

What are people afraid of during dental treatment? Anxiety-provoking capacity of 67 stimuli characteristic of the dental setting

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Relatively little is known about the anxiety-provoking capacity of the various objects and situations characteristic of the dental setting. The aims of the current study were to establish a hierarchy of anxiety-provoking capacities of a large set of dental stimuli and to determine the differences in relation to gender, age, ethnicity, and level of dental trait anxiety. An additional aim was to derive an estimate of the number of stimuli to be presented to anxious patients in order to obtain full coverage of their dental fears. A questionnaire describing 67 potentially anxiety-provoking stimuli was constructed and presented to 960 adults. The results indicated that invasive stimuli (e.g. surgical procedures) were rated as the most anxiety provoking and that non-invasive stimuli (e.g. the dentist as a person) were the least anxiety provoking. The fear-evoking capacity of the dental stimuli varied with gender, age, ethnicity, and level of dental trait anxiety, whereas the rank order of these stimuli appeared to be independent of these factors. Furthermore, it appeared that the top 25 most anxiety-provoking objects and situations found in the current study contained only eight (28%) stimuli, which had been taken into account in previous research. The present findings support the need for assessment procedures using a broad spectrum of potentially anxiety-provoking stimuli.

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Most people experience some apprehension or anxiety when attending a dentist for treatment (1–6). STOUTHARD & HOOGSTRATEN (6) found that only 14.2% of the people in their Dutch sample experienced no fear or apprehension while visiting the dentist. By contrast, 40% indicated that they were anxious about dental treatment, and 10% claimed to be extremely anxious. People with high levels of dental anxiety often report that their anxiety has a large impact on daily life in terms of limited functioning and oral health-related problems (7–11).

The negative influence of severe dental anxiety on daily life raises questions regarding the aspects of the dental setting that have the potential to evoke impairing anxiety responses. Research shows that peoples' past experiences in the dental setting determine the way they perceive the dental situation and the extent to which distinct stimuli evoke fear and avoidance behavior (12–14). Quite a large number of studies have been conducted to identify the potential anxiety-provoking stimuli present in the dental setting. These stimuli include receiving an injection (15, 16), having dental X-rays taken (17), the sight of the needle (18–23), various aspects of the drill, such as sight, sound, smell and sensation (8, 23–25), negative

behaviour of the dentist (14, 26–29), pain sensations (4, 23, 30–32), and several other potentially fear-evoking aspects present in the dental practice (e.g. the smell, the dental personnel, and the chair; 23–39).

However, these studies have several limitations. First, they cover very few of the anxiety-provoking stimuli that are present in a dental setting. For example, only 5 out of the 27 studies covered more than 12 dental stimuli (9, 18, 25, 36, 38) and none covered more than 22, which makes it likely that essential stimuli were missed. Furthermore, a substantial number of studies used the Dental Fear Schedule (DFS) (19–24, 31, 34, 36), which was developed primarily to assess the severity of dental trait anxiety rather than to identify the potential anxiety-provoking capacity of various stimuli. Therefore, the DFS covers only a limited number of the dental objects and situations to which patients can be exposed. Next, information is lacking in most of the studies carried out regarding the rationale underpinning the selection of stimuli used in the questionnaires. In fact, only six studies provide such information (9, 17, 18, 21, 25, 34). Finally, owing to the great variability in the various samples (i.e. students, children, dental patients, and

general population groups) and in the sample sizes (which range from 19 to 1,437 subjects) of the previous studies it is difficult to draw unequivocal conclusions.

Treatment of patients suffering from dental fear or phobia, particularly in settings to which dentally anxious patients are referred in order to reduce their pathological fear response, cannot start if the dentist or psychologist remains unaware of the characteristics, the maintaining factors, and the consequences of the patients' condition. Thus, assessment of a wide range of anxiety-provoking stimuli is of both empirical and clinical importance. Accordingly, the main aim of the current study was to establish a hierarchy of anxiety-provoking stimuli within the dental setting. The second aim was to assess differences in gender, age, ethnicity, and level of dental trait anxiety in the extent to which certain stimuli evoke a fear response. In addition, the relative contribution of these variables to the total variance in stimuli ratings was assessed. Given that the existing questionnaires on dental fear cover only a limited set of stimuli, the final aim was to derive an estimate of the number of stimuli required to be presented to anxious patients in order to obtain full coverage of their dental fears.

Material and methods

A total of 1,119 Dutch people were approached by one of four advanced graduate students (two women and two men) and were invited to participate in a study on dental fear. The participants were approached in a wide range of public places (public transport, terraces, parks, shopping malls, libraries, etc.) across the Netherlands. To obtain a geographically diverse sample (e.g. urban as well as rural areas) and sufficient opportunity to complete the questionnaire, exact locations were selected in advance. The decision to use face-to-face administration, rather than telephone, mail or internet administration, was based on considerations related to accuracy of the screening, coverage properties, response rates, and magnitude of the survey/respondent burden (40).

Instruments

The first part of the questionnaire developed for this study consisted of four items pertaining to demographic variables (i.e. age, gender, marital status, and ethnicity). The second part contained the Dental Anxiety Scale (DAS) (41). This 4-item scale measuring dental trait anxiety is the questionnaire most widely used in studies on dental anxiety. Responses are scored from 1 to 5, providing total scores ranging from 4 (not anxious at all) to 20 (extremely anxious). Dental Anxiety Scale scores of 13 or higher are considered as indicative of high dental trait anxiety (42). Cronbach's alpha for the DAS in the present sample was 0.89.

The third part of the questionnaire contained 67 potentially anxiety-provoking stimuli present in the dental setting. Each stimulus was scored on a 4-point scale, from 1 (not anxiety provoking at all) to 4 (extremely anxiety provoking). The large majority of the potential anxiety-provoking stimuli adopted in this study ($n = 65$ stimuli) resulted from a comprehensive review of the potentially threatening stimuli reported in the literature (27 studies, all cited in the Introduction). Inspection of data obtained from previous unreported studies conducted in our department, in which

anxiety-provoking stimuli were assessed by means of interviews and open-ended questions, resulted in the addition of two items: 'keeping the mouth opened' and 'hands of the dentist in your mouth'.

Procedure

The study was approved by and carried out under the auspices of the Netherlands Institute for Dental Sciences (IOT) and performed according to the ethical principles described in the Helsinki Declaration. Participants were first informed about the aim of the study. Only if a participant was willing to participate, had reached the age of 16 yr, and had sufficient command of the written Dutch language, he/she was asked to complete the questionnaire. Of the 1,119 people approached, 987 (88%) agreed to participate. Reported reasons for refusal were: don't feel like/no time (96.2%) and insufficient command of the Dutch language (3.8%).

Statistical analyses

Mean scores were used to establish the hierarchy of the 67 stimuli comprising the dental setting. In order to derive the factor structure of the 67 stimuli, a principal components analysis with varimax rotation was conducted. Student's *t*-tests were used to detect differences in gender, age, and ethnicity, regarding dental trait anxiety levels. Mann-Whitney *U*-tests were used to identify differences in anxiety-provoking capacities of stimuli with regard to gender, age, ethnicity, and levels of dental trait anxiety. These analyses were applied to each of the 67 stimuli separately, as, from a conceptual point of view, adding up different responses to different fears was considered inappropriate. To determine the relationship between the rank orders of the fear-evoking capacities of the 67 stimuli of men and women, younger and older participants, Dutch and non-Dutch participants, and those with low and high levels of dental trait anxiety, Spearman rank correlations were calculated. If a significant Spearman rank correlation was found it was assumed that the rankings of both groups did not differ. Stepwise regression analysis was conducted to assess the relative contribution of gender, age, ethnicity, and level of dental trait anxiety to the total variance in the number of stimuli rated as extremely fear evoking. For all statistical analyses, a *P*-value of < 0.05 was considered statistically significant. When appropriate, the Bonferroni-Holm procedure was adopted to correct for type I errors. All statistical analyses were conducted using spss version 14.0 software (SPSS, Chicago, IL, USA).

Results

Of the 987 completed questionnaires, 27 could not be used due to missing data (less than 80% of the questions were answered) and these were excluded from subsequent data analyses. Of the 960 remaining participants (response rate: 85.8%), 558 were female (58.1%) and 401 were male (41.8%); the gender of one participant remained unknown. The age of the respondents varied between 16 and 81 yr [mean = 39.1, standard deviation (SD) = 15.3]. To define relatively younger and older subjects in the sample, a median split procedure (median = 38.0) was used. The mean age of the younger

group was 26.3 yr (SD = 6.3) and the mean age of the older group was 52.2 yr (SD = 9.7).

The marital status of the participants revealed that 24.0% were single, 57.7% were married or cohabiting, 13.2% were dating, and 5.1% were divorced. The distribution of ethnicity showed that 71.5% were Dutch, 7.4% Surinamese, 6.8% Moroccan, 5.2% Turkish, and 0.8% Antillean, while 8.3% reported another ethnicity. The distributions of marital status and ethnicity are in line with the figures published by the Dutch Central Bureau of Statistics for the Netherlands (43, 44). The mean DAS score for the total sample was 8.5 (SD = 3.3), which concurs with estimates reported in previous studies conducted in the Netherlands (45, 46).

Hierarchy of stimuli

Table 1 shows the hierarchy, the mean score and the standard deviation for all 67 stimuli, and the proportion of participants who rated each stimulus as extremely anxiety provoking (i.e. score 4). The situations that were rated as most anxiety provoking were 'having dental surgery', 'having some gum burned away', and 'having a root canal treatment', which were rated as extremely anxiety-evoking by 22.0, 25.2, and 24.0% of the participants, respectively. In general, the stimuli that were rated as most anxiety provoking pertained to invasive dental procedures, possibly resulting in tissue damage and pain.

Stimuli that were rated as least anxiety provoking included items such as 'the dentist as a person', 'the dentist entering the dental surgery', and 'the sight of the white gown'. These situations were rated as extremely anxiety provoking by only 0.4, 0.9, and 2.1% of the participants, respectively. In general, these stimuli appeared to be related to non-invasive procedures or otherwise neutral stimuli, for example, those specifically relating to the interior of the dental practice and the dentist as a person.

Factor structure of the stimuli

Principal components analysis with varimax rotation was performed on the 67 potentially fear-evoking stimuli. To be included on a factor an item had to have a loading of ≥ 0.30 . The initial solution revealed seven factors with an eigenvalue of ≥ 1 , explaining 62.6% of the variance. Subsequent inspection of the Scree plot revealed that a two-factor solution was most appropriate. When items loaded onto both factors, the item was added to the factor on which the item had the highest loading. This solution explained 51.4% of the variance (Table 2). The two factors were: (i) an invasive-treatment-related stimuli factor; and (ii) a non-invasive-treatment-related stimuli factor.

Gender, ethnicity, and age related to potentially anxiety-provoking stimuli

All but two stimuli were rated as more anxiety provoking by women than by men (97%). The two exceptions were 'the dentist as a person' ($P = 0.18$) and 'the sight of the white gown' ($P = 0.39$). With regard to ethnicity, 56

stimuli (84%) were rated as significantly more anxiety provoking by people with a non-Dutch background than by people with a Dutch background (see Table 1). Analysis of the age groups revealed that the younger group rated 28 stimuli (41.8%) as significantly more anxiety provoking than the older participants (see Table 1).

Level of dental trait anxiety

Individuals with a DAS score of ≥ 13 ($n = 113$) rated all stimuli as significantly more anxiety provoking than people with a DAS score of < 13 . The mean DAS score of the female participants was significantly higher than that of their male counterparts [$t(930) = -7.09$, $P < 0.001$]. No significant difference between the mean DAS scores of the Dutch and the non-Dutch participants was found ($P = 0.49$). The difference between the mean DAS scores of the younger and older participants was also non-significant ($P = 0.26$).

Rank order of gender, ethnicity, age, and level of dental trait anxiety

A strong correlation between the ranking of anxiety-provoking stimuli of men and women was found ($R_s = 0.99$, $P < 0.001$), indicating that – in terms of the extent to which these stimuli evoke a fear response – there was no meaningful difference in the rank-order as reported by both sexes. Likewise, the Spearman rank correlation between Dutch and non-Dutch participants, between younger and older individuals, and between those with low and high levels of dental trait anxiety, were strong and statistically significant ($R_s = 0.98$, $P < 0.001$, $R_s = 0.98$, $P < 0.001$, $R_s = 0.96$, $P < 0.001$ respectively).

Relative contribution of gender, ethnicity, age, and level of dental trait anxiety

To determine the relative contribution of gender, ethnicity, age, and level of dental trait anxiety to the total variance in stimuli ratings, a stepwise regression analysis was performed. The dependent variable was the number of extremely anxiety-provoking stimuli (score 4) per participant (mean = 4.2; SD = 8.0). This analysis revealed that of the four independent variables, dental trait anxiety was the factor explaining most of the variance in the number of stimuli rated as extremely anxiety provoking, followed by ethnicity and gender, accounting for 34.3, 1.6, and 0.9% of the variance respectively (see Table 3). Age did not enter the model.

Number of stimuli required to cover the full range of potential fear-evoking stimuli

Of the 960 participants, 437 scored at least one stimulus as extremely anxiety provoking. The range of the number of stimuli rated as anxiety provoking varied from 1 to 67 stimuli per participant (mean = 9.2; 95% confidence interval: 8.3–10.1). For this group ($n = 437$), the number of stimuli required to obtain maximum coverage of the

Table 1

Mean scores (and standard deviation) of the 67 stimuli, the proportion of subjects who rated the stimulus as extremely anxiety provoking, and P-values for the statistical hypothesis tests that mean scores differ according to age and ethnicity

Stimulus	Mean	95% CI	Percentage of persons rating stimulus as extremely anxiety provoking	Differences according to ethnicity	Differences according to age	
1	Having dental surgery	2.72	2.67–2.79	22.0	0.010	<0.001
2	Having some gum burned away	2.70	2.64–2.77	25.2	<0.001	<0.001
3	Having a root canal treatment	2.67	2.61–2.74	24.0	0.003	<0.001
4	Insufficient anesthetics	2.58	2.52–2.64	21.6	<0.001	<0.001
5	Extractions of tooth or molar	2.57	2.51–2.64	20.4	<0.001	<0.001
6	Cutting or tearing in soft tissue	2.57	2.51–2.63	19.9	<0.001	<0.001
7	Dentist drilling your tooth or molar	2.33	2.27–2.39	12.1	<0.001	<0.001
8	Pain	2.32	2.26–2.38	14.1	<0.001	<0.001
9	Being pushed about/rough/harsh treatment	2.29	2.23–2.35	13.3	<0.001	0.010
10	Sensation of pain	2.22	2.16–2.28	12.1	<0.001	<0.001
11	Sensation of the needle	2.19	2.13–2.25	12.3	<0.001	<0.001
12	Getting injured	2.19	2.13–2.25	11.5	<0.001	0.001
13	Sensation of an injection	2.17	2.11–2.23	12.4	<0.001	<0.001
14	Receiving an injection	2.15	2.09–2.21	11.1	0.001	<0.001
15	A dentist in a hurry	2.12	2.06–2.19	12.3	<0.001	NS
16	Seeing the needle	2.07	2.01–2.14	9.1	0.010	<0.001
17	Things at the back of your mouth	2.02	1.97–2.08	7.0	NS	NS
18	Having a panic attack	2.01	1.94–2.08	11.8	0.030	<0.001
19	Sensation of the active drill	1.95	1.89–2.01	7.2	<0.001	<0.001
20	The sight of the hyperemic needle	1.94	1.88–2.00	9.9	<0.001	<0.001
21	The steel probe gets stuck in the mouth	1.94	1.88–1.99	6.1	<0.001	0.001
22	The sound of the drill	1.93	1.87–1.98	6.4	0.001	<0.001
23	The fact that you don't know...	1.87	1.81–1.92	5.4	0.010	NS
24	Not knowing what's happening in the mouth	1.87	1.82–1.93	5.4	<0.001	<0.001
25	Filling of cavity in a tooth or molar	1.85	1.79–1.91	6.0	0.002	<0.001
26	Lack of explanation of the dentist	1.82	1.77–1.88	6.3	NS	NS
27	Braces fixed on your teeth	1.78	1.72–1.84	7.3	<0.001	NS
28	Sight of certain dental instruments	1.75	1.70–1.81	4.7	<0.001	<0.001
29	Perceived lack of control	1.74	1.68–1.79	5.0	NS	NS
30	Cold air spray on tooth or molar	1.73	1.67–1.78	5.3	<0.001	NS
31	Dentist scratches your teeth	1.70	1.64–1.75	3.6	<0.001	NS
32	Feeling helpless	1.70	1.65–1.75	3.0	<0.001	0.010
33	Sight of the drill	1.69	1.64–1.75	5.2	<0.001	NS
34	The sense of being enclosed in the dental chair	1.60	1.55–1.65	3.6	<0.001	NS
35	Dentist removes calculus from your teeth	1.59	1.54–1.64	2.3	<0.001	0.001
36	The perceived fear reaction	1.57	1.52–1.61	1.9	NS	NS
37	The sight of blood	1.54	1.49–1.59	4.4	<0.001	<0.001
38	Strange objects in your mouth	1.54	1.49–1.58	2.8	0.020	NS
39	Dental check up with a steel probe	1.53	1.48–1.58	2.9	<0.001	NS
40	Lack of sufficient conversation	1.53	1.48–1.57	3.3	0.003	NS
41	Feeling of numbness from anesthetic	1.52	1.48–1.57	1.5	<0.001	<0.001
42	The smell of the drill	1.52	1.47–1.57	2.6	<0.001	NS
43	The sight of the cold air spray instrument	1.50	1.46–1.55	2.6	<0.001	NS
44	Having teeth cleaned	1.49	1.45–1.54	2.5	<0.001	NS
45	Molds or imprints are made	1.48	1.43–1.53	3.5	NS	NS
46	Dentistry related unpleasant tastes	1.39	1.35–1.43	1.1	<0.001	NS
47	Hands of dentist in your mouth	1.37	1.32–1.41	2.3	<0.001	NS
48	Approaching the dental office	1.37	1.32–1.41	2.1	NS	NS
49	Lying in the dental chair (position)	1.36	1.32–1.41	1.8	NS	NS
50	Keeping mouth opened	1.36	1.32–1.40	2.4	0.002	NS
51	The smell in the dental surgery	1.35	1.31–1.39	1.6	<0.001	<0.001
52	Having a dental checkup	1.33	1.29–1.37	1.3	NS	NS
53	Getting in the dentist's chair	1.30	1.26–1.34	1.4	NS	NS
54	Sensation of water spray in the mouth	1.28	1.24–1.32	0.9	NS	NS
55	The waiting room	1.28	1.24–1.32	1.4	0.002	NS
56	The protective garb of dental personnel	1.28	1.24–1.32	1.5	0.030	NS
57	A remark made by the dentist	1.27	1.24–1.31	0.7	<0.001	NS
58	Dentist's manner	1.27	1.23–1.30	1.0	<0.001	NS
59	Having dental X-rays taken	1.26	1.22–1.30	1.8	<0.001	NS
60	Open your mouth	1.23	1.20–1.27	1.0	<0.001	NS

Table 1
Continued

Stimulus	Mean	95% CI	Percentage of persons rating stimulus as extremely anxiety provoking	Differences according to ethnicity	Differences according to age
61 Calling the dentist for an appointment	1.21	1.18–1.25	1.3	<0.001	NS
62 The dentist examines your teeth (without probe)	1.21	1.18–1.24	0.9	<0.001	NS
63 The dentist describes procedure	1.21	1.18–1.25	0.7	<0.001	NS
64 Bright lights used in the dental surgery	1.19	1.16–1.22	0.8	<0.001	NS
65 The dentist entering the dental surgery	1.18	1.15–1.21	0.9	<0.001	NS
66 The dentist as a person	1.13	1.11–1.16	0.3	<0.001	NS
67 The sight of the white gown	1.12	1.09–1.14	0.4	NS	NS

CI, confidence interval; NS, not significant.

Table 2

Results of the principal components factor analysis on the 67 fear-evoking stimuli

Item	Factor 1. Invasive-treatment-related stimuli	Factor 2. Non-invasive-treatment-related stimuli
Internal consistency (i.e. Cronbach's alpha) of the scale	0.97	0.97
Eigenvalue	18.01	16.45
Percentage of variance explained	26.88	24.57

Table 3

Result of a stepwise regression analysis with the number of extremely anxiety-provoking stimuli as the dependent variable

Variable	Beta	T	P	R ² cum
Total DAS score	0.56	21.17	<0.001	0.34
Ethnicity	0.13	5.16	<0.001	0.36
Gender	0.10	3.58	<0.001	0.37

R² cum, cumulative variance accounted for; DAS, dental anxiety scale; T, t-statistic.

patients' reported potential anxiety-provoking stimuli was calculated. Hereto, first, the number of items with a score of 4 (i.e. extremely anxiety provoking) for the five items with the highest rank numbers (see Table 1) was calculated (A: range 0–5). Next, for each participant, the number of items with a score of 4 was calculated (B: range 0–67). The ratio (A/B × 100) of these two values results in a percentage that indicates the proportion of all extremely anxiety-provoking items covered by the five items with the highest rank numbers for each participant. A ratio of 100 means that the first five items displayed in Table 1 covered all extremely anxiety-provoking stimuli reported by a participant. This procedure was repeated for 10, 15, 20, 25, 30, 40, 50, 60, and 67 items. In Fig. 1 for each group of items only the percentage of participants with a 100% coverage is presented. It shows that

Percentage of participants with 100% coverage

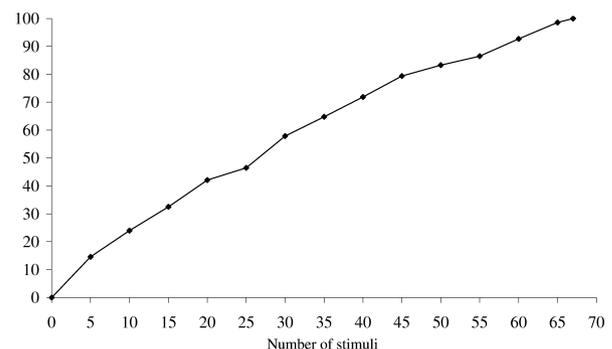


Fig. 1. Number of stimuli in relation to the percentage of subjects in whom the full range of their reported anxiety-provoking stimuli was covered.

the likelihood that a subjects' full range of reported anxiety-provoking stimuli was covered increased linearly with each increasing number of stimuli that patients could consider as anxiety provoking.

Discussion

One of the objectives of the assessment phase in the treatment of anxious dental patients is to gather meaningful information concerning the circumstances under which anxiety symptoms become manifest and thereby exert a negative influence on their dental treatment. To this end, the assessment of the various anxiety-provoking stimuli is of particular importance.

The main aim of the current study was to establish a hierarchy of anxiety-provoking stimuli comprising the dental setting. It was found that, in particular, the more invasive types of stimuli were ranked as highly anxiety provoking, whereas stimuli related to the dental office (e.g. the dental chair), the dental team (e.g. the dentist), and their equipment (e.g. protecting clothes) were found to be the least fear provoking. These results were confirmed by the results of the factor analysis describing a factor structure with two factors encompassing items relating to either potentially invasive treatments or to relatively less invasive procedures and neutral aspects of

the dental setting. In general, these findings are in accordance with previous studies on hierarchies of anxiety-provoking stimuli (18, 23, 37, 47). Interestingly, the dentist as a person generally does not seem to evoke much distress. This suggests that the term 'fear of the dentist', as sometimes used in this context (48, 49), is not a proper denominator to be used in relation to the dental anxiety problem.

It appeared that the fear-evoking capacities of the large set of stimuli used in the present study were dependent on gender, ethnicity, age, and severity of dental trait anxiety. That is, women generally scored higher than men, non-Dutch participants scored higher than Dutch participants, and highly dentally anxious participants scored higher than low dentally anxious participants. With regard to age, a mixed picture was found. The fact that women not only scored higher on dental trait anxiety, but also rated all 67 stimuli as significantly more anxiety provoking than men, is in line with other studies assessing gender differences in anxiety-provoking stimuli (4, 17, 24, 34, 36, 50) and is consistent with the current view on gender differences in anxiety disorders (51, 52).

Similarly, people with a non-Dutch background rated a large majority of the stimuli as more anxiety provoking than their Dutch counterparts. These differences may be explained by the fact that people from foreign countries and non-western civilizations tend to utilize regular dental care less often (53–56), resulting in increased severity of dental anxiety (8, 12, 56), extensive or more invasive treatment (55), and a poor level of oral health (7, 12, 57, 58, 59). Some plausible explanations for these findings are provided by SELIKOWITZ (53), who asserts that the lack of regular care by immigrants may be explained by alternative attitudes towards oral health care, poor knowledge of the local healthcare system, cultural isolation, or lack of the ability to communicate with, or understand, the dentist. As a result of the rising numbers of ethnic minorities, the issue of cultural and ethnical differences is becoming increasingly important (60, 61). The findings of the current study support the notion that it is necessary to remain sensitive to cultural differences among dental patients, particularly those relating to the perception of dental treatment in terms of danger or the likelihood of inflicting harm or pain.

Another interesting finding is that almost 60% of the stimuli were rated as more anxiety provoking by younger participants than by older participants. Closer inspection of the differences revealed that the more invasive stimuli accounted largely for the age differences found in the present study.

All 67 stimuli were rated as significantly more fear evoking by individuals with relatively high levels of dental trait anxiety than by those with lower levels of dental trait anxiety. This corroborates the results of some studies (16, 18), but not of all. For example, DE JONGH & STOUTHARD (30) found that some stimuli differentiated high- from low dentally anxious participants very well, while the sight and feeling of certain instruments and the sense of lack of control did not. The finding that of all variables, the severity of dental trait anxiety was the most

powerful predictor in terms of explained variance of the stimulus severity ratings, suggests that the construct 'level of dental trait anxiety', as indexed by the DAS (i.e. a general measure of perceived emotional arousal and physiological reactions), is closely related to the one used in the present study, which can be defined as 'the extent to which one perceives the dental setting as anxiety provoking'.

The rank order of the stimuli appeared to be independent of gender, age, ethnicity, and level of dental trait anxiety. This suggests that the rank order of fear-evoking capacity of the 67 stimuli is culturally insensitive. Clearly, this notion merits further research attention, including replication in clinical samples in different countries. The finding that the rank order of the stimuli in high and low dentally anxious subjects did not differ is in line with previous findings reported by GALE (18). However, as far as we are aware, no earlier study has focused on the differences in rank orders of dental stimuli in relation to the other demographic variables that were included in the current study, such as gender, age, and ethnicity.

Probably the most interesting result is that with the use of a small set of questions pertaining to potentially anxiety-provoking stimuli, only a limited coverage of patients' fears could be obtained. The results suggest that with a larger set of stimuli, for example > 25, the 100% coverage of present anxiety-provoking aspects of the dental setting would be substantially greater. For instance, with a questionnaire containing five stimuli, full coverage of all the presented anxiety-provoking stimuli would be obtained in only 14.6% of the subjects, whereas with 40 stimuli used the full coverage of anxiety-provoking stimuli would increase to about 72% of the participants. These findings cast serious doubts on the validity of assessment procedures available in both research and clinical settings aimed to determine patients' anxiety-evoking stimuli. In these settings, researchers and clinicians often rely on questionnaires such as the DFS, but the present findings suggest that the sets of items contained by these questionnaires are too limited to cover fully patients' individual dentistry-related fears. This notion is further underscored by the fact that in the top 10 of the most anxiety-provoking stimuli found in the current study, the more frequently reported fear-provoking stimuli in dental anxiety research, such as the waiting room (18, 23, 37) and the sight (18, 23) and sensation of the needle (18, 23, 37) and the drill (18, 23, 37), were all absent. Even more interestingly, of the top 25 most anxiety-provoking stimuli found (see Table 1) in the current study, only eight (28%) have been taken into account in previous research (for example, 9, 25, 30).

A number of issues are relevant to the clinical implications of the current study. For instance, it is conceivable that in the present study participants were asked to rate anxiety-provoking capacities of stimuli or situations that they may not have encountered before. This may have influenced negatively the reliability and validity of their responses and may have led to over-reporting and overestimation of the prevalence of anxiety-provoking stimuli in the dental setting. The same negative influence

holds true for the wording of some of the items. While our ambition to be comprehensive may have resulted in apparently redundant wording of some items or show some overlap with that of other items, the wording of other items may in itself have caused a sense of apprehension. An example is the description of an electro-surgical procedure in periodontal treatment ('having some gum burned away').

In conclusion, the present study indicates that people consider invasive types of dental procedures as most anxiety provoking. The results further suggest that, in contrast to the fear-evoking capacities of dental stimuli, the rank order of the dental setting stimuli is rather robust as it was found to be independent of gender, age, ethnicity, and level of dental trait anxiety. Furthermore, the results suggest that for assessment of which aspects of the dental setting would boost the fear response of an individual patient, common procedures, such as the use of questionnaires containing only a limited set of potential fear evoking stimuli, are unsuitable. This particularly holds true for clinical settings where dentally anxious patients are referred to for specialized treatment, such as dental fear clinics. Within these settings, the use of assessment procedures covering a complete set of potentially anxiety-provoking stimuli would not only enable clinicians to obtain a 'personal profile' of each patient, but would also enhance the likelihood of a positive outcome following exposure-based treatments aimed to alleviate patients' idiosyncratic fears (62).

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