Online Consumer Reviews on Hearing Health Care Services: A Textual Analysis Approach to Examine Psychologically Meaningful Language Dimensions

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Abstract

Purpose: The study examined psychologically meaningful language dimensions (i.e., social and emotional dimensions, health dimensions, and personal concerns) within online consumer reviews on hearing healthcare services using an automated textual analysis approach.

Method: 9,622 consumer reviews of hearing healthcare services, including an open-ended question (i.e., free text response to the prompt "share details of your own experience at this place") and an overall rating (on a 5-point scale ranging from "very good" to "very poor") were extracted from Google.com from 40 different cities across the U.S. In addition, some meta-data about the cities (i.e., region, population size, median age, percentage of older adults) were also recorded. Text responses were analyzed using the automated Linguistic Inquiry Word Count (LIWC) software for selected language dimensions. The language dimensions of online hearing healthcare reviews were descriptively compared with language dimensions observed in the natural language of typical bloggers. Language dimensions from free text responses were correlated with quantitative overall experience ratings.

Results: Automated linguistic analysis showed that consumer reviews on hearing healthcare services had higher social processes, positive emotions, hearing, health, money and work and lower negative emotions and time-awareness when compared to typical bloggers. Examining the

association between overall experience rating and the language dimensions reveled two broad findings. First, higher engagement of consumers in terms of social processes, positive emotions, hearing, and work dimensions was related to higher experience ratings. Second, higher engagement of consumers in terms of negative emotions, time awareness, and money was related to lower experience ratings.

Conclusion: Online reviews contain information about various dimensions (i.e., social and emotional dimensions as well as personal concerns) that have bearing towards the way in which they rate their healthcare experiences. Automated linguistic analysis of consumer reviews appears helpful in identifying gaps in service delivery that may influence consumer experience.

Key Words

Hearing healthcare services, Patient experience, Patient satisfaction, Consumer reviews, Administration, Hearing loss, Hearing clinic

Introduction

Patient experience is defined by the Agency for Healthcare Research and Quality (2017) to "encompass a range of interactions that patients have with the health care system, including their care from health plans, and from doctors, nurses, and staff in hospitals, physician practices, and other health care facilities." However, patients' needs and wants may vary across healthcare disciplines. For example, diabetes patients value population health initiatives around diabetes (Nash, Skoufalos, & Harris, 2018), older adults value physicians friendliness, kindness, ability to joke and provide adequate time during consultation concerning their healthcare (Marcinowicz, Pawlikowska, & Oleszczyk, 2014), and cancer patients value therapies with wider spread of

outcomes that offer then the potential of a longer period of survival (Lakdawalla et al., 2012). However, little is known regarding the aspects of service delivery most valued by consumers of hearing healthcare. For these reasons, it is necessary to understand experiences and healthcare outcomes of patients to promote patient-centered care. Evaluating and improving patient experiences along with other elements such as clinical effectiveness and safety of care is essential in providing more comprehensive, high-quality health care.

Although measuring outcomes of hearing healthcare services are common in clinical practice, there is surprisingly limited literature on patient experience in hearing healthcare. A recent study in the Netherlands examined the patient experiences with audiology care using a structured questionnaire on seven sub-scales including accommodation and facilities, employees' conduct and expertise, arrangement of appointments, waiting times, client participation and effectiveness of treatment (Hendriks et al., 2017). The study showed that the patient experiences on several elements including concerning accommodation and facilities, arrangement of appointments, waiting times and client participation differed significantly across the participating centers. Another large-scale market research in the U.S. showed that consumers visit multiple hearing clinics prior to purchasing a hearing aid (Kochkin, 2002). The same study also identified elements such as consumers interactions with professional staff, the convenience of the location of the clinic, the price of services and devices, and positive word-of-mouth advertising as the top influencing factors in choosing a hearing clinic. These studies point to the fact that patient experience and satisfaction extends beyond their contact with audiologists and extends to the entire experience—the staff, the service, the product, and other factors (Jacobs, 2016; Picou, 2020).

Patient experience can be studied using various methods including administering standardized self-reported measures administered in a clinical setting (Hendriks et al., 2017) or conducting large scale surveys on patients (Kochkin, 2002; Picou, 2020). In addition, there is a growing interest in examining patient experiences using online consumer reviews. The main advantage of analyzing online consumer reviews is the fact that the user can focus on elements that are most important to each individual. This coupled with the fact that the data is usually unsolicited and provided in a natural setting (e.g., the home) is likely to increase the ecological validity of the data. However, this approach also has a few limitations such as lack of consumer demographic information (e.g., age, gender) as well as some issues with reliability of reviews (Anderson & Simester, 2014) making it difficult to establish generalizability of the findings. Despite these limitations, there is growing interest in examining the consumer reviews in the healthcare context. For example, John and Lipner (2019) examined the consumer perception of biotin for improvement in hair, skin, or nails by Amazon consumers, by examining their online reviews. In another study, Adusumalli et al. (2015) analyzed consumer-generated reviews from WebMD.com to understand the drug performance and reported that online reviews can be viewed as an orthogonal source of information for consumers, physicians, and drug manufacturers to assess the performance of a drug. Within audiology, Manchaiah et al. (2019) examined the benefits and limitations of direct-to-consumer hearing devices by analyzing the Amazon.com consumer reviews. These studies belong to an emerging area of study called "consumer health informatics" (Demiris, 2016) and provide a unique insight about patient experiences that may not be evident in clinical studies.

Although a few studies have examined the patients experience towards hearing healthcare services (Hendriks et al., 2017; Kochkin, 2002), our understanding on what patients or consumers say about hearing healthcare experience is limited. For this reason, in a recent study we extracted 9,622 online reviews about hearing healthcare services from Google.com and examined them using automated text analysis approach (Manchaiah et al., Submitted). Although consumers indicated high satisfaction with hearing healthcare services via quantitative rating (mean rating of 4.78 out of 5), examination of open text responses revealed key areas of dissatisfaction that warrant attention in order to improve the user experience of healthcare. For instance, the topic modelling which helps identify key themes identified six clusters (i.e., administration, benefit, acquisition, communication, professionalism, service, satisfaction) which fell into two domains, named as *clinical processes* and *staff and service interactions*. Of these, the administration cluster (e.g., booking appointment or processing third party reimbursement) was the main indicator of overall experience ratings. The observations suggest that examination of textual response may provide more useful than just looking at the overall experience ratings.

Examination of textual data, such as response to open-ended questions, have typically been analyzed using qualitative methods such as content or thematic analysis. However, there has been a growing body of literature on applications of automated text analysis techniques and/or natural language processing (NLP) techniques to quickly and meaningfully analyze large amount of textual data (Boyd, 2017). These methods have been applied extensively in health data (Boyd, 2017) as well as on hearing health data primarily to examine social media conversations around hearing loss and tinnitus (Kimball et al., 2019; Manchaiah et al., 2018, 2019a, 2019b; Ni et al., 2020). While there are several unique automated text analysis approaches (for review see Boyd,

2017), two commonly used approaches include: (a) topic modelling, and (b) analysis of language dimensions. The topic modelling approach helps identify key themes within the natural language text data and provides a similar "bird's eye view" of the data as qualitative analyses. However, analysis of language dimensions using software such as Linguistic Inquiry Word Count (LIWC; Pennebaker et al., 2015) may help identify psychologically meaningful language categories or dimensions. The LIWC analysis provides a quantitative score for the language dimensions of interest which can be used to correlate with or predict other dimensions of interest (e.g., overall experience rating in consumer reviews). Moreover, LIWC has strong empirical evidence in identifying meaningful insights on aspects such as attentional focus, emotionality, social relationships, thinking styles, and individual differences (Pennebaker et al., 2015; Tausczik & Pennebaker, 2010). For this reason, it would be a worthwhile exercise to apply LIWC analysis to the consumer reviews of hearing healthcare services.

The aim of the current study was to examine psychologically meaningful language dimensions within online consumer reviews on hearing healthcare services using automated textual analysis approach. Specific objectives were to (a) examine language dimensions of consumer reviews (i.e., text responses to open-ended questions) in terms of social and emotional dimensions, health aspects, and personal concerns, and (b) examine the relationship between language dimensions of the consumer reviews and the overall experience ratings.

Method

Study Design and Ethical Considerations

The study used a cross-sectional design and analyzed online consumer reviews generated from Google.com using automated text analysis software. As the data were anonymous (no personally identifiable information) and publicly available, ethical approval was not required (Buchanan & Zimmer, 2015).

Data Extraction

Consumer reviews about hearing healthcare services on Google.com was searched and extracted. The search was conducted to include consumer reviews from 40 cities across the U.S. which were chosen based on a purposive and maximum-variation sampling methods to include cities from different regions (i.e., Northeast, Midwest, South, West) and population size (i.e., 1 million, 500,000 to 1 million, 200,000 to 500,00, and < 200,000) as illustrated in Table 1. The search focused on finding Google listings of hearing healthcare clinics by using various terminologies such as audiology clinics in "city name," hearing clinic in "city name," hearing aid center in "city name." To exclude extreme positive (or negative) reviews, a cut off was set to include clinics with a minimum of 10 reviews. This comprehensive search strategy yielded hearing healthcare clinics in different settings (e.g., independent practice, clinics attached to a hospital or an ENT practice).

Table 1: Consumer review characteristics

City meta-data and consumer experience rating	N	%
Region		
▪ Northeast	1,018	10.6
▪ Midwest	1,609	16.7
▪ South	3,832	39.8
▪ West	3,163	32.9
Population		
▪ >1 million	3,990	41.5
▪ 500,000 to 1 million	3,217	33.4
▪ 200,000 to 500,000	1,620	16.8
▪ <200,000	795	8.3
Median age of the city population		
▪ Below 34 years	4,859	50.5
▪ 34 years and above	4,763	49.5
% of people over 65 years in the city population		
▪ 10% and below	2,243	23.3
▪ Above 10%	7,379	76.7
Overall consumer experience rating		
▪ 1 = Very poor	359	3.7
▪ 2 = Poor	82	0.9
▪ 3 = Average	75	0.8
▪ 4 = Good	279	2.9
▪ 5 = Very good	8,827	91.7

The consumer reviews on Google.com were elicited for an open-ended question “Share details of your own experience at this place”, and also the rating data (5-point scale). Meta-data related to the clinic (e.g., clinic name, city, URL) and cities (i.e., region, population, percentage of population over 65 years) were extracted to an excel document for analysis.

The initial search resulted in a total of 13,168 individual reviews. Of these, 3,546 reviews were provided no text response and were thus excluded. The remaining, 9,622 consumer reviews were included in the analysis.

Automated Linguistic Analysis of Textual Responses

The LIWC software program (Pennebaker et al., 2015) was used to analyze the text responses to open-ended questions. The LIWC software used a word counting strategy and looks for 6,400 words or word stems within any given text file. The search words have been classified by independent judges into language dimensions. These dimensions include standard language categories (e.g., articles, prepositions), psychological processes (e.g., positive and negative emotion categories), etc. Here, each of the word stem defines one or more word categories. For example, the word ‘cried’ is part of four word categories: sadness, negative emotion, overall affect, and a past tense verb. In other words, LIWC counts and calculates the percentage of words in a variety of linguistically and psychologically meaningful categories.

While the LIWC software provides outputs in over 90 language dimensions, as described in its handbook not all dimensions may be relevant to the topic of interest (Pennebaker et al., 2015). Moreover, correlating large number of language dimensions with overall rating may increase the

chances of statistical significance by chance. For these reasons, it is advised to pre-select some language dimensions of interest (personal communication with Prof. James Pennebaker). In the current study, 10 language dimensions that were deemed relevant to hearing healthcare experiences based on the existing literature informed the framework for the analysis (see Table 2) .

The LIWC handbook provides typical values for 90 language dimensions based on the natural language analysis of large datasets (e.g., typical blog, natural speech, Twitter posts, New York Times newspaper). These values provide the common frequency of each language dimension and serve as a reference when examining the output of LIWC on online consumer reviews. These values of language dimensions are difficult to interpret without a reference. Thus, it is common to compare the LIWC output with reference values from previous studies and/or to some of the reference values provided in the LIWC handbook. However, there are no mean normative values for consumer reviews that directly relate to hearing healthcare, and thus, we selected typical blogger values from the LIWC handbook for comparison. The typical blogger values provide a reference on expected percentage values in each of the language dimensions. While a descriptive comparison of LIWC output from this study with typical blogger may provide some insights, a direct statistical comparison is not appropriate as the text responses in these two datasets were generated are for different purposes and it is highly likely to see statistical significance among all dimensions especially when dealing with large sample size in terms of texts. For these reasons, the descriptive comparisons should be viewed with caution.

Table 2: Descriptive statistics of key linguistic analyses variables and its correlation with overall hearing aid benefit and satisfaction ratings. Mean values of linguistic variables for a typical blogger (taken from LIWC handbook; Pennebaker et al., 2015) are reported for comparison.

Dimension: Explanation	**Typical blogger, Mean**	**Mean (SD) for the current sample**	**Correlation with overall rating (r_{pb})**
Word count: The degree to which consumers engaged in the topic by providing descriptions of their views and experiences to an open-ended question.	3,206.45	48.2 (58.9)	-0.16**
Social and emotional dimensions			
Social processes: The degree to which consumers described thinking about and referring to other people.	8.95	13.9 (9.1)	0.06**
I-words: I-words (I, me, my) are used when people are looking inward and being self-reflective and correlate with honesty, anxiety, and self-consciousness.	6.26	5.35 (4.8)	0.005
Positive emotions: The degree to which consumers expressed positive emotions.	3.66	10.3 (11.2)	0.15**
Negative emotions: The degree to which consumers expressed negative emotions.	2.06	0.82 (2.7)	-0.27**
Health dimensions			
Hearing: The degree to which consumers described their hearing.	0.75	3.2 (3.7)	0.06**
Health: The degree to which consumers described their health.	0.61	1.8 (3.5)	-0.19

Personal concerns			
Time awareness: The degree to which consumers described time, such as having to wait to see a hearing healthcare professional, get their hearing aids, etc.	5.86	4.1 (4.9)	-0.09**
Money: The degree to which consumers expressed personal opinions or concerns about money.	0.59	0.9 (3.1)	-0.13**
Work: The degree to which consumers expressed personal opinions or concerns about work.	2.04	7.6 (10.9)	0.04**

Note: *=*p*-value of <0.05; **=*p*-value of <0.01.

Despite the fact that word counting approaches such as LIWC cannot account for context and intended audience, they are still reported to provide clear insights into a person's psychology in terms of thoughts, emotions, and behaviors (Boyd, 2017). LIWC has high internal reliability and external validity as shown in hundreds of studies (Pennebaker et al., 2015; Tausczik & Pennebaker, 2010).

Data Analyses

SPSS software was used for statistical analyses. The data were examined using descriptive statistics. The language dimension values of a typical blogger from the LIWC handbook (Pennebaker et al., 2015) were compared descriptively with the current sample. Point-biserial correlation (special case of Pearson's product-moment correlation) was performed to examine the correlation between overall user rating (categorical data of 1-5 points) and the language dimension variables (continuous variables). A *p*-value of 0.05 was used for statistical significance interpretations.

Results

Consumer Experience Ratings

This study extracted and analyzed a total of 9,622 consumer reviews on hearing healthcare services. The reviews were distributed across the U.S. regions, cities with different sized populations, and different population demographics as illustrated in Table 1. The mean consumer rating of 4.78 (SD = 0.83) in a 5-point scale (or 95% consumers reporting "very good" and "good") indicated a favorable rating towards the hearing healthcare services.

Examination of Language Dimensions within Textual Responses

Table 2 provides LIWC analysis values of 10 language dimensions identified from online consumer reviews on hearing healthcare services, normative value for language dimensions of typical blogger, and also the correlation between language dimensions of consumer reviews (i.e., text response) and the overall experience ratings (5-point rating). The mean number of words was 48.2 (SD = 58.9) suggesting good engagement of consumers who provided comments about their experiences with hearing healthcare services.

The LIWC results for each language dimensions are presented in percentages. However, examining the current data in comparison with a similar dataset (i.e., a typical blogger) is likely provide some useful insights. Examining the social and emotional dimensions suggest that hearing healthcare consumer reviews had very high social processes, very high positive emotions, and very low negative emotions when compared to normal bloggers. The consumers also had high engagement in terms of health, hearing and several aspects of personal concerns

such as money and work in their reviews. However, hearing healthcare consumers had slightly lower I-words and time awareness when compared to typical bloggers.

The association between language dimensions and overall experience rating examined using point-biserial correlation reveled two broad findings (see Table 2). Positive correlation values suggest that the overall experience rating was higher (or lower for negative correlations) in relation to language dimensions studied. The study results suggested a positive statistically significant correlation between experience ratings and language dimensions such as social processes, positive emotions, hearing and work. On the other hand, a negative statistically significant correlation between experience ratings and language dimensions such as negative emotions, tine awareness, and money. These results reveled two broad findings. First, higher engagement of consumers in terms of social processes, positive emotions, hearing, and work dimensions was related to higher ratings. Second, higher engagement of consumers in terms of negative emotions, time awareness, and money was related to lower ratings.

Discussion

Consumer experience has become an important indicator of quality of healthcare service delivery in recent years (Agency for Healthcare Research and Quality, 2017). The current study examined online consumer reviews using automated linguistic analysis to gain insights about consumer experiences relating to hearing healthcare services. Online reviews are generally provided by consumers independently without solicitation from clinicians or healthcare organizations using their natural language and hence may provide more ecological valid data. The linguistic analysis

of these reports helps understand the thoughts, emotions, and behaviors of these consumers who provided the reviews.

The mean consumer experience ratings (4.78 in a 5-point scale) in the current study indicated an overall favorable rating towards hearing healthcare services. These results are consistent with the recent MarkeTrack 10 study which reported that 94% of hearing aid owners were satisfied with their hearing healthcare professionals (Jorgensen & Novak, 2020). While these results provide a positive reflection of hearing healthcare services, as highlighted earlier, close examination of consumer reports for an open-ended question can provide more detailed insights to those elements of consumer experience that may have contributed to positive or negative overall experience (Manchaiah et al., Submitted).

Qualitative interviews with older adults with hearing loss show that they value both relational and technical competencies of their hearing healthcare practitioner, commercialized approaches to service delivery, and the clinical environment (relevant to both clinician and the clinic), all of which contribute to their development of trust in their hearing healthcare experience (Preminger et al., 2015). Similarly, the recent MarkeTrak survey showed that having a welcoming clinic environment positively influenced consumer purchase decisions (Jorgensen & Novak, 2020). In another study, Poost-Foroosh et al. (2011) examined factors in client-clinician interaction that influence hearing aid adoption and reported that empowering patients through patient-centered interactions may help improve hearing aid adoption. These studies highlight how clinic and clinician related aspects may influence the patient experience. The current study provides novel contribution to this growing body of work by identifying the key elements described in

reflections of hearing healthcare service experiences in online consumer reviews. Specifically, consumers who provided positive overall experience ratings were more inclined to describe their experiences in light of social processes, positive emotions, hearing, and work dimensions. These results emphasize the fact that user experience outside the clinic environment (e.g., social processes, work) and also their internal emotional experience (positive or negative) are important determinants of the user experience. Moreover, in the current study the consumers who provided poor overall experience ratings were more inclined to describe negative emotions, time awareness, and money when reflecting upon their experiences. These observations suggest that audiologists need to focus on these issues to enhance the patient experience. For instance, financial cost may be a barrier for many older adults in their decision to seek help and/or obtain hearing aids. Talking about cost of audiology consultations and also offering patients multiple cost options may facilitate informed and shared decision making during the appointment for a better patient (or consumer) experience (Ekberg, Barr, & Hickson, 2017; Jorgensen & Novak, 2020).

Study Implications

Patient experience is an important indicator of patient outcomes, although there is limited audiological literature examining the hearing healthcare patient (or consumer) experiences. This topic is timely as future hearing healthcare is likely to be differentiated by the professional service delivery aspects (i.e., patient-centered rehabilitative strategies) as various elements of audiological practice including hearing assessment and hearing aid fitting are becoming automated due to advancements in technologies such as artificial intelligence and machine learning (Swanepoel and Hall, 2020). Insights obtained from the current study may help hearing

healthcare professionals to optimize their service delivery in order to enhance their patient experiences. For instance, reducing the waiting times, cost of hearing healthcare services, and also improving their hearing experiences through addressing social/emotional dimensions is likely to improve patient hearing healthcare experience and satisfaction. From a theoretical perspective, the current study is unique as it takes the consumer health informatics approach to analyze the natural language of consumer reviews to gain insights to patient experiences (Demiris, 2016). This novel methodology can supplement the knowledge gained through clinical studies and large-scale surveys. Another benefit of examining the responses to open-ended question is that users can focus on elements that they think are important rather than answering a series of questions developed by clinicians/researchers.

Study Limitations and Future Directions

Despite the novelty of the current study, it has a few limitations in terms of sampling as well as reliability. First, it is common for some clinics to encourage their patients to leave an online review in platforms such as Google or Yelp which may have resulted in some sampling bias. Furthermore, there is no way to verify if reviews left by consumers by their own will or if they were encouraged to leave a review by the clinic sites with some incentive (e.g., discount towards next purchase). Second, the current study does not have user demographics (e.g., age, gender, duration of hearing loss, degree of hearing loss) making it difficult to generalize the results. However, generally those who leave online reviews are likely to be different to the general population (e.g., younger, more tech savvy, more educated, have either positive/negative experience and have the urge to express it in some way) which may further contribute to sampling bias (Anderson & Simester, 2014). Third, the linguistic analyses using the LIWC

software ignores important aspects such as context, irony, sarcasm, and idioms (Tausczik & Pennebaker, 2010), although this method has found to be very powerful in providing insights to person's psychology (Boyd, 2017). Fourth, the current study examined limited number of pre-selected language dimensions that are generic. For these reasons, the current study results much be treated as tentative until they are confirmed through studies on clinical samples.

Future studies in this area should attempt to draw on clinical samples to examine if the current study results are replicated. Exploration of demographic (e.g., age, gender) and audiological (e.g., degree and type of hearing loss, duration of hearing loss) factors influencing the consumer experience may help with understanding whether these findings can be generalized to the wider population. In addition, examining the language dimensions in comparison with standardized self-reported measures such as Consumer Quality Index for 'audiology care' (CQI; Hendriks et al., 2017) may also provide a more comprehensive understanding of patient experiences on hearing healthcare services. It would also be interesting to examine if the consumer experience varies across clinical settings (e.g., independent practice versus ENT practice). Lastly, while some of the generic dimensions are still applicable, there may be some unique dimensions related to hearing aid experience. Such an exploration requires creating some new language dimensions based on qualitative data as well as expert group input and creating the custom LIWC dictionaries which can be considered for future studies.

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