiple researches have been conducted in order to examine anti-vaccination movements on social media. Some arguments are categorized by social network and gender. Arguments on anti-vaccination Facebook pages are based on oppression by the media and government, which could lead to conspiracy theories. Also, it is noticeable that the anti-vaccination movement seems feminized, since the majority of the users are women (Smith & Graham, 2019).

According to a study on first-time mothers, they were influenced by both normative as informational arguments on Facebook. Anti-vaccination proponents use maternal empowerment, natural solutions, fear appeals, distrust towards medicines and misinformation to pursue mothers (Bradshaw et al., 2020). Thus, existing literature on the topic demonstrates the large range of determinants at play in influencing anti-vaccine movements, ranging from the facilitating role of social media in spreading these sentiments, as well as the gendered influence of first-time mothers.

Research on anti-vaccination attitudes on Twitter concluded that these arguments are strongly based on conspiracies and mistrusting the government (Mitra et al., 2013). Basic knowledge on vaccines and their importance is lacking and unfortunately, those most in need for knowledge seem most vulnerable to false and questionable vaccination information (Hussain et al., 2018). Even small persuasiveness of anti-vaccination information can be exposed rapidly to many people (Betsch et al., 2012; Curiel & Ramírez, 2020). Anti-vaccination information is collected and spread by groups of Web 2.0 users, but information and communication on public health can also be found here, hence both sides are exposed on the Internet. Vaccination decisions are influenced by the available information, which can either lead to an increased or a decreased personal risk of vaccines and potential side-effects. The key is to identify and tackle those who are vulnerable to false information and to provide them with correct information. Public health websites can be made attractive, easy to find and to use with easy to understandable information and advice (Betsch et al., 2012). With Web 2.0, users have ownership over the Internet and can make information available as they want it to be (Murugesan, 2007). A pitfall of Web 2.0 is echo chambers, in which users reinforce their beliefs by sharing knowledge in online environments. This strengthens the positions in favour or against vaccines. To reduce the spread of unreliable and misleading information, information on public health must be available in those echo chambers as well (Meyer et al., 2019).

### 3. Vaccination decision making framework

A vaccination-decision making framework (Figure 1) was created based on previous research describing determinants and other factors that involve vaccine hesitancy and acceptance. Typologies of anti-vaccination rhetoric are more present in literature than pro-vaccination rhetoric, but in this research, these anti-vaccination factors will be tested on pro-vaccination arguments as well.

#### 3.1 Determinants of vaccine hesitancy

Vaccine hesitancy determinants can be identified through the “three C’s” model and the vaccine hesitancy matrix (WHO, 2014). The “three C’s” model of vaccine hesitancy illustrates three determinants influencing vaccine hesitancy: confidence, complacency and convenience (WHO, 2014). ‘Confidence’ includes trust in vaccines, effectiveness, safety, confidence in health systems quality, healthcare professional services and trust in health policy makers (WHO, 2014). ‘Complacency’ is the general lack of belief regarding vaccine necessity to prevent disease outbreaks. These individuals have a low perceived risk of vaccine-preventable diseases and are mostly unaware of actual disease threat. Other health issues are then prioritized. Due to the national immunization programme, complacency is being kept alive, since the prevalence and incidence of vaccine-preventable diseases and infections are low, which makes individuals assume that taking the vaccine is a higher risk than the disease itself, because the latter is not present anymore (WHO, 2014). ‘Convenience’ includes the geographical and physical accessibility of vaccination services and the willingness-to-pay for vaccines, affordability, understandability and culture (WHO, 2014). The “three C’s” model is used in this research to categorize anti-vaccination arguments.

Additionally to the “three C’s” model, a vaccine hesitancy matrix can be used to arrange the determinants of vaccine hesitancy into the following three categories: ‘contextual’, ‘individual and group’, and ‘vaccine/vaccination specific issues (WHO, 2014). The matrix will be used in this research to comprehend anti-vaccination arguments. The factors in the matrix influence the behavioural vaccination decision (MacDonald, 2015). These factors are used in the vaccination decision-making framework (Figure 1). Individuals who show vaccine hesitancy benefit from technical information on

what is in the vaccine and how it works. Also, they need to be able to reflect on their decision based on their own wellbeing, norms and values and consequences for others (RIVM, 2021).

Furthermore, vaccination refusal might be caused by alternative perspective on the responsibility of parents and of understandings of health and distrust in governmental organizations (Kata, 2010). Anti-vaccination proponents online use terms like “health freedom”, “vaccine safety” and “informed consent” and they suggest people to do their own research. In short, Web 2.0 creates misinformed users by spreading fear and doubt (Kata, 2012).

### 3.2 Determinants of vaccination acceptance

A theoretical framework of vaccination acceptance specifically in pertussis cocooning (Visser et al., 2016) was created. The model anticipates the effects anti-vaccination and vaccination decisions might have. Decisional uncertainty is also included in the model, this is about whether an individual thinks vaccination decisions are easy. Uncertainty is an important determinant in decision making (Visser et al., 2016).

For pro-vaccination proponents, it is important to create accessible vaccine locations and to facilitate the procedure required to make an appointment (Yeung, 2016). Also, easy registration for making an appointment and reminders via SMS, mail or a letter (Vann et al., 2018), create a positive feeling towards the vaccine. The majority of Dutch individuals want to get vaccinated when vaccines are effective and safe (RIVM, 2021). A successful vaccination campaign needs to be correct logistically, must have an effective vaccine and uses transparent, scientific and reliable information to inform vaccination recipients correctly. Mass media play a role in this communication, but also general practitioners and the Municipal Health Services and other health professionals (RIVM, 2021).

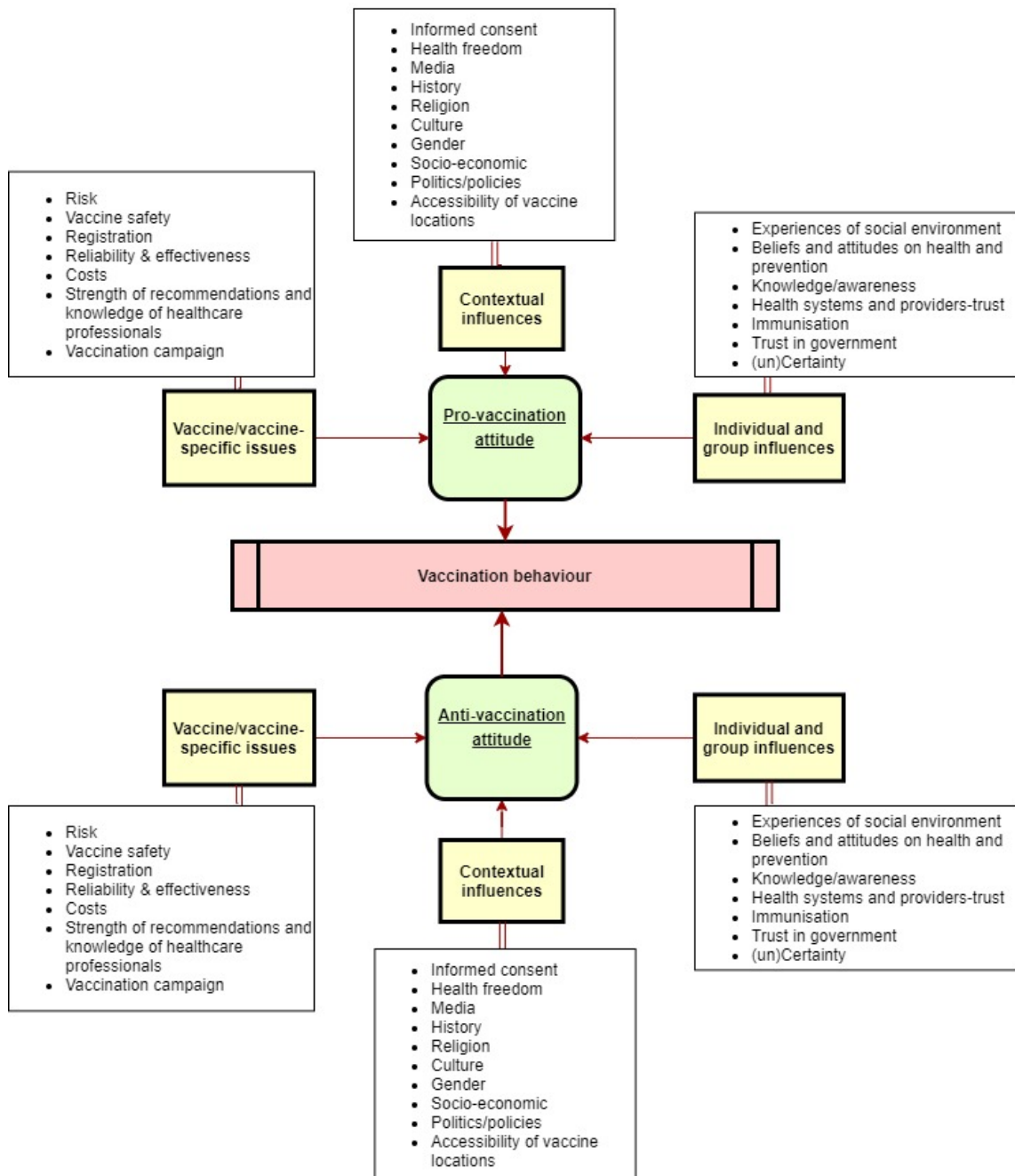
Overall, factors influencing vaccination acceptance are social environment (WHO, 2020), demographic factors like age and job and psychological factors like the trust in government and risk perception. Elderly people tend to have more vaccine acceptance, just as people who do not work in care areas (RIVM, 2021).

### 3.3 Vaccination-decision making framework

The aforementioned determinants are stated in the vaccination decision-making framework (Figure 1). The determinants are seen as arguments used in the vaccination discourse. The determinants illustrate which categories of arguments are possible.

**Figure 1**

Vaccination Decision-making Framework



#### 4. Research question

Twitter has open access and therefore everybody might be able to contribute. Twitter can be a tool for changing healthcare perspective and health decisions (Sinnenberg et al., 2017). However, how this works exactly depends on the type of arguments of pro- and anti-vaccination categories. Therefore, the research question of this thesis is as follows:

*“What are the types of arguments that are used by pro- and anti-vaccination proponents in the online vaccination discourse on Twitter?”*

The expectation for the research question is that pro-vaccination arguments are more often fact-based while that anti-vaccination arguments are more often based on norms, beliefs and religious reasoning (Smith & Graham, 2019) and on conspiracy and mistrust (Mitra et al., 2013).

## 5. Research methods

### 5.1 Design

This study is part of a bigger research on online vaccination discourse in which a dataset will be used for several other analyses as well. Tweets of an existing Twitter database, collected in the context of the larger study, were consulted to identify the tweet valence, content and types of arguments. Instead of a study population, this research has tweets as its subjects.

### 5.2 Data collection

Data collection instruments for the 85,000 tweets were Twitter Application Programming Interface (API), the terms and services of Twitter, webcrawling and the tweets were collected through hashtags and key words. The search terms were: #vaccineren, #ikvaccineer, #ikvaccineerniet, #vaccinatiegraad, #vaccinatieschade, #antivaxx, #provaxx, #antivax #provax, #antivaxxer, #provaxxer, #mazelen. The key words were: vaccineren, vaccineer, vaccinatie, vaccinatietwijfel, antivaxx, provaxx, provax, antivaxxer, provaxxer. The 85,000+ selected Dutch tweets from 2012 until 2019 were collected in a raw database. Eventually, 2,000 out of the 85,000 tweets have been examined for this research. This is a random subset collected to do the first explorative and manually analysis in Excel.

### 5.3 Data analysis and data management

The raw dataset was cleaned by switching all upper case to lower case and by removing URLs, user-names, numbers, punctuations, extra spaces and one-character long words to improve digital eligibility. Then, the 2,000 tweets were coded manually in Excel. To improve inter-coder reliability, six coders alternated the tweets. First, four coders each coded 100 tweets and discussed it with the others. Then, 500 tweets per person were coded on tweet valence and doubts were discussed with the six coders. The following categories were followed: pro-vaccination, anti-vaccination, hesitant, relevant but neutral, irrelevant and relevant but indefinable. Next, the pro-, anti- and hesitant tweets were alternated and coded on content. Again, doubts were discussed.

This content was partially deductively (top-down) taken from Kata (2012) who has previously categorized anti-vaccination tweets for content, and inductively taken from what the group decided on (see appendix I for content scheme). Inductive codes were necessary because not all codes fitted the content of the tweets well. This bottom-up way of coding was discussed during meetings with all coders. That way, coders could agree or disagree, depending on whether they could use this code as well or fit it under any other code. Finally, the data analysis for this specific study started. Solely the pro- and anti-vaccination tweets were used to be coded in NVivo on the type of arguments they include. A research on qualitative literature led to a deductive coding scheme (appendix II) which was supplemented with one inductive code, because no other code applied. Therefore, this was also an iterative process. Then, the codes were extracted from NVivo to analyze them. The data analysis started with counting how often a code was mentioned, putting that into percentages and comparing the pro- and anti-vaccination arguments with each other. It is important to look at the relative frequencies, because the number of pro-vaccination tweets and anti-vaccination tweets differs. It is important to keep in mind that there is no minimum or maximum stated for when a code has been used "a lot" or "not a lot". Therefore, it will be mentioned whether a code has been coded more or less than another code.



## 5.4 Ethics and data management

Data collection happened from 2012 until 2019, prior to the FETC guidelines which are currently applicable. A Data Protection Impact Assessment (DPIA) is discussed with the Research Data Management Support of UU and the privacy contact employee of the Faculty of Social and Behavioural Sciences and will be submitted to the Data Protection Officer of the University of Utrecht (UU). For data management, the protocol of the Ethics Review Board of the Faculty of Social and Behavioural Sciences of UU will be followed.

All selected tweets were extracted into raw data as digits and the dataset was stored securely. The tweets are made anonymous, meaning that identification is not possible because personal data has not been used for this research. To prevent the spread of sensitive information, no direct quotes will be used. Twitter is publicly accessible, which is why informed consent was not obtained from the participants. Therefore, the creators of the tweets cannot agree with their participation and cannot terminate it and they will not be compensated in any form. The risk of harm of them is minimized because they will not participate in surveys, interviews or observations, no shocking images will be shown, and no physical or mental harm will be caused. Since Twitter is a 13+ platform, it can be assumed, but not guaranteed that the creators of the tweets are mentally capable and over 16 years old. The Faculty Ethics Review Board of the Faculty of Social and Behavioural Sciences has approved the research with document number 20-693. The ethics protocol request can be found in appendix III and the ethical approval in appendix IV.

## 6. Results

Out of the 2,000 analysed tweets, 354 were pro-vaccination and 57 were anti-vaccination which are the dataset for this research. Thus, the vast majority of these selected tweets included arguments in favour of vaccination. The rest of the tweets were hesitant, relevant but neutral, irrelevant or relevant but indefinable. In Table 1 below, the pro- and anti-vaccination codes, their number of references and their frequency can be found. Vaccination codes can be found in appendix II.

**Table 1**

Pro- and Anti-vaccination Codes and their amount of References and Frequency<sup>1</sup>

Pro-vaccination code	References	Frequency	Anti-vaccination code	References	Frequency
Vaccine/vaccination-specific issues					
G01 - Risk	72	20,3%	G26 - Risk	8	14,0%
G02 - Safety	14	4,0%	G27 - Safety	30	52,6%
G03 - Registration	0	0,0%	G28 - Registration	0	0,0%
G04 - Reliability	36	10,2%	G29 - Reliability	6	10,5%
G05 - Costs	3	0,8%	G30 - Costs	0	0,0%
G06 - Health profess.	4	1,1%	G31 - Health profess.	3	5,3%
G07- Campaign	11	3,1%	G32 - Campaign	1	1,8%
Contextual influences					
G08 - Informed consent	0	0,0%	G33 - Informed consent	0	0,0%
G09 - Health freedom	55	15,5%	G34 - Health freedom	6	10,5%
G10 - Media	54	15,3%	G35 - Media	3	5,3%
G11 - History	10	2,8%	G36 - History	0	0,0%
G12 - Culture	18	5,1%	G37 - Culture	1	1,8%
G13 - Gender	1	0,3%	G38 - Gender	0	0,0%
G14 - Socio-economic	3	0,8%	G39 - Socio-economic	2	3,5%

<sup>1</sup> The references are the amount of times the a tweet was coded to that code. The frequency is calculated by dividing the amount of references by the total amount of pro- or anti-vaccination tweets and multiplied by 100 to get to the percentage (for example:  $(72/354)*100=20,3\%$ ).

G15 - Politics/policies	15	4,2%	G40 - Politics/policies	6	10,5%
G16 - Locations	2	0,6%	G41 - Locations	0	0%
Individual and group influences					
G17 - Soc. environment	30	8,5%	G42 - Soc. environment	12	21,1%
G18 - Beliefs	101	28,5%	G43 - Beliefs	7	12,3%
G19 - Knowledge	29	8,2%	G44 - Knowledge	2	3,5%
G20 - Health systems	3	0,8%	G45 - Health systems	5	8,8%
G21 - Immunization	1	0,3%	G46 - Immunization	3	5,3%
G22 - Trust	2	0,6%	G47 - Trust	13	22,8%
G23 - (un)certainty	0	0%	G48 - (un)certainty	1	1,8%
G24 - Politics/policies	6	1,7%	G49 - Politics/policies	0	0%
G25 - Locations	0	0%	G50 - Locations	0	0%
			G51 - Recommendation	1	1,8%

## 6.1 Vaccine/vaccination specific issues

### 6.1.1 Risk

Generally mentioned more than other codes, is the code “Risk” which for pro-vaccination, was mostly focused on herd immunity and the risk of getting sick of the vaccine-preventable disease. This included tweets like the danger non-vaccinated children are for the public health and herd immunity. The most used argument in favour of vaccination is that the vaccines have limited to no risk, while the infectious diseases can have a big negative impact on one’s health. Also, some healthcare professionals like pediatricians tweet about their experiences with children getting extremely sick from vaccine-preventable diseases like the measles.

However, for anti-vaccination, tweets about risk were more focused on the risk of getting sick from the vaccine: vaccination damage. This is a different point of view from risks. In one of the tweets it is stated that their general practitioner has never seen a child die from the measles, but that they have seen children getting sick because of vaccines. This means that pro- and anti-vaccination proponents have a different way of interpreting risk.

### 6.1.2 Vaccine safety

From risks, it gets to the most used argument for anti-vaccination: vaccine safety. This code has been more used for anti-vaccination than for pro-vaccination. The latter tweets are mostly focused on disagreeing with articles which claim the unsafety of vaccines. Also, the well-known article about the relation between vaccines and autism was mentioned now and then. One of the tweets include information on someone’s grandchild who was not vaccinated against pertussis and now goes to special education, assuming that the damage would have been way less when the child was vaccinated.

As stated, vaccine safety was generally more mentioned in anti-vaccination tweets. Often, the tweets include experiences of social environment. This is either about people from the social environment who got sick because of vaccines, or people who did not get sick regardless of not getting vaccinated. Also, it is stated that people who get vaccinated, are a danger to others and again, the autism research is mentioned. The anti-vaccination tweets often state that the disadvantages of not getting vaccinated do not outweigh the advantages. In one of the tweets it is stated that the writer would not have been a mother anymore if she would have gotten her children vaccinated. Vaccination is often seen as an experiment which is called barbarian and lethal. This means that the anti-vaccination proponents often look for more negative experiences regarding vaccines and try to fight experiences of pro-vaccination proponents with mistrust.

### 6.1.3 Reliability and effectiveness

The code “Reliability and effectiveness” was used equally in the pro- and anti-vaccination tweets. This would state that pro- and anti-vaccination proponents value reliability and effectiveness equally. In

the pro-vaccination tweets, it is often stated that vaccines are effective because of the diseases they eliminate. They also state that because of vaccines, immune systems are improved and diseases cannot spread. One of the tweets claims that without vaccines, humanity would become extinct. Also herd immunity is mentioned. In the anti-vaccination tweets, it is stated that vaccines do not work well, do not protect and are trash. Also, vaccinating is called a satanic ritual and that vaccines can change one's DNA. Again, this shows how pro-vaccination proponents use science-based facts while anti-vaccination proponents state beliefs and mistrust.

#### 6.1.4 Costs

Costs are solely mentioned in three pro-vaccination tweets. Two of them are about how the HPV-vaccine can prevent high healthcare costs because of less cancer screening. Also, one of the tweets state that all vaccines should be free, because the creator of the tweet has paid for the maternal pertussis vaccine herself while she was pregnant. This could suggest that anti-vaccination proponents value costs less than the pro-vaccination proponents.

#### 6.1.5 Strength of recommendations and knowledge of healthcare professionals

This code is relatively more mentioned in anti-vaccination tweets than in pro-vaccination tweets. The pro-vaccination tweets are about how anti-vaccination proponents have no trust in healthcare professionals and how they ignore their advice by endangering others. Also, according to one the tweets, some professionals express themselves nuances, which can lead to others distrusting their knowledge. Lastly, it is stated that doctors do let their own children get vaccinated and they would not be doing that if vaccines were not safe. One of the anti-vaccination proponents states that one should be mad at healthcare professionals for lying. Another one calls the professionals false prophets. According to Hussain et al. (2018) there must be more emphasis on developing trust in healthcare professionals to combat the anti-vaccination movement.

#### 6.1.6 Vaccination campaign

Tweets about the vaccination campaign are more mentioned in the pro-vaccination group. In this group, tweets are about the content of the national immunization programme and promotions for the campaign #ikvaccineer and the programme. One tweet is about the governmental flyer and one anti-vaccination tweet is about how the governmental way of communicating about vaccines is scaring children. All in all, the vaccination campaign is not a popular topic among the Twitter users.

## 6.2 Contextual influences

### 6.2.1 Health freedom and media

Health freedom and media have almost been equally often mentioned. That means that these can be seen as of similar importance in the pro-vaccination discourse. Health freedom in this case is mostly about how it should be mandatory to get vaccinated. Alternatively, in the tweets it states that child daycares should be allowed to deny access to children who have not been vaccinated. This goes hand in hand with politics and policies. Some tweets appeal to Dutch political parties to make vaccinating mandatory. In the anti-vaccination discourse, health freedom has been mentioned less. In this case, the tweets were mostly critiques about how pro-vaccination proponents are in favour of compulsory vaccinating. The anti-vaccination proponents want to be able to make their own health decisions.

Also media was more often mentioned in the pro-vaccination tweets than in the anti-vaccination tweets. Pro-vaccination tweets often state information on 'fake news' while the anti-vaccination tweets state that 'fake news' does not exist. Some pro-vaccination tweets illustrate celebrities who got vaccinated and they often cite from news channels about outbreaks of vaccine-preventable diseases. Also, these tweets include some comments on how the media must be more transparent and on how healthcare professionals and parents are portrayed in the media. Some of them agree with the portrayal while others think these items are too one-sided, mostly when they are

about anti-vaccination movements. Additionally, in the pro-vaccination tweets on media, often infographics and posters from hospitals or health organizations and news articles and TV items are shared which show the importance of vaccines. Thus, pro-vaccination proponents tend to share their information sources while the anti-vaccination proponents do not.

### 6.2.2 History, culture, gender, socio-economic and accessibility of vaccine locations

In the pro-vaccination tweets, history, culture, gender, socio-economic and the accessibility of vaccine locations were mentioned, in the anti-vaccination tweets only culture and socio-economic were mentioned. Thus meaning that the anti-vaccination proponents value history, gender and the accessibility of vaccine locations less than pro-vaccination proponents.

The pro-vaccination proponents tweeted about history, mainly to compare how the development of infectious diseases was before the invention of vaccines. One of them states that it has been 25 years since the last polio outbreak. Others talk about how diseases have been exterminated over the years.

Culture is relatively more mentioned in the pro-vaccination tweets. In these tweets, it is mostly stated that the vaccination debate has a religious point of view. One of the tweets states that if everything is the will of God, so are vaccines. Some state that religious people do let their children get vaccinated, which they call child abuse, others contradict that by stating that lots of Christians do get vaccinated. The one anti-vaccination tweet on culture is about the hypocrisy of not wanting to endanger children with criminals, but do letting them get vaccinated.

Gender is only mentioned once in the pro-vaccination tweets and it is about how boys should also be able to get vaccinated against HPV.

The socio-economic code was relatively more used in anti-vaccination tweets. These were about how people follow other people's decisions easily and for pro-vaccination these were about how the HPV-vaccine can help reduce medical costs, a comparison between vaccination and accepting migrants and about financial child benefits.

Tweets about the accessibility of vaccine locations included how in developing countries, the locations are much further away than in the Netherlands and how getting vaccinated is worth it, regardless of the distance of the vaccine location.

### 6.2.3 Politics and policies

Politics and policies of contextual influences were relatively more mentioned in anti-vaccination tweets. The pro-vaccination tweets are mostly about sharing petitions to let political parties decide on compulsory vaccination. That way, daycare centers would be allowed to refuse children who are not vaccinated. The anti-vaccination include attacks on political parties in favour of vaccination and praises for parties against vaccination. These tweets link closely to the code "Trust in government", indicating the political sensitivity of vaccination decisions.

## 6.3 Individual and group influences

### 6.3.1 Experiences of social environment

Experiences of social environment are more shared in the pro-vaccination discourse than in the anti-vaccination tweets. In one of the tweets, one complains about a brother refusing a vaccine, others share how their youngsters chose in favour of the vaccines themselves. Some people share experiences on how they saw people getting sick without vaccines, for example in Africa. A paediatrician and an children's internist also share experiences of seeing many sick children in Dutch hospitals.

Anti-vaccination experiences of social environment mostly include children getting sick from vaccines and vaccine-damage is mentioned generally often. People share experiences on how children have not been vaccinated and have also not been more sick than other children. According to them, the immune system of most children is strong enough from itself to battle infections, bacteria and viruses. One of the tweets states that a friend, who is a general practitioner, has never seen a child

getting sick from one of the infectious diseases vaccines fight against. Thus, both anti- and pro-vaccination proponents rely on their social environment and on professionals' experiences.

### 6.3.2 Beliefs and attitudes on health and prevention

The first remarkable finding is that pro-vaccination arguments are differently divided than anti-vaccination arguments. The most used argument for pro-vaccination include tweets about hypocrisy, e.g. comments on how others won't let their children get vaccinated, but they do let them wear glasses or a safety belt in the car. Also, these tweets were about how not vaccinating is unsafe and anti-social. Pro-vaccination proponents also tweeted about the fact that they let their children get vaccinated, which indicates their belief on health prevention. Additionally, in some tweets is the comparison of feeling a bit sick or having a hurtful arm with regard to the vaccine, versus the idea of getting sick with a vaccine-preventable disease. Herd immunity and the need for protecting those who cannot get vaccinated are also beliefs on health and prevention. Some people get mad about the anti-vaccination movement and have the belief that anti-vaccination parents should get legally punished for child abuse because they would rather let their children die than getting them vaccinated. Others state that they would do everything to keep their children safe, including having them vaccinated. Beliefs and attitudes on health and prevention are sometimes supported by scientific facts. Anti-vaccination tweets are about the danger of vaccines and how pro-vaccination proponents are dumb. All in all the beliefs and attitudes of pro-vaccination proponents are more substantiated with arguments.

### 6.3.3 Knowledge and awareness

Knowledge and awareness are more mentioned in pro-vaccination tweets, including advantages of vaccines and effectiveness against infectious diseases. Also, the tweets are about the difficulty to convince anti-vaccination proponents of the science behind vaccines and how media are spreading awareness. One of the tweets shows a simulation which illustrates what happens if people do not vaccinate. Lastly, in these tweets it is debated whether doing research on google is informative enough, fake news is mentioned and informative news items are recommended. One of the anti-vaccination tweets is about being tired of convincing others of the dangers of vaccines. The battle against fake news and spreading awareness is more lively among pro-vaccination proponents.

### 6.3.4 Health systems and providers-trust

This code is relatively more discussed in anti-vaccination tweets which are mostly about how healthcare providers and health systems like the pharmacy are mafia, toxic, liars, not well informed and false prophets. Pro-vaccination tweets on the other hand are about the unjustified ignorance of the knowledge of healthcare providers and systems. The anti-vaccination tweets involve more emotion and anger than the pro-vaccination tweets.

### 6.3.5 Immunization, (un)certainty and recommendation

Immunization is more mentioned in anti-vaccination tweets. These were about how the only way of strengthening immune systems is by getting sick. The one pro-vaccination tweet is about how vaccines do strengthen the immune system.

(Un)certainty is only mentioned once in anti-vaccination tweets and it includes considering all information there is to find about vaccination and then making a decision. A recommendation to stop vaccinating is only given once in an anti-vaccination tweet. No argument or information is included there.

### 6.3.6 Trust in government

Almost equally mentioned as risks in pro-vaccination tweets was "Trust in government" for anti-vaccination tweets. This theme was more often mentioned in anti-vaccination discourse than in the pro-vaccination tweets, indicating mistrust. The tweets on anti-vaccination includes how vaccination

is an experiment which is supported by the government. In the tweets comparisons are made, e.g. on how the government does not let criminals enter daycare, but they do allow vaccines. Others think that the government is making people scared and that they are corrupt. In one of the tweets, vaccination propaganda is called a new form of terrorism. The limited number of pro-vaccination tweets on the other hand are a critique on politicians and how they are responsible for ill children if they continue spreading the word of anti-vaccination. Therefore, the anti-vaccination tweets are mostly about mistrust and the pro-vaccination tweets about safety and governmental responsibility.

#### 6.3.7 Politics and policies

Politics and policies on individual and group influences are only mentioned in pro-vaccination tweets and these are about compulsory vaccination and fighting against political parties which do not agree with vaccination. Also, wrongful deaths are discussed, indicating that pro-vaccination proponents would like to see more political involvement in vaccination decisions.

#### 6.4 Unmentioned themes

With regard to pro-vaccination tweets, some topics were not mentioned. These are: "Registration", "Informed consent", "(un)Certainty" and "Accessibility of vaccine locations – individual and group influences". Unmentioned topics in the anti-vaccination discourse include: "Registration", "Costs", "History", "Gender", "Accessibility of vaccine locations – contextual influence", "Politics and policies – individual and group influences" and "Accessibility of vaccine locations – individual and group influences". Overlapping non-mentioned themes are registration and accessibility of vaccine locations – individual and group influences. The fact that these themes are not discussed in either pro- or anti-vaccination tweets or neither, would indicate that these Twitter users value them less than other people or other platforms.

### 7. Discussion

The aim of this research was to explore the type of arguments that are used by pro- and anti-vaccination proponents in the online vaccination discourse on Twitter. Hypothetically, pro-vaccination arguments are more based on science while anti-vaccination arguments are more based on beliefs and mistrust. This expectation has been met in this research.

#### 7.1 Analysis of results

##### 7.1.1 Vaccine specific issues

As expected, risk, vaccine safety and reliability and effectiveness were mentioned relatively often in relation to other codes on vaccine specific issues. The pro-vaccination focus was mainly on the risk of getting sick without vaccines and the main focus for anti-vaccination was on getting sick from vaccines. In line with the expectation for the research question, the pro-vaccination arguments with regard to vaccine/vaccination specific issues were supported with scientific arguments more than the anti-vaccination attitudes which were more supported by beliefs and mistrust (Mitra et al., 2013; Smith & Graham, 2019). This is also in line with findings of the WHO (2014) and the RIVM (2021). However, it turns out that costs, the strength of recommendations and knowledge of healthcare professionals and the vaccination campaign were less important to the Twitter users than expected. The reason for this difference can differ per determinant. For example, the fact that costs are of less importance to the Twitter users than expected in the literature, might have to do with the country. In general, the Netherlands has an accessible and affordable healthcare system and most of the literature is on studies from the US which makes it hard to extrapolate the results. Besides, the lack of value on the strength of recommendations and knowledge of healthcare professionals might be because the focus in the tweet selection was mainly on words like vaccine and not on healthcare. This emphasizes the effectiveness of vaccines and not on healthcare. Lastly, differences in importance of a vaccination campaign might have to do with the period in which the tweets are written. Except for the maternal

pertussis vaccine in 2019 and some relatively small campaigns, little to no epidemics happened and no new vaccines were introduced between 2012 and 2019 (Rijksoverheid, 2021). This might explain the lack of extra attention for vaccination campaigns because there was no immediate need for it. However, there is no direct official explanation to be found for all these differences.

### 7.1.2 Contextual influences

The most striking finding for contextual influences was that health freedom was an important topic for both pro- and anti-vaccination proponents. Besides, politics and policies were mentioned relatively often, especially in anti-vaccination tweets. This has mainly to do with compulsory vaccination and it makes sense that the codes health freedom and politics are linked with each other then. Again, the pro-vaccination tweets were more focused on facts while anti-vaccination arguments were mainly based on beliefs and mistrust. As prospected by Mitra et al. (2013) and Smith and Graham (2019).

Media on the other hand is highly valued and criticized by pro-vaccination proponents and less by anti-vaccination proponents. The RIVM (2021) expected that mass media would play an important role and that there would be need for transparent information, which is in line with these findings. Also, as Mnookin (2011) and Smith et al. (2007) stated, media can have a negative effect and fearful on vaccine uptake. This is also in line with the findings of the tweets.

There was less attention for history, culture, gender, socio-economic and the accessibility of vaccine locations than for the other contextual influences. There is no direct official explanation to be found for these differences. These determinants might have been influenced by the country they take place in because most research in the found literature is not specified for the Netherlands, leading to potential differences in importance and value. Other countries have other views on the importance of culture, socio-economic and the accessibility of vaccine locations. The Netherlands is relatively small and therefore mostly accessible, which makes accessibility no problem. Besides, communication channels are quick and there are no strong Dutch cultural beliefs against vaccination, making it a non-cultural debate. Additionally, as mentioned before, healthcare is relatively affordable which might lead to less socio-economic problems. With regard to history, the national immunization programme exists from 1957 (RIVM, 2012) and has been successful, possibly giving it Twitter users little opportunity to criticize. Gender is solely mentioned in combination with the HPV vaccine, because this vaccine is linked to gender, which limits the topic.

### 7.1.3 Individual and group influences

The most found theme in all tweets was “Beliefs and attitudes on health and prevention” in the pro-vaccination tweets. In anti-vaccination tweets this theme played a moderately important role. The beliefs of parents were mostly on feeling responsible for the health of their children, as expected by Kata (2010) and the WHO (2014). Therefore, it turns out that the pro-vaccination proponents have a stronger feeling towards the fact that vaccines are needed to prevent the spread of diseases. At the same time, complacency is being kept alive by the existence of the RVP because anti-vaccination proponents then believe that the risk of taking a vaccine is higher than the risk of the disease.

A remarkable difference is found in the code “Experiences of social environment” which was used more in anti-vaccination tweets, suggesting that these proponents rely on their social environment more than pro-vaccination proponents. These experiences were mostly negative towards vaccines or positive towards not using vaccines while the experiences from pro-vaccination proponents are positive towards the use of vaccines. A possible explanation for this difference is that the experiences of the pro-vaccination proponents are more often supported by science while those from anti-vaccination proponents are more based on mistrust. This might also have to do with the fact that people often look for stories which are in line with their beliefs and this is in line with findings of the WHO (2020) in which it is stated that the social environment can influence vaccination acceptance.

This is the same for the code “Health systems and providers-trust” in which the pro-vaccination proponents show trust and the anti-vaccination proponents show mistrust. A similar thing is happening with regard to “Trust in government” which is especially mentioned often in anti-vaccination tweets.

Kata (2010) also found mistrust in governmental organizations among anti-vaccination organizations. This indicates that (mis)trust in government is of more importance for anti-vaccination proponents.

#### 7.1.4 Unmentioned themes

The fact that some topics are not mentioned in the tweets, would imply that Twitter users value them less than others or less than on other platforms. This is contradicting the literature on which the vaccination decision-making framework is based. Especially the lack of mentioning registration and accessibility is striking since it contradicts what Yeung (2016), Vann et al. (2018) and the WHO (2014) stated in their articles. This might have to do with the fact that the article of Yeung (2016) is about the uptake of influenza vaccination among adults while the RVP is mostly for children. Also, both articles are not focused on the Netherlands. The research of Vann et al. (2018) for example is conducted in ten countries. Besides, Visser et al. (2016) stated that uncertainty is an important determinant in decision making while this does not imply for this research. The reason for this contradiction is unknown, because the study of Visser et al. was also conducted among Dutch parents and 2016 falls within the range of the tweets. However, a potential explanation on this difference might be found in the study population.

#### 7.2 Strengths

One of the strengths of this research is the use of triangulation with a literature research and a qualitative analysis. The credibility of this research is strengthened with the use of two sources of information: qualitative literature and tweets. Because Twitter is an open platform, this research represents the reality even though the variation of participants cannot be guaranteed. Secondly, there is little researcher bias in the first part of the coding because doubts were discussed with the other coders and the tweets were alternated among the coders, improving inter-coder reliability. This research is furthermore strengthened by its interdisciplinary approach. There is a psychological perspective in individual determinants and sociological perspective in contextual determinants. As can be seen in the theoretical framework, attitudes are influenced by multiple, interdisciplinary aspects. Lastly, a strength of this research is that pro- and anti-vaccination tweets are collected jointly and analyzed with the same, broad framework of categories.

#### 7.3 Limitations

With regard to the coding in NVivo, there was no inter-coder reliability, which could lead to researcher bias. Secondly, relatively few anti-vaccination tweets were found, making it difficult to compare them to the pro-vaccination tweets. However, the amount of pro-vaccination tweets is also limited, also leading to little variation and validity. The exact number of tweets to make the research completely valid is unknown. However, the generalization is also not guaranteed. Even though Twitter is an open-access platform to everybody aged 13 or older (Twitter, n.d.), not everybody is able to use it. This includes elderly people or ones with a physical or mental disability. Thirdly, with the use of the anonymized dataset, some tweets were difficult to interpret. Also, links in tweets were not clicked on, making it even more difficult to determine the context of the tweet. Fourthly, no algorithm was build, even though this was supposed to happen. With the help of the algorithm the content of the tweets could have been predicted, but because of limited time, this did not happen. Lastly, a limitation includes the fact that the database includes tweets from 2012 till 2019, leaving the current COVID-19 pandemic opinions and attitudes out. The coronavirus is identified in 2019, leading to new attention, willingness and hesitancy towards the COVID-19 vaccine and vaccines in general (Troiano & Nardi, 2021).

#### 7.4 Further research

First, further research might combine the vaccination decision-making framework with the categorization of Kata (2012). Overlap in these categories would suggest the big importance of that



category and differences would suggest the need for more research. To do that, either a new framework must be created with new, combined codes, or a new analysis must be done to compare the two based on the content of the tweets. The structures of the bottom-up analysis in Excel and the top-down analysis in NVivo could also be compared to examine which types of arguments match. Secondly, further research can be done on more recent tweets, especially with the COVID-19 pandemic going on. Hypothetically, more anti-vaccination tweets will be found then and demographic factors might play a bigger role (RIVM, 2021). Thirdly, further research could lead to the initially planned algorithm to predict the type of arguments in tweets. Lastly, more research is needed on how the findings of the online vaccination discourse can influence information and communication channels.

## 8. Conclusion

The answer to the research question: *“What are the types of arguments that are used by pro- and anti-vaccination proponents in the online vaccination discourse on Twitter?”* is quite broad. As in line with the literature, the types of arguments in pro-vaccination tweets turn out to be more based on scientific facts and the anti-vaccination tweets are more based on beliefs, attitudes and mistrust. However, topics like registration, costs, informed consent and the accessibility of vaccine locations are less important for these Twitter users than expected from the literature. This might be because of differences in physical distance and healthcare, compared to other countries.

The most used types of arguments by pro-vaccination proponents in the online vaccination discourse on Twitter are respectively their beliefs and attitudes on health and prevention, the risk of getting sick from infectious diseases and the decrease of herd immunity as a result of vaccine refusal, health freedom and compulsory vaccination, the use of media in the vaccination debate and the reliability and effectiveness of vaccines.

The most used types of arguments by anti-vaccination proponents in the online vaccination discourse on Twitter are respectively vaccine safety (or unsafety as they would state), mistrust in the government, experiences of the social environment and beliefs and attitudes on health and prevention stating that vaccines are not necessary to protect the immune system.

To conclude, it goes without saying that the impact of social media on vaccination decisions can be huge. With the use of social media, every user gets a voice which also opens up an opportunity to spread misinformation or fear.

## 9. Bibliography

- Anderson, R. M., & May, R. M. (1985). Vaccination and herd immunity to infectious diseases. *Nature*, 318(6044), 323.
- Bazin, H. (2001). The ethics of vaccine usage in society: lessons from the past. *Endeavour*, 25(3), 104-108.
- Berman, J. M. (2020). *Anti-vaxxers: How to Challenge a Misinformed Movement*. MIT Press.
- Betsch, C., Brewer, N. T., Brocard, P., Davies, P., Gaissmaier, W., Haase, N., ... & Stryk, M. (2012). Opportunities and challenges of Web 2.0 for vaccination decisions. *Vaccine*, 30(25), 3727-3733.
- Boeije, H. (2010). *Analysis in qualitative research*. Sage.
- Bradshaw, A. S., Shelton, S. S., Wollney, E., Treise, D., & Auguste, K. (2020). Pro-vaxxers Get Out: Anti Vaccination Advocates Influence Undecided First-Time, Pregnant, and New Mothers on Facebook. *Health Communication*, 1-10.
- Brunson, E. K. (2013). The impact of social networks on parents' vaccination decisions. *Pediatrics*, 131(5), e1397-e1404.
- Chatterjee, A., & O'Keefe, C. (2010). Current controversies in the USA regarding vaccine safety. *Expert review of vaccines*, 9(5), 497-502.
- Chen, R. T., & DeStefano, F. (1998). Vaccine adverse events: causal or coincidental?. *The Lancet*, 351(9103), 611-612.
- Chen, R. T., & Hibbs, B. (1998). Vaccine safety: current and future challenges. *Pediatric annals*, 27(7), 445-455.
- Curiel, R. P., & Ramírez, H. G. (2020). Vaccination strategies against COVID-19 and the diffusion of anti-vaccination views. *arXiv preprint arXiv:2009.13674*.
- Dollarhide, M. (2019). Social media definition. *Investopedia*.
- Fine, P. E., Eames, K., & Heymann, D. L. (2011). "Herd immunity": a rough guide. *Clinical infectious diseases*, 52(7), 911-916.
- Fine, P. E. (1993). Herd immunity: history, theory, practice. *Epidemiologic reviews*, 15(2), 265-302.
- Fox, J. P., Elveback, L., Scott, W., Gatewood, L., & Ackerman, E. (1971). Herd immunity: basic concept and relevance to public health immunization practices. *American Journal of Epidemiology*, 94(3), 179-189.
- Hinshaw, A., Aragon, T., Berg, A., Buka, S., Charo, R., Fairbrother, G., ... & Leland, A. (2013). Childhood immunization schedule and safety: stakeholder concerns, scientific evidence, and future studies. *Institute of Medicine*.
- Hussain, A., Ali, S., Ahmed, M., & Hussain, S. (2018). The anti-vaccination movement: a regression in modern medicine. *Cureus*, 10(7).
- Hors-Fraile, S., Atique, S., Mayer, M. A., Denecke, K., Merolli, M., & Househ, M. (2016). The unintended consequences of social media in healthcare: new problems and new solutions. *Yearbook of medical informatics*, (1), 47.
- Jenkins, M. C., & Moreno, M. A. (2020). Vaccination discussion among parents on social media: A content analysis of comments on parenting blogs. *Journal of health communication*, 25(3), 232-242.
- John, T. J., & Samuel, R. (2000). Herd immunity and herd effect: new insights and definitions. *European journal of epidemiology*, 16(7), 601-606.
- Jolley, D., & Douglas, K. M. (2014). The effects of anti-vaccine conspiracy theories on vaccination intentions. *PLoS one*, 9(2), e89177.
- Kata, A. (2012). Anti-vaccine activists, Web 2.0, and the postmodern paradigm—An overview of tactics and tropes used online by the anti-vaccination movement. *Vaccine*, 30(25), 3778-3789.
- Kata, A. (2010). A postmodern Pandora's box: anti-vaccination misinformation on the Internet. *Vaccine*, 28(7), 1709-1716.

- Lee, K., Palsetia, D., Narayanan, R., Patwary, M. M. A., Agrawal, A., & Choudhary, A. (2011, December). Twitter trending topic classification. In *2011 IEEE 11th International Conference on Data Mining Workshops* (pp. 251-258). IEEE.
- Lee, L. H., & Pichichero, M. E. (2000). Costs of illness due to Bordetella pertussis in families. *Archives of family medicine, 9*(10), 989.
- MacDonald, N. E. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161-4164.
- Massey, E. (1722). *A sermon against the dangerous and sinful practice of inoculation..* William Meadows.
- McCarthy, P. C., Sharyan, A., & Sheikhi Moghaddam, L. (2018). Meningococcal vaccines: current status and emerging strategies. *Vaccines, 6*(1), 12.
- Mendel-Van Alstyne, J. A., Nowak, G. J., & Aikin, A. L. (2018). What is 'confidence' and what could affect it?: A qualitative study of mothers who are hesitant about vaccines. *Vaccine, 36*(44), 6464-6472.
- Meyer, S. B., Violette, R., Aggarwal, R., Simeoni, M., MacDougall, H., & Waite, N. (2019). Vaccine hesitancy and Web 2.0: exploring how attitudes and beliefs about influenza vaccination are exchanged in online threaded user comments. *Vaccine, 37*(13), 1769-1774.
- Mitra, T., Counts, S., & Pennebaker, J. (2016, March). Understanding anti-vaccination attitudes in social media. In *Proceedings of the International AAAI Conference on Web and Social Media* (Vol. 10, No. 1).
- Mnookin, S. (2011). *The panic virus: a true story of medicine, science, and fear*. Simon and Schuster.
- Moser, C. A., Reiss, D., & Schwartz, R. L. (2015). Funding the Costs of Disease Outbreaks Caused by Non-Vaccination. *The Journal of Law, Medicine & Ethics, 43*(3), 633-647.
- Murugesan, S. (2007). Understanding Web 2.0. *IT professional, 9*(4), 34-41.
- Omer, S. B., Salmon, D. A., Orenstein, W. A., Dehart, M. P., & Halsey, N. (2009). Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. *New England Journal of Medicine, 360*(19), 1981-1988.
- Ortega-Sanchez, I. R., Vijayaraghavan, M., Barskey, A. E., & Wallace, G. S. (2014). The economic burden of sixteen measles outbreaks on United States public health departments in 2011. *Vaccine, 32*(11), 1311-1317.
- Plans-Rubió, P. (2012). Evaluation of the establishment of herd immunity in the population by means of serological surveys and vaccination coverage. *Human vaccines & immunotherapeutics, 8*(2), 184-188.
- Rijksoverheid. (2021). RVP nieuws 2009-2021. Retrieved June 22, 2021, from <https://rijksvaccinatieprogramma.nl/professionals/rvp-nieuws>
- RIVM. (2020). Bij twijfel over vaccinatie. Retrieved January 5, 2021, from <https://rijksvaccinatieprogramma.nl/vaccinaties/twijfels>
- RIVM. (2012). Het RVP sinds 1957. Retrieved June 22, 2021, from <https://www.rivm.nl/documenten/rvp-sinds-1957>
- RIVM. (2019). HPV - Humaan Papillomavirus. Retrieved January 5, 2021, from <https://www.rivm.nl/hpv-humaan-papillomavirus>
- RIVM. (2021). Verkenning factoren van invloed op deelname aan COVID-19 vaccinatie. RIVM Corona Gedragsunit.
- Scullard, P., Peacock, C., & Davies, P. (2010). Googling children's health: reliability of medical advice on the internet. *Archives of disease in childhood, 95*(8), 580-582.
- Sinnenberg, L., Buttenheim, A. M., Padrez, K., Mancheno, C., Ungar, L., & Merchant, R. M. (2017). Twitter as a tool for health research: a systematic review. *American journal of public health, 107*(1), e1-e8.
- Smith, N., & Graham, T. (2019). Mapping the anti-vaccination movement on Facebook. *Information, Communication & Society, 22*(9), 1310-1327.
- Smith, A., Yarwood, J., & Salisbury, D. M. (2007). Tracking mothers' attitudes to MMR immunization 1996-2006. *Vaccine, 25*(20), 3996-4002.

- Storm, A. E. (2011). Religious Conviction and The Boston Inoculation Controversy of 1721.
- Troiano, G., & Nardi, A. (2021). Vaccine hesitancy in the era of COVID-19. *Public Health*.
- Twitter. (n.d.). *Twitter. Wat er gebeurt*. Retrieved January 8, 2021, from <https://Twitter.com>
- Vann, J. C. J., Jacobson, R. M., Coyne-Beasley, T., Asafu-Adjei, J. K., & Szilagyi, P. G. (2018). Patient reminder and recall interventions to improve immunization rates. *Cochrane Database of Systematic Reviews*, (1).
- Van Panhuis, W. G., Grefenstette, J., Jung, S. Y., Chok, N. S., Cross, A., Eng, H., ... & Burke, D. S. (2013). Contagious diseases in the United States from 1888 to the present. *The New England journal of medicine*, 369(22), 2152.
- Van Wijhe, M. (2018). The public health impact of vaccination programmes in the Netherlands.
- Visser, O., Kraan, J., Akkermans, R., Ruiter, R. A., van der Velden, K., Hautvast, J. L., & Hulscher, M. E. (2016). Assessing determinants of the intention to accept a pertussis cocooning vaccination: A survey among Dutch parents. *Vaccine*, 34(39), 4744-4751.
- WHO. (2020). Behavioural considerations for acceptance and uptake of COVID 19 vaccines: WHO technical advisory group on behavioural insights and sciences for health, meeting report, 15 October 2020. World Health Organization. <https://apps.who.int/iris/handle/10665/337335>
- WHO. (2018). Immunization. Retrieved December 9, 2020, from <https://www.who.int/topics/immunization/en/>
- WHO. (2014). Report of the SAGE working group on vaccine hesitancy. *Geneva, Switzerland: WHO*. Retrieved from [https://www.who.int/immunization/sage/meetings/2014/october/1\\_Report\\_WORKING\\_GROUP\\_vaccine\\_hesitancy\\_final.pdf](https://www.who.int/immunization/sage/meetings/2014/october/1_Report_WORKING_GROUP_vaccine_hesitancy_final.pdf)
- Wolfe, R. M., & Sharp, L. K. (2002). Anti-vaccinationists past and present. *Bmj*, 325(7361), 430-432.
- Wolfe, R. M., Sharp, L. K., & Lipsky, M. S. (2002). Content and design attributes of antivaccination web sites. *Jama*, 287(24), 3245-3248.
- Yeung, M. P., et al. (2016). "Factors associated with the uptake of seasonal influenza vaccination in adults: a systematic review." *Journal of Public Health* 38(4): 746-753.

## Appendices

### Appendix I: Deductive and inductive content scheme

Black: deductive (top-down)

Grey: inductive (bottom-up)

1	(anti) safety and effectiveness
2	(anti) alternative medicine
3	(anti) civil liberties
4	(anti) conspiracy theories/search for truth
5	(anti) morality, religion and ideology
6	(anti) misinformation and falsehoods
7	(anti), other, namely
8	(pro), other, namely
9	(hesitant), other, namely
10	Inconsistentie/hypocrisie
11	Aanval op de andere groep; de andere groep wegzetten als dom/gevaarlijk
12	Anekdotisch bewijs of tweets die zeggen "Ik doe A (niet)"
13	Oproep tot actie
14	Altruïsme
15	Strafbaar stellen
16	Autoriteitsargument/social proof
17	Informatie aanbieden
18	Prijzen/complimenteren van voorvechters voor of tegen vaccinatie
20	Vragen en opmerkingen over vaccinatieproces
21	Vragen over consequenties wel of niet vaccineren
22	Vraagtekens bij loop van het debat

## Appendix II: Deductive and inductive coding scheme

	<b>PRO-VACCINATION: Vaccine/vaccination-specific issues</b>
G01	Risk
G02	Vaccine safety
G03	Registration
G04	Reliability & effectiveness
G05	Costs
G06	Strength of recommendations and knowledge of healthcare professionals
G07	Vaccination campaign

	<b>PRO-VACCINATION: Contextual influences</b>
G08	Informed consent
G09	Health freedom
G10	Media
G11	History
G12	Culture
G13	Gender
G14	Socio-economic
G15	Politics/policies
G16	Accessibility of vaccine locations

	<b>PRO-VACCINATION: Individual and group influences</b>
G17	Experiences of social environment
G18	Beliefs and attitudes on health and prevention
G19	Knowledge/awareness
G20	Health systems and providers-trust
G21	Immunisation
G22	Trust in government
G23	(un)Certainty
G24	Politics/policies
G25	Accessibility of vaccine locations

	<b>ANTI-VACCINATION: Vaccine/vaccination-specific issues</b>
G26	Risk
G27	Vaccine safety
G28	Registration
G29	Reliability & effectiveness
G30	Costs
G31	Strength of recommendations and knowledge of healthcare professionals
G32	Vaccination campaign

<b>ANTI-VACCINATION: Contextual influences</b>	
G33	Informed consent
G34	Health freedom
G35	Media
G36	History
G37	Culture
G38	Gender
G39	Socio-economic
G40	Politics/policies
G41	Accessibility of vaccine locations

<b>ANTI-VACCINATION: Individual and group influences</b>	
G42	Experiences of social environment
G43	Beliefs and attitudes on health and prevention
G44	Knowledge/awareness
G45	Health systems and providers-trust
G46	Immunisation
G47	Trust in government
G48	(un)Certainty
G49	Politics/policies
G50	Accessibility of vaccine locations

<b>ANTI-VACCINATION: Inductive coding</b>	
G51	Recommendation to just stop vaccinating



## Appendix III: Ethics protocol request

J. Merts - 24 February 2021 - 16:12:30

**(1.1) Title**

Pro- and anti-vaccination arguments in the online vaccination discourse on Twitter

**(1.2) Study type**

Secondary use of existing data

**(1.3) Division**

Social Policy and Public Health

**(1.4) Start date**

02 June 2019

**(1.5) End date**

30 June 2021

### Basic information

J. Merts - 24 February 2021 - 16:19:41

(1) Name(s) and surnames(s), Solis ID and e-mail address of the student(s):

Name and surname   Student number   E-mail

Jacintha Merts

4225422

jacintha.merts@planet.nl

(2) Name and surname, position and division of main thesis supervisor:

Name and surname   Position   Division   E-mail

Marijn Stok

Assistant professor

Social sciences

f.m.stok@uu.nl

(3) What is the study's (main) research question?

“What are the types of arguments that are used by pro- and anti-vaccination proponents in the

online vaccination discourse on Twitter?" N.B.: this study is part of a bigger, overall study which started in 2019. That's why the start date is June 2019.

### Existing data

J. Merts - 24 February 2021 - 16:19:41

(1) Will you be using:

- Data provided by supervisor
- Specifically: data from RADAR, CONAMORE, WIL or HBSC
- Open access data (e.g. DANS, ICPSR, GESIS, other), or Statistics Netherlands
- Online data such as social media data or data scraped from web pages

(2) Where was the data collected?

- the Netherlands
- Abroad, outside the Netherlands. Please name the country \_\_\_\_\_

### Data provided by supervisor

J. Merts - 24 February 2021 - 16:19:41

(1) The data...

- ... are anonymous
- ... are pseudonomised and the identifying key is not in possession of the researcher (student)
- ... are pseudonomised and the identifying key is available to the researcher (student)
- ... are not anonymous

(2) The research project in which the data were collected received earlier ethical approval from some ethical review board

- Yes, I upload the approval document at the end of this application
- No, indicate the year of data collection and why is there is no such approval \_\_\_\_\_

(3) The information letter and a consent form are available

- Yes, I will upload them at the end of this application
- No, please explain

No informed consent is needed from the participants, because the original data was taken from Twitter which is publicly accessible.

### Data management 1

J. Merts - 24 February 2021 - 16:19:41

(1) Data are or will be stored on faculty servers (YODA and/or FSBS research storage) in accordance with faculty protocol

- Yes
- No, because data are not allowed to leave the external institute where the research project takes place
- No, but a copy of the anonymized raw data will be stored on the faculty servers
- Other, please explain

(2) Access to data is limited to student and supervisor(s).

- Yes
- No, please explain

(3) Storage period is in accordance with faculty protocol and/or additional statutory provisions.

- Yes
- No, please explain

(4) Data are not shared with external organization

- Correct
- No, please explain

### Attachments

J. Merts - 24 February 2021 - 16:19:41

(1) Questionnaire

No files have been uploaded yet

(6) Earlier approval by FERB (if applicable)

[FETC approval 20-693.pdf](#) deleted J. Merts 24 February 2021 - 16:19:03

(9) Miscellaneous documents e.g. data set description (optional)

No files have been uploaded yet

### Signature

J. Merts - 24 February 2021 - 16:19:41

(1) Corona protocols

I declare that I have read the relevant [UU Corona protocols](#), and will follow them as I perform the study

(2) I declare that I have completed the above truthfully, my Solis ID is:

4225422

## Appendix IV: Ethical approval

<b>P.O. Box 80140, 3508 TC Utrecht</b> The Board of the Faculty of Social and Behavioural Sciences Utrecht University P.O. Box 80.140 3508 TC Utrecht	<b>Faculty of Social and Behavioural Sciences</b> Faculty Support Office Ethics Committee  <b>Visiting Address</b> Padualaan 14 3584 CH Utrecht
<b>Our Description</b> 21-0590 <b>Telephone</b> 030 253 46 33 <b>E-mail</b> FETC-fsw@uu.nl <b>Date</b> 02 June 2019 <b>Subject</b> Ethical approval	

### **ETHICAL APPROVAL**

Study: Pro- and anti-vaccination arguments in the online vaccination discourse on Twitter  
Principal investigator: J. Merts  
Supervisor: Marijn Stok

The study is approved by the Ethical Review Board of the Faculty of Social and Behavioural Sciences of Utrecht University. The approval is based on the documents sent by the researchers as requested in the form of the Ethics committee and filed under number 21-0590. The approval is valid through 30 June 2021. The approval of the Ethical Review Board concerns ethical aspects, as well as data management and privacy issues (including the GDPR). It should be noticed that any changes in the research design oblige a renewed review by the Ethical Review Board.

Yours sincerely,

Image not found or type unknown

Peter van der Heijden, Ph.D.  
Chair