Acoustic parameters used in dental hypnosis practices

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Abstract. Dental hypnosis has been reported in many journals as a science since James Braid used hypnosis term in his publication in 18th century. Recent research supports the view that hypnotic communication and suggestions effectively changes aspects of the person’s physiological and neurological functions and can enhance the efficacy of various treatment interventions in dentistry. So, the dental hypnosis is truly science not a black magic. The acoustic parameter expression is a tool consisted of three parameters that are duration, pitch and intensity that is used to measure how effective the special sentences/phrases can bring the people consciousness state to unconsciousness state by giving some suggestion. It works by modifying people mind to change their fear of dental treatment for example, to be a contrary condition.

1. Introduction

Going to a dentist is often a frightening experience. About 5% to 10% of the population is so fearful of dental treatment that they will not go to a dentist under any circumstances. A larger proportion also has the fear but willing to go to a dentist when having an acute dental problem, usually being in severe pain. Up to 75% of the US population has a degree of dental anxiety [1]. Then came the dental hypnosis, a method practice in dentistry to make the dental caring problem be more accepted by the patient. It is the way of communication between the dentist and the patient over the subconscious mind [2]. Recent research support that hypnotic communication and suggestions effectively is capable of changing any aspects of the physiological and neurological functions and can enhance the efficacy of various treatment interventions in dentistry [3]. The core element in hypnosis is a shift of focus of attention that involves the brain’s imaginative ability, which has direct and powerful connections with emotions. These are the parts of the brain that form and maintain the phobia, so using hypnosis to gain access to the parts is a particularly effective approach. In this state, carefully scripted suggestions set instilling confidence and calmness, rather than fear and panic, will be accepted at a deep level, which would have little effect if heard in a normal state of mind [4]. The state of hypnosis are mild, medium and deep hypnosis. In mild hypnosis the subject produces alpha brainwaves, whilst in medium generates theta brainwaves. This theta waves also indicating a subject has entered the subconscious mind. As in deep hypnosis the subject generates a delta wave [5].

Practicing hypnosis in dental practices may be readily accepted by the patient when the dentist can communicate well to the patient before any dental treatment [4]. Which also giving a suggestion to the
patient in a pattern of intonation which is a combination of pressure, tone, duration and volume of the pronunciation [6] or some physical parameters of pitch, formant, phoneme duration and sound intensity. These parameters emphasize the verbal expressions containing in the messages delivered by the speaker [4]. These parameters also create the dialect or intonation. If the sentence is wrongly pronounced, it leads to miss-communication. Therefore, a dentist practicing the dental hypnosis techniques ought to understand how to apply the acoustical parameters in every sentence he expressed [7]. And so, this manuscript reports our researches on the acoustical parameters of verbal expressions effectively inducing the state of hypnosis in the dental hypnosis. These parameters are correlated with the brain state recorded by an electroencephalogram.

2. Methods

Some subjects are collected with consecutive-sampling which meet the criteria of inclusion and exclusion. The research then conducted using qualitative method that is based on holistic nature background which is positioning human as the subjects with inductive data analysis and agreements between researchers and the subjects [8]. Before the practice, a subject is prepared by installing electroencephalogram electrodes (figure 1). Afterward a dental hypnotherapist is introduced communicating of the procedure and delivering the hypnosis procedures (figure 2) all in Bahasa (Indonesian language).

![Figure 1. Installing EEG electrodes](image1)

![Figure 2. Inducing dental hypnosis](image2)

The voice of hypnotherapist is recorded for segmentation processes using a digital audio editor into sentences which inserted into the Praat (a free software for speech analysis) acquiring acoustic parameters. Meanwhile, the brainwaves are also analyzed to see when the subject is hypnotized; that is when the brain generates theta & alpha waves. Finally, these parameters are analyzed using principal component analysis method resulting the most dominant acoustic parameter in dental hypnosis.
3. Results
We have four session of data collection related to four young-adult subjects; two males and two females. For each session we processed the subject’s EEGs acquiring the dominant brainwave, i.e. the theta & alpha waves; and the dental hypnotherapist’s voices acquiring the acoustic parameters.

3.1. The dominant brainwaves
The theta & alpha waves (mid-frequency band) are generated dominantly on different brain cortices or electrodes, and at different inductions-phrase sentence. The maximum dominations for each electrode are presented in table 1 to 4 for session I to IV, respectively. The rows in bold are the maximum mid-frequency band percentage that present on such electrode at certain sequence sentence.

| Electrode | Mid-frequency band (%) | Induction-phrase sentence |
|-----------|-------------------------|---------------------------|
| C3        | 45                      | 1st                       |
| C4        | 49                      | 8th                       |
| T4        | 38                      | 8th                       |
| P4        | 55                      | 8th                       |
| T6        | 50                      | 8th                       |
| O1        | 48                      | 10th                      |
| O2        | 46                      | 10th                      |

| Electrode | Mid-frequency band (%) | Induction-phrase sentence |
|-----------|-------------------------|---------------------------|
| Fp1       | 38                      | 30th                      |
| Fp2       | 30                      | 12th                      |
| F3        | 50                      | 23rd                      |
| Fz        | 41                      | 18th                      |
| F4        | 34                      | 8th                       |
| T4        | 45                      | 20th                      |

| Electrode | Mid-frequency band (%) | Induction-phrase sentence |
|-----------|-------------------------|---------------------------|
| Fp1       | 75                      | 14th                      |
| F7        | 56                      | 28th                      |
| F3        | 55                      | 28th                      |
| F8        | 71                      | 21th                      |
| T3        | 56                      | 28th                      |
| C3        | 59                      | 14th                      |
| C4        | 64                      | 28th                      |
| T4        | 78                      | 14th                      |
| T6        | 62                      | 27th                      |
| O1        | 56                      | 28th                      |


3.2. The dominant acoustic parameters
The hypnotherapist voices during dental hypnosis are recorded, segmented by sentences and inserted into the Praat acquiring acoustic parameters, i.e.: duration, intensity, pitch (F0) and formants (F1 to F5).
Such parameters are analyzed to see the dominant acoustic parameter among them. The principal component analysis then employed to obtain the dominant acoustic parameter. From the chart in figure 3 we can see if duration and intensity (0) are the dominant acoustic parameters for all session. In addition, pitch is also dominant in session I and II.

4. Discussions

All of the subjects generate the mid frequencies during the dental hypnosis. And, the brain hemisphere that is affected the most in this study is the parietal which is a central area of primary sensory for sense of touch and hearing [9]. The time needed for each subject entering the hypnotic state or relaxed condition are varied. Investigating table 1 to 4 on the mid-frequency band for each session, we can easily observe if the subject in session III has the highest hypnotizability; that is the degree to which a subject is responsive to hypnotic inductions. The 3rd subject is the fastest subject entering the subconscious that is at the 3rd induction phrase (see table 3). In contrast, the 2nd subject is the most difficult subject entering the hypnotic state that is at the 23rd induction phrase (see table 2).

In contrary, the hypnotherapist assessed if the subjects at 3rd and 4th sessions are the most difficult subjects entering hypnotic state comparing to the subjects at 1st and 2nd sessions. Her assessment is simply a subjective view which is not in accordance with our EEG’s assessment in table 1 to table 4. Moreover, all the induction phrases are classified by a linguist into speech act into five styles; i.e. climatic style, repetitive style, directive-ordering style, assertive-declaring style and expressive-admiring style. Table 5 and table 6 show the pitch and the intensity, consecutively, for each style. It is shown that the climatic style and directive style have a larger average of frequency, as well as the intensity, than others.

![Figure 3. Chart of PCAs obtaining the dominant acoustic parameters for session I, which is the same as session II. Whilst for session III and IV, the dominant parameters are duration and intensity.](image-url)
Table 5. Pitch for each Style

| Style              | Pitch (Hz) | Min  | Max  | Mean  | STD  |
|--------------------|------------|------|------|-------|------|
| Climactic          |            | 190.53 | 289.29 | 230.75 | 19.03 |
| Repetitive         |            | 176.65 | 266.93 | 223.10 | 20.60 |
| Directive-Ordering |            | 179.17 | 289.29 | 235.50 | 21.42 |
| Assertive-Declaring|            | 191.88 | 266.18 | 217.79 | 23.59 |
| Expressive-Admiring|            | 176.65 | 266.18 | 226.87 | 20.47 |

Table 6. Intensity for each Style.

| Style                | Intensity (dB) | Min  | Max  | Mean  | STD  |
|----------------------|----------------|------|------|-------|------|
| Climactic            |                | 49.67 | 76.32 | 65.46 | 6.70 |
| Repetitive           |                | 43.57 | 76.30 | 63.41 | 8.11 |
| Directive-Ordering   |                | 51.02 | 76.32 | 67.45 | 6.59 |
| Assertive-Declaring |                | 49.67 | 68.57 | 57.32 | 6.39 |
| Expressive-Admiring  |                | 48.07 | 76.30 | 62.68 | 7.85 |

5. Conclusions
Duration and intensity are the most dominant acoustic parameters which give the effectiveness of the dental hypnosis. Pitch is also an important parameter but does not dominantly effective, unless it is combined with intensity to generate the right intonation. A relatively low frequency and intensity will bring the subject into subconscious in inductions stage, so the subject can receive any suggestions, direction or commands effectively. It is also indicated by the brainwaves recorded during the dental hypnosis sessions. Five styles of phrase delivered in induction stage and suggestion stage are also characterized. The climactic style and directive style pose a relatively higher pitch and intensity than others.

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References
[1] Agdal M L, Raadal M, Skaret E and Kvale E 2010 *Act. Odont. Scand.* **68** 298
[2] Simon D, Potter C and Temple G 2007 *Hypnosis and Communication in Dental Practice Principle and Interpretation* 4th ed. (London Quintessence Publishing Co Ltd) pp 76-80
[3] Anup P, Iti G, Jyoti O and Narpat Singh R 2014 *Indian J. Multi. Dent* **4** 984
[4] Butler J 2011 *Vital* **8** 33
[5] Jensen M P, Adachi T and Hakimia S 2015 *Am J Clin Hypn.* **57** 3230
[6] Abdurrochman A and Tumbelaka B Y 2007 Proc. Research and Studies VI TPSDP (Yogyakarta: Indonesia) p 78
[7] Erickson M H, Hershman S and Secter I I 2005 *The Practical Applications of Medical and Dental Hypnosis* (OTC Publishing Corp.) p 51
[8] Sugiyono 2011 *Metode Penelitian Pendidikan, Pendekatan Kuantitatif, Kualitatif dan R&D* (Alfabeta Bandung : Indonesia) p 52
[9] White T and Hilgetag C C 2008 *Gyrification and Development of The Human Brain*, ed Nelson C A and Luciana M (MIT Press) p 91