The Vaccination Debate: An Exploration of Long Term Concept and Perspective Mining

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In this paper we will explore methods for long-term concept and perspective mining in the context of the QuPiD2 project (Quality and Perspectives in Deep Data).[1] We will analyze 250 years of vaccination debates, by using a mix of distant- and close reading, computational analyses and NLP techniques. Our aim is to map the variations and changes in perspectives in the vaccination debate both from a synchronic and diachronic perspective. For centuries, the debate was dominated by the dichotomy between a vast majority that was in favour of vaccination, versus a minority that was against the use of vaccinations. These debates showed remarkable consistency: the same arguments were repeated over and over again. Due to the internet revolution, the debate became larger and has a different dynamic, with group polarization and the formation of so-called 'Echo Chambers' where like minded people easily find each other and confirm each other's beliefs. Digital analysis can help us distinguish the multiple perspectives and see how they relate to the previous 'offline' debates. We will present our methods for historical and contemporary concept- and perspective mining and aim to see how the vaccination debate changed over the centuries.

Vaccination Debate: the first 250 years:

The artificial induction of immunity against smallpox existed in the Netherlands since the second half of the eighteenth century. Children were injected with human pox to induce an innocent version of the disease, rendering them immune to the serious version of the disease. Vaccinations were introduced in the Netherlands in 1799, following Edward Jenner's scientific publication on the benefits of injections with cowpox. Even though Jenner's findings were widely embraced as a blessing, internationally and in the Netherlands, skeptics and even furious adversaries remained. This situation of a vast majority of people that is 'pro' vaccinations and a minority that is 'con' still exists over 200 years later. The arguments pro and con have remained surprisingly the same as well. We will follow the first 250 years of the vaccination debate by looking at the situation in the Netherlands, by studying (digitized) old prints, 'delphered' newspaper articles, journals *De Gids* and *Vaderlandsche Letteroefeningen* and other secondary sources, up until the advent of the internet in the late nineties.

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[1] https://qupid-project.net/

Contemporary Debate, Computational Perspectives Mining:
In the 1990's, as a result of the internet revolution, the anti-vaccine minority was able to get themselves better heard and also was able to flock together more easily. In online communities information is spread easily and people run the risk of getting 'trapped' inside their own Echo Chambers of people affirming each other's beliefs. There is so much information available online that people tend to ignore the information that is contrary to what they think. This tendency is strengthened by algorithms that personalise the content people are presented with. At the same time, online communication seems to be imbued with a polarising tone. The increasing size and intensity of the vaccination debate, which possibly poses a risk to public health, warrants the use of computational methods to analyse what is going on and why.

The QuPiD2 tools enable us to look closely at the debate in an international and internet context, trying to dissect the arguments and perspectives automatically with NLP techniques. We decompose text into propositions that can be compared across texts, and determine the perspective of the author or quoted sources towards them. For example, we extract whether a proposition (e.g. "vaccinations cause autism") is true, false or uncertain according to some source using factuality detection. By aggregating and comparing those propositions and perspectives about vaccinations on the basis of the entities and concepts that are being mentioned in relation to them, we aim to obtain some insight into (patterns in) pro-vaccine and anti-vaccine world views and the types of claims and arguments that are most undisputed or controversial in the debate. Using this approach, we aim to see if the internet revolution has merely enlarged the debate, or also changed its nature with different perspectives and more rapid changes in the concept of vaccinations.

Results: Even though smallpox was eradicated in the 1970's, and many other vaccines against different diseases were invented since Jenner, the debate remained mostly the same. Opponents of vaccines claimed they had bad side effects, were unnatural and against God's Will. The stability in the debate prior to the internet revolution also is reflected by a stability in word co-occurrences in texts that deal with vaccinations. The biggest shifts we detect is vaccinations drifting away from words like 'cow' and 'smallpox', which is not very surprising because in 1800 vaccinations were a new weapon against smallpox that came from the cow, while it came to be used more widely for many diseases the following 200 years. The few negative voices against vaccinations (e.g. this one doctor, these few preachers) usually remained relatively isolated in their own small networks. Vaccine opponents were mostly known to live in religious communities, even though numerically, according to estimates in the 1970's, approximately five times as many lived widely spread outside these communities. Based on preliminary results we hypothesise that in the online debate of the 21st century the role of God has played a less prominent role, while a new element of conspiracy theories has come to the surface. More results will follow during DHBenelux.

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