ANALYSING AND USING SUBJECTIVE CRITERIA TO IMPROVE DENTAL CARE RECOMMENDATION SYSTEMS

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Abstract

Online reviews and rating sites are shaping industries as the users rely on recommendations given by former consumers and sharing opinions on the web. Dentistry has also been impacted by dental patients' reviews. This paper classifies trust-related information for dental care recommendations onto 4 categories: context, relationship, reputation and subjective criteria. It discusses each category and describes how they help focussing on trust when matching patients and dentists in brief. The paper then focuses on subjective criteria and presents the results of a survey aimed at showing trust-related information emerged from subjective characteristics. Traits of personalities are used as subjective characteristics of patients and that of dentists are derived from the online patients' reviews. 580 Australian patients were surveyed to determine what factors affect their decision to find the trusted dentist. Subjective characteristics of dentists such as dentists' qualities and experienced dentists are considered the most important factors after location and cost. The most preferred dentists' qualities by almost all types of personalities are experienced, professional and quality of service. When the patients are further classified based on levels of fear, their preferences for dentists' qualities changed. Subjective qualities of both patients and dentists are important factors to improve the matching capability for the dental care recommendation systems.

Keywords: online reviews, social networks, subjective qualities, dental care, recommendation systems, dental crowdsources

1. INTRODUCTION

Overflow of information on the Internet is imminent with huge success of social media recently. For example, Facebook[1] has almost 1.4 billion users, Twitter[2] has 288 million monthly active users and tweeting 500 million tweets per day and Linked[3] in has more than 347 million users. Information overload is now a fundamental problem in online world. With this growth of social media, online reviews and opinions about products and services are growing significantly. These opinions are shaping some of the industries including health, which is inevitable in this internet age. In the health sector, massive amount of online information is available, but it could cause dreadful consequences if used without being able to understand it well. By nature, health information is sensitive and therefore people, who are sharing their information either via online reviews, forums, blogs, or any health social networks (HSNs), may not explain their situation clearly. Therefore, there is a chance that users could misunderstand and use misleading information, which could result in catastrophic consequences (Doyle and Sixsmith 2008, Giustini 2012, Weitzel et al. 2012 and Fernandez-Luque et al. 2012).

In dental care, patients are reluctant to visit dentists because of the nature of invasive treatments which may cause pain (Armfield 2010 and Armitage & Reidy 2012). However, there are many studies done to show that the level of dental anxiety can be reduced by certain behaviour and characteristics of dentists (Dyer et al. 2013 and Sbaraini et al. 2012). There is an upward trend using dental reviews and rating sites, which is referred as dental crowdsources in this paper. Dental crowdsources have been excellent online sources to determine which dentist has what sort of characteristics.

In recommendation systems, information is retrieved and filtered to customise what the users would be most happy with, in terms of either products or services. Retrieval of information about the users has been achievable and used in most popular recommendation sites such as Amazon for books, Netflix for movies, Last.fm for music, TripAdvisor for restaurants and hotel accommodations, etc. Popular recommendation methods, collaborative filtering (CF) and content based filtering (CB) or combination of both, referred as hybrid method, are used. Many other types of methods such as item-based, knowledge-based, trust-based and others have been used by automatically combining intelligence with machine learning for the recommendations systems (de Gemmis et al. 2011). For example, CB is capable of gathering information from users about what type of book or movie or music or restaurants they like either based on their previous consumptions or ratings. However, CF analyses other users in the community, who have rated or used the product or service in a similar way based on other users' consumption, new book or movie or music or hotel, is recommended. Both methods are good techniques in recommendation and it is improved by combinations of both approaches as hybrid.

Nonetheless, these methods are not able to capture situations such as where the users were in, or what was the condition, or who else was present at the time of making the decision on the recommended list. We have proposed a trust-based framework where trust is analysed from multi-perspectives to find the best suitable dentist in the location; for which condition, who has recommended, where it was and type of dentists and patients, etc. Hence, we have classified both dentists and patients based on their subjective characteristics to improve effectiveness of dental care recommendation system.

In this paper, we explore trust-based information related to dental care recommendation system, referred as trust components. One of the components, subjective criteria is then further analysed by incorporating them in profiles of both dentists and patients. Online survey to the dental patients as a methodology is described. The results from the survey are discussed to show how subjective characteristics of both patients and dentists can impact on matching algorithm in the dental care recommendation system. Finally, conclusion is drawn with further future directions in this research.

[1] Facebook (http://newsroom.fb.com/company-info/)
[2] Twitter (https://about.twitter.com/company)
[3] LinkedIn (https://press.linkedin.com/about-linkedin)

2. TRUST COMPONENTS FOR DENTAL CARE RECOMMENDATION SYSTEM

In the context of dental care treatment, patients undergo various methods of treatment each corresponding to different levels of severity in terms of pain and discomfort. Therefore, trust is an important factor while choosing a dentist to ascertain which dentist would make them feel the most comfortable and perform the satisfied treatments. The trust is mostly obtained from patients' opinions.

Trust components related to the dental care recommendation system are evaluated from social network's perspectives whether it is online or offline, referred as social trust. Social networks have been prevalent in human society for a long time but it used to be predominantly offline traditionally. However, the prospect of social networks has now expanded exponentially due to the latest development in information and technology (Hu et al. 2014). Hence, the growth of online social networks (OSNs) is inevitable and has offered many opportunities including comprehensive user profiling for recommendation systems.

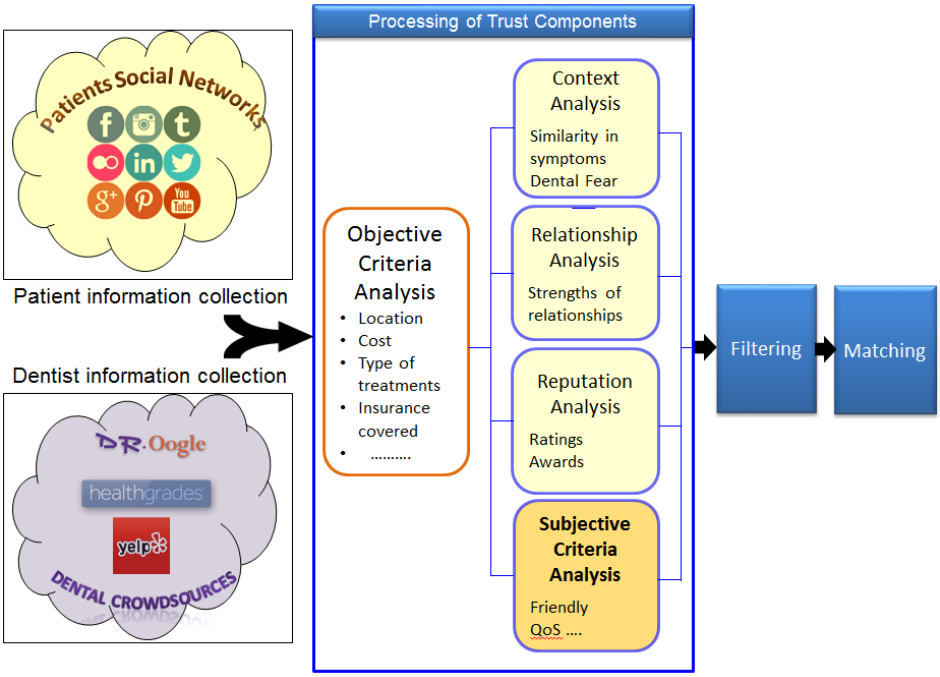

Figure 1. Trust-based information retrieval for Dental care recommendation system

User profiling is the backbone of any recommendation system. For the dental care recommendation system, user profiling for both patients and dentists are envisioned by integrating the trust relevant information as shown in the figure above. Patients are able to ascertain their situation and symptoms better than ever by sharing and comparing on online social networks (Vayena et al. 2012). A kind of social trust can be determined by examining the comparison of symptoms shared in the network. The users are also able to question and understand certain types of symptoms and treatments online. Social networks help to make new friends but the strength of friendships is very important in determining trust between them. A level of trust can be derived from the relationship between friends with regards to recommendations (Wei et al. 2011). Similarly, growing number of dental crowdsources are also useful to measure reputations of dentists and dental practices, in terms of ratings. Subjective characteristics of both dentists and patients are available in OSNs and can be used determine the suitability of each other. The trust components for this study are considered and acquired from social networks' perspectives. Therefore, this system can be also referred as social recommendation system. 4 major trust components from the figure above are described briefly below. Subjective criteria is further analysed with survey data and hence highlighted in the figure above.

3.1 Context Analysis

Regardless of which methods are used to filter the information for recommendations, context is the most important while recommending. Since the recommendation system is about finding a suitable dentist, dynamics of context analysis are critical (Andersen et al 2008 and Gong & Sun 2011). The more information of the context is provided, the better it is to filter the right information from the pool of dentists in the system. For example, demographic information, medical history, known causes, or dental symptoms are basic information that has to be understood well so that a patient can relate to the information provided by other users in the network. Therefore, context is paramount while evaluating trustworthiness of a user in the social network.

Similarity between users in the network in terms of their needs, motivations and other ancillary information such as life style, cultural background, habits, medical history, genetic and side effects, are important when compared. These kinds of information are not easily attainable because privacy of users is the major challenge on the internet. However, sites like 'PatientsLikeMe[4]' are emerging in the health care area so that users are able to share their health symptoms and treatments systematically. 'Similarity in symptoms', 'similarity in treatments' and other similarity information can be compared in between users, which could help to build trusting relationships, as the similarity develops connections in a social network (Bisgin et al 2012). Internet users in HSNs are empowered by the information available to see the similarity of their symptoms and inspired to share more information online (Swan 2009). The users with the similar symptoms could trust each other in sharing information. 'Similarity in side-effects' is another profound piece of information which impacts in the interpersonal trust in users within HSNs. If there is similarity in side-effects in users who had the particular treatment and symptom, there is more likelihood of listening to each other in the network. Additionally, 'similarity in dental fear' can even escalate the level of trust between users. For example, a non-commercial site which provides awareness to the public about the dental anxiety/fear, 'DentalFearCentral[5]' was established in 2004. This site provides descriptions of common fears in dental care and tips to deal with them. This kind of information can reduce dental phobia and increase the possibility of connecting with users more in the social networks. Hussein et al. (2014) have integrated many contextual aspects in their framework, similar approach can be used to increase the level of trust between dental patients.

2.2 Relationship Analysis

Social networks are built from the relationships amongst users in the community. Relationship(s) could be new, or could have already been built due to previous experiences, profile similarity or socially affiliated with each other. Social network analysis based on the strength of relationships, is a powerful tool to determine the users' trust for influence (Chen et al. 2014 and Kwan & Ramachandran 2009). For example, if 'B' is a friend of 'A', 'B' will be more credible than others for 'A' in many context of referrals, simply based on implicit trust (Nepal et al 2012). Social media giant, Facebook, uses this method to recommend friends who are not in the friends' list. In this study, knowing who has recommended the dentist or dental practice would be useful to see a level of trust because the power of strength of friendship does have a prominent place in recommendation system. However, there are situations where explicit trust may be required to determine the suitability of dentist in other situations, such as direct friends. In several studies, when individuals were allowed to choose between recommendations from friends and recommendation systems, they preferred recommendations from friends even though recommendation systems were augmented with novelty factors (Swearingen & Sinha 2001). In the health care domain, because of inherent risk of impacting in health due to misunderstanding, as mentioned above, people tend to listen to people they know, even more.

[4] www.patientslikeme.com
[5] www.dentalfearcentral.org

2.3 Reputation Analysis

Reputation is a social concept which is known for a publicly recognised achievement or credibility of a person. In this study, reputation is investigated for both patients and dentists. Reputation will be established with evidences for both parties in the network (Kim and Phalak 2012). Patients' reputation (or credibility) is analysed based on quality of information shared within the social network, which has direct link to developing relationship with peer patients, as described above. Whereas for dentists, reputations is the aggregated star ratings assigned by their patients in the dental crowdsources. Reputation is based on the dentist's or dental practice's former behaviour experienced by dental patients and represented in the form of star ratings. Dental crowdsources are analysed to work out reputation trust for dentists and dental practices. This is also referred as 'global trust' as it is an external and publicly available to the patients. The concept of reputation increases trust of dentist to the patients while recommending. It also has a potential in providing an incentive for good behaviour and punishment for bad behaviour to the dentists (Simpson 2011). There are many dental rating sites where the dental patients can allocate star ratings based on the experience they had in their last visit to the dentist. The ratings are usually based on number of criteria used to evaluate the quality of service provided to the patients. There is no consistency of the criteria across the dental crowdsources. Therefore, there is a challenge to aggregate ratings and need standard criteria across the industry.

2.4 Subjective Criteria Analysis

Majority of HSNs allow users to create, share and retrieve health related information and retain personal data and activities online within their profile. The trend of sharing, creating and searching information is stored in their profile, however, subjective characteristics such as attitude or perception is challenging to retrieve. Not only retrieving subjective characteristics of patient is challenging but privacy provision and anonymity adds even more complexity to the process of retrieving subjective information of internet users. Nevertheless, advancement of technology in data mining have been exploring sentimental analysis of users based on the words they use or the way they express their view online (Dasgupta and Ng 2009). Although it is not possible to completely retrieve subjective characteristics, certain level of behaviour can be learnt from this kind of analysis.

Subjective characteristics have been included as a latent construct with users' rankings and ratings for products (Luo et al 2008) and rating a professional is a lot to do with his/her subjective characteristics. Subjective characteristics of an individual have been recognised as an inherent factor when recommending an individual. In other words, the perception of subjective characteristics is critical while reviewing a service provider or dental professional. Most of the time, subjective characteristics of dentists are revealed by the patients when they write reviews either offline or online. The terminologies used by patients to describe their dentists, are subjective characteristics or behaviours of the dentists, and they are referred as dentist's qualities in this study. We propose that dentists are recommended based on what their patients thought of him/her in their previous dental visits. Based on the dentists' qualities, we have profiled the dentists in this study.

Similarly, patients can be classified from the reviews they write not only about dentists but also assimilating reviews to other items and services, as well as information collated from the way they are using social networking sites (SNSs) (Vayena et al. 2012). Online involvement of the patients is possible to gather however, it is usually restricted by privacy law. The internet users not necessarily use the same user identification (ID) across different social networks; hence it is restricted to be able to find the characteristics of them. However, with a ubiquitous nature of social media, it is anticipated that an explicit type of users can be determined, based on many variables such as types of post, language used, frequency of posts, and time of the day of postings and so on. There is not only one source for creating a profile but can be combined what user supplied, what other users said about him/her and system generated data (Ellison & Boyd 2013). Nevertheless, due to the privacy and ID issues about users, we have selected traits of personalities as subjective characteristics for patients in this paper. In the next section, profiling of both dentists and patients is briefly explained.

3. ANALYSIS ON SUBJECTIVE CRITERIA

In dental care recommendation system, we have profiled both dentists and patients from their subjective characteristics. Online information through SNSs have been an incredible source to find more information about users (Vayena et al. 2012). We have carried out text mining analysis of dental crowdsources to determine dentists' qualities and used to profile dentists. In contrast, popular personality test is used to determine subjective characteristics of patients in this study.

4.1 Dentists' qualities for profiling

Subjective characteristics of dentists are revealed by the patients when they write reviews. Figure 2 (left) shows how the dentist's qualities are extracted from the dental crowdsources. The text mining of the dental reviews is done to extract subjective characteristics of dentists. The dental patients' reviews from the popular dental crowdsources such as Yelp[6] and DrOogle[7] in the US are extracted. Popular cities of the US like New York, Los Angeles and San Francisco are chosen for this process because of the number of patients' reviews available for this analysis. The reviews are analysed from text mining to determine what patients are saying about the dentists. From the analysis, we have extracted 10 major dentists' qualities: friendly, caring, professional, experienced, knowledgeable, explains well, quality of service, recommendable, reliable and good personality (Pradhan et al. 2014). These qualities are used to profile dentists in the patients' survey, which is discussed towards the later stage of this paper.

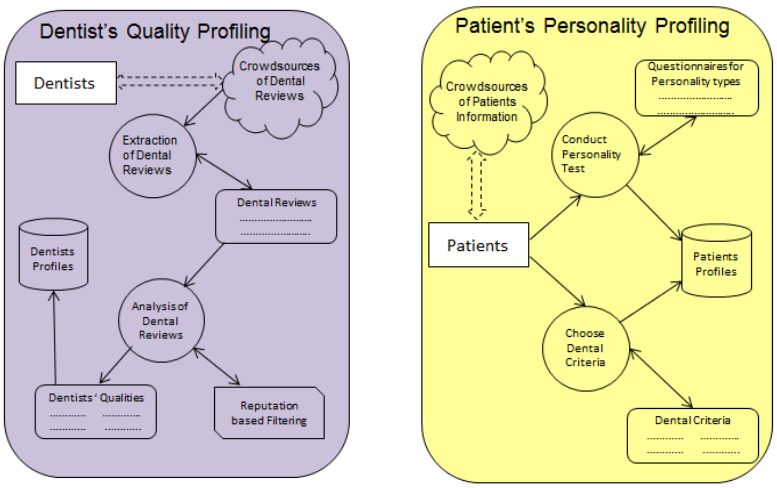

Figure 2. Process of creating profiles (Left: Dentists and Right: Patients) (Pradhan et al. 2014)

4.2 Personalities for patients profiling

In a dental treatment environment, subjective characteristics of patients are crucial for better outcome from the treatment. With the explosive growth of social media like Facebook and Twitter, some researchers have been analysing postings and tweets to create patient profiles, based on the keywords used. We believe that the subjective characteristics of patients can be extracted in the future. However, in the current scenario, we have selected one of the popular personality tests for profiling patients, i.e., DISC: Dominant (D), Influential (I), Steady (S), and Conscientious (C), personality test. Figure 2 (right) shows the process of profiling patients. Behaviour usually is an expression of personality in any

[6] www.yelp.com
[7] www.doctoroogle.com

given circumstances. Extensive lists of behaviours which qualify into the categories of DISC are available such as ambitious, outspoken and decisive as D, friendly, expressive and people-oriented as I, good listener, consistent and family-oriented as S and organised, perfectionist and detail-oriented as C (DISCInsights 2014). Different combinations of D, I, S and C are put together with the following 15 types of personality traits. This list simplifies the DISC personality test for users to understand.

1	Achiever	S/D	6	Developer	D	11	Persuader	ID
2	Agent	S/I	7	Inspirational	DI	12	Practitioner	C/IS
3	Appraiser	IC	8	Investigator	S/CD	13	Promoter	I
4	Counsellor	IS	9	Objective Thinker	C	14	Result-oriented	DI
5	Creative	DC	10	Perfectionist	C/S	15	Specialist	S

Table 1. Profiles based on DISC personality test (discprofiles4u)

4. RESEARCH METHODOLOGY

More than 1000 Australian dental patients participated in online survey through third party research house. 580 out of 1046 are eligible to complete the survey because the rest were screened out if they do not visit dentist at least once in 2 years.

There were 32 questions in the survey. They were divided into major 5 categories. First 5 questions (1 to 5) were basic demographic information such as, age group, sex, level of education etc. Next 5 questions (6 to 10) were targeted to learn information in their dental visit such as frequency of visits, how many different dentists visited in last 10 years, level of dental fear, and types of dental work done. The following 5 questions (11 to 15) were directed to find out about types of their dentists including how they found their dentists, and what is preferred method to find next dentist if needed and how they see their dentist based on 10 dentists' qualities described above. The following 2 questions (16 and 17) are the most critical question of this survey which asked about their preferences in terms of finding a dentist for both objective and subjective information.

The rest of the questions (18 to 31) are formulated to determine personality of the participants. As mentioned above, the questionnaires were imported from freely available DISC personality test (available from discpersonalitytesting.com). The results are discussed in the next section.

5. RESULTS ON SUBJECTIVE QUALITIES

Subjective criteria of both patients and dentists are analysed from the patients' dental care survey results. We assumed that people usually go to visit their dentist and hence all the participants are dental patients. The participants' demographic information, level of dental fear, types of personality are discussed. Dentists' qualities are mapped with personalities and the level of fear they have.

6.1 Dental patients

580 Australians participated in this survey during the month of October in 2014. They range from age groups starting from 16 years of age to 66 and above years as shown in Figure 3 below. 63% of the participants were females. The distribution of age groups and sexes of the participants are shown in the figure below.

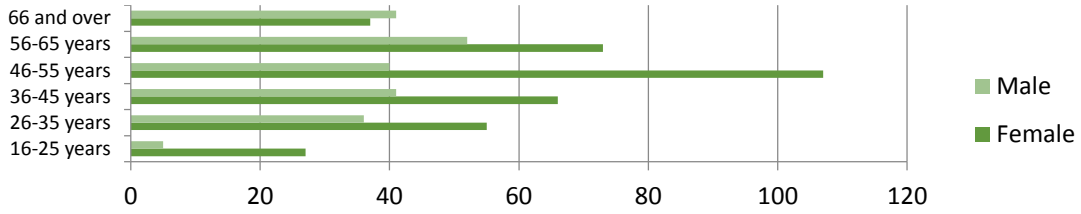

Figure 3. Distribution of age groups and sex of the participants (X-axis = number of participants)

6.1.1 *Dental fear of participants*

Dental anxiety is one of the major reasons why patients avoid seeing dentist. Trust in choosing a suitable dentist is determined by the perception of how likely the dentist would be able to reduce the level of dental fear. In line with this statement, one of the participants stated in a comment box "Just started and am thrilled with the dentist - she helped diminish my fear."
In the survey, the participants asserted their level of dental fear in the Likert scale from 0 (not fearful) to 10 (highly fearful). The summary of the result is shown in the table and graph below.

Number of Participants	580
Mean	4.20
Median	4
Mode	1
Std. Deviation	3.03
Minimum	0
Maximum	10
Sum	2435
1st quartile (Q1)	1
2nd quartile (Median)	4
3rd quartile (Q3)	7

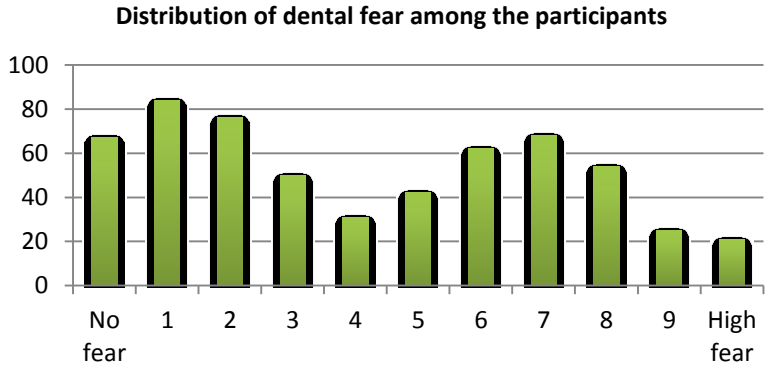

Figure 4. Distribution of dental fear of the participants (Y-axis = number of participants)

From the distribution of dental fear above, the participants are categorised into 4 groups; not fearful (scale: 0 - 2), moderately fearful (scale: 3 - 5), fearful (scale: 6 - 8) and highly fearful (9 and 10). There were only less than 8% highly fearful participants but almost 40% of them were not fearful. From the survey result, it shows that the level of dental fear seems to diminish with frequency of dental visits to their dentists. However, correlation between them is only 0.121, as shown below.

Figure 5. Correlation between level of dental fear and frequency of dental visits of the participants.

Correlations

			Frequency of dental visits	Level of dental fear
Spearman's rho	Frequency of dental visits	Correlation Coefficient	1.000	.121**
		Sig. (2-tailed)	.	.003
		N	580	580
	Level of dental fear	Correlation Coefficient	.121**	1.000
		Sig. (2-tailed)	.003	.
		N	580	580

**. Correlation is significant at the 0.01 level (2-tailed).

The graphs below illustrate the percentage of participants in 4 levels of dental fear and how they are distributed against the frequency of dental visits.

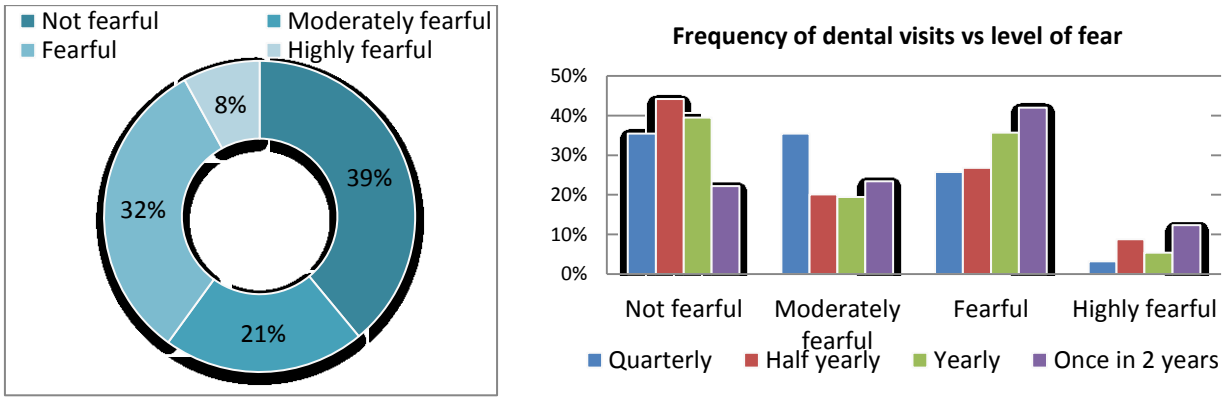

Figure 6. Distribution of participants with different level of fear versus frequency of dental visits.

6.1.2 *Personality traits of participants*

In this study, we are measuring subjective characteristics of dental patients from their personality traits as discussed in the previous section. We have allowed participants to self-assess their personalities and choose one from the 15 personality traits listed in the table 1 as well as answer questions to determine their personality through a set of questions which is freely available online in DISC personality test site. There is a big discrepancy between what participants believe they are and what personality test reveals them what their personalities are. The graphs below show what they chose and what is resulted from the personality test.

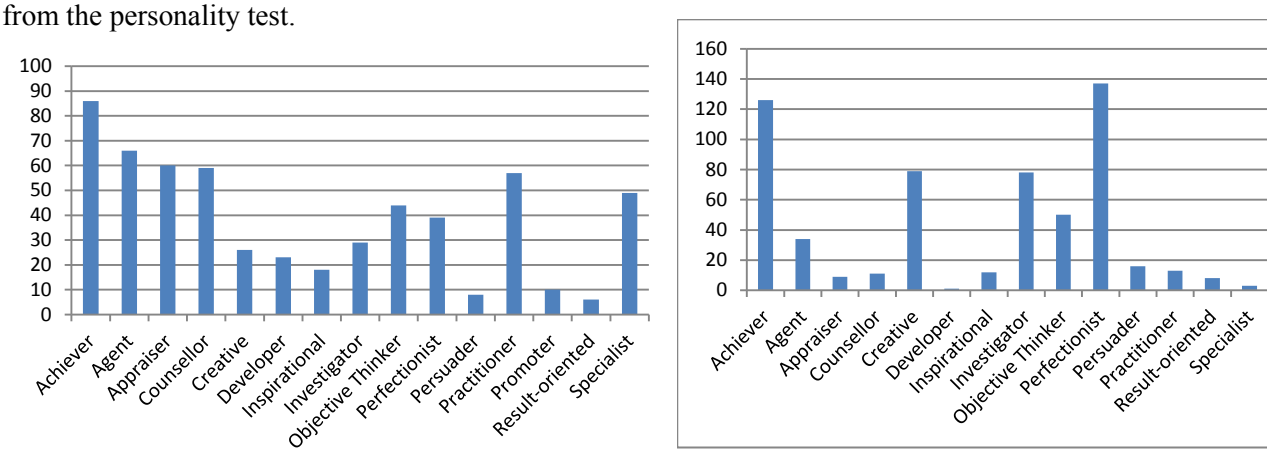

Figure 7. Personality traits self-chosen (left) and resulted from the test (right) (Y-axis = number of participants)

Infact, only 52 participants (9%) chose their personalities correctly as shown in the matrix below. 3 out of 580 participants did not continue the questions for personality test and hence the total number is 577. Self-chosen personality traits are represented by vertical rows and the traits resulted by personality tests are shown horizontally. In this paper, the results from the personality test are taken as the accurate personality traits for further analysis of the results. As per the personality test conducted online, the most of the participants are 'perfectionist' (23.6%) and 'achiever' (21.7%). They are followed by 'creative' (13.6%) and 'investigator' (13.4%). Total 420 participants (72.4%) out of 580 fall into these 4 personality traits, and is shown in the right hand side graph in the Figure 7. The rests are under 10% and are not included for the analysis in this paper. Although 10 participants nominated themselves being 'promoter', the test results shows none of them among the participants existed for that trait; hence they are omitted from the horizontal list in the table below.

Personality Traits (Self vs Test)	Achiever	Agent	Appraiser	Counsellor	Creative	Developer	Inspirational	Investigator	Objective Thinker	Perfectionist	Persuader	Practitioner	Promoter	Result-oriented	Specialist	Total
Achiever	17	12	13	12	7	1	5	12	5	8	2	15	4	2	11	**126**
Agent	5	4	3	8	2	0	1	2	1	1	0	5	0	0	2	**34**
Appraiser	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	**9**
Counsellor	2	0	2	2	0	0	0	0	1	1	0	0	2	0	1	**11**
Creative	18	4	8	4	3	7	2	6	9	9	1	5	1	0	2	**79**
Developer	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Inspirational	2	2	2	1	2	0	0	0	0	0	0	1	0	0	2	**12**
Investigator	8	11	12	7	1	2	2	5	5	2	2	10	0	0	11	**78**
Objective Thinker	7	6	4	4	1	4	1	0	5	5	1	4	0	3	5	**50**
Perfectionist	13	20	11	18	6	6	5	3	15	12	1	12	1	0	14	**137**
Persuader	6	1	1	0	0	1	1	0	2	1	0	1	1	0	1	**16**
Practitioner	1	2	1	0	1	1	0	1	1	0	1	3	0	1	0	**13**
Result-oriented	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	**8**
Specialist	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	**3**
Total	**85**	**66**	**60**	**59**	**25**	**23**	**17**	**29**	**44**	**39**	**8**	**57**	**10**	**6**	**49**	**577**

Table 2. Personality traits of the participants (Self-chosen versus personality test result)

6.2 Subjective qualities of both patients and dentists

In this study, 10 dentists' qualities were extracted from dental crowdsources to profile dentists. Among those 10 dentists' qualities, the participants described their existing dentists as professional, experienced and friendly. They have also asserted that the dentists provide good quality of service, as shown in the radar graph in Figure 8 by the 4 personality traits, who participated the most in the survey. The dentists are described almost identically by those 4 personality traits as shown below.

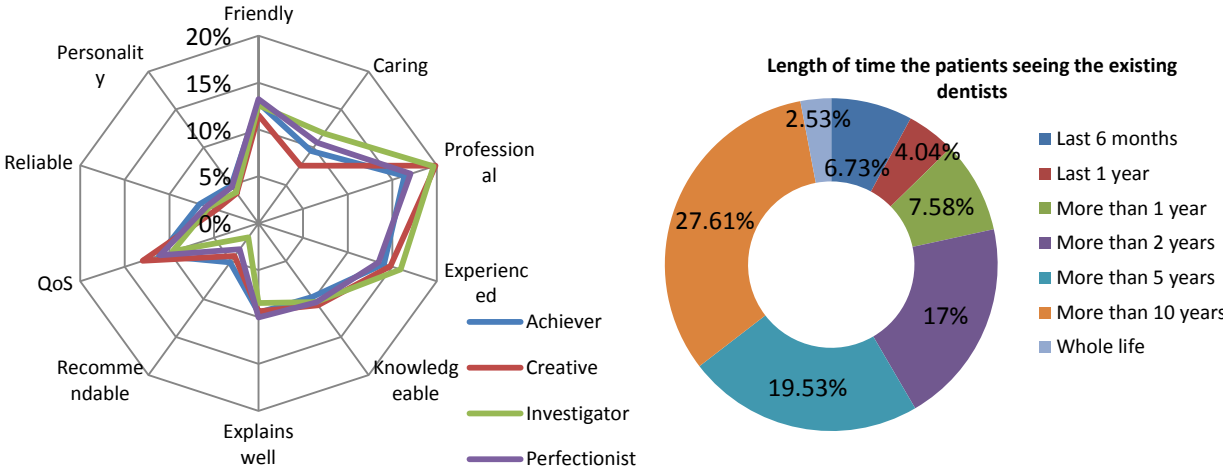

Figure 8. Participants describing their existing dentists and length of time have been seeing the dentists.

These qualities were also chosen the most preferred when the participants were asked to choose the most important dentists' qualities while choosing an ideal dentist. This leads to conclude that most of the patients are satisfied with their existing dentists. 27.61% and 19.53% of 594 participants pointed out that they have been seeing the same dentist for more than 10 years and 5 years respectively as shown in the right side of the figure above. Additionally, 92.4% of the patients indicated that they would go back to the same dentist. Australians are in general satisfied with their dentists.

Top 3 most important dentists' qualities nominated by 'achiever' and 'perfectionist' are compared by segmenting the participants by their different levels of dental fear. Experienced and professional dentists are the most important qualities of dentists but highly fearful achievers and perfectionist prefer to have reliable and friendly dentists respectively, as shown in the graph below.

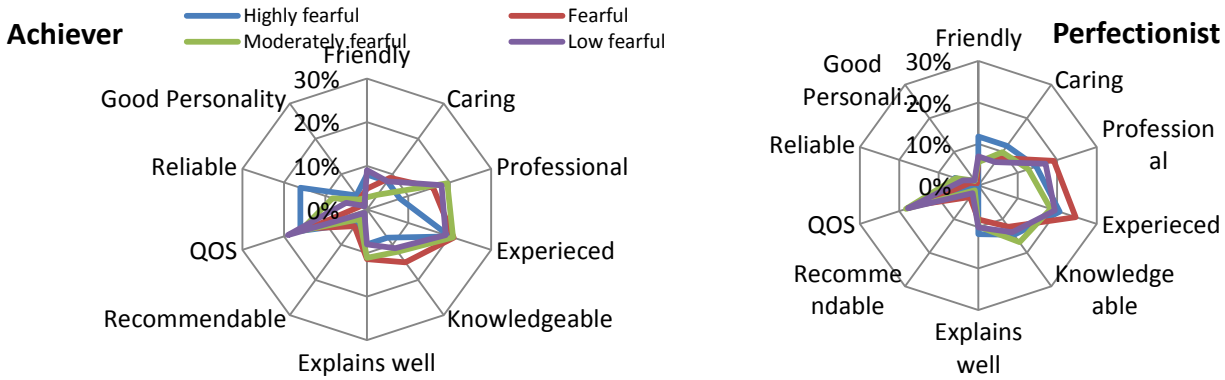

Figure 9. Preferred dentists' qualities by Achiever and Perfectionist with different level of fears.

Similarly, 3 most important factors patients considers while searching for a dentists are experienced dentists, location and cost. However, less fearful achievers and perfectionists also consider recommendations provided for the dentists as well. Highly fearful achievers recognise patients' reviews are important as shown in the graph below.

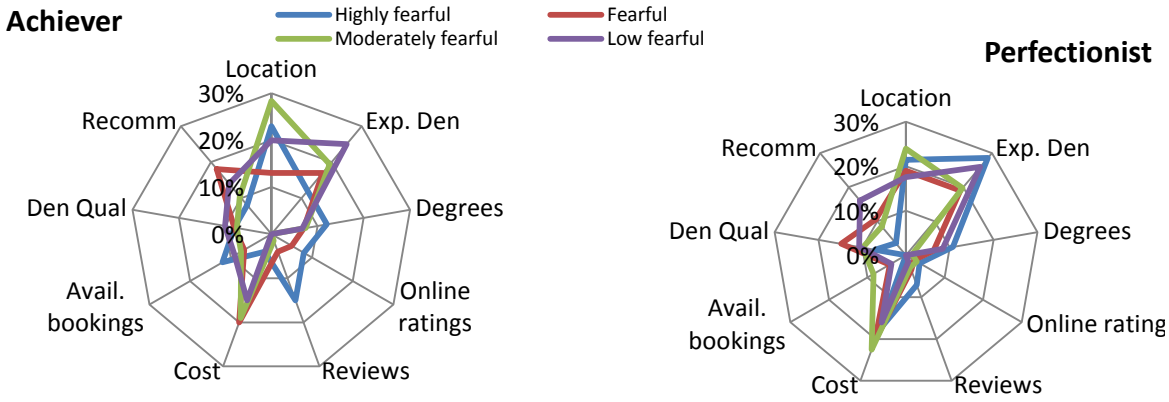

Figure10. Most important factors considered by Achiever and Perfectionist with different level of fears.

Through this study, the subjective qualities of both patients and dentists are analysed to find the best way to match them together. Level of dental fear with personality traits are examined to see how preferences of dentists' qualities are differed. Thus, matching algorithms in dental care recommendations systems can be improved by analysing further subjective criteria both patients and dentists.

6. CONCLUSION

The number of reviews are increasing day by day and impacting the way new patients make decisions in choosing a suitable dentist. We have analysed the trust-related information for dental care recommendation system, so that the decision of choosing a suitable dentist is made easy. Multiple perspectives of trust such as context, relationships, reputation and subjective characteristics of both patients and dentists, are briefly discussed. More importantly, we have analysed how subjective characteristics can add a clear guidance to improve the suitability of matching of patients with dentists. Patients are classified into 15 personality traits by using popular personality test. They are further classified based on level of dental fear to show how they prefer different dentists' qualities for different levels of fear.

This result will be shared with dental practices and government agencies or associations for the approval so that a dental care recommendation system can be promoted to existing dental care search sites. Rules and regulations required for approval from related regulatory bodies will be explored in the near future.

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