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Understanding vaccination resistance: Vaccine search term selection bias and the valence of retrieved information

Jeanette B. Ruiz[a,*], Robert A. Bell[a,b]

[a] Department of Communication, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA
[b] Department of Public Health Sciences, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA

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ABSTRACT

Context: Dubious vaccination-related information on the Internet leads some parents to opt out of vaccinating their children.
Objectives: To determine if negative, neutral and positive search terms retrieve vaccination information that differs in valence and confirms searchers' assumptions about vaccination.
Methods: A content analysis of first-page Google search results was conducted using three negative, three neutral, and three positive search terms for the concepts "vaccine," "vaccination," and "MMR"; 84 of the 90 websites retrieved met inclusion requirements. Two coders independently and reliably coded for the presence or absence of each of 15 myths about vaccination (e.g., "vaccines cause autism"), statements that countered these myths, and recommendations for or against vaccination. Data were analyzed using descriptive statistics.
Results: Across all websites, at least one myth was perpetuated on 16.7% of websites and at least one myth was countered on 64.3% of websites. The mean number of myths perpetuated on websites retrieved with negative, neutral, and positive search terms, respectively, was 1.93, 0.53, and 0.40. The mean number of myths countered on websites retrieved with negative, neutral, and positive search terms, respectively, was 3.0, 3.27, and 2.87. Explicit recommendations regarding vaccination were offered on 22.6% of websites. A recommendation against vaccination was more often made on websites retrieved with negative search terms (37.5% of recommendations) than on websites retrieved with neutral (12.5%) or positive (0%) search terms.
Conclusion: The concerned parent who seeks information about the risks of childhood immunizations will find more websites that perpetuate vaccine myths and recommend against vaccination than the parent who seeks information about the benefits of vaccination. This suggests that search term valence can lead to online information that supports concerned parents' misconceptions about vaccines.

1. Introduction

Growing apprehensions about the risks of vaccines among the general public [1] have been accompanied by more frequent outbreaks of vaccine-preventable disease [2,3]. Concerns about vaccine safety lead some parents to postpone vaccination of their children, against the recommendation of their pediatrician, while other parents reject all vaccinations for their children [4–6]. These concerns motivate many parents to seek information about vaccines from other parents, traditional media, and the Internet [7]. A survey of providers found that fear of side effects presented in the media was the most common reason given by parents for refusing vaccines [8].

The Internet may be partially responsible for low child vaccination rates. Vaccination-refusing parents are more likely to have obtained information about vaccines from the Internet than parents who have their children vaccinated [8,9]. Kata found that a reliance on Internet-based information is problematic due to the presence of inaccurate and deceptive online information [9]. Zimmerman and colleagues found that websites often erroneously link vaccinations to chronic diseases and adverse reactions [10], thereby proliferating vaccine myths. Myths perpetuated online undermine vaccination programs by lowering the public's perceived effectiveness and safety of vaccines [11,12].

There is evidence of a selectivity effect in online vaccine information searches in which search terms varying in valence yield information that differs in accuracy and tone [13]. People often seek information to support existing beliefs [11,14]. This confirmatory bias has also been found in online health information-seeking

* Corresponding author. Tel.: +1 530 400 3102.
E-mail addresses: jbruiz@ucdavis.edu (J.B. Ruiz), rabell@ucdavis.edu (R.A. Bell).

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Table 1
Search terms used and retrieval results ($N = 84$ websites).

Search term	Valence	No. of websites included
"Vaccine risks"	Negative	9
"Vaccination risks"	Negative	10
"MMR risks"	Negative	9
"Vaccine"	Neutral	10
"Vaccination"	Neutral	10
"MMR"	Neutral	7
"Vaccine benefits"	Positive	10
"Vaccination benefits"	Positive	10
"MMR benefits"	Positive	9

Note: A total of 90 first-page results were initially retrieved (10 results × 9 search terms). Six of these websites were judged to have ineligible content based on a priori exclusion criteria, resulting in a study sample size of 84 websites.

behavior [12]. In the domain of vaccination, a confirmatory bias is illustrated by both the pro-vaccine parent who searches "vaccination benefits" and the parent whose skepticism about vaccination leads to a search for "vaccination risks."

The purpose of this study is to determine if online search strategies employing negative, neutral, or positive search terms lead to content that correspond with the valence of those terms. We know of no study that has investigated this question. We thus carried out a content analysis that addressed four broad research questions: (a) What vaccine myths are most likely to be perpetuated online? (b) How often do vaccination websites counter myths about vaccination safety and effectiveness? (c) Do websites that discuss vaccination make explicit recommendations about childhood vaccination, and if so, what are these recommendations? (d) Does the online information retrieved about vaccination differ depending on whether the search terms used are negative, neutral, or positive?

2. Methods

2.1. Search terms

Web searches were conducted on September 2, 2013, via the Google search engine (www.google.com), using three negative, three neutral, and three positive search terms for the base concepts "vaccine," "vaccination," and "MMR," as shown in Table 1. These three terms were chosen because they are the most popular vaccine information search terms used, based on Google Trends data [15]. The term "immunization" was not selected for analysis because it did not appear as a popular search term on Google Trends. We note that previous research found that searching with the search term "immunization" produced mostly "provaccination" sites [13]. These nine searches were conducted using both Google Chrome and Mozzila Firefox to confirm that results are independent of the browser used.

2.2. Retrieval of websites

Only the first page of search results, comprising a list of 10 websites, was retrieved for each term because web users rarely go beyond first-page results [16–18]. The nine search terms used generated 90 potential websites for analysis (3 terms × 3 valences × 10 first-page websites). After eliminating six ineligible websites, 84 websites remained for analysis. A website was excluded from the study if it was a list serve website, a video result, a book preview and/or review, a directory devoted solely to listing other websites, a non-English website, a website focused exclusively on adult vaccines such as shingles, a website about veterinary vaccines, a journal article that required purchase for access, or a broken link that led to no active page.

2.3. Coding procedure

Coding of websites focused on two issues: *myths* (inaccuracies) about childhood vaccination and explicit *recommendations* regarding vaccination. A list of 15 common myths was compiled based on a combination of past vaccine research and information found on the Centers for Disease Control and Prevention (CDC) website [19,20]. "Myth" was defined as a false claim about vaccination (e.g., "vaccines cause autism"). Claims were identified as myths based on CDC positions [20]. A recommendation was defined as a statement that encouraged vaccination (e.g., "make sure your child's vaccinations are up to date") or discouraged it (e.g., "do not harm your child by vaccinating them").

Two coders unaware of study objectives independently examined each website's pages, completing a coding form for each website. Both were "naïve" coders, as neither had searched for vaccine information in the past on their computers. Following standard website analysis protocols [21,22], "website" was defined as the landing page for the search result link. Coding entailed determining if each myth was *perpetuated* in the website, *countered*, or *not addressed*. Note that our coding procedures acknowledge that a website can both spread and counter myths. A myth was coded as "perpetuated" if it was presented as fact, with or without evidentiary support or argument. A myth was coded as "countered" if it was described and then characterized as untrue or unsupported. Presentation of a myth, followed by its rebuttal, was coded as an act of myth "countering." An example would be, "Some parents believe that vaccines cause autism. There is no support for this claim." The recommendation variable was coded for each website as *vaccination recommended*, *vaccination discouraged*, or *no recommendation*. Cohen's kappa was used to assess coding reliability; the mean value was 0.94 (range: 0.83–1.0). Thus, all variables reported in this paper were coded at a "substantial" to "excellent" level of agreement [23].

2.4. Data analysis

Data analysis was carried out using Stata [24] to generate descriptive statistics. Inferential statistics were not employed in this study because the websites analyzed constituted the population of "top ranked" websites most consumers would peruse, not a sample from which we wished to generalize. Furthermore, use of inferential statistics would be inappropriate because the websites analyzed were chosen based on their visibility in search engine results, not randomly selected from the population of vaccination-related websites.

3. Results

3.1. Perpetuated vaccine myths

In total, 16.7% ($n = 14$) of websites spread myths about vaccination. More precisely, 6.0% ($n = 5$) of the 84 websites analyzed perpetuated one myth about vaccination, 2.4% ($n = 2$) perpetuated two myths, and 8.3% ($n = 7$) perpetuated three or more myths. The most commonly perpetuated myth was "children's vaccines cause autism" (9.5%, $n = 8$), followed by "children's vaccines cause other severe illnesses" (8.3%, $n = 7$). The other 13 myths were spread less frequently or not at all (Table 2).

3.2. Search term selectivity and myth perpetuation

For the 28 websites retrieved as a result of negative search terms, an average of 1.93 myths were perpetuated ($SD = 2.09$). The mean number of perpetuated myths in the 27 websites retrieved with neutral search terms was 0.53 ($SD = 0.52$). For the 29 websites retrieved from using positive search terms, an average of 0.40