Ask Dr. Twitter: Characterizing Social Media Claims about Controversial Science Issues

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BACKGROUND

In the past, the evaluation of scientific data and scientific language remained in the hands of experts (Keller, B., Labrique, A., Jain, K. M., Pekosz, A., & Levine, O., 2014), and was limited to well-established conclusions discussed in simplified adaptations (McClune & Jarman, 2010; Myers, 1995). Today, through new Web technologies, people are able to easily access information about science, and also the interpretations of this information by other members of the public. The public now has easy access to a lot of information that varies in quality and reliability (Gervais, 2008, Vandendorpe, 2007) with little traditional gatekeeping but an increase in self-publication, user-generated material (Bromme and Goldman, 2014, Graesser et al, 2014) and anonymous authorship (Lietsala and Sirkkunen, 2008). New advancements in technology allows information to spread more easily and quickly (Perloff, 2010). Misinformation about science is also readily accepted and accessed by the public, as illustrated by the popularity of arguments that have resulted in an "anti-vaccination movement" on the Internet (Kata, 2010) with measurable impacts on individual and community health (see Larsen et al, 2014). This has resulted in greater amounts of inaccurate information or misinformation available to the public, with faster and easier modalities of distribution. The problem of massive digital misinformation is so pervasive that the World Economic Forum names it as a "main risk for modern society" (Howell, 2013).

The goal of the extant study is to characterize the nature of public claims on social media about controversial science issues, and the presence of misinterpretations of science in these claims. One source of public user-generated media is Twitter, a social networking platform with 313 million monthly users as of June 2016 (Twitter, 2016). Because Twitter is used widely for communication between members of the public, it is becoming interesting to researchers of public sentiment, including on health and science issues. Extant research includes studies of public sentiment on health or science issues, topics of interest in science and the presence of pseudoscience claims in Tweets (see Dredze, Broniatowski, Hilyard, 2016; Liang & Mackey, 2011, Munro, Hartt, & Pohlkamp, G., 2015; Thackeray et al, 2012). While research suggests pseudoscientific claims are distributed widely on Twitter, little qualitative research exists on the nature of these claims, and the responses to these claims in the dialogue on social media.

RESEARCH QUESTION

A) What is the nature of comments on social media regarding vaccination safety?

B) How is scientific information about vaccination interpreted or misinterpreted in claims made by the public on social media?

ANALYSIS OVERVIEW

The work in this study builds upon previous communications research on message factors that contribute to successful persuasion (see Toulmin, 1958; Hovland, Janis & Kelley, 1953). Open coding (Strauss & Corbin, 1998) was used to develop a set of codes that described the content of the interviews. In-depth theme analysis of anti-vaccination Tweets is based on theoretical work on error analysis in scientific reasoning (see Allchin, 2001, 2012). Overall, this study will involve **1) qualitative theme analysis of Tweets using a 10% subset of collected Tweets, 2) inter-rater reliability validation*, 3) training of a machine learning algorithm (Discovertext, 2017) for Tweet analysis, 4) analysis of the full dataset of Tweets using the trained algorithm.** This poster focuses on the qualitative analysis.
* Completion of IRR study currently pending.

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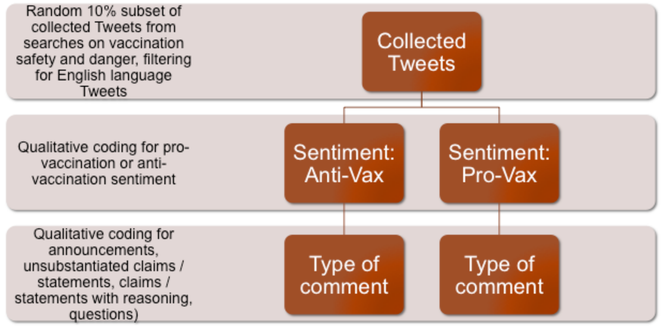
METHODOLOGY / ANALYSIS FRAMEWORK

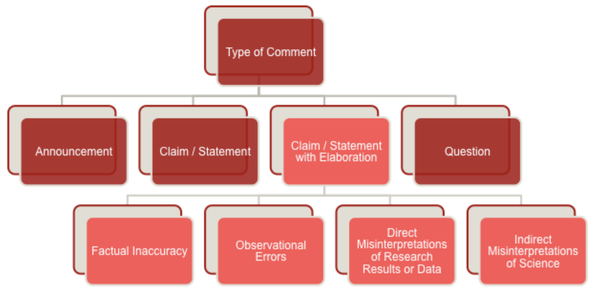
SAMPLING

1. 16 searches were deployed per week in a randomized sequence at various scheduled times each day for 7 months (May-December 2016) using variants of the terms "vaccine safety" and "vaccine danger."
2. 2. For each "fetch" of data, up to 100 tweets were collected using the software DiscoverText, which archived the text of each Tweet, all user meta-data and all embedded multimedia and links.
3. Data was retrieved from the Twitter Search Application Program Interface (API), which collected the posts that were considered most relevant for the week by the computing algorithm (Twitter, 2016). 26,050 Tweets on vaccination safety / danger were collected.

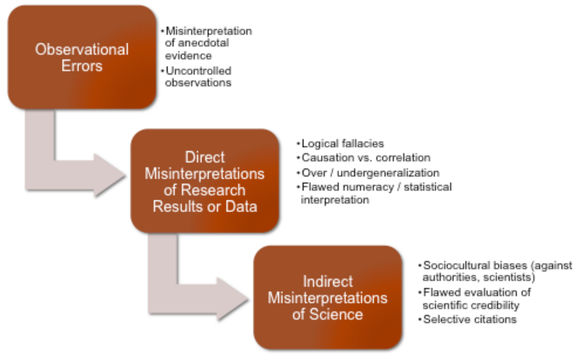
QUALITATIVE ANALYSIS, ROUND 1 — SENTIMENT, TYPE OF COMMENTARY



QUALITATIVE ANALYSIS, ROUND 2 — TYPE OF COMMENTARY



QUALITATIVE ANALYSIS, ROUND 3 — 3 LEVELS OF ERRORS IN SCIENTIFIC REASONING in ANTI-VACCINATION TWEETS, based on Allchin, 2001 framework



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PRELIMINARY FINDINGS

PRO-VACCINATION TWEETS (N=860, 34% of subset)

TYPES	PERCENTAGE OF TWEETS
ANNOUNCEMENTS	20%
CLAIMS WITHOUT ELABORATION	**48%**
CLAIMS WITH ELABORATION / REASONING	27%
QUESTIONS	4%

EMERGENT THEMES:
•Vaccines are safe / effective
•Vaccines have history of saving lives / protecting people and animals
•Vaccination is a smart choice / right decision to avoid disease
•Promotion of studies that show vaccines are safe
•Promotion of vaccination research achievements

ANTI-VACCINATION TWEETS (N=1,428, 56% of subset)

TYPES	PERCENTAGE OF TWEETS
ANNOUNCEMENTS	15%
CLAIMS WITHOUT ELABORATION	36%
CLAIMS WITH ELABORATION / REASONING	**43%**
QUESTIONS	5%

EMERGENT THEMES:
•Vaccines are not safety tested in certain groups (i.e. pregnant women, infants)
•Vaccines are not held to same standards as pharmaceutical drugs
•Conflict of interest with government, large companies, doctors
Evidence is "incomplete" or ignoring some studies

IN-DEPTH FOCUS ON ANTI-VACCINATION CLAIMS with ELABORATION (N=614): ERRORS IN SCIENTIFIC REASONING

TYPES	PERCENTAGE OF TWEETS
BASED ON FACTUAL INACCURACY ONLY, confirmed by collaborating epidemiologist	12%
OBSERVATIONAL ERROR	13%
DIRECT MISINTERPRETATION OF SCIENTIFIC DATA / CONCLUSIONS	**36%**
INDIRECT MISINTERPRETATION OF SCIENCE	**39%**

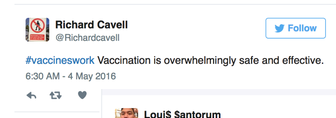

Figure 1.

Figure 2.

Figure 3.

Figure 4.

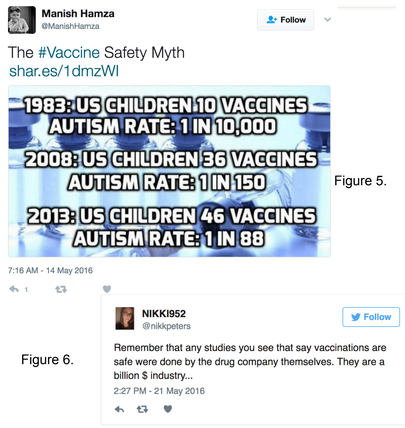

Figure 5.

Figure 6.

Figures 1-6. Examples of Tweets from coded categories. 1) Pro-vaccination claim without elaboration; 2) Pro-vaccination claim with elaboration, 3) anti-vaccination claim with elaboration based on factual inaccuracy, 4) anti-vaccination claim with elaboration based on observational error (anecdotal evidence), 5) anti-vaccination claim with elaboration based on direct misinterpretation of data (flawed statistical inferences), 6) anti-vaccination claim with elaboration based on indirect misinterpretation of science (biases against corporations)

CONCLUSIONS

1. The conversation about vaccination on social media is not one-sided. Pro-vaccination Tweets made up approximately 1/3 of the data set.

2. Anti-vaccination tweets that included elaboration showed some evidence for their claims, albeit flawed from a lens of scientific epistemology.

3. In contrast, pro-vaccination Tweets often consisted of claims and statements that did not offer elaboration — proponents of vaccination could benefit from explaining their reasoning (Hovland, Janis & Kelley, 1953) when engaging in argumentation with vaccine skeptics.

4. Implications of this research include a better understanding of the public's dialogue about controversial science issues, the reasoning used in arguments for both sides, and flaws in scientific reasoning. Implications for lifelong science education include an increased focus on legitimate forms of scientific evidence and reasoning.