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

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1. A short Vaccination History
2. The Vaccination Debate 1800-2000
3. The Vaccination Debate in the 21st Century
A Short Vaccination History
1. A short Vaccination History

Smallpox was a devastating disease, causing death and deformations, at a mortality rate of 30-35%.

People tried to prevent it by ‘artificial’ immunisation for centuries. In the Eighteenth Century this artificial immunisation was administered with the help of human pox. 

Source: wikipedia
1796: Edward Jenner scientifically proves the effectiveness of injections with cowpox. His findings are endorsed quickly all over the world.
Jenner calls his injections ‘vaccinations’ after the Latin vacca (cow). Even though later vaccinations against other diseases have nothing to do with cows, the name is kept to honour Jenner.
The Vaccination Debate
1800-2000
3 Main Objections against Vaccinations

Result of Close Reading Vital Texts and Newspaper Articles:

1. Vaccinations means interference with God’s Will: 1800-now
2. Vaccinations have ‘harmful side effects’: 1800-now
3. Vaccinations are not ‘natural’: 1800-now
7 Supposed Harmful Side Effects

1. Vaccinations cause syphilis (19th century)
2. Vaccinations cause ‘nervosity’ (Capadose, 1828)
3. Vaccinations cause a permanent change in people’s constitution (Capadose, 1828)
4. Vaccinations cause skin tumors (Capadose, 1820’s)
5. Vaccinations cause more children to contract the measles (1820’s)
6. Vaccinations cause Encephalitis (1928’s-1939’s, government research)
Can we also measure the debate?

We looked at co-occurrence/associations of terms with ‘vaccinations’.

Our sources: *Vaderlandsche Letteroefeningen* (1776-1876) and *De Gids* (1837-1909), journals for the educated, liberal, person, with topics on anything that could be interesting. In total nearly a 100 million words.

Associations can be traced by looking at context, or proximity or co-occurrence of words in text:

- At “nearest neighbour” level
- At sentence level
- At paragraph level
- At article level
Articles in our corpus are relatively small and often on the same subject. ‘Vaccinations’ is a suitable concept to study on article level in this corpus, because it is relatively straightforward. Association scores generated over time in AMCAT* (https://amcat.nl/)

*Amsterdam Content Analysis Toolkit, developed by Wouter van Atteveldt, hosted by the VU
1. Search for any texts with the term ‘vaccin*’. ‘inoculation’ (inenting), and ‘cowpox’ (koepok*)
2. Concatenate them and remove the stop words
3. Look at the most frequently occurring words
4. Track associations (occurrence in the same article) between these words over time in the *entire corpus*
### Table II: Association scores for pokken (smallpox) and vaccinatie (vaccination) in VLO

<table>
<thead>
<tr>
<th></th>
<th>1816-1836</th>
<th>1836-1856</th>
<th>1856-1876</th>
</tr>
</thead>
<tbody>
<tr>
<td>pokken to vaccin*</td>
<td>0.500</td>
<td>0.667</td>
<td>0.111</td>
</tr>
<tr>
<td>vaccin* to pokken</td>
<td>0.469</td>
<td>0.428</td>
<td>0.231</td>
</tr>
</tbody>
</table>

### Table III: Associations scores for koe (cow) and ‘pokken (smallpox) in VLO

<table>
<thead>
<tr>
<th></th>
<th>1816-1836</th>
<th>1836-1856</th>
<th>1856-1876</th>
</tr>
</thead>
<tbody>
<tr>
<td>koe* to pokken</td>
<td>0.031</td>
<td>0.006</td>
<td>0.019</td>
</tr>
<tr>
<td>pokken to koe*</td>
<td>0.739</td>
<td>0.778</td>
<td>0.593</td>
</tr>
</tbody>
</table>

### Table IV: Associations scores for inenting (inoculation) and ‘pokken (smallpox) in VLO

<table>
<thead>
<tr>
<th></th>
<th>1816-1836</th>
<th>1836-1856</th>
<th>1856-1876</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inenting to pokken</td>
<td>0.565</td>
<td>0.455</td>
<td>0.267</td>
</tr>
<tr>
<td>Pokken to inenting</td>
<td>0.565</td>
<td>0.556</td>
<td>0.148</td>
</tr>
</tbody>
</table>
Findings

Associations with vaccinations stay relatively stable. Little changes of significance were found.

However: vaccinations seem to slowly drift away from ‘origin’ words like ‘smallpox’, ‘budding’ (uitbotting), and to some extend ‘cow’, indicating that vaccinations started to be discussed more frequently as a broader and stand alone topic, independent from its origins.

Difficult to quantify the debate with ‘blunt’ tools:
1) ‘God’ or ‘unnatural’ are not among the most frequent occurring words and therefore difficult to use for any statistical patterns
2) Harmful side effects, and the words associated to them, change over time
The Vaccination Debate in the 21st Century
So we had this....:

1. Vaccinations means interference with God’s Will: 1800-now
2. Vaccinations have ‘harmful side effects’: 1800-now
3. Vaccinations are not ‘natural’: 1800-now

How does this change in the online debate, if at all?
Natural Language Processing

- 295 English documents collected from the Web about vaccinations (news, blogs, governmental reports, etc.)
- Manually annotated (in progress)
  - events, argumentation (claims), emotions, opinions
- Automatically annotated with Natural Language Processing (NLP) pipeline

http://www.newsreader-project.eu
Natural Language Processing

• Semantic Role Labeling (SRL)

- **Who**: Vaccination
- **did what**: eliminated
- **to whom**: measles
- **where**: in the United States
- **when**: in 2000

- Agent (A0)
- Predicate
- Patient (A1)
- Location (AM-LOC)
- Time (AM-TMP)

• What is being done with/to vaccines?
  (look for statements where vaccin* is mentioned in any of the semantic roles)
<table>
<thead>
<tr>
<th>Most frequent predicates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent (A0)</strong></td>
</tr>
<tr>
<td>What do vaccines do?</td>
</tr>
<tr>
<td>cause</td>
</tr>
<tr>
<td>prevent</td>
</tr>
<tr>
<td>contain</td>
</tr>
<tr>
<td>work</td>
</tr>
<tr>
<td>have</td>
</tr>
<tr>
<td>provide</td>
</tr>
<tr>
<td>protect</td>
</tr>
<tr>
<td>use</td>
</tr>
<tr>
<td>failure</td>
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<tr>
<td>reduce</td>
</tr>
<tr>
<td>give</td>
</tr>
<tr>
<td>help</td>
</tr>
<tr>
<td>do</td>
</tr>
<tr>
<td>produce</td>
</tr>
<tr>
<td>make</td>
</tr>
<tr>
<td>induce</td>
</tr>
<tr>
<td>need</td>
</tr>
<tr>
<td>require</td>
</tr>
<tr>
<td>stimulate</td>
</tr>
<tr>
<td>save</td>
</tr>
</tbody>
</table>
A closer look

- What vaccines do:
  - CAUSE things, like:
    - death, harm, side effects, mild symptoms, autism, SIDS, seizures, abortion, neurological disorders, brain damage, diabetes mellitus, immune dysfunction, outbreaks of diseases, spread of chickenpox, severe allergic reactions
  - PREVENT things, like:
    - disease, rabies infection, measles, hepatitis A, potentially fatal diseases, the onset of AIDS, replication, 6 million deaths worldwide
  - PROTECT/SAVE things, like:
    - babies' immature immune system, people, children, our lives, you
  - CONTAIN things, like:
    - ingredients, antigens, germs, a live virus, thimerosal (mercury), unsafe toxins, a cancer-causing monkey virus, the dangerous pertussis toxin with unsafe additives
Clusters of predicates

- Predicate clusters on the basis of word similarity
- We used the pre-trained word vectors of word2vec (Mikolov et al. 2013) and scikit learn (http://scikit-learn.org) for the clustering
Some interesting clusters

CLUSTER 1: vaccines as a product

buy, store, manufacture, supply, cost, storage, research, production, stockpile, testing, label, product, harvest, maker, delivery, brand, producer, provider, sell, design, coverage, market, manufacturer, utility, demand, stock, vaccine, availability, purchase
Some interesting clusters

CLUSTER 2: the effects of vaccines

(a) incite, ignite, induce, represent, involve, precede, prevent, avoid, harm, herald, affect, constitute, contain, attenuate, engender, originate, spread, interfere, occur, origin, intersect, cause, injure, provoke, damage, detect

(b) decline, decrease, strain, fall, wane, cut, eliminate, rate, association, grow, weaken, impact, increase, deficiency, drop, extension, requirement, study, gain, reduce, restrict, revenue, change, climb, lower, result, combination, estimate
Some interesting clusters

CLUSTER 3: shaming and blaming

claim, oppose, criticism, **fight**, warrant, discontinue, dismiss, trial, **suspect**, defer, suspend, reject, **quack**, refuse, hospitalize, kill, **blame**, counter, assault, recall, withdraw, shun, **conspiracy**, case, **accusation**, deny, **allege**, postpone, delay, block, stop, **denial**
Some interesting clusters

CLUSTER 4: vaccines as a controversial topic

(a) proof and signals
indication, investigation, check, see, document, prove, expose, determine, confirm, know, say, light, tell, yield, discover, show, publish, indicate, shed, suggest, appear, reveal, bearing, release, report, acknowledge, surprise, test

(b) belief and trust
aim, law, immunity, risk, promise, protection, chance, fear, divide, suppose, distrust, connection, link, hope, opinion, view, term, think, core, coin, control, concern, belief, trust, priority, believe
1. **Vaccinations means interference with God’s Will**

We found only a few instances where God was mentioned with this intention (and not as in: *for God’s sake, oh my God*). Overall, it doesn’t seem to play a large role in the debate and has little or nothing to do with his predetermined plans.

- “The human immune system is a **wonderland of protection**. It is one of God's **great gifts** to us.”
- “To those who are struggling with the outcomes of vaccines, all I can tell you is that there is hope and our **merciful and just God hears you**.”
2. Vaccinations have ‘harmful side effects’

There is a lot of emphasis on the dangers of vaccines. By far the most mentioned side effect is autism, but the list seems to be extending (diabetes, immune dysfunction, SIDS, etc.).

- “In recent years, powerful scientific evidence has emerged indicating that vaccines cause brain injury such as autism, epilepsy, schizophrenia, depression, attention-deficit disorder and other mental illnesses.”
3. Vaccinations are not ‘natural’

This argument is mainly expressed by pointing out all ‘unnatural ingredients’ that vaccines contain. In addition, vaccines are contrasted with ‘the natural immune system’.

- “Vaccines do not ‘help' the immune system; they **suppress** it!”
- “The explanation - which makes sense to me - is that vaccinations **interfere** with the immune system and make the recipients **more susceptible** to disease.”
- “[...] injecting mercury (thimerosal), aluminum, MSG and formaldehyde weakens the immune system by **unnaturally shocking it** into ‘fight or flight’ mode”
4. Vaccinations are profitable (conspiracy theories)

New argument: vaccine profits lead to global conspiracy between Big Pharma, the government and media.

- “To make matters worse, the vaccine manufacturers are \textcolor{red}{immune} to vaccine violence damage control because they have \textcolor{red}{their own court of law with their own judges}, who are \textcolor{red}{paid shills} of the industry.”
- “[...] it's all the fault of big pharma, which \textcolor{red}{eager to sell} a new vaccine against Zika virus, also \textcolor{red}{pushes} ever more and more vaccines in order to \textcolor{red}{maximize profits}.”
- “Selling vaccines is \textcolor{red}{extremely profitable} and the process of \textcolor{red}{mandating} vaccines is \textcolor{red}{fraught} with \textcolor{red}{conflicts of interest} between vaccine manufacturers, the ACIP and the American Academy of Pediatrics.”
- From time to time, they allow live viruses into the flu shots, thereby \textcolor{red}{spreading influenza} and causing the very kind of \textcolor{red}{fear} and \textcolor{red}{panic} that \textcolor{red}{drives} people into pharmacies to \textcolor{red}{buy} more vaccines.”
- “The real public health emergency in America is the one that is being \textcolor{red}{covered up} by government agencies working overtime with industry and mainstream media to \textcolor{red}{restrict the freedom} of Americans to take \textcolor{red}{control} of their health...”
Conclusions

Vaccine Debate Stable remains stable over the centuries:
- Vaccines do harm, though the kind of harm is in flux
- Vaccines are unnatural

however:

- ‘God’s Will’ as an argument seems to be replaced by Conspiracy Theorists
Data

Vaderlandsche Letteroefeningen, 1776-1876
De Gids, 1837-2000
A quick exploration of “Delphered” newspaper articles
Corpus of the online vaccination debate: https://vaccinationcorpus.wordpress.com

Literature

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