Original Paper

Differences in emotional and pain-related language in tweets about dentists and medical doctors: Text-analysis of Twitter content

Abstract

Background: Social media provides people with easy ways to communicate their attitudes and feelings to a wide audience. Many people unfortunately have negative associations and feelings about dental treatment due to former painful experiences. Former research indicates that there might exist a pervasive and negative occupational stereotype related to dentists, and that this stereotype is expressed in many different venues, including in movies and in literature.

Objective: This study investigates the language used in relation to dentists and medical doctors in the social media channel Twitter. The purpose is to compare the professions concerning the use of emotional words and pain-related words, which might underlie the pervasive negative stereotype identified in relation to dentists. We hypothesize that (A) tweets about dentists will have more negative emotion words than tweets about medical doctors, and that (B) pain related words are used more frequently in tweets about dentists than medical doctors.

Methods: Twitter content (“tweets”) about dentists and medical doctors were collected scanning the keywords “dentist” and “doctor” using the Twitter API 140Dev. Word content of the selected tweets were analysed using the Linguistic Inquiry and Word Count software. The research hypotheses were investigated using non-parametric Wilcoxon-Mann-Whitney tests.

Results: Over 2.3 million tweets were collected in total, of which about 1/3 contained the word “dentist” and about 2/3 contained the word “doctor”. Hypothesis A was supported as there were a higher proportion of negative words used in tweets about dentists than in tweets about medical doctors; $W = 634925.00, P < .001$. Similarly, tests showed a difference in proportions of anger words ($W = 582087.00, P < .001$), anxiety words ($W = 660532.00, P < .001$), and sadness words ($W = 617011.00, P < .001$), with higher proportions in tweets about dentists than tweets about doctors. Also, Hypothesis B was supported as there were a higher proportion of pain related words used in tweets about dentists than about doctors; $W = 590139.00, P < .001$.

Conclusions: The results from this study support the existence of a negative stereotype for dentists among Twitter-users. The impact of expression of this stereotype on Twitter needs to be further explored with other study designs.

Keywords: dental anxiety; dentistry; psychology; social media; Internet; dental public health; Twitter; professional role; occupational stereotype
**Introduction**

An increasing number of people use social media such as Facebook and Twitter, and they are becoming central as news outlets and even creating headline news themselves as when the US President tweets and stirs controversy [1]. The ubiquity of social media has created an opportunity for researchers to use these tools as sources of data on a range of topics, including the spread of illnesses and attitudes to health related topics [2, 3].

It is obvious that social media have become very important in modern society and that many people find these media to be useful and fulfilling. However, prior research has suggested that social media may be used to spread distorted or false information and that such information may have important negative consequences, for instance when dangerous information is spread about how to contain epidemics or when mental disorders are associated with negative emotions and unsupportive tweets [4, 5].

In order to make sense of the world people have a tendency to think about others in terms of stereotypes or categories [6, 7], and the existence of occupational stereotypes is relatively well-established [8, 9]. This tendency has obvious benefits in terms of saving cognitive resources [10], but could pose problems concerning how accurate these impressions turn out. For the health professions there appears to exist strong stereotypes about medical doctors and nurses. For instance, nurses are often seen as good communicators, nurturing, feminine and caring [11, 12], while doctors are described as confident and decisive [12]. Concerning dentists, it has been documented that stereotypes related to gender, i.e. that females are believed to be more emotionally and relationally competent than males, impacts the expectations and impressions of male and female dentists alike. For instance, female dentists were expected to spend more time talking to their patients, while the male dentists’ were expected to value patients’ tolerance of pain without complaints [13].

Although logic dictates that stereotypes could be either good or bad, evidence suggests that stereotypes are most often negative. In their review of related research Baumeister and colleagues [14] argue that illusory correlation appears to form more easily between a social group and negative/bad (distinctive) behaviors compared to positive or neutral behavior, and bad information about a person has more impact on impression formation than good information. Also, it appears to be easier to acquire bad reputations than good reputations because fewer instances of bad behavior is needed to confirm this as indicating a bad trait or disposition compared to good behavior [14]. Interestingly, stereotypes or social categorizes are quite easily learnt by social learning processes, but the process of learning about other groups or categories from others appears to distort or change the content of the stereotypes; making them more extreme and less variable [15]. Such distortions related to the social (vicarious) learning of stereotypes could then influence negatively how people think about certain social groups or categories, including professions.

Thus, negative or bad behaviors could be a major influence on professional stereotypes when such behaviors are perceived as distinctive to the profession. In the case of dentists and dentistry, bad distinctive behaviors could include instances of painful treatment. Research on patients’ experiences suggests that painful experiences are quite common among dental patients. For instance, in a study of Norwegian adults 20-30% rated their last dental visit as moderately painful or worse, and 60% reported having at least one very painful experience at the dentist’s office [16]. Also, a study of Canadian adults found that 42,5% reported having moderate to severe pain during their last dental treatment [17]. In light of these findings, it would be reasonable to assume that painful experiences might serve as a foundation for
creating negative stereotypes in relation to dentists. This notion appears to be supported by the findings of Thibodeau and Mentasti [18] that reviewed 100 movies portraying dentists. In this study it was shown that visits to the dentist in movies are often portrayed as a negative and painful experience, where the dentist is being depicted as: “(...) incompetent, menacing, sadistic, immoral, unethical, or corrupt, and one might assume that all dentists behave in this manner” (p. 657). This association between negative experiences and the popular image of dentists has been found in large population studies as well, and appears to hamper the image of dentists [19], as well as being regarded as a contributing cause of the maintenance and/or establishment of dental anxiety [20]. The impact of the negative occupational stereotype related to dentistry could be that people exposed to it are reluctant to seek dental care, and some authors have argued that the dental community should consider promotional campaigns or marketing strategies to dispel the negative images associated with dentistry and to influence reluctant patients [21, 22].

With new technologies and social media there are new venues for health communication, as well as new venues for expressing stereotypes and social categories. Based on the findings that indicate the existence of negative associations related to dentistry and dentists, we would expect that these associations and stereotypes influence how the profession is talked about in social media. The current study seeks to investigate the language used in Twitter-posts about dentists, and compare these posts with those about another well-known health-profession (medical doctors). We hypothesize that (A) tweets about dentists will have more negative emotion words than tweets about medical doctors, and that (B) pain-related words are used more frequently in tweets about dentists than medical doctors.

Methods

Data Source
Text-data was collected from Twitter in a four-week period starting the last week of May 2015. The data collection used 140Dev server software [23], which ran at servers of the Northern Research Institute in Tromsø, Norway. The server monitored and stored all tweets containing the words “dentist” and “doctor”. In the study-period the server downloaded and stored 524,958 tweets containing the word “dentist” and 1,821,914 tweets containing the word “doctor”. To preserve the tweeters’ privacy, none of the supplemental user information available from Twitter was downloaded. The study can therefore be said to build only upon non-identifiable, publicly available information.

Data Selection and Preparation

Since the research questions of the study were related to how most people use Twitter to communicate about health professionals, the authors made an informal analysis of the suitability of the collected material by browsing through a random selection of tweets from each database. Based on the screening process it was decided that selection criteria would have to be imposed on the material, since the text-data contained many entries that were outside of the scope of this study, for instance commercial content. In order to remove irrelevant content and to increase the likelihood that selected tweets were personal and relevant to the tweets’ authors, personal and possessive pronouns were used to filter the data. Thus, we included only data with one or more of the following words present: "I", "me", "my", "mine", "we", "us", “our”, and "ours". A selection of tweets with personal or possessive pronouns included are shown in Table 1. In addition, only original tweets were chosen for analysis, i.e., we excluded tweets tagged as being retweets.
Table 1. A selection of relevant tweets with pronoun filtering enabled; pronouns in italics.

<table>
<thead>
<tr>
<th>Target group</th>
<th>Tweets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentist</td>
<td>“I hate the dentist man. Leave my wisdom teeth aloneeee. They not bothering me”</td>
</tr>
<tr>
<td></td>
<td>“just went to the dentist and my mouth feels like someone has punched it”</td>
</tr>
<tr>
<td></td>
<td>“Someone come to the dentist with me I’m scared”</td>
</tr>
<tr>
<td>Medical Doctor</td>
<td>“I tweet this on a daily basis. But I truly dislike my doctor office.”</td>
</tr>
<tr>
<td></td>
<td>“My ear is still ringing... Time to go back to the doctor”</td>
</tr>
<tr>
<td></td>
<td>“hearing the doctor say I’m out for 6 weeks is probably the worst thing that has happened to me”</td>
</tr>
</tbody>
</table>

To obtain approximately the same amount of text-data for each target-group, a random selection of 10000 rows of the databases were saved as word-files for each target-group (e.g., one file containing 10000 lines for dentist, and a similar file for doctor).

Data Analysis

To investigate the research hypotheses these files were then run through Linguistic Inquiry and Word Count [LIWC; 24]. The LIWC is a computer application that analyses text-files according to a pre-defined dictionary, and that gives information about the percentage of words in the text-files that matches the dictionary. Other authors have found LIWC to be a valid approach to measure emotion in verbal expression [25]. In order to investigate Hypothesis A, we looked specifically at the word-categories in the LIWC dictionary related to negative emotions (Negative emotions and three categories of specific negative emotions), and also an overall emotional category (Affective processes) and Positive emotions (see Table 2).

Table 2. Emotional categories used from the LIWC-dictionary.

<table>
<thead>
<tr>
<th>Category</th>
<th>Overall</th>
<th>Emotional valence</th>
<th>Specific emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affective processes</td>
<td></td>
<td>Positive emotions</td>
<td>Anger</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Anxiety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative emotions</td>
<td>Sadness</td>
</tr>
</tbody>
</table>

In order to investigate Hypothesis B, we selected synonyms to pain and pain-related words from a popular English dictionary [26], which were then entered into the dictionary for the LIWC-analysis software to provide a separate pain-category (see Table 3).

Table 3. Synonyms of pain used as a dictionary in LIWC.

<table>
<thead>
<tr>
<th>ache</th>
<th>burned</th>
<th>discomfort*</th>
<th>maladies</th>
<th>sore</th>
<th>stitches</th>
<th>torment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ached</td>
<td>burns</td>
<td>hurt</td>
<td>malady</td>
<td>soreness*</td>
<td>strain*</td>
<td>torture*</td>
</tr>
<tr>
<td>aches</td>
<td>burnin</td>
<td>hurts</td>
<td>misery</td>
<td>sores</td>
<td>suffer</td>
<td>trouble</td>
</tr>
<tr>
<td>aching*</td>
<td>burnt</td>
<td>hurtful*</td>
<td>pain</td>
<td>sting</td>
<td>tenderness*</td>
<td>troubles</td>
</tr>
<tr>
<td>affliction*</td>
<td>cramp</td>
<td>illness*</td>
<td>pain*</td>
<td>stings</td>
<td>throbb*</td>
<td>troubled</td>
</tr>
<tr>
<td>agony</td>
<td>cramped</td>
<td>injur*</td>
<td>pains</td>
<td>styngy</td>
<td>throe*</td>
<td>twinge*</td>
</tr>
<tr>
<td>burn</td>
<td>cramps</td>
<td>irritation*</td>
<td>sickness*</td>
<td>stitch</td>
<td>tingle*</td>
<td>wound*</td>
</tr>
</tbody>
</table>

*Indicates that a word stem was used: All words containing this word stem were counted.
Descriptive analyses were performed with a single file for each target group, while specific hypotheses testing required segmentation of the text-files to simulate individual tweets. For the purposes of this study we used 1000 segments per text-file, which was done automatically by choosing this option in LIWC. See Figure 1 for a visualization of the segmentation process. Data was analysed using JASP (version 0.8.6).

Figure 1. Visualization of a single text-file with N lines of text segmented into N text-files.

Results

User Statistics
The data selected for analyses contained a total of 166266 words for “dentist” (704397 characters without spaces) and 182311 words for “doctor” (776152 characters without spaces). Table 4 shows the mean proportions of emotional words for each professional category (group). In addition, grand mean baseline values for word categories across different writing tasks [24] have been included for comparison (see Table 4).

<table>
<thead>
<tr>
<th>Word Category</th>
<th>Dentist Mean (SD)</th>
<th>Doctor Mean (SD)</th>
<th>Baseline Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affective Processes</td>
<td>6.29 (1.87)</td>
<td>5.63 (1.72)</td>
<td>4.41</td>
</tr>
<tr>
<td>Positive Emotions</td>
<td>3.22 (1.46)</td>
<td>3.14 (1.43)</td>
<td>2.74</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>3.05 (1.41)</td>
<td>2.45 (1.22)</td>
<td>1.63</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.42 (.53)</td>
<td>.34 (.47)</td>
<td>.33</td>
</tr>
<tr>
<td>Anger</td>
<td>1.25 (.92)</td>
<td>.93 (.76)</td>
<td>.47</td>
</tr>
<tr>
<td>Sadness</td>
<td>.53 (.56)</td>
<td>.41 (.49)</td>
<td>.37</td>
</tr>
<tr>
<td>Pain</td>
<td>.34 (.45)</td>
<td>.25 (.40)</td>
<td>n/a(^b)</td>
</tr>
</tbody>
</table>

\(^a\)N=1000 in each group.
\(^b\)Pain-related words are not included in the original LIWC-dictionary.
Mean-values from Table 4 show interesting descriptive differences related to the professional categories, but since the data is not normally distributed, non-parametric Wilcoxon-Mann-Whitney tests were used to test the equality of the distributions (see Table 5).

Table 5. Comparisons of the equality of distributions for the emotional word categories over professional categories.

<table>
<thead>
<tr>
<th>Word Category</th>
<th>W</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affective Processes</td>
<td>587704.00</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Positive Emotions</td>
<td>518461.00</td>
<td>= .15</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>634925.00</td>
<td>&lt; .001 (b)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>582087.00</td>
<td>&lt; .001 (b)</td>
</tr>
<tr>
<td>Anger</td>
<td>660532.00</td>
<td>&lt; .001 (b)</td>
</tr>
<tr>
<td>Sadness</td>
<td>617011.00</td>
<td>&lt; .001 (b)</td>
</tr>
<tr>
<td>Pain</td>
<td>590139.00</td>
<td>&lt; .001 (b)</td>
</tr>
</tbody>
</table>

\(a\)Wilcoxon-Mann-Whitney test.
\(b\)The alternative hypothesis specifies that group dentist is greater than group doctor (one-tailed); other tests are two-tailed.

The analysis showed that there was a difference between tweets about dentists and tweets about doctors with more affective words used in tweets about dentists \((W = 587704.00, P < .001)\), but a significant difference was not found for positive emotion words. With regards to Hypothesis A, a Wilcoxon-Mann-Whitney test showed that there were more negative words used in tweets about dentists than in tweets about medical doctors; \(W = 634925.00, P < .001\). Similarly, tests of equality of distributions were made for the specific emotion categories. These tests showed a difference in proportions of anger words \((W = 582087.00, P < .001)\), anxiety words \((W = 660532.00, P < .001)\), and sadness words \((W = 617011.00, P < .001)\), with words from these categories in tweets about dentists than tweets about doctors. Also, Hypothesis B was supported as there were a more pain related words used in tweets about dentists than about doctors; \(W = 590139.00, P < .001\).

Discussion

Principal Results
This study demonstrated that more negative emotion words were used in tweets relating to dentists than in tweets relating to medical doctors. Thus, dentists seemed to be associated with more negative emotions in tweets than medical doctors were. Tweets about dentists did contain more affective words than tweets about medical doctors, but not more positive emotions. As such, the study could be seen as supporting the idea that there is a negative stereotype relating to dentists that is also revealed on Twitter. Twitter may therefore be one of several channels where the negative stereotype is transmitted, spread, and learnt, as other research indicate that emotions can be spread through online social networks [27, 28].
Dental anxiety is a widespread problem [29, 30]. The results of the present study is in accordance with the idea that there are several pathways to developing dental anxiety. In a recent qualitative study of online videos related to dental anxiety three main pathways are outlined: direct experiences of aversive dental treatment, vicarious learning through parents and peers, and exposure to negative information [31]. Thus, negative occupational stereotyping might be an important factor in the development of dental anxiety, as it creates negative associations and expectations irrespective of the individuals’ own experiences. Thus, ambiguous stimuli or information in the dental situation might be interpreted negatively based on the negative emotions and expectations related to the stereotype. For instance, non-verbal communication such as the tone of voice of the dentist when providing information might be considered as condescending or authoritative by some patients due to negative expectations, while patients without negative expectations are less prone to draw similar conclusions. Thus the current results underline the importance of cognitive processes in the development of dental anxiety [30].

The hypothesis was supported that negative emotions would be more frequently used related to dentists than to doctors. For anxiety words this was expected given that a potential occupational stereotype related to dentistry can be linked to the relatively widespread phenomena of sub-clinical dental anxiety or low-grade/moderate worry about dental treatment, which is believed to be quite prevalent in most societies [32, 33]. More surprising perhaps was the differences observed for both anger and sadness, which can be more difficult to understand. However, it is a quite common finding that people are willing to share anger or anger-related materials online [34], and that feelings of anger might be related to the idea that dental treatment is somehow unethical in the sense that it is expensive, painful, or administered without proper consent [35, 36]. Also, the motivational direction of anger is argued to be different from some other feelings, in that anger is an approach-oriented emotion concerned with removal of an obstacle rather than withdrawal or avoidance from an obstacle [37, 38]. Thus, people might be motivated to write about (i.e., approach) their angry feelings about dentists and dental treatment. This is in part supported by the fact that anger words are used more in the data used in this study than other specific negative emotional words.

In addition, we found an expected difference between tweets concerning dentist and medicinal doctors for pain-related words, with more pain-related words used in relation to dentists. This might be a testament to the significance of pain in relation to dentistry [16, 17], but it poses the question why pain is not as significant in relation to medical doctors? For instance, a visit to the doctor might very well be associated with pain and discomfort, as is many medical problems. A possible reason for the current results might be how pain is perceived in these different contexts. Pain in relation to a health problem is most often alleviated through interaction with a medical professional (i.e., doctor), either through a medical procedure or the prescription of pain-killers. This is quite easily imagined as when we seek our general practitioner to help us with acute back pain or a swollen knee after we have taken a fall, but also in relation to acute dental problems. However, in the case of non-acute dentistry it might be argued that pain might appear to be caused by the visit to the dentist, rather than as a byproduct of necessary examinations or treatment. This might happen because we are expected to get frequent dental check-ups to prevent dental problems even though we are symptom-free, while the expectation of getting medical check-ups without symptoms are uncommon (except for people in specific risk groups). Thus, we might end up receiving painful dental treatment and suffering both physical and financial discomforts for which there is no apparent reason (to the layperson), except for the professional opinion of the dental professional. Such differences in the perception of pain related to the professions might
provide us with some explanation for the difference observed in the current study, and it is important to consider pain experiences in the dental setting as a key factor in determining patient satisfaction [39-41].

Limitations
As is often the case with studies of language in natural settings, the results of this study will have to be viewed in light of the inherent challenges in interpreting language and language elements (e.g., manifest content) as related to social or psychological processes (e.g., latent content). Specifically, we propose that more negative words in tweets about dentists is related to the existence of a negative occupational stereotype or negative expectations related to dentists, and that these findings might impact people’s behaviors, beliefs or attitudes related to oral health. How differences in word-categories influence real-life learning processes or reasoning, as suggested here, is not clear. However, the relevance of investigating linguistic data and word-counts in relation to thinking and behavior has been demonstrated elsewhere for a wide range of issues [42-45]. While the current results support the existence of a negative occupational stereotype and negative expectations related to dentists [as others have argued previously; 18, 22, 46], the actual impact of the stereotypes and expectations are outside of scope of this study.

Conclusions
In conclusion, our study suggests that dentists are tweeted about in more negative terms than medical doctors. More research is needed concerning the potential impact of this behavior on dental patients’ health behavior and health beliefs. It is unclear what can be done to reduce the proportion of dentist-related tweets with negative emotion words, or the potential impact of a negative occupational stereotype about dentists expressed in social media. Potential interventions however could include informational campaigns highlighting preventive dental care [21], reducing both actual dental costs and uncertainty about dental cost [19, 47], and increasing focus on the importance of provider-patient interaction in dental education [48].

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Conflicts of Interest
None declared.

Abbreviations
LIWC: Linguistic Inquiry and Word Count


