A four-part setting on examining the anxiety-provoking capacity of the sound of dental equipment

Hai Ming Wong, Cheuk Ming Mak¹, Ying Feng Xu¹

Departments of Paediatric Dentistry and Orthodontics, Faculty of Dentistry, The University of Hong Kong, Hong Kong, ¹Department of Building Services Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

Abstract
This paper reports the results of a four-part questionnaire survey to assess the effects of the sound of dental equipment on people’s perceptions and dental anxiety levels. The convenience sample for the survey comprised 230 dental students and 230 gender and age matched non-dental university students. The subjects were requested to complete the questionnaires themselves. The results show that the sound of dental equipment has a great influence on dental anxiety. Dental students, who are more familiar with the operation of this equipment, are less prone to anxiety when they hear its sound than their non-dental counterparts.

Keywords: Anxiety-provoking stimuli, dental equipment, health, sound

Introduction
Dental anxiety is regarded as a serious worldwide health issue despite the technological advances made in modern dentistry. The negative influences of dental anxiety on daily oral health raises questions regarding aspects of the dental setting that have the potential to evoke dental anxiety responses. 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,²,³ having dental X-rays taken,³ the sight of the needle,⁴ various aspects of the drill such as its appearance, sound, and feeling,⁵ improper behavior on the part of the dentist,⁶ pain sensations,⁷ and several other potentially fear-evoking aspects of the dental practice environment including its smell, dental personnel, and the chair.⁸

Although many studies have investigated potential dental anxiety-provoking stimuli, few have focused on the anxiety-provoking impact of dental equipment, including the high-speed air-turbine (dental drill) and the ultrasonic dental scaler. The psychological influence of the sound of dental equipment remains unclear, especially in terms of the effect of the dental drill on willingness to seek dental treatment.

Scofield and Helm⁹ conducted a study to explore the correlation between physiological response and anxiety among a sample of university undergraduates who heard a dental drill and those who did not. The researchers used the electromyogram (EMG) to record signals from participants’ forehead muscles before and while playing a videotape of a tooth being drilled. They used Corah’s Dental Anxiety Scale (DAS)¹⁰ to measure anxiety. Although the research method used in their study was innovative, many questions were left unanswered. The most obvious weakness of the study was that the sample was selected solely from the students in a psychology class. Given that the sample did not represent the total student population, the results do not allow for firm conclusions to be drawn for college students in general.

Yamada, Ebisu and Kuwano¹¹ conducted a survey on the effect of the sound of dental drills on the feelings of patients in Japanese dental clinics. They found that among the 11 dental anxiety-provoking stimuli examined, three items including hearing the sound of a dental drill had more influence on dental anxiety than the others. Their results indicate that the fear of hearing the sound of a dental drill has a great influence on dental anxiety. However, the questionnaire design and data analysis seems to be controversial, and modifications need to be considered. Only 11 dental provoking stimuli were considered, and different results might have been obtained if more dental anxiety-provoking stimuli had been investigated.

Many people are now very concerned about noise and vibration in the indoor environment, as they relate to general health. These concerns have led to a large number of studies examining noise and vibration problems both in the environment and in dentistry.¹²-¹⁴ The effect of the sound...
of dental equipment on dental anxiety is of importance as it affects oral health, which in turn has an influence on general health. The specific problem that motivated this study is that few systematic investigations have examined the effect of the sound of dental equipment on dental anxiety. The aim of this study was thus to examine the effect of the sound of dental equipment on peoples’ perceptions and to assess the relationship between the sound of a dental drill and dental anxiety levels. A four-part questionnaire survey on anxiety-provoking stimuli was designed and used in the study.

**Methods**

**Sample selection**

A convenience sample was selected for this survey. Two hundred and thirty dental students at the University of Hong Kong were invited to participate, and 230 gender and age-matched non-dental students were recruited from other universities in Hong Kong. The students completed a four-part questionnaire themselves.

**Questionnaire survey**

The questionnaire was used to examine the effects of the sound of a dental drill on people’s perceptions and assess the relationship between that sound and dental anxiety.

The first part of the questionnaire contained 73 potentially anxiety-provoking stimuli present in the dental setting. This part was modified from the survey instrument used by Oosterink and coworkers (2008). Each stimulus was scored on a 4-point scale ranging from 1 (not anxiety-provoking at all) to 4 (extremely anxiety-provoking).

The second part of the questionnaire comprised the Dental Anxiety Scale (DAS) and the Dental Anxiety Question (DAQ). The DAS is a 4-item dental trait anxiety measuring scale that is the most widely used scale in dental anxiety studies. The four items in the scale are “If you had to go to dentist tomorrow, how would you feel about it?”, “When you are waiting in the dentist’s office for your turn in the chair, how do you feel?”, “When you are in the dentist’s chair waiting while the dentist gets the drill ready to begin working on your teeth, how do you feel?”, and “You are in the dentist’s or hygienist’s chair having your teeth cleaned. While you are waiting and the dentist is getting out the instruments which he or she will use to scrape your teeth around the gums, how do you feel?”. Responses are scored from 1 to 5, giving total scores ranging from 4 (not anxious at all) to 20 (extremely anxious). In this study, a high dental trait anxiety level was defined as a DAS score of 13 or higher according to the threshold proposed by Corah and colleagues. Respondents were asked the question and were scored from 1 to 4 to measure their degree of fear toward dental treatment.

The third part of the questionnaire was about the perceived unpleasantness of the sound of the dental drill. Respondents were asked three questions focusing on their degree of perceived unpleasantness towards noise and their experience of hearing the sound of the dental drill. The three questions were “Are you easily habituated to environmental noise?”, “Would you feel more comfortable during dental treatment if the sound of the dental drill were lower?” and “What is the grade of perceived unpleasantness brought by the sound of the dental drill?” In the first question, environmental noise referred to general environmental noise including indoor environmental noise, construction site noise, neighborhood noise, and traffic noise. This question was intended to investigate the general attitude of dental and non-dental students to sound. In the third question, the grades included “no perceived unpleasantness”, “slight perceived unpleasantness”, “moderate perceived unpleasantness”, and “extreme perceived unpleasantness”.

The fourth part of the questionnaire developed for this study consisted of items pertaining to demographic variables such as university attendance, age, and gender.

**Statistical analysis**

Data were coded and analyzed using SPSS for Windows 17.0 (SPSS Inc., Chicago, IL, USA). Bivariate associations between the demographic characteristics of dental and non-dental students were examined via χ² tests. Mean capacities were used to establish a hierarchy of the 73 stimuli and the proportion of subjects who rated each stimulus as extremely anxiety provoking among the dental and non-dental students. Ten of the 73 stimuli were selected and divided into five anxiety-provoking factors: Sound (the sound of the drill, the sound of scaling teeth), smell (the smell of the drill, the smell of the scaler), taste (the taste of the drill when the dentist drills your teeth, the taste of the scaler when scaling teeth), sight (the sight of the drill, the sight of the scaler), and feeling (the feeling of the active drill, the feeling of the active scaler). Mann-Whitney U-tests were used to identify differences in the scores for anxiety-provoking factors, the DAQ, and the DAS between dental and non-dental students. Spearman rank correlations were calculated to detect the relationship of the rank orders between the DAQ and the DAS and anxiety-provoking factor capacities. Stepwise regression analyses were conducted to examine the relative influence of each of the anxiety-provoking factors on dental trait anxiety. A P-value of less than 0.05 was considered statistically significant in all statistical analyses.

**Results and Discussion**

Fifty percent of both the dental and non-dental students were male, and the age range was from 17 to 24 years. There was no statistically difference for gender and age between the dental and non-dental students (P>0.05).
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Hierarchy of stimuli

The hierarchy of the mean capacities and standard deviations for the 73 stimuli and the percentage of participants who rated each stimulus as extremely anxiety provoking (capacity 4) are displayed in Table 1 for the non-dental students and in Table 2 for the dental students. It can be seen from Table 1 that “the sound of the drill” and “the sound of scaling teeth” ranked 16th and 17th among the 73 stimuli, with 22.27% and 15.45% of the non-dental students rating them as extremely anxiety-provoking, respectively. These results indicate that

Table 1: Mean scores for the 73 stimuli and the percentage of students rating the stimulus as extremely anxiety-provoking for the non-dental students

| Rank | Stimulus                                      | Mean  | SD   | Lower | Upper | %    |
|------|----------------------------------------------|-------|------|-------|-------|------|
| 1    | Having some gum burned away                  | 3.20  | 0.99 | 3.06  | 3.33  | 51.36|
| 2    | Being pushed about/rough/harsh treatment     | 3.05  | 0.91 | 2.93  | 3.17  | 36.82|
| 3    | Having root canal treatment                  | 3.02  | 1.06 | 2.88  | 3.16  | 45.00|
| 4    | Tooth extraction                             | 2.98  | 0.94 | 2.86  | 3.11  | 35.45|
| 5    | Sensation of the needle                      | 2.90  | 0.92 | 2.78  | 3.03  | 29.55|
| 6    | Pain                                         | 2.89  | 0.97 | 2.76  | 3.02  | 31.36|
| 7    | Sensation of pain                            | 2.87  | 0.97 | 2.74  | 3.00  | 30.45|
| 8    | Getting injured                              | 2.85  | 0.99 | 2.72  | 2.99  | 31.36|
| 9    | Cutting or tearing in soft tissue            | 2.84  | 0.95 | 2.71  | 2.96  | 28.64|
| 10   | Receiving an injection                       | 2.83  | 0.99 | 2.70  | 2.96  | 29.09|
| 11   | Having dental surgery                        | 2.76  | 1.05 | 2.62  | 2.90  | 30.45|
| 12   | Insufficient anesthetics                     | 2.73  | 1.00 | 2.60  | 2.86  | 26.82|
| 13   | Feeling of the active drill                 | 2.70  | 0.98 | 2.57  | 2.83  | 25.00|
| 14   | Sensation of an injection                    | 2.66  | 1.00 | 2.53  | 2.80  | 22.73|
| 15   | Dentist drilling your tooth                  | 2.65  | 0.97 | 2.52  | 2.77  | 21.82|
| 16   | The sound of the drill                       | 2.61  | 0.99 | 2.48  | 2.74  | 22.27|
| 17   | The sound of scaling teeth                   | 2.53  | 0.92 | 2.41  | 2.65  | 15.45|
| 18   | The fact that you do not know                | 2.51  | 0.95 | 2.38  | 2.64  | 16.82|
| 19   | Having braces fixed to your teeth            | 2.49  | 0.98 | 2.36  | 2.62  | 17.73|
| 20   | Filling a cavity in a tooth or molar         | 2.48  | 0.93 | 2.35  | 2.60  | 15.00|
| 21   | The perceived fear reaction                  | 2.47  | 0.90 | 2.35  | 2.59  | 13.64|
| 22   | Perceived lack of control                    | 2.46  | 0.97 | 2.33  | 2.59  | 15.91|
| 23   | Feeling of the active sealer                 | 2.45  | 0.97 | 2.32  | 2.58  | 15.00|
| 24   | Feeling helpless                             | 2.45  | 0.93 | 2.33  | 2.57  | 14.55|
| 25   | The sight of the hyperemic needle            | 2.43  | 1.04 | 2.29  | 2.57  | 18.18|
| 26   | A dentist in a hurry                         | 2.42  | 1.01 | 2.28  | 2.55  | 16.82|
| 27   | Lack of explanation from the dentist         | 2.36  | 0.96 | 2.24  | 2.49  | 12.73|
| 28   | Not knowing what is happening in the mouth   | 2.35  | 0.87 | 2.24  | 2.47  | 9.55 |
| 29   | Dentist scales your teeth                    | 2.35  | 0.95 | 2.22  | 2.48  | 12.27|
| 30   | Strange objects in your mouth                | 2.32  | 0.91 | 2.20  | 2.44  | 10.91|
| 31   | Having a panic attack                        | 2.31  | 0.93 | 2.19  | 2.43  | 11.82|
| 32   | The steel probe gets stuck in the mouth      | 2.29  | 0.97 | 2.16  | 2.42  | 13.18|
| 33   | The smell of the drill                      | 2.25  | 0.96 | 2.13  | 2.38  | 13.18|
| 34   | The taste of the sealer when scaling teeth   | 2.25  | 0.96 | 2.13  | 2.38  | 12.27|
| 35   | Dentist’s hands in your mouth                | 2.25  | 0.98 | 2.12  | 2.38  | 12.27|
| 36   | The taste of the drill when dentist drills your teeth | 2.23  | 0.95 | 2.11  | 2.36  | 12.27|
| 37   | Seeing the needle                            | 2.23  | 0.98 | 2.10  | 2.36  | 12.73|
| 38   | The sight of blood                           | 2.21  | 0.97 | 2.08  | 2.34  | 11.82|
| 39   | Things at the back of your mouth             | 2.20  | 0.96 | 2.08  | 2.33  | 11.82|
| 40   | The smell of the sealer                      | 2.19  | 0.98 | 2.06  | 2.32  | 12.73|
| 41   | Insufficient conversation                    | 2.16  | 0.93 | 2.04  | 2.29  | 9.09 |
| 42   | Feeling of numbness from anesthetic          | 2.16  | 0.87 | 2.04  | 2.27  | 6.82 |
| 43   | Dentist removes calculus from your teeth     | 2.10  | 0.87 | 1.98  | 2.22  | 6.36 |
| 44   | Sight of the drill                           | 2.10  | 0.89 | 1.98  | 2.21  | 7.27 |
| 45   | Sight of the sealer                          | 2.04  | 0.90 | 1.92  | 2.16  | 6.36 |
| 46   | Dentistry-related unpleasant tastes          | 2.00  | 0.90 | 1.88  | 2.12  | 6.36 |
| 47   | The sense of being enclosed in the dental chair | 1.99  | 0.94 | 1.87  | 2.12  | 7.27 |
| 48   | Dental checkup with a steel probe            | 1.98  | 0.89 | 1.86  | 2.10  | 5.91 |
| 49   | Having teeth cleaned                         | 1.97  | 0.90 | 1.85  | 2.09  | 5.91 |
| 50   | The smell in the dental surgery              | 1.96  | 0.88 | 1.84  | 2.08  | 5.45 |

(continued)
Table 1: (Continued)

| Rank | Stimulus                                | Mean  | SD   | Lower | Upper | % \(^a\) |
|------|-----------------------------------------|-------|------|-------|-------|---------|
| 51   | Sight of certain dental instruments     | 1.96  | 0.93 | 1.84  | 2.08  | 7.27    |
| 52   | Lying in the dental chair (position)    | 1.95  | 0.90 | 1.83  | 2.07  | 5.00    |
| 53   | Cold air spray on tooth or molar        | 1.95  | 0.91 | 1.83  | 2.07  | 6.36    |
| 54   | Having molds or imprints made           | 1.95  | 0.83 | 1.84  | 2.06  | 4.09    |
| 55   | Sensation of water spray in the mouth   | 1.93  | 0.91 | 1.81  | 2.05  | 5.91    |
| 56   | Getting into the dentist’s chair        | 1.92  | 0.89 | 1.80  | 2.04  | 5.00    |
| 57   | Bright lights used in the dental surgery| 1.90  | 0.91 | 1.78  | 2.02  | 5.45    |
| 58   | Having dental X-rays taken              | 1.85  | 0.87 | 1.73  | 1.96  | 6.82    |
| 59   | The dentist examines your teeth (without probe) | 1.85 | 0.87 | 1.73 | 1.96 | 5.00 |
| 60   | The dentist describes the procedure     | 1.83  | 0.88 | 1.71  | 1.95  | 5.45    |
| 61   | Keeping mouth open                      | 1.79  | 0.85 | 1.67  | 1.90  | 3.64    |
| 62   | The sight of the cold air spray instrument | 1.75  | 0.80 | 1.64  | 1.86  | 1.82    |
| 63   | Dentist’s manner                        | 1.75  | 0.91 | 1.62  | 1.87  | 5.00    |
| 64   | Having a dental checkup                 | 1.74  | 0.86 | 1.62  | 1.85  | 5.00    |
| 65   | The waiting room                        | 1.72  | 0.83 | 1.61  | 1.83  | 3.64    |
| 66   | A remark made by the dentist            | 1.69  | 0.80 | 1.58  | 1.79  | 2.27    |
| 67   | The protective garb of dental personnel | 1.67  | 0.78 | 1.57  | 1.78  | 2.27    |
| 68   | The dentist entering the dental surgery | 1.65  | 0.80 | 1.54  | 1.75  | 2.73    |
| 69   | Opening your mouth                      | 1.60  | 0.82 | 1.50  | 1.71  | 3.64    |
| 70   | Approaching the dental office           | 1.59  | 0.81 | 1.48  | 1.70  | 3.18    |
| 71   | The dentist as a person                 | 1.58  | 0.79 | 1.47  | 1.68  | 2.73    |
| 72   | The sight of the white gown             | 1.54  | 0.74 | 1.44  | 1.63  | 2.73    |
| 73   | Calling the dentist for an appointment  | 1.35  | 0.67 | 1.26  | 1.44  | 2.27    |

\(^a\)Percentage of students rating the stimulus as extremely anxiety-provoking

Table 2: Mean scores for the 73 stimuli and the percentage of subjects rating the stimulus as extremely anxiety-provoking for the dental students

| Rank | Stimulus                                | Mean  | SD   | Lower | Upper | % \(^a\) |
|------|-----------------------------------------|-------|------|-------|-------|---------|
| 1    | Pain                                    | 2.89  | 0.87 | 2.77  | 3.00  | 26.96   |
| 2    | Sensation of pain                       | 2.85  | 0.93 | 2.73  | 2.97  | 28.26   |
| 3    | Getting injured                         | 2.85  | 0.89 | 2.74  | 2.97  | 26.29   |
| 4    | Receiving an injection                  | 2.77  | 0.94 | 2.65  | 2.90  | 26.09   |
| 5    | Sensation of the needle                 | 2.71  | 0.98 | 2.59  | 2.84  | 23.91   |
| 6    | Sensation of an injection               | 2.69  | 0.94 | 2.57  | 2.81  | 21.30   |
| 7    | Tooth extraction                        | 2.67  | 0.95 | 2.55  | 2.80  | 19.57   |
| 8    | Insufficient anaesthetics               | 2.62  | 0.93 | 2.50  | 2.74  | 20.00   |
| 9    | Being pushed about/rough/harsh treatment| 2.60  | 0.85 | 2.49  | 2.72  | 13.04   |
| 10   | Having some gum burned away             | 2.53  | 0.96 | 2.40  | 2.65  | 18.26   |
| 11   | Feeling helpless                        | 2.50  | 0.97 | 2.37  | 2.63  | 17.83   |
| 12   | Lack of explanation from the dentist    | 2.44  | 0.80 | 2.34  | 2.55  | 9.13    |
| 13   | Cutting or tearing in soft tissue        | 2.42  | 0.92 | 2.30  | 2.54  | 13.04   |
| 14   | The perceived fear reaction             | 2.40  | 0.95 | 2.27  | 2.52  | 13.91   |
| 15   | Having dental surgery                   | 2.38  | 0.95 | 2.25  | 2.50  | 11.74   |
| 16   | Having a panic attack                   | 2.35  | 0.97 | 2.23  | 2.48  | 13.48   |
| 17   | The fact that you do not know           | 2.31  | 0.92 | 2.19  | 2.43  | 12.17   |
| 18   | A dentist in a hurry                    | 2.28  | 0.91 | 2.16  | 2.40  | 9.57    |
| 19   | Perceived lack of control               | 2.26  | 0.91 | 2.14  | 2.38  | 9.13    |
| 20   | Insufficient conversation               | 2.25  | 0.78 | 2.15  | 2.35  | 5.65    |
| 21   | Seeing the needle                       | 2.21  | 0.98 | 2.08  | 2.34  | 10.87   |
| 22   | Not knowing what’s happening in the mouth| 2.20  | 0.89 | 2.09  | 2.32  | 8.26    |
| 23   | Dentist drilling your tooth             | 2.20  | 0.89 | 2.08  | 2.32  | 7.39    |
| 24   | Having root canal treatment             | 2.20  | 0.91 | 2.08  | 2.32  | 7.83    |
| 25   | Feeling of the active drill             | 2.20  | 0.90 | 2.08  | 2.32  | 6.96    |
| 26   | The steel probe gets stuck in the mouth | 2.17  | 0.91 | 2.05  | 2.28  | 8.26    |
| 27   | Feeling of the active sealer            | 2.16  | 0.93 | 2.04  | 2.28  | 8.70    |
| 28   | The sound of the drill                  | 2.13  | 0.96 | 2.01  | 2.26  | 7.39    |

(continued)
among the total of 73 anxiety-provoking stimuli examined, the sound of these two items of dental equipment (dental drill and dental scaler) provoked a relatively high level of dental anxiety. However, Table 2 shows that for dental students, “the sound of the drill” and “the sound of scaling teeth” ranked as only the 28th and 31st most anxiety-provoking stimuli, with 7.39% and 5.22% rating them as extremely anxiety-provoking, respectively. These contrasting results show that the non-dental students regarded the sound of dental equipment as more anxiety-provoking than did the dental students and that a higher percentage of non-dental students rated the sound of dental equipment as extremely anxiety-provoking. This may be due to dental students being less influenced by the sound of dental equipment as a result of their greater familiarity with its operation.

### Dental anxiety and dental anxiety-provoking capacity

Individuals with a DAS score of 13 or higher were defined as participants with dental anxiety in line with the recommendation of Corah and colleagues (1978).[17] In this

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Table 2: (Continued)

| Rank | Stimulus                                         | Mean | SD  | Lower | Upper | % |
|------|-------------------------------------------------|------|-----|-------|-------|----|
| 29   | Strange objects in your mouth                    | 2.10 | 0.83| 1.99  | 2.21  | 5.22|
| 30   | The sight of the hyperemic needle                | 2.05 | 0.94| 1.93  | 2.17  | 7.83|
| 31   | The sound of scaling teeth                       | 2.01 | 0.89| 1.89  | 2.12  | 5.22|
| 32   | The sight of blood                               | 1.99 | 0.96| 1.86  | 2.11  | 7.83|
| 33   | Things at the back of your mouth                 | 1.95 | 0.83| 1.84  | 2.06  | 3.48|
| 34   | Dentist scales your teeth                        | 1.95 | 0.85| 1.84  | 2.06  | 4.35|
| 35   | The taste of the drill when dentist drills your teeth | 1.93 | 0.90| 1.81  | 2.05  | 4.35|
| 36   | Dentistry-related unpleasant tastes              | 1.91 | 0.76| 1.81  | 2.01  | 2.61|
| 37   | Filling a cavity in a tooth or molar             | 1.90 | 0.83| 1.79  | 2.00  | 3.04|
| 38   | The taste of the sealer when scaling teeth       | 1.83 | 0.83| 1.73  | 1.94  | 3.91|
| 39   | Having molds or impressions made                 | 1.82 | 0.82| 1.72  | 1.93  | 3.04|
| 40   | Sight of certain dental instruments              | 1.80 | 0.85| 1.68  | 1.91  | 3.48|
| 41   | The smell of the drill                          | 1.77 | 0.86| 1.66  | 1.88  | 4.78|
| 42   | Having braces fixed to your teeth                | 1.76 | 0.79| 1.66  | 1.86  | 2.61|
| 43   | Feeling of numbness from anesthetic              | 1.76 | 0.80| 1.66  | 1.87  | 2.61|
| 44   | Sight of the sealer                              | 1.76 | 0.83| 1.65  | 1.86  | 2.61|
| 45   | The protective garb of dental personnel          | 1.72 | 0.75| 1.62  | 1.82  | 1.30|
| 46   | Dentist removes calculus from your teeth         | 1.70 | 0.79| 1.59  | 1.80  | 2.17|
| 47   | The smell in the dental surgery                  | 1.69 | 0.80| 1.59  | 1.80  | 2.61|
| 48   | Dental checkup with a steel probe               | 1.67 | 0.70| 1.58  | 1.76  | 0.87|
| 49   | Lying in the dental chair (position)             | 1.67 | 0.77| 1.56  | 1.77  | 1.30|
| 50   | Sight of the scaler                              | 1.64 | 0.78| 1.54  | 1.75  | 2.17|
| 51   | The smell of the sealer                          | 1.64 | 0.74| 1.55  | 1.74  | 1.74|
| 52   | The sense of being enclosed in the dental chair  | 1.60 | 0.74| 1.50  | 1.69  | 1.30|
| 53   | Dentist’s hands in your mouth                    | 1.58 | 0.69| 1.49  | 1.67  | 1.30|
| 54   | Cold air spray on tooth or molar                 | 1.58 | 0.71| 1.49  | 1.67  | 0.87|
| 55   | Getting into the dentist’s chair                 | 1.57 | 0.71| 1.48  | 1.67  | 0.43|
| 56   | Having teeth cleaned                             | 1.55 | 0.73| 1.45  | 1.64  | 1.74|
| 57   | Bright lights used in the dental surgery         | 1.53 | 0.70| 1.44  | 1.62  | 0.43|
| 58   | Dentist’s manner                                 | 1.52 | 0.72| 1.42  | 1.61  | 1.30|
| 59   | Sensation of water spray in the mouth            | 1.51 | 0.76| 1.41  | 1.61  | 2.61|
| 60   | Approaching the dental office                    | 1.51 | 0.69| 1.42  | 1.60  | 0.87|
| 61   | The waiting room                                 | 1.49 | 0.63| 1.41  | 1.57  | 0.00|
| 62   | Having dental X-rays taken                       | 1.48 | 0.67| 1.40  | 1.57  | 0.87|
| 63   | Keeping mouth open                               | 1.45 | 0.68| 1.36  | 1.54  | 0.43|
| 64   | The sight of the cold air spray instrument       | 1.40 | 0.60| 1.33  | 1.48  | 0.00|
| 65   | The sight of the white gown                      | 1.38 | 0.62| 1.30  | 1.46  | 0.00|
| 66   | The dentist entering the dental surgery          | 1.36 | 0.57| 1.29  | 1.44  | 0.00|
| 67   | Calling the dentist for an appointment           | 1.36 | 0.61| 1.28  | 1.44  | 0.00|
| 68   | A remark made by the dentist                     | 1.35 | 0.58| 1.27  | 1.42  | 0.00|
| 69   | Having a dental checkup                          | 1.34 | 0.56| 1.27  | 1.42  | 0.00|
| 70   | The dentist describes the procedure             | 1.33 | 0.60| 1.25  | 1.41  | 0.00|
| 71   | The dentist examines your teeth (without probe)  | 1.30 | 0.55| 1.23  | 1.38  | 0.43|
| 72   | Opening your mouth                              | 1.29 | 0.56| 1.21  | 1.36  | 0.00|
| 73   | The dentist as a person                          | 1.23 | 0.52| 1.16  | 1.30  | 0.43|

*Percentage of students rating the stimulus as extremely anxiety-provoking
study, 22.3% of the non-dental students had dental anxiety in comparison with only 5.2% of the dental students.

Table 3 shows the differences between dental and non-dental students in the scores for anxiety-provoking factors, the DAQ, and the DAS. The mean capacities of the five anxiety-provoking factors among the non-dental students were all significantly higher than those among the dental students ($P<0.001$). Significant differences in DAQ ($P<0.01$) and DAS ($P<0.001$) scores were also found between the dental and non-dental students. These results show that the non-dental students had a statistically higher level of dental anxiety when measured by the DAQ and the DAS and a greater capacity to become anxious on hearing the sound of dental equipment in comparison with the dental students.

The relationships of the rank orders between DAQ/DAS scores and anxiety-provoking factor capacities for the dental and non-dental student sample as a whole were analyzed by Spearman rank correlations. Significantly positive correlations (0.194-0.685) between DAQ/DAS and all five anxiety-provoking factors were found with $P$-values of less than 0.01. This indicates that a higher capacity for the sound of dental equipment to provoke anxiety corresponds to a higher level of dental anxiety when measured by DAQ and DAS scores.

Perceived unpleasantness of the sound of dental equipment
Among the 230 non-dental students, 42.3% reported that they did not easily adapt to environmental noise and 98.0% reported that they would feel more comfortable during dental treatment if the volume of the dental drill were lower. There were 15.5% of the non-dental students who did not perceive the sound of the dental drill to be unpleasant, while 25.9% of them regarded it as extremely unpleasant.

Among the 230 dental students, 42.6% reported that they did not easily adapt to environment noise and 76.2% reported that they would feel more comfortable during the dental treatment if the volume of the dental drill were lower. When hearing the sound of the dental drill, there were 23.0% of the dental students who did not perceive unpleasantness, but 18.3% of them perceived extreme unpleasantness.

The percentage of non-dental students who did not easily adapt to environmental noise is almost the same as that among the dental students. This indicates that the dental and non-dental students had a similar general attitude to sound. In other words, the ability of the dental and non-dental students to adapt to environmental noise was almost the same, making comparison of dental and non-dental students according to their views on the unpleasantness of sound produced by dental equipment meaningful. The percentage of non-dental students who perceived the sound of the dental drill to be unpleasant was higher than the proportion of dental students who held the same view. This is why a higher percentage of non-dental students reported that they would feel more comfortable during dental treatment if the volume of the dental drill were lower.

Risk factors of dental anxiety
A stepwise regression analysis was performed to determine the relative influence of the anxiety-provoking factors on dental and non-dental students. The DAS score was chosen as the dependent variable and the five anxiety-provoking factors were selected as the independent variables. The results of the stepwise regression analysis are shown in Tables 4 and 5. A statistically significant model was obtained, and when “feeling” and “sound” were input into the model, significant $P$-values ($P<0.001$) were obtained for non-dental students. The standardized betas revealed that the “feeling” factor contributed principally to dental trait anxiety and that the “sound” factor had a secondary influence on trait anxiety. In addition, dental trait anxiety was also affected by the “dental/non-dental” property. The value of $R^2$ indicated that 94.0% of the variance in the DAS score was explained by the regression model. However, for dental students, only “feeling” entered the statistically significant model ($P<0.001$). This suggests that the fear of the sound of dental equipment has a significant influence on dental anxiety among non-dental students, but not on dental students.

### Table 3: Mean (SD) scores for anxiety-provoking factors, DAQ, and DAS between the dental and non-dental students

| Variable | Non-dental students | Dental students |
|----------|---------------------|-----------------|
| Sound*** | 2.57 (0.94)         | 2.07 (0.86)     |
| Smell**  | 2.22 (0.97)         | 1.70 (0.78)     |
| Taste*** | 2.24 (0.91)         | 1.88 (0.85)     |
| Sight**  | 2.03 (0.71)         | 1.70 (0.80)     |
| Feeling*** | 2.58 (0.97) | 2.18 (0.91)     |
| DAQ***   | 2.14 (0.86)         | 1.87 (0.72)     |
| DAS**    | 9.74 (3.79)         | 8.04 (2.43)     |

Mann-Whitney test. ***$P<0.01$, **$P<0.001$.

### Table 4: Results of stepwise regression analysis with DAS as the dependent variable for the non-dental students

| Variable | $\beta$ | Standardized-$\beta$ | $P$ |
|----------|---------|----------------------|-----|
| Feeling  | 3.431   | 0.693                | 0.000 |
| Sound    | 1.122   | 0.284                | 0.000 |

$R^2 = 0.940$, $F = 1700.854 (P<0.001)$. Excluded independent variables: Smell, sight, taste.

### Table 5: Results of stepwise regression analysis with DAS as the dependent variable for the dental students

| Variable | $\beta$ | Standardized-$\beta$ | $P$ |
|----------|---------|----------------------|-----|
| Feeling  | 4.451   | 0.963                | 0.000 |

$R^2 = 0.927$, $F = 2918.780 (P<0.001)$. Excluded independent variables: Smell, sight, taste, sound.
Conclusions

The present study indicates that among the five anxiety-provoking factors examined (sound, smell, taste, sight, and feeling), the sound of dental equipment has a great influence on dental anxiety among non-dental students. Dental students, who are more familiar with the operation of dental equipment, are less influenced by the sound of such equipment in terms of dental anxiety.

Further research in this area should use population-based samples. Investigation of the sound quality and spectral characteristics of the sounds of different types of dental equipment and their relationship with dental anxiety would also extend our knowledge of the factors inducing fear of dental treatment.

Address for correspondence:
Dr. Cheuk Ming Mak,
Department of Building Services Engineering,
The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.
E-mail: becmmak@polyu.edu.hk

References

1. Corah NL, O'Shea RM, Bissell GD. The dentist-patient relationship: Perceptions by patients of dentist behavior in relation to satisfaction and anxiety. J Am Dent Assoc 1985;111:443-6.
2. Scott DS, Hirschman R, Schroder K. Historical antecedents of dental anxiety. J Am Dent Assoc 1984;108:42-5.
3. Doebbling S, Rowe MM. Negative perceptions of dental stimuli and their effects on dental fear. J Dent Hyg 2000;74:110-6.
4. Gale EN. Fears of the dental situation. J Dent Res 1972;51:964-6.
5. de Jongh A, Aartman IH, Brand N. Trauma-related phenomena in anxious dental patients. Community Dent Oral Epidemiol 2003;31:52-8.
6. Abrahamsson KH, Berggren U, Hallberg L, Carlsson SG. Dental phobic patients’ view of dental anxiety and experiences in dental care: A qualitative study. Scandinavian J Caring Sci 2002;16:188-96.
7. Mellor AC. Dental anxiety and attendance in the north-west of England. J Dent 1992;20:207-10.
8. Domoto PK, Weinstine P, Melnick S, Ohmura M, Uchida H, Ohmachi K, et al. Results of a dental fear survey in Japan: Implications for dental public health in Asia. Community Dent Oral Epidemiol 1988;16:199-201.
9. Scofield LE, Helm HW Jr. The sound of the dentist’s drill and students’ anxiety scores. Psychol Rep 2001;88:812.
10. Corah NL. Development of a dental anxiety scale. J Dent Res 1969;48:596.
11. Yamada T, Ebisu S, Kuwano S. A questionnaire survey on the effect of the sound of dental drills on the feeling of patients in dental clinics. Acoust Sci Technol 2007;27:305-8.
12. Mak CM, Wu J, Ye C, Yang J. Flow noise from spoilers in ducts. J Acoust Soc Am 2009;125:3756-65.
13. Yan Y, Mak CM. A study of coupled flexural-longitudinal wave motion in a periodic dual-beam structure with transverse connection. J Acoust Soc Am 2009;126:114-21.
14. Sorainen E, Rytikonen E. High-frequency vibration and noise in dentistry. Kuopio University Publications C. Nat Environ Sci 2005;180:80.
15. Oosterink FM, de Jongh A, Aartman IH. What are people afraid of during dental treatment? Anxiety-provoking capacity of 67 stimuli characteristic of the dental setting. Eur J Oral Sci 2008;116:44-51.
16. Neverlien PO. Assessment of a single-item dental anxiety question. Acta Odontol Scand 1990;48:365-9.
17. Corah NL, Gale EN, Illig SJ. Assessment of a dental anxiety scale. J Am Dent Assoc 1978;97:816-9.

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