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The continuum of attitudes towards vaccination

A qualitative analysis of arguments used in pro-, anti- and hesitant Tweets

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1. Abstract

This study examines the way in which different standpoints towards vaccination (pro-vaccination, anti-vaccination and hesitant towards vaccination) are expressed on Twitter, by exploring the arguments that are used and investigating the role of science within the different standpoints. The results show that in general, the same type of arguments is used in the entire continuum of vaccination standpoints. Furthermore, scientific arguments are most prominent in the pro-vaccination Tweets as opposed to the anti-vaccination and hesitant Tweets. In the anti-vaccination Tweets, the importance of doing research yourself is highlighted and posters express a lack of trust in science. In the hesitant Tweets, the importance of good information provision is seen as important.

2. Problem statement

In the past decades, vaccinations have been developed for several diseases. The occurrence of many diseases, such as measles and polio decreased or was even eradicated on a global scale, because of vaccination (Doherty et al., 2016). To keep these diseases under control, high levels of vaccination amongst the entire population are needed. However, the vaccination rate of measles, mumps and rubella fell below the necessary rates to 92.9 percent between 2012 and 2018 in the Netherlands, which led to a measles outbreak in 2013 and 2014 (Van Der Aa, 2020). An explanation for this decrease in vaccination rates is that increasingly more people seem to be hesitant about the safety, efficacy and necessity of vaccination (Edwards & Hackell, 2016). As a consequence of this hesitancy, some people no longer want themselves or their children to be vaccinated. This makes it possible that diseases that seemed to be eradicated revive and can be widely spread again (Doherty et al., 2016).

Over the last decades, these doubts about the safety, necessity and efficacy of vaccination have been widely spread on the internet. These messages seem to be posted by a new group of people who are hesitant towards vaccines, namely by people whose arguments are closely related to reasoning in a postmodern paradigm. This means among other things that scientific knowledge is no longer seen as the (only) truth (Hoffman et al., 2019; Kata, 2012; Stahl et al., 2016). Via social media accounts, internet users can easily spread their opinion on vaccination with the rest of the world. Ultimately, these anti-vaccine messages spread on websites and social media platforms influence decisions of parents regarding vaccination (Betsch et al., 2010; Kata, 2012).

Prior research on online vaccine-related messages has mainly focused on differences between pro-vaccination messages and anti-vaccination messages. By using the term vaccine hesitancy, I refer to a wider continuum from total refusal to total acceptance of vaccines (MacDonald, 2015). For this research, the way in which Twitter users express their attitudes towards vaccination will be examined.

Hereby, I will focus on the types of arguments people use across the different sides of the continuum, being pro-vaccination, anti-vaccination or hesitant towards vaccination. Moreover, prior research shows contradictive results. On the one hand, researchers showed that people who are skeptic about vaccines tend to use scientific-based arguments (Faasse et al., 2016) On the other hand, human vaccine skeptics are often associated with higher levels of science rejection (Rutjens et al.,2018). In this study, I will try to reconcile these findings by focusing on the vaccine hesitancy continuum, instead of focusing on the pro- vs anti-vaccine division. By knowing what arguments vaccine hesitant people use, policymakers might be able to develop interventions that aim to increase vaccination rates.

3. Existing research & Theoretical approach

What is vaccine hesitancy?

In short, vaccine hesitancy can be described as a “delay in acceptance or refusal of vaccination despite availability of vaccination services” (MacDonald, 2015, p. 4163). Furthermore, vaccine hesitancy is a complex and context specific phenomenon. It is hereby important to note that vaccine hesitancy can be seen as a continuum, instead of a narrow dichotomy of pro- and anti-vaccination. This continuum of hesitancy varies from people who fully accept vaccines without any doubts to people who completely refuse any kind of vaccination (MacDonald, 2015).

Reasons for vaccine hesitancy

Current research shows that the determinants of vaccine hesitancy are widely varied. The results of a systematic overview on a global scale show that the factors causing vaccine hesitancy vary across time and place and differ per context (Larson et al., 2014). For example, a higher income turned out to be a promoter of vaccine hesitancy in India, while in the United States of America both high and low income were seen as barriers to vaccination (Larson et al., 2014). Moreover, vaccine hesitant people are a heterogeneous group, of which most individuals can be placed somewhere in the middle of the hesitancy continuum (Dubé et al., 2013). It is important to note that someone who is hesitant towards vaccines might still take all kinds of vaccines. In order to measure decision-making about vaccinations for infants a distinction can be made between *1. vaccine accepters*, who are people who do not question the vaccination, *2. vaccine-hesitant people*, who still accept vaccination, but express some worries and doubts, *3. Late vaccinators*, who let their children vaccinate at a later point in time or only partly and *4. vaccine rejecters*, who are entirely against vaccination and reject all kinds of vaccines. (Benin et al., 2006).

In order to categorize the various factors causing vaccine hesitancy, three main domains can be distinguished (Dubé et al., 2014). The first domain concerns the contextual factors. Within this domain

political as well as religious factors play a role. Moreover, this domain entails the media environment and the pharmaceutical industry. So, the contextual domain is about the broad environment of an individual. The second domain consists of individual and social group influences about vaccine related issues. Hereby, the beliefs, attitudes and motivations of an individual have a central role. Other aspects in this domain are social norms regarding vaccination, knowledge people have about vaccination and the risk perception that a person experiences. Factors in this second domain might be part of a religious lifestyle (which is a factor in the first domain) but can also stand alone. A third domain is about vaccine-specific issues. This domain concerns the way vaccines are delivered and scheduled. This domain also involves the role of healthcare professionals who deliver the vaccines. With the aim of structuring the various factors, the three different domains described above are used as guidelines for introducing new theories. Moreover, another comprehensive model that is often used to explain the behavior determinants of vaccine hesitancy is the 3C's model. This model consists of the concepts confidence, complacency and convenience and is closely linked to the definition of vaccine hesitancy (MacDonald, 2015). The 3C's model can be integrated into the three domains and the concepts are discussed under the related domain. By integrating these two models, new theoretical insights might be found.

Contextual factors

In this domain, several major factors arise like religious beliefs, political preferences and the influence of (social) media. As the role of social media has become more important recently, it will be covered separately in another section. Traditionally, religion is often mentioned as one of the key factors causing vaccine hesitancy or vaccine skepticism. On the other hand, vaccine acceptance can be related to trust in science. An interesting aspect about the role of religion in relation to trust in science, is that both science and religion can function as ultimate explanatory frameworks (Preston & Epley, 2009). This means that both science and religion function as a belief system that offers answers to major questions about the world and life in general. These two frameworks cannot always be combined with each other and therefore sometimes clash. In line with this theory, Rutjens et al. (2018) found that orthodox religious identities predict vaccine skepticism. These scholars found that this relation was mediated by trust in science: orthodox religious people tend to have less faith in science and are therefore more skeptical towards vaccines. With regards to political identity, Rutjens et al. (2018) expected that political conservatism could predict vaccine rejection, as it is an important factor in some other types of skepticism, notably climate skepticism. However, with regards to vaccination, this relationship was not found. Thus, the contextual factor of religion seems to influence vaccine skepticism most prominently. A contextual factor of the 3C's model is the concept convenience, which is about the absence of possible obstacles that might lead to vaccine hesitancy. These obstacles can either be physical or cultural. When people experience more inconvenience, they are likely to be more hesitant towards vaccines.

Individual and social group influences

Within the domain of individual and group influences, psychological theories give insight into beliefs, attitudes and motivations that individuals have regarding vaccination. Psychologists argue that psychological motivations are important for the spread of vaccine hesitancy (Browne, 2018; Bryden et al., 2018; Hornsey et al., 2018). One of the psychological causes of vaccine skepticism arises from a worldview called magical health beliefs (Browne, 2018; Bryden et al., 2018). These beliefs about health are based on intuitively right medicine, that are natural and pure. Vaccines however are seen as being impure, chemical and toxic, which leads to negative attitudes towards vaccines. Secondly, a relation was found between people with anti-vaccination attitudes and people who tend to believe in conspiracy theories (Hornsey et al., 2018). Four different conspiracy theories were presented to participants from countries all over the world in a questionnaire. The results showed that particularly in western countries anti-vaccination attitudes were strongly predicted by having conspiracy beliefs. These psychological studies show that worldviews play a big role in predicting vaccine hesitancy. The concept complacency of the 3C's model can also be categorized within the domain of individual and social group influences. Complacency is about the risks that individuals perceive. When a person thinks that the risk of a disease that can be prevented by vaccination is low and thinks that vaccination is not needed to prevent the outbreak of these diseases, this person will likely not vaccinate his or her children. Therefore, the initial success of vaccination programs might work paradoxically, since people experience low levels of risks and therefore no longer perceive the necessity of vaccination.

Vaccine-specific issues

The role of healthcare professionals is highlighted within this domain. Especially local pharmacists should be deployed for reducing vaccine hesitancy according to a recent study conducted in the United States by Lisenby et al. (2021). Pharmacists are able to promote vaccination by educating citizens about the vaccines. Moreover, as pharmacists are in direct contact with the parents of young children, they can help to gather information about the profiles of parents who hesitate about vaccinating their child. Next to that, the pharmacist can ask the parents whether they have any concerns about the vaccination. If that is the case, the pharmacist can correct possible misinformation (Clark et al., 2009). The concept confidence of the 3C's model is related to this, as confidence is about trust that people have in the effectiveness and safety of vaccines, trust in the (healthcare) system and trust in those who develop the vaccine policies and programs.

Web 2.0 in relation to a postmodern paradigm

Although high levels of vaccine hesitancy already exist for decades, the use of internet and social media has further facilitated the proliferation of anti-vaccination sentiments (Stahl et al., 2016). Several scholars state that currently, we live in an era of web 2.0 (Kata, 2012; O'reilly, 2007). One of the key features of web 2.0 as opposed to web 1.0 is that internet users can create their own content

and that they are able to spread their own information with the rest of the world. Instead of one provider who controls what is posted, internet users can interact with and respond to each other online. Consequently, people start to communicate and spread (mis)information about health issues on the internet (Hughes et al., 2008; Kata, 2012). This results in the fact that nowadays, many people use the web as the basis for making health decisions (Forkner-Dunn, 2003), including decisions regarding vaccination (Betsch et al., 2010). When participants were exposed to a vaccine-critical website for five minutes, they were less likely to vaccinate their children as opposed to the control group (Betsch et al., 2010). Furthermore, a quantitative study examined the relationship between social media and vaccine hesitancy on a global scale (Wilson & Wiysonge, 2020). This was carried out by measuring to what extent people used social media for organizing all kinds of action, measuring public attitudes towards vaccination and by measuring the vaccination rates. The results showed a significant relation between on the one hand organization on social media and on the other hand vaccine hesitancy which results in a decline of vaccination rates. In order to tackle this, the researchers suggest that anti-vaccination messages on social media platforms should be actively removed.

This online spread of (mis)information is closely related to the postmodern paradigm in which we currently live (Kata, 2010; Kata, 2012). In the postmodern era, scientific facts are no longer automatically accepted as being the truth. Hereby, statements of experts and authorities are often doubted and sometimes seen as manipulative. The online spread of vaccine messages fits into this paradigm, as this allows people to conduct their own research and interpret health statements in their own way.

Types of arguments on social media

Kata (2010) studied multiple anti-vaccination websites and found that the arguments that were given could be divided into six main themes, being: safety and effectiveness; alternative medicine; civil liberties; conspiracy theories; morality, religion and ideology and misinformation and falsehood. In the first place, the theme of safety and effectiveness was seen in all analyzed websites. Hereby, on the websites was stated that vaccines cause diseases and that vaccines are toxic for human health. Some illnesses mentioned on the websites were autism, cancer, diabetes and AIDS. Besides, on a large majority of websites immunization as a consequence of vaccination was doubted. Secondly, messages about alternative medicine were spread and promoted on 88% of the examined websites. Readers were called to 'go back to nature' for example by letting children get sick, in order to let their immune system function naturally. Thirdly, the theme of civil liberties was often seen on websites. In 75% of the websites, civil liberty was related to parental rights, which is the opportunity as a parent to raise your child according to your own standards, even if you do not want to have your child vaccinated. Fourthly, in every reviewed website, the topic of conspiracy ideas was present. Within this theme, on a majority of the websites was stated that information about vaccines was not accessible for citizens and

was purposely hidden for the wider public. Fifthly, morality, religion and ideology were the least represented themes on the websites. Within this theme, immoral acts were described in 38% of the websites. Hereby, examples that were mentioned were about the use of aborted fetuses in vaccines and testing vaccines on young children in less developed countries. Sixthly, on a large part of websites misinformation was found regarding vaccination. This means that false conclusions were drawn of sources and statements that were presented without (scientific) evidence.

Language use on social media

A study that examined the language that was used in pro-vaccination and anti-vaccination Facebook comments, found that anti-vaccine related comments often consisted of greater analytical thinking and more health references as opposed to pro-vaccine comments (Faasse et al., 2016). The researchers selected one pro-vaccination comment that was posted on a Facebook post about child vaccination. For one week, all the comment that were posted under this first comment were selected. Thereafter, an algorithm divided the comments into three categories, being 'pro-vaccination', 'anti-vaccination' or 'unrelated or unclear'. Subsequently, a text analysis was carried out that ordered the comments into one of the following categories: analytical thinking, authenticity, positive emotion, anxiety, anger, social, family, causation, tentative, certainty, body, health, risk, work, money, and death. The results showed that comments that were typified as being anti-vaccination contained more often analytical thinking, were more often represented as being factual and were more often logically structured as opposed to pro-vaccination comments. Moreover, the anti-vaccination comments contained less words that are related to anxiety and fear. Concluding, these comments seem to be highly confidential and trustworthy. As a result, parents that look for information about vaccination might consider to not let their child get vaccinated.

4. Research question

Research question

In this explorative research, the main question is: In what way are different standpoints towards vaccination (pro-vaccination, anti-vaccination or hesitant towards vaccination) expressed in Tweets posted between 2012 and 2019? This question is divided into two sub-questions. The first sub-question is: What type of arguments are used in the pro-, anti- and hesitant Tweets? The second sub-question is: What is the role of science-based arguments in the pro-, anti- and hesitant Tweets?

Expectations

In the first place, I expect that a majority of the Tweets is categorized as anti-vaccination, because most of the literature is focused on anti-vaccination sentiments. Moreover, I expect that the Tweets

coded as anti-vaccination, pro-vaccination and hesitant towards vaccination can be coded based on the framework of Kata (2010). For example, when a Tweet states that vaccines cause diseases and that vaccines are toxic, this Tweet is categorized in the ‘safety and effectiveness’ category. At the same time, when a pro-vaccination Tweet states that vaccines are safe, it is coded into the same category. Moreover, based on the 3C’s model, I expect that vaccine hesitancy is expressed around the concepts of complacency, convenience and confidence. Furthermore, based on the study Rutjens et al. (2018), I expect that in the anti-vaccination Tweets, scientific arguments are not prominently present.

5. Research methods

Design and procedure

The main research question of this explorative study is approached with a qualitative research strategy, since the aim of this study is to acquire rich and deep data about the way in which people on Twitter express their standpoint towards vaccination. This is done by theoretical sampling, which is the joint process of collecting, coding and analyzing the data in order to develop a new theory. For this study, this means that the collected Tweets are coded and analyzed iteratively. An existing database is used to answer the research question. This database consists of approximately 85.000 Tweets, that were gathered between 2012 and 2019. Tweets were collected if they contained the Dutch translation of the following hashtags or keywords:

#vaccinate, #Ivaccinate, #Idon’tvaccinate, #vaccination coverage, #vaccinationdamage, #antivaxx, #provaxx, #antivax #provax, #antivaxxer, #provaxxer, #measles.

Key words: Vaccinate, vaccination, vaccination doubts, antivaxx, provaxx, antivax, provax, antivaxxer, provaxxer.

The Tweet as well as potential URL links and pictures are included in the database. Next to that, the time the Tweet was posted, and the Tweets-ID is incorporated.

Data sampling

For this study, 2000 Tweets are randomly selected out of the larger database. The shortest Tweets in this database have around 35 characters, while the longest Tweets have around 420 characters. Moreover, in many Tweets, the poster refers to a hyperlink. These links are not examined in this study. Tweets were posted in the time span of 2012 till 2019. This time span is chosen, because the vaccination rate of measles first dropped below the desired 95 percent in 2012, which led to a major measles outbreak in the years of 2013 and 2014. Therefore, since 2012 the vaccination debate revived and can be seen as socially urgent. For this reason, it is particularly interesting to examine online expressions of vaccination standpoints in this timeframe.

Data collection instrument and data-analysis approach

The method that is used in this study is a content analysis. All 2000 Tweets are coded manually. First, the Tweets are coded as being either anti-vaccination, pro- or hesitant towards vaccination. However, not all Tweets are relevant for this study, because some Tweets, for example, were about vaccination of animals or vaccinations that are not part of the national vaccination program. These Tweets are coded in the category not relevant. Other Tweets are coded as relevant but neutral or relevant but unclear if the standpoint of the poster is not clear.

Secondly, in order to examine the different arguments mentioned for sub-question 1, the coding scheme of Kata (2010) is used. This coding scheme addresses different types of arguments that are used by vaccine hesitant people. For example, when a Tweet is about the freedom a parent perceives to not vaccinate their child, this Tweet is categorized in the 'civil liberties' category. The six different categories that are used are: safety and effectiveness; alternative medicine; civil liberties; conspiracy theories/search for truth; morality, religion and ideology and finally misinformation and falsehood (Kata, 2010). In the case that one of the Tweets did not fit into an existing category, new categories were added to the existing ones. Moreover, Tweets could be coded into multiple categories.

Thirdly, for answering the second sub-question in which the role of science-based arguments is examined, a new coding scheme is made out of a combination of the codes conspiracy theories/search for truth and misinformation and falsehood. Based on the anti-, pro- and hesitant Tweets, the following categories are distinguished: lack of trust in science; scientific arguments vs common sense/emotion; importance of doing research yourself and importance of good information provision. An overview of the different codes used can be found in appendix 1.

Ethical aspects

A first ethical issue within this study is that participants are not aware of the fact that they take part in a study, which means that there is no informed consent. At the time that the Twitter users posted their Tweets somewhere between 2012 and 2019, they had no idea that researchers were collecting their messages at a later point in time. However, it can be argued that the Twitter users wanted to share the information they post with others, otherwise they would not have posted it online. Moreover, this study can be seen as socially and scientifically relevant. A second ethical issue is about protecting anonymity and privacy of the participants. For this study, it is highly important that the database is safely stored and inaccessible for third parties. To handle this, the data is safely stored online and none of the Tweets is downloaded. Another ethical aspect is related to minimizing the risk of harm for participants. The analyzed Tweets might include personal information about, among others, people's political preferences, their religious identity, or health-related information. To guarantee that people

cannot be traced back in online search engines, quotes from the Tweets are not used in this study. Ethical approval was given by the Faculty Ethics Review Board (see appendix 2).

6. Results

The first sub-question is: What type of arguments are used in the pro-, anti- and hesitant Tweets? 1522 of the original 2000 Tweets could not be coded into pro-, anti- vaccination or hesitant towards vaccination. These Tweets are coded as either not relevant, relevant but neutral, or relevant but unclear. Thereafter, 354 of the 2000 coded Tweets turn out to be pro-vaccination, 57 are anti-vaccination and 67 Tweets are labeled as hesitant towards vaccination. In my content analysis, support is found for the original argument types as identified by Kata (2010). These original types are firstly presented, with the exception of the codes conspiracy theories/search for truth and misinformation and falsehoods. These two codes are covered in the second sub-question. However, additional arguments are also identified in this dataset. These arguments are presented after the original types. As the first sub-question is about the type of argumentation, the different attitudes towards vaccination are presented separately per argument.

Safety and effectiveness (188 Tweets)

40 of the 188 Tweets about safety and effectiveness are coded as anti-vaccination. The main message in these Tweets is that vaccines are dangerous and harmful for people's health. For example, one Tweet states that the poison within vaccines kills people each year. The statement that vaccines are poison is made multiple times. One person writes that they are tired of convincing people of the dangers of vaccination. Moreover, Twitter users write about vaccination damage, such as ear infections and delayed speech development. A solution for this vaccination damage is increased resistance towards certain diseases according to some other Twitter users. Furthermore, many anti-vaccination Tweets that focus on the safety and effectiveness of vaccines present anecdotal evidence to support their claim. For example, one parent tweets that their child almost died because of vaccination, so this person will not get vaccinated in the future or have their children get vaccinated.

In a lot of the pro-vaccination Tweets, posters state that vaccines are highly effective, for example by providing numbers about the percentage of protection. Moreover, in multiple Tweets it is mentioned that not vaccinating is dangerous or even deadly. For instance, one Tweet states that without vaccination against infectious diseases, humanity would die out. There are more Tweets that refer to these infectious diseases, like measles and polio. In these Tweets, people often mention horrors of the past in order to underline the importance of vaccination.

Out of the 31 vaccine-hesitant Tweets nine Tweets are questions and remarks about the vaccination process. One poster for example advocates for more research on different responses from

children to vaccination. Another Twitter user questions why babies should be vaccinated at a very young age, whilst their immune system does not yet work optimally. Furthermore, there are Tweets about hesitant parents, who find it difficult to decide whether they want to let their child get vaccinated, because of the possible risks of vaccination.

Alternative medicine (7 Tweets)

The argument of alternative medicine contains the fewest Tweets of all codes. One Tweet is categorized as anti-vaccination. This Tweet argues that the natural resistance of humans should be strengthened in order to solve problems, instead of vaccination. Five of the six pro-vaccination Tweets are an attack on the other (in this case anti-vaccination) group. In these Tweets, people write of homeopathic practices as something ridiculous, which is according to these Twitter users very dangerous.

Civil liberties (51 Tweets)

Here too, only one Tweet is categorized as anti-vaccination. In this Tweet, the poster calls mandating vaccinations a crime by people who approve the use of poison for the European Union. Forty of the Tweets within this category are categorized as pro-vaccination. In the vast majority of these Tweets, posters want to make vaccination compulsory for those children who go to daycares or schools. In general, these Tweets are relatively short statements with no additional argumentation. The implicit argument here seems to be that children should have compulsory vaccination before they go to daycare, because other babies in daycare might be too young to get vaccinated, which is risky for them. This is made explicit in only very few Tweets.

Ten Tweets in this code are determined as vaccine-hesitant. These Tweets are mostly about the ethical dilemma of making vaccination compulsory, whereby people express their questions and concerns.

Morality, religion and ideology (42 Tweets)

Three Tweets are coded as anti-vaccination. In one of these Tweets, vaccination is compared to a satanic ritual. In another Tweet, vaccination is compared to sacrificing children. On the other hand, in the 37 pro-vaccination Tweets, the focus is more on judging religious people who do not vaccinate their children. Multiple times, religious people are called hypocrites, because on the one hand they do not vaccinate their children, but on the other hand they still make use of healthcare. Moreover, one poster first states that he or she respects all Christians, but then writes that saying that children belong to the Lord and parents can only raise them goes too far. The two hesitant Tweets are more about the ideology of vaccination and are considerations about advantages and disadvantages of vaccination.

Extension of coding scheme

For all three standpoints (pro-, anti-, and hesitant), the coding scheme of (Kata, 2010), is extended with the following codes: inconsistency/hypocrisy, attack on the other group, anecdotal evidence altruism, authority argument/social proof, questions and remarks about the vaccination process, questions about the consequences of (not) vaccinating, and questioning the vaccination debate.

Inconsistency/hypocrisy. (13 Tweets)

The argument of inconsistency/hypocrisy is made two times in anti-vaccination Tweets. Both of these Tweets are about the high profits of the pharmaceutical industry. For instance, in one anti-vaccination Tweet the poster writes that parents do not want to leave their children in daycare with convicted sex offenders. On the other hand, parents let their children get vaccinated by convicted pharmaceutical companies.

Ten of the Tweets in this category are labeled as pro-vaccination. For example, one of the Tweets states that it is hypocritical to, on the one hand, not let your child get vaccinated, but on the other hand wear glasses yourself. Furthermore, in these pro-vaccination Tweets coded within the category 'inconsistency/hypocrisy' the hypocrisy is often related to the religion of the anti-vaxxers. For instance, by stating that God gave both clothes and vaccines to humans, which makes the interpretation of the Bible inconsistent by people who do not vaccinate because of their religion. More than half of the Tweets within this category are questions, in which Twitter users express their incomprehension with anti-vaxxers and ask them why they do not vaccinate, but at the same time do other things that are beneficial for their health or wellbeing.

The one hesitant Tweet about inconsistency/hypocrisy is a reflection on arguments for and against making vaccination compulsory.

Attack on the other group. (153 Tweets)

Within this code, the other group is presented as being stupid or dangerous. Hereby, the other group exists of either pro-vaxxers or anti-vaxxers. Of the 153 Tweets within this category, 15 Tweets are labeled as anti-vaccination. In ten of these 15 Tweets, the attacks are related to conspiracy theories/search for truth and misinformation and falsehoods. An example of such a Tweet is that smart parents and girls would not let themselves be used for vaccination experiments. This can be seen as an indirect attack, because of the mentioning that smart people would not vaccinate. In another Tweet, people who vaccinate are presented as stupid idiots who do not even know that each vaccination is full of poison.

Calling the other group 'idiots' is also common within the 136 pro-vaccination Tweets. The word 'idiots' is used twelve times. For example, by stating that the measles are back thanks to the idiots who refuse to vaccinate their children. Moreover, antivaxxers are portrayed as not able to reason logically, which is according to one poster 'typical anti-vaxx'. In addition to this, another poster labels

anti-vaxxers as life-threatening. In multiple Tweets, anti-vaxxers are presented as being stupid. Several Tweets consists of small sentences in which a (fictive) name is presented who does not vaccinate and is called stupid. The structure of such a Tweet is as follows: “This is Rose (fictive name). Rose is very stupid, because she thinks that vaccinating can be compared to gas chambers. Do not be like Rose”. In other Tweets, not vaccinating is called a crime.

The two hesitant Tweets within this category are less extreme than the pro- and anti- Tweets, by taking both sides into consideration. For example, one of the hesitant Tweets shows a nuance by stating that it is a pity for a person’s daughter that she is sick, but the writer cannot know whether that is because of vaccination.

Anecdotal evidence (56 Tweets)

Another strategy of argumentation is the use of anecdotal evidence within Tweets. Fifteen of the 56 Tweets in this group are coded as anti-vaccination Tweets. Nearly all of these anti-vaccination Tweets that contain anecdotal evidence (except from one) are about safety and effectiveness (code 1). For instance, one Tweet describes that the person’s grandchildren are super healthy and resistant; vaccinating them would make them sick. This Tweet clearly shows that an example of one’s own life is used in order to make a claim about the safety of vaccines in general.

Thirteen of the 34 pro-vaccination Tweets with anecdotal evidence are about safety and effectiveness (code 1). Most of these Tweets contain personal anecdotes based on people’s own experiences. One Twitter user for example mentions that he or she suffers from severe asthma after getting the whooping cough as a child, whilst this person was not vaccinated. Thereafter, this Twitterer mentions that people are enormously stupid if they do not vaccinate their children.

The seven hesitant Tweets in this category are mostly questions, for instance about the vaccination process. Hereby, Twitters express their questions for example by asking whether it would be good to vaccinate twelve-year old’s.

Altruism (89 Tweets)

The next added argument is about altruism. This argument states that you do not vaccinate for yourself, but for the other or for society in general. Only one Tweet about altruism is coded as anti-vaccination. In this Tweet is mentioned that on the contrary on what is often said, vaccinated people endanger others, instead of the non-vaccinated.

Within the 82 pro-vaccination Tweets, a lot of comparisons are made. For example, in one Tweet vaccination is compared to a smoking ban. This Tweet states that it is fine if people damage their own lungs, but the health of other’s should not be endangered. Furthermore, a lot of the Tweets in this category are about herd immunity. In an example of such a Tweet, the poster blames people who do not vaccinate for taking advantage of the vaccinated people. Moreover, a part of these Tweets that are about altruism also mention civil liberties. These Tweets are about obliging vaccination,

mostly in relation to children that go to daycare or schools. Twitter users for example state that it should be possible for daycares and schools to deny children that are not vaccinated.

Here too, most of the six hesitant Tweets are questions. One Twitter user for example asks whether their children would still be protected if they would not vaccinate. Another hesitant Tweet is about the ethical dilemma of obligating vaccinations.

Authority argument/social proof (10 Tweets)

Another way of making an argument in the vaccination debate is by making use of social proof or using an authority argument. There are no anti-vaccination Tweets in which this type of argumentation is used. Eight of the ten Tweets are coded as pro-vaccination Tweets. In these Tweets, posters mention that fortunately, most people vaccinate their children. This is a clear example of a social proof argument. Another Tweet that represents an authority argument uses the authority of President Obama of the United States. The argument made in this case, is that vaccination is good, because the former President of America vaccinates too.

The two hesitant Tweets in this category are again Tweets with a question. In one of these Tweets, the authority argument is used, as the Twitter user literally writes that he or she will ask the question to an expert, who knows more about possible risks of vaccination.

Questions and remarks about the vaccination process (26 Tweets)

This code was originally meant for the hesitant Tweets, but later it turned out that this code was also applicable for four pro-vaccination Tweets. One of these pro-vaccination Tweets is for example about the accessibility of vaccination in the Netherlands as compared to development countries. The writer of the Tweet tries to convince another person to vaccinate by emphasizing on the accessibility of vaccination in the Netherlands. Therefore, this Tweet can be seen as a remark about the vaccination process.

Almost all Tweets of the other 22 vaccine-hesitant Tweets are questions (as opposed to remarks) about the vaccination process. A part of these are questions about why citizens are not allowed to determine by themselves whether they want to vaccinate or not. Another typical Tweet for this code is a Tweet that asks a health council why the vaccination for mumps, measles, rubella is designed the way it is.

Questions about the consequences of (not) vaccinating (2 Tweets)

Only two Tweets are about the consequences of (not) vaccinating. These two hesitant Tweets are both about refusing children at daycares or schools when they are not vaccinated. One of these Tweets states that refusing unvaccinated children is a good idea. In the other Tweet, this refusal is labeled as exorbitant.

Questioning the vaccination debate (8 Tweets).

One of the Tweets in this code is coded as pro-vaccination. This Tweet is probably a reaction to another Tweet and mentions that the other Tweet is very condescending, which will probably not turn the anti-vaxxer into a pro-vaxxer according to the writer of the Tweet. The other seven Tweets are all hesitant Tweets. A typical Tweet for this argument firstly states that the advantages of vaccination are clear, whereafter the writer states that apparently, the disadvantages may not be exposed. In line with this message, another Tweet describes that it is exhausting to see the polarization of the vaccination debate, because people who do not vaccinate are immediately called idiots.

The second sub-question is: What is the role of science-based arguments in the pro-, anti- and hesitant Tweets? In order to answer this question, Tweets of the code conspiracy theory/search for truth and the code misinformation and falsehoods are combined. For these two codes, a separate coding scheme is made with the following codes: scientific arguments vs common sense/emotion, importance of doing research yourself, lack of trust in science and importance of good information provision. In contrast to the outline of sub-question 1, for this sub-question, firstly, all the arguments of the anti-vaccination Tweets, secondly the arguments in the pro-vaccination Tweets and thirdly the arguments in the hesitant Tweets are presented.

Anti-vaccination Tweets

(33 Tweets in total, 13 Tweets of conspiracy theory/search for truth and 20 Tweets of misinformation and falsehoods)

Lack of trust in science (6 Tweets)

A substantial part of the anti-vaccination Tweets expresses a lack of trust in science. This lack of trust in science is often related to conspiracy theories. A clear example of such a Tweet states that the majority of the population in the Netherlands will be killed by medical science if no action is taken. Moreover, this Tweet mentions that not a single physician or vaccine should be trusted. Other Tweets in this category are about corruption in the pharmaceutical industry. In one of these Tweets, the writer literally describes that published documents of the American Food and Drug Administration (FDA) are a conspiracy.

Scientific arguments vs common sense/emotion (2 Tweets)

There is only one anti-vaccination Tweet that is based on a scientific argument. The writer of this Tweet first states that he or she does not vaccinate, whereafter the poster sums up how long certain vaccines have been tested on side effects. The argumentation based on common sense is also used only once. The poster of this Tweet writes that after 3,5 years of reading about the subject, the person is convinced of its own common sense and happy with the choice of not vaccinating.

Importance of doing research yourself (5 Tweets)

A part of the anti-vaccination Tweets highlights the importance of doing research yourself. In a typical example of such a Tweet, the poster states that if vaccines are as safe as claimed, people should be able to examine this themselves. When this is not allowed, it can be seen as proof that vaccines are rubbish. Another Tweet states that the disadvantages of vaccination do not outweigh the advantages. Moreover, the poster of this Tweet writes that people are scared and therefore vaccinate. However, the writer of this Tweet had informed themselves well and therefore decided to not vaccinate their children.

Pro-vaccination Tweets

(40 Tweets in total, 2 Tweets of conspiracy theory/search for truth and 38 Tweets of misinformation and falsehoods)

Lack of trust in science (5 Tweets)

Five of the pro-vaccination Tweets are about a lack of trust in science. In these Tweets, the posters mention the lack of trust in science they see by anti-vaxxers. One poster writes that nothing surprises him anymore, ever since he knew that people are (made) paranoid towards science, with a consequence of not vaccinating their own children. The other Tweet mentions that anti-vaxxers expect to be tricked.

Scientific arguments vs common sense (10 Tweets)

In a substantial part of the pro-vaccination Tweets, the importance of the use of scientific arguments and scientific facts is explicitly mentioned. One Tweet for example states that the fact is that the large majority of experts, supported by all statistics, emphasize that vaccines save lives. In another Tweet, the poster writes that it is never proven that vaccines might damage children. On the contrary, it protects children from horrible diseases. Some other Tweets are about reactions on anti-vaxxers and their view on science. One poster mentions that it gets harder to convince people with statistics or the explanation of science. Moreover, the writer highlights that the counter argument that certain statements are just opinions of scientists is hard to refute. In addition to this, another poster seems to react on an anti-vaxxer by stating that one cannot just demonstrate a correlation between being sick and vaccinating, whereafter the poster concludes that that is not research, but just a feeling. In multiple Tweets, anti-vaxxers are illustrated as being an idiot or as being crazy for not trusting scientific facts. An example of a part of such a Tweet is that crazy people will always believe that vaccines cause autism, despite the fact that the original research was carried out very badly.

Importance of good information provision (7 Tweets)

In contrast to what is described in the anti-vaccination Tweets, a lot of the pro-vaccination Tweets mention the importance of good information provision. In most of these Tweets, the posters advocate for improving the information provision of trustworthy knowledge regarding vaccination. One poster for example writes that he or she want to help the RIVM (Dutch National Institute for Health and Environment) by making reliable sources easier to find. Another Twitter user posts that the spread of dangerous fake new should be countered.

Hesitant Tweets

(23 Tweets in total, 14 Tweets of conspiracy theory/search for truth and 9 Tweets of misinformation and falsehoods)

Lack of trust in science (3 Tweets)

In a few of the hesitant Tweets, a lack of trust in science is expressed. In one Tweet, the poster writes that he or she wants to decide him- or herself which vaccination is needed for their children, whereafter the writer states that the government or pharma cannot just be trusted. Moreover, multiple Tweets express a lack of trust in the RIVM. In one Tweet for example, the RIVM is blamed for downplaying of side effects.

Scientific arguments vs. common sense (3 Tweets)

The three hesitant Tweets coded as scientific arguments vs. common sense can be seen as considerations about scientific prove for vaccination on the one hand and on the other hand the role of feelings and emotions in the vaccination debate. In one Tweet, the poster writes that there is no proof that diseases disappear after vaccination, whereafter the poster states that decisions about vaccination should be based on scientific research, instead of feelings or emotions. In another hesitant Tweet, the poster mentions that testing the effects of vaccination on humans only for a few weeks is not only irresponsible, but also unscientific. In conclusion, these hesitant Tweets seem to acknowledge the importance of scientific research as opposed to feelings and emotions.

Importance of good information provision (7 Tweets)

A substantive part of the hesitant Tweets is about the importance of good information provision. In a Tweet that clearly illustrates this, the poster mentions that more people would vaccinate if there would be more openness about the harmful substances within vaccination. This plea for more openness in the debate is mentioned in most of these Tweets. One poster for instance writes that in Germany, only eight per cent of the side effects of vaccination is mentioned, whereafter the poster asks whether that is also the case in the Netherlands. Another clear example of the importance of good information provision is a question, in which the poster literally asks for a link to good information and asks to

what age it is still useful to vaccinate. Moreover, in another Tweet, a poster first states to be almost sure to advise their girls get vaccinated against HPV and thereafter asks the RIVM when they expect the results of a study examining fatigue complaints.

Overall, pro-vaxxers seem to use more scientific based arguments than anti-vaxxers, while in a substantive part of the anti-vaccination Tweets, a lack of trust in science is expressed. Moreover, the hesitant Tweets are mostly about the importance of good information provision.

7. Discussion

In this thesis, the expression of pro-, anti- and hesitant vaccination standpoints is researched, by examining Tweets that were posted on this topic between 2012 and 2019.

A first interesting conclusion is that 1522 of the 2000 analyzed Tweets could not be used for further analysis, as they were either not relevant, relevant but neutral or relevant but unclear. Moreover, it was remarkable to see that a majority of the further analyzed Tweets turns out to be pro-vaccination which is not in line with the expectations. Since most of the literature is about the anti-vaccination side of the continuum, the expectation was that the majority of the Tweets would be anti-vaccination.

With regards to the type of arguments used as asked in the first sub-question, the results show that posters use widely varied arguments in their Tweets. In line with the expectations, the coding scheme of Kata (2010) could be used for the coding of the Tweets. However, in order to cover all types of argumentation, this coding scheme was in the first place extended with eight new codes. These new codes are not only arguments, but sometimes also describe the content of a Tweet. In line with the expectations, the coding scheme of Kata (2010) could also be used for the pro-vaccination and the hesitant Tweets. A conclusion of these findings is that in general, the same types of arguments are made in the entire vaccination continuum (anti-, pro-, and hesitant). However, some variation is found. For example, in none of the anti-vaccination Tweets, the authority/social proof argument is used. Moreover, a relatively high percentage of the Tweets that are labeled as an attack on the other group are pro-vaccination Tweets. Furthermore, the hesitant Tweets are mainly questions about the vaccination process or the vaccination debate.

For the second sub-question, the role of science-based arguments in the pro-, anti-, and hesitant Tweets is examined. The results show that science-based arguments are most prominently used in the pro-vaccination Tweets as opposed to the anti-vaccination and hesitant Tweets. A large part of these pro-vaccination Tweets describes the importance of using scientific arguments within the vaccination

debate. Moreover, anti-vaxxers are blamed for making unscientific claims and are therefore called being stupid or idiots by the pro-vaxxers. On the other hand, only one anti-vaccination Tweet is based on a scientific argument. With regards to the anti-vaccination Tweets, many posters express a lack of trust in science. Furthermore, a part of the anti-vaccination Tweets highlights the importance of doing research yourself, which again shows that science cannot be trusted. For the hesitant Tweets, the main finding is that a lot of the Tweets are about the importance of good information provision, which is not seen so clearly in the anti-, and pro-vaccination Tweets. This can be seen as logical, since hesitant people are often searching for the right information in order to make a decision about vaccination. Overall, the results of this study show that the role of science is most important in the pro-vaccination Tweets as opposed to the anti-vaccination Tweets. These findings are in line with the study of Rutjens et al. (2018), that found that vaccine skeptics are related to higher levels of science rejections. This also means that in this study, no proof is found for the claim that people who are skeptic about vaccines are likely to use scientific-based arguments, as was examined by Faasse et al. (2016). A possible explanation for this is that in the study of Faasse et al. (2016) Facebook messages are examined instead of Tweets. Maybe, the content of Facebook comments differs from the content of Tweets. Moreover, Faasse et al. (2016) used other categories for measuring the use of science in social media messages. For the hesitant Tweets, the main finding is that the poster seemed to be searching for information they can trust.

The results of this study show that the different arguments that posters on Twitter use can be divided into the three domains of vaccine hesitancy as is distinguished by Dubé et al. (2014). In the first place, some of the arguments that are found in this study are about contextual factors as morality and religion and the ideology of civil liberties. With regards to religiosity, Rutjens et al. (2018) examined that having an (orthodox) religion predicts vaccine skepticism. Therefore, one could expect that religious people would express these sentiments on Twitter. However, none of anti-vaccination Tweets in this study were written on religious grounds. On the contrary, a large majority of the Tweets in the category 'Morality, religion and ideology' are pro-vaccination. The general message of these Tweets is a judgement of religious people who do not vaccinate their children. A possible explanation for these differences is that people who are against vaccination do not feel free to express their thoughts on Twitter, as they might get negative responses of pro-vaxxers. In this study, only a few Tweets are about the accessibility of vaccines. These Tweets are mostly pro-vaccination Tweets in which anti-vaxxer are convinced to get a vaccine because of the good accessibility in the Netherlands as opposed to some other countries. Therefore, the concept convenience as a contextual factor in the 3C's model, which is about the absence of possible obstacles for vaccines (MacDonald, 2015) is not frequently found in this study.

The results of this study show that a large part of the anti-vaccination Tweets is about labeling vaccines as being toxic. A possible explanation of these beliefs is the magical health belief model according to Browne (2018). People with this worldview make choices about their health based on intuitively right medicine, seen as natural and pure in contrast to vaccines, that are toxic and impure. This claim is closely related to the argument of alternative medicine. Interestingly, in this study there are only seven Tweets labeled in the category of alternative medicine, of which one Tweet is anti-vaccination. However, Kata (2010) found the mentioning of alternative medicine in 88% of the examined websites. An explanation for this difference might be that anti-vaxxers do not feel free to express their thoughts about alternative medicine on Twitter. Another explanation could be that these magical health beliefs are less common in the Netherlands as opposed to the United States of America, where Kata (2010) conducted her study.

Another way in which the results of this study follow the distinction of the three domains of Dubé et al (2014) is the role of health care professionals. In this study, the role of health care professional is mainly present in the authority argument. By stating that one works as a physician, the poster tries to convince other people to vaccinate their children. According to Lisenby et al., (2021) the promotion of vaccination among these health care professionals is helpful and might take away doubts among hesitant people.

Strengths and limitations

With regards to the internal validity of this study, one of the limitations is the interpretation of the researcher while categorizing the Tweets. For some Tweets, it is difficult to determine whether the poster was writing the Tweet sarcastically, which makes it difficult to code the Tweet as either pro, anti or hesitant towards vaccination. In order to cope with this, Tweets that could not be labeled clearly as pro, anti or hesitant are coded as relevant but unclear. These Tweets are not further coded on the basis of argumentation. All Tweets on which there were doubts are discussed in the research group. Tweets that are clearly written sarcastically as pro-, anti- or hesitant are separately coded as being sarcastic. In total 0.7% of all Tweets are marked as sarcastic.

One of the strengths of this study is the fact that the Tweets are analyzed by multiple researchers. The four researchers first started coding the same Tweets, whereafter differences in coding were discussed in order to reduce differences between the researchers. Thereafter, the researchers met on a regular basis to discuss Tweets that were difficult to determine. Because of these meetings, the interpersonal reliability of the study has increased.

The database of 2000 Tweets that is used for this study is a random sample of a larger database. For the external validity, this means that it is likely that the analyzed Tweets are representative for the

Dutch Twitter debate on vaccination between 2012 and 2019. As the Twitter users are not aware that their Tweets are analyzed for research, the ecological validity can be seen as relatively high. The Twitter users posted their messages as everyday practice and no experiment was made up for this research.

Implications and recommendations

This study gives many insights into the discourse of the Twitter debate on attitudes towards vaccination, by looking at the entire continuum of the debate, instead of only focusing on anti-vaccination messages. In order to keep the vaccination rates high, hesitance about vaccination should be taken away. In their study, Wilson and Wiysonge (2020) found a positive relation between social media messages and vaccine hesitancy. Therefore, these scholars suggested to actively remove anti-vaccination messages that are posted online. However, in line with the results of this study, it would be better to not remove these messages, as there seems to be a strong call for an open debate by many Twitter users. For anti-vaxxers, removing Tweets can be seen as a confirmation of conspiracy theories, in which is mentioned that science or the government cannot be trusted. Moreover, Twitter users who are hesitant towards vaccines advocate for an open debate and state that it is important to hear argumentations from pro-vaxxers as well as from anti-vaxxers. Regarding future studies, it would be interesting to do a quantitative analysis with the same or a larger database. For this future study, the coding scheme that is found in this study can be used. In this quantitative study, relations between the different arguments could be further examined.

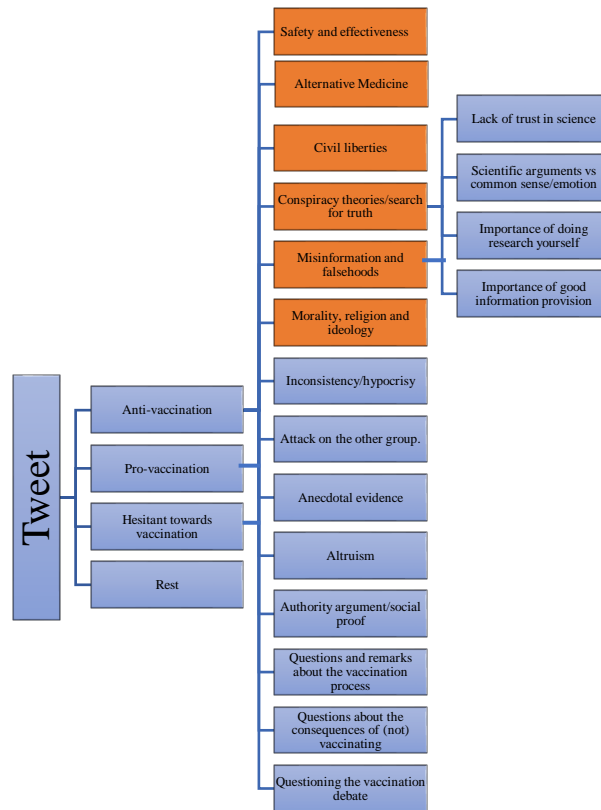
In conclusion, in this study is found that Twitter users apply a wide array of argumentation in the vaccination debate. In general, the same types of arguments are made in the entire vaccination continuum. However, some differences are found, as the authority/social proof argument was not used in anti-vaccination Tweets and most of the hesitant Tweets are questions about the vaccination process or the vaccination debate. Compared to the anti- and hesitant Tweets, the pro-vaccination Tweets have a relatively high level of science-based argumentation. Examining the arguments made on Twitter regarding the vaccination debate by people who are anti-, pro- or hesitant towards vaccination might help policymakers to develop specific policy plans for different groups in the continuum. Especially the arguments made by Twitter users who are hesitant towards vaccination are interesting for these policy makers, as these people are explicitly searching for information they can trust.

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Appendix 1: Coding tree



Appendix 1: Coding tree of the analyzed Tweets with the original categories made by Kata (2010) marked in orange.

Appendix 2: Ethical approval FERB



Ethical approval Jerien Bonte vaccine hesitancy.pdf