



# A comparison of language use in pro- and anti-vaccination comments in response to a high profile Facebook post, ☆,☆☆



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## ABSTRACT

**Background:** Vaccinations are important for controlling the spread of disease, yet an increasing number of people are distrustful of vaccines, and choose not to (fully) vaccinate themselves and their children. One proposed contributor to this distrust is anti-vaccination misinformation available on the internet, where people search for and discuss health information. The language people use in these discussions can provide insights into views about vaccination.

**Methods:** Following a prominent Facebook post about childhood vaccination, language used by participants in a comment thread was analysed using LIWC (Linguistic Inquiry and Word Count). Percentage of words used across a number of categories was compared between pro-vaccination, anti-vaccination, and unrelated (control) comments.

**Results:** Both pro- and anti-vaccination comments used more risk-related and causation words, as well as fewer positive emotion words compared to control comments. Anti-vaccine comments were typified by greater analytical thinking, lower authenticity, more body and health references, and a higher percentage of work-related word use in comparison to pro-vaccine comments, plus more money references than control comments. In contrast, pro-vaccination comments were more authentic, somewhat more tentative, and evidenced higher anxiety words, as well as more references to family and social processes when compared to anti-vaccination comments.

**Conclusion:** Although the anti-vaccination stance is not scientifically-based, comments showed evidence of greater analytical thinking, and more references to health and the body. In contrast, pro-vaccination comments demonstrated greater comparative anxiety, with a particular focus on family and social processes. These results may be indicative of the relative salience of these issues and emotions in differing understandings of the benefits and risks of vaccination. Text-based analysis is a potentially useful and ecologically valid tool for assessing perceptions of health issues, and may provide unique information about particular concerns or arguments expressed on social media that could inform future interventions.

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## 1. Introduction

Vaccinations are important for preventing the spread of disease through a population. However, concerns about possible adverse effects and the safety of new vaccines are prevalent [1] and linked

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to lower vaccination rates [2]. Vaccine concerns and refusals are increasing [3–5], and refusals are linked to outbreaks of preventable illnesses. For example, in 2014 the United States experienced a record number of measles cases [6,7]; in developed countries a large proportion of these infections occur among the intentionally unvaccinated [8].

Even when vaccination rates are generally high, clusters of un- or under-vaccinated children have been linked to disease outbreaks [9]. These outbreaks also affect children with compromised immune systems precluding vaccination and those too young to be vaccinated—at a large cost to individuals and the public-sector. Vaccine refusal is not evenly distributed in the population – it occurs predominantly in public charter and private schools, and in schools in high socioeconomic areas [5,10], which also have a

higher proportion of parents with concerns about the safety and health risks of vaccines [11]. This is consistent with other studies linking vaccine-resistance with education levels [12]. While the proportion of internet users on Facebook does not differ substantially by either income or education level [13], internet users themselves are more likely to have both higher levels of education and household income [14]. This makes the internet a useful domain within which to examine vaccine hesitancy, and Facebook provides a forum in which such views are discussed and information disseminated [15].

One hypothesised reason for heightened concern about vaccine safety is anti-vaccination misinformation readily available on the internet [16,17]. People increasingly consult the internet on a range of health issues, and discuss their health perspectives online [18]. Online health-related information is often inaccurate or incomplete [19]. Anti-vaccination webpages contain particularly low quality information, and much of the provided critique is also mediocre [20]. The impact of exposure to such information is striking; for example, viewing a website containing anti-vaccination information for 10 min or less increased perceived risk of vaccination, and decreased the perceived risk of vaccine refusal [21].

Misinformation spreads readily over the internet, and is often resistant to correction [22]. This is compounded by an “echo chamber” effect whereby people self-select into groups and seek out sources of information that reinforce pre-existing beliefs, including beliefs about vaccination [23,24]. Occasionally, however, people with opposing viewpoints are brought together in one (virtual) location. This happened in January 2016, when Mark Zuckerberg (co-founder of Facebook) posted a photo of himself holding his baby daughter, captioned “Doctor’s visit – time for vaccines!” As of May 2016, the post had received approximately 3.4 million ‘likes,’ and 84,000 comments. Commenters addressed the risks of vaccination and vaccine refusal, resulting in a discussion between individuals unlikely to engage with one another under different circumstances and providing a unique opportunity to compare the emotional and cognitive components of broadly pro- and anti-vaccination comments using linguistic analysis.

The words that people use can provide important insights into their thoughts and emotions [25,26]. Within the health domain, language use has been linked to successful weight loss, determining expert versus lay health advice, and public anxiety and online health-information seeking behaviour during an illness outbreak [27–29]. The Linguistic Inquiry and Word Count (LIWC) text analysis program’s [30] dictionary comprises psychologically meaningful word categories, and output includes the percentage of words within a given text that belongs to each category. Applying this technique allows for a direct comparison of emotional content, cognitive processes, and areas of particular importance in pro- and anti-vaccination (and unrelated, control) comments.

It is important to note that the characterizing individuals as “pro-vaccine” or “anti-vaccine” greatly oversimplifies. Yes, some people are universally supportive or critical of vaccines, but many others occupy a middle-ground in which the value of vaccines is recognized but potential dangers pose real concerns [31]. The focus of the present study, therefore, is the content of the actual statements, claims, and comments that individuals make rather than the classification of their personal beliefs more generally.

Because the scientific data clearly support the safety and efficacy of vaccines, we hypothesized that comments expressing opposition to vaccinations would have less evidence of analytic thought. Because vaccine hesitancy is often associated with heightened perceptions of risk and concerns about safety, we hypothesised that anti-vaccination comments would also use more risk-related, anxiety, and health words. Finally, because vaccine-sceptical websites often include arguments about responsible parenting, possible vaccine-caused harm to the immune system, and

profit-related conspiracies [17], we hypothesized that anti-vaccine comments would contain more family-, biological-, money-, and work-related (the category including medical, scientific, government, and corporate references) words.

The aim of this study was to investigate the types of arguments and language used by pro- and anti-vaccination individuals within the same conversational context in an effort to better understand underlying thought processes and inform future attitude- and behaviour-change attempts.

## 2. Method

We monitored responses to the original “time for vaccines” photograph post on Facebook over the subsequent week. One particularly popular comment (which garnered over 49,000 likes) and the 1489 replies to that comment which were posted within one week, were selected for analysis. This presented the largest number of related comments (i.e. forming the ongoing conversation) available, enabling a direct comparison of language use in pro- and anti-vaccination comments under the same circumstances. Similar to many of the earliest comments on the photograph, the selected comment was in favour of vaccination. The one-week time period was chosen because of the generally rapid spread and subsequent decay of interest in social media content [32], which was seen in the current study where the number of comments posted each day diminished quite rapidly from 790 comments on day one (with 277, 149, 129, 61, and 60 comments posted on days two through six, respectively) to only 24 comments on day seven.

This research was conducted with the approval of the University of New South Wales Behavioural Sciences Human Research Ethics Advisory Panel (UNSW HREAP Approval Number 2694). All data collected for this study were publicly available through Facebook, thus informed consent was not required.

### 2.1. Facebook comment data

All identified comments (index comment, plus 1489 response comments) were aggregated into a single Excel spreadsheet. Commenters’ names and names of other Facebook users to whom statements were directed, were removed from the dataset. In addition, all image files (most often ‘meme’ images) and html tags were removed. Meme image text was not retained for analysis because the focus of the current research was on the language people chose to use when discussing vaccination. While meme images are interesting in their own right, and represent varying opinions, the language contained within them was not generated by the commenter themselves. Data indicating the date and time that comments were posted was retained, and each comment was assigned a number between 1 and 1490 indicating its chronological appearance. Number of ‘likes’ for each comment were also retained. Facebook ‘reactions’ (love, haha, wow, sad, and angry) were not globally available until late February 2016 [33], and thus were not available at the time the original photo and subsequent comments were posted.

### 2.2. Data coding

To assess differences between comment types, two independent raters coded all comments as ‘pro-vaccination,’ ‘anti-vaccination,’ or ‘unrelated or unclear.’ A third independent rater (who was unaware of study hypotheses) resolved disagreements, and 14 cases where all three raters disagreed were resolved through discussion between the two initial raters. Commenter names were removed from the dataset prior to coding to reduce potential rater bias from emerging. See [Supplementary Materials](#) for examples of comments coded into each category and those that

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