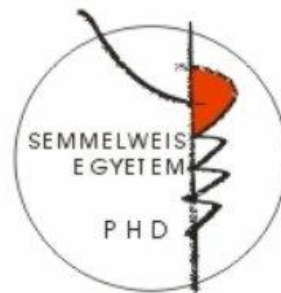


Diagnostic possibilities of dental fear,
focusing on hand-drawing, hand-writing and salivary parameters

PhD thesis

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1. Introduction

In daily dental practice it is a very relevant issue how dental fear and anxiety related to the treatment can be terminated or at least reduced. On several occasions even not phobic patients may be discouraged by anxiety or fear related to dentists or dental treatments. Mainly the somatic diseases of the oral region are dealt with by the dental profession, whereas these discrepancies are often combined with psychological or even patho-psychological deviations which may influence the dental treatment as well. From these symptoms, dental fear and anxiety and the related phobic reactions are the most common and well-known factors. Consequently it may bear utmost relevance to implement a couple of techniques in the dentist's toolbox which may facilitate revealing and overcoming the patients' enhanced fear concerning dental treatments.

'Fear' could be defined as a reaction, which, has concrete evoking factor in the background, whilst anxiety is a feeling characterized by the permanent sense of fear and distress, without any concrete danger in its background. Consequently under '*dental fear*' we may mean the fear reactions developed in the patient by dental activity and its prospective occurrence.

Several factors may stand in the background of dental fear. The problem most commonly emerges in childhood or during puberty for the first time, typically based on prior bad experiences, painful or fearful dental treatment, loss of control or sense of vulnerability during sitting in the dental chair. Bad social status, neglected condition of the teeth could without doubt be considered as important factors in the development of dental fear. Children's dental fear strongly depend on the parents', especially on the mother's sense of fear related to dentistry as it may be conveyed to the child as well. The relationship and the communication between the dentist and the patient may also have an important role, as the inappropriate functioning of patient-dentist relationship may develop an enhanced sense of fear.

Considering the possibilities of the examination and diagnostics of dental fear, the level of dental fear may be evaluated during the *conversation and the establishment of the contact with the patient*, moreover the well-applicable *questionnaires* known from the literature may also facilitate measuring dental fear and anxiety (Dental Anxiety Scale /DAS/, Dental Fear Survey /DFS/, Dental Anxiety Question /DAQ/, Dental Beliefs Survey /DBS/, Background Scale, Spielberger's State-Trait Anxiety Inventory /STAI-S, STAI-T).

Besides surveying the patient personally or with the help of questionnaires, *hand-drawings* may play an important role in the diagnostics of dental fear. The projective drawing tests based on the hand drawings of the patient, could primarily be used for the exploration of the psychic background of dental fear. Prior studies referred to the fact that unconscious contents related to the orofacial region may be expressed in the freeform drawings of the teeth which derives from the

region's redundant symbolic-system (f.e.: demolition/absorption, sexuality, aggression, decay). Those drawing-themes related to the subject of the facial or oral region (such as the teeth, mouth, face, tongue), may develop specific, extra contents from the patient's thoughts, which may be in an intimate correlation with the question of dental psychosomatics and the issue of dental fear as well.

From a similar aspect previous studies have revealed that not only drawing-analysis's base-parameters may be related to dental fear, but certain base-parameters of free association hand-writing (couplings) about teeth may also be linked to this issue. In hand-writing as it is controlled by the psychomotorium, several psychological parameters may be converged in a symbolic form resulting that with the help of writing-analysis we may be able to form a notion of certain part of the patient's present psychic factors.

The examination of the different *psychophysiological parameters* may also facilitate to measure dental fear. These include among others heartbeat, skin resistance, blood pressure, palmer sweat and several parameters, which may be measured from *human whole saliva*. According to the data of the related literature the flow rate of human whole saliva and parameters of it, may react well to emotional stress, for instance the alpha amylase and total protein concentration may increase due to psychic stress, resulting that it may be an appropriate method of examining dental fear.

Various possibilities of therapy of dental fear are known, from which the effects of photo-acoustic stimulation was examined in the present study. Photic and acoustic stimuli have long been used to induce the development of altered states of consciousness and relaxation. During this method, the ears may be stimulated by rhythmic sounds via headphones, while the eyes may be excited with vibrating, glinting light effects, which may be well perceptible even across closed eyelids. The developing trans state is very interesting from a phenomenological aspect: as a result of the vibrating photic impulses the subject may easily experience various, simple imaginations, spontaneously appearing simple or more complicated forms (lines, wave-forms, spirals, tunnels). Thanks to these pleasant experiences the altered state of consciousness may be achieved even in case of less co-operative, passive patients. The method was applied with good results during the treatment of several orofacial diseases with psychogenic origin. Besides the aforementioned, photo-acoustic stimulation has a relevant effect on certain psycho-physiologic parameters such as the flow rate of human whole saliva and its alpha amylase and total protein concentration, secretory IgA, HSP70/HSPA, skin resistance, and the relaxation of the whole body.

2. Objectives

Drawing and writing analysis in the diagnosis of dental fear

- The reduction and treatment of dental fear is a big challenge in the everyday dentistry. According to our assumption besides the appropriate dentist-patient communication, and the application of the different questionnaires related to dental fear, the analysis of hand-drawings may facilitate significantly the process. In these drawings presumably even deeper contents may be revealed which may correlate to dental fear. *Therefore it was evaluated in this study whether an interrelation between dental fear and the level of anxiety and the morphological parameters of hand-drawing can be revealed.*
- A special group receiving dental treatment is the disabled youths. Previous data about the level of dental fear regarding the Hungarian youths living with physical disabilities is not available. *It was our object to examine the level of dental fear and anxiety of the special group of the patients living with physical disabilities compared to a healthy control-group.*
- Neither are prior data available about how does the morphological parameters of the hand-drawings of physically disabled youths (presumably living with an injured body-schema as well) correlate with the body-schema's injuries/intacts and how these factors relate to the level of dental fear. *It is an interesting question in regard of this whether there may be any difference between the drawings illustrating a tooth/teeth, a mouth or a person.*
- Similar to the hand-drawings certain basic parameters of hand-writing may be practical sign of dental fear. The written registration and analysis of the thoughts concerning teeth may be a good opportunity to form a notion about our patient's sense of fear regarding dentistry. The opportunity of multiple analysis of the writing patterns, repeated free associations, the comparison of the results and long-term documentation of these may present itself. *According to our presumption the examination of the basic graphological parameters of hand writings may be a new and useful method of selecting the patients with dental fear and ensuring for them special treatment.*
- The human whole saliva's flow rate and certain parameters of it may react intensively to emotional stress. *As the human saliva is an easily and non-invasively collectable liquid and its alpha amylase and total protein concentration are known to be in good correlation with*

emotional stress, the question may occur whether it may also affiliate the diagnostics of dental fear as well?

The photo-acoustic, the separate photic, the separate acoustic stimulations and the human saliva

As mentioned previously several methods may be appropriate to reduce dental fear. For this purpose the photo-acoustic stimulation was examined in the present study.

- It may be a relevant question both from the researchers' and clinicians' point of view whether *there is any difference between the effects of different stimulation patterns on salivary or phenomenological parameters.*
- A further question may be whether in case of *a repeated, long-lasting stimulation a cumulative effect appears on any of our measured salivary or phenomenological parameters.* It is also an interesting issue whether *there is any difference between the effects of the combined application of photo-acoustic stimulation or the separately used photic or separately used acoustic stimulation regarding the evaluated parameters.*

3. Methods

Hand-drawings and hand-writings in the examination of dental fear

The interrelation of dental fear and morphological parameters of hand-drawing and hand writing was evaluated in this study. Primary and grammar school of Hungarian subjects from Budapest participated in this study (n = 254). Subjects were divided into 3 groups: those participated in drawing task only was considered as "drawing preference" group (n = 74); those participated in writing task only was considered as "writing preference" group (n = 51); whereas those participated in both tasks were considered as "no preference" group (n = 120). Dental fear was measured by the Hungarian versions of the Dental Anxiety Scale (DAS) and the Dental Fear Survey (DFS). To measure the subjects' expectations in terms of dental fear of their surrounding people (parents, brother, sister, friends) the Expectation Scale (ExP) was used. To measure anxiety level the Hungarian version of Spielberger's State and Trait Anxiety Inventory (STAI-S, STAI-T) was used. Following administration of the scales subjects were asked to make drawings and free associations (couplings) as to the teeth.

The subjects participated voluntarily, after the appropriate information about the study had been given. Agreements of the students' parents were also obtained. In case of *hand-drawings* a 15 x 15-cm square on a sheet of paper was used, and the participant was asked to draw a tooth (or teeth) in it. Analysis of tooth drawings was performed with the help of Zoltán Vass's program the

ESPD: 2000- Expert System for Projective Drawings available for free. In case of hand-drawings we measured the (formal, structural) parameters as follows: type, shape, size, localization, size, symmetry, torque, line quality, line length, shading, detailing, transparency, repeating, closeness/openness of the drawing. We evaluated a few parameters connected to the content of the drawing as well as whether it was an upper or a lower tooth and if it had roots or not, the drawing was realistic but of an immature form, the drawing was realistic and shown as perspective, or realistic, but illustrating no perspective, schematic drawing or a unrealistic, fairytale-like tooth drawing

For *hand-writing* free associations (couplings), another sheet of paper was given and the participant was asked to write any thoughts that came into his/her mind about teeth. Evaluating the written free associations fourteen basic graphoanalytical parameters were administered. Eight of them are in connection with the body of the text, including space between the words, conscious space between the lines, average space between the lines, conscious left margin, minimum left margin, average left margin, right margin, and upper margin. Six parameters are related to the letters such as letter size-corrected upper zone, letter size-corrected lower zone, zone height-corrected upper zone, zone height-corrected lower zone, letter width and large initial height. For statistical analysis, the “Statistica 11” software (Stat Soft, US) was used, the minimal level of significance was $p \leq 0.05$.

Effect of being disabled on dental fear and on parameters of hand-drawings

The interrelation between dental fear and drawing parameters and the integrity of body scheme were investigated in the following study. 79 students participated, 46 of them living with physical disabilities (male: 30, female: 16), and 33 healthy students a control group (male: 9, female: 24), mean age: $18,16 \pm 3,01$ years. According to our previous studies the survey listed below were administered: socio-demographic data sheet, DAS, DAQ question, DFS, Expectation Scale, DBS, STAI-S, STAI-T, tooth drawings and free associations (couplings) as to the teeth. We calculated also the DASQ values as well which is the sum of the values of DAS and DAQ.

In relation to tooth drawings data collection and evaluation was the same as previously described. Six colored pencil (black, brown, blue, green, red, yellow) were given to prepare drawings of a man, a tooth and a mouth. In case of mouth drawing we created new partly content parameters as well, such as: is it opened or not, is it smiling or not, is it a plumped or a linear shaped mouth, whether teeth are present in the mouth or not, the tongue is present or not. For statistical analysis, the “Statistica 8” software (Stat Soft, US) was used, the minimal level of significance was $p \leq 0.05$. Cronbach alpha and Pearson correlation values were administered as well as one-way ANOVA, Student's t test and the test of independence.

The correlation of dental fear and salivary parameters

The connection between dental fear and anxiety and salivary parameters were examined in the following study. There are some parameters like alpha amylase and total protein concentration of human whole saliva which is known to be in good correlation with emotional stress. 30 healthy subjects participated in this study (male: 17, female: 13, mean age 31,1±11,1). The participants fulfilled the same dental fear questioners as described above, and prepared their drawings and written free associations as to the teeth.

After the dental fear questionnaires resting whole saliva was collected with the method described by Schwartz et al. The participants were told to swallow first, and then allow the resting saliva to accumulate in their mouth during 5 minutes and then to transfer it into a collecting vessel. The collected saliva was stored on -20 °C until use (detailed description of salivary analysis could be seen in chapter “Collection and handling of saliva”). For statistical analysis, the R Project for Statistical Computing program was used, the minimal level of significance was $p \leq 0.05$.

The study design of photo-acoustic, separately used photic or separately used acoustic stimulation

In this study four diverse stimulation frequency patterns of photo-acoustic stimulation were investigated in a self-control design with repeated stimulation. Experiments were repeated four times, and all the four divergent stimulation patterns were administered in each experiment based on the Latin square system. Resting whole saliva was collected in 5 min phases. The treatment schedule was as follows:

1. First arrival phase
2. Control phase
3. Stimulation phase 1
4. Poststimulation phase 1
5. Stimulation phase 2
6. Poststimulation phase 2
7. Stimulation phase 3
8. Poststimulation phase 3
9. Stimulation phase 4
10. Poststimulation phase 4
11. last (post experimental) control phase

Every phase lasted five minutes. In this study 20-20 healthy volunteers without any oral pathologies participated (*photo-acoustic* stimulation: male: 8, female: 12, age between: 22-35 yrs., mean age: $26,4 \pm 4,45$ yrs., *photic* stimulation: male: 8, female: 12, age between: 22-35 yrs., mean age: $25,6 \pm 4,12$ yrs., *acoustic* stimulation: male: 8, female: 12, age between: 22-35 yrs., mean age: $26,3 \pm 3,86$ yrs.). Subjects were asked not to eat within 60 minutes prior to sample collection. They were also asked to avoid alcohol and caffeine. All the subjects were non-smoker and were not taking any medications.

The photo-acoustic, separately used photic or separately used acoustic stimulation

Photo-acoustic, photic and acoustic stimulation was carried out with the use of a signaler (“David paradise XL”, Comptronic Devices Ltd, Edmonton, Alberta, Canada). Stimuli were administered under eye-closed condition in a sitting position

Four diverse stimulatory frequency patterns were studied as follows:

- increase from 1 Hz to 15 Hz
- decrease from 15 Hz to 1 Hz
- increase from 1 Hz to 15 Hz followed by a decrease from 15 Hz to 1 Hz at half time
- decrease from 15 Hz to 1 Hz followed by an increase from 1 Hz to 15 Hz at half time

Phenomenological effects of photo-acoustic, photic and acoustic stimulation

Phenomenological parameters of the stimulation phases were measured with a short list of queries about the appearance of complex (“lifelike”, “true”) imaginations, subjective trance experience and day-dreaming like imaginations. The subjects were asked to rate via numerical analogue scales, how strongly each of the above three phenomena dominated their subjective experience during the stimulation phases. Phenomenological parameters were measured in relation with the stimulation phases only (thus they were not measured in relation with the poststimulation or control phases).

Collection and handling of saliva

Resting whole saliva was collected with the method described by Schwartz et al. The participants were told to swallow first, and then allow the resting (or stimulated) saliva to accumulate in their mouth during the 5 min stimulation phases, poststimulation phases or control phases and then to transfer it into a collecting vessel. The collected saliva was stored on ice, homogenized by a vortex mixer for one minute, and precleared by centrifugation (i.e. $10.000 \times g$; 4°C ; 10 min). The supernatant was removed and stored at -20°C until use.

Excreted amount of saliva was measured by means of a small measuring tube, and the flow rate was calculated considering 5 min. duration of saliva collection. Total protein concentration of the saliva samples was determined based by the Bradford (Coomassie blue) method using a Bradford reagent kit (Sigma-Aldrich, Hungary). Amylase activity of the sample was determined with the starch split (starch-iodine) method. Briefly: The reaction mixture was composed of 1 w/v% starch (Sigma-Aldrich, Hungary) which was used as a substrate in a buffer containing (0,2 M Tris, pH 7,4) The substrate solution was pre-incubated at 25 °C for 15 min, and then 1-1,5-2 µl saliva sample was added. The enzymatic reaction was conducted at 25 °C for 4 min, stopped with 1M HCl and an iodine solution containing 0.005 w/v% of I₂ and 0.05 w/v% of KI was mixed with the reaction mixture for color development. After incubation at room temperature, the absorbance was measured at 660 nm. Based on the concentration/activity values and the flow rate total protein output and amylase output values were calculated.

For statistical analysis the “Microsoft Excel 2010” (www.realstatistics.com) was used. For the statistical analysis two-factor ANOVA with repeated measurements, Friedman’s test, and Wilcoxon matched pairs test were used, the minimum level of significance was $p \leq 0.05$.

In the case of healthy volunteers photo-acoustic, photic and acoustic stimulation is considered as a noninvasive tool. Saliva collection was also completely noninvasive. The subjects participated voluntarily, after the appropriate information about the study had been given. Agreements of the subjects were also obtained. Phenomenological queries and saliva samples were number-coded and stored anonymously, without any indication of the name, gender or age of the subjects. Our study was planned in compliance with the Helsinki Declaration.

Our investigations related to dental fear and anxiety and the morphological parameters of hand drawings and hand writings were controlled and approved by the Regional Scientific Ethical Board (issue number: ETT-TUKEB 89/2008). Also our research related to photo-acoustic stimulation and salivary measurements were controlled by the Regional Scientific Ethical Board (issue number: ETT-TUKEB 23009-0/2010-1018EKU (896/PI/010)).

4. Results

Interrelation between dental fear and morphological parameters of hand drawings and hand writings

Hand drawings and hand writings were evaluated in our study of 245 participants. 120 of them participated in both drawing and writing tasks („no preference” group) after the dental fear surveys were fulfilled. 74 participants made only drawings of a tooth or teeth (drawing preference” group)

and 51 subjects made only written free associations as to the teeth (“writing preference group”). Mean age of drawing preference group was higher than the other groups.

Evaluating the drawing parameters of the “drawing preference” group data indicate that DAS related to the parameter of detailing, both STAI-S and STAI-T values related to shape and closeness/openness of the drawing, quality of the lines and if the drawing had roots or not. Whereas Expectation scale related to the torque, line quality and detailing of the drawing.

Evaluating the writing parameters of the “writing preference” group data indicate that dental fear values (DAS and DFS) related to space between the words, right margin, corrected lower zone of letter high and letter width. Expectation scale related to the space between the lines. The right margin, the upper margin and zone height-corrected lower zone of the letters related to STAI-S significantly.

Evaluating the drawing parameters of the “no preference” group the detailing, closeness/openness of the drawing, and if it represents roots or not related to dental fear while examining the writing parameters data indicate that the space between the words and upper margin related to dental fear (DAS, DFS). Expectation scale related to drawing parameters only in this group, namely the size of the drawing and whether it represents roots or not. In case of anxiety scales the data indicate a significant connection with closeness/openness of the drawing (drawing parameter) and right margin, letter size and zone height-corrected upper zone (writing parameter).

Interrelation between dental fear, intactness of body scheme and basic drawing parameters

Dental fear and drawing parameters of physically disabled and healthy volunteers were examined. 79 young subjects participated, 46 physically disabled (male: 30, female: 16), and 33 healthy (male: 9, female: 24) subjects as a control group, mean age: $18,16 \pm 3,01$ yrs. Chronbach alpha values of the scales were high enough: DAS:0,76, DASQ:0,83, DFS: 0,94, DBS:0,74, STAI-S:0,87, STAI-T:0,81 (Chronbach alpha value is not interpretable in case of the single question DAQ and the Expectation scale which is not necessary to answer all questions) We have to mention that the correlation between the scales were similar to those of similar studies, however in case of disabled person correlations between DBS and other scales is somewhat lower than usual. This low value may indicate that dentists treat their disabled patients according to templates, with keeping distance. This might be the reason why a sufficiently varied picture of patient-dentist relationship could not be formed. Disabled subjects scored higher in all the scales than healthy ones and there was a statistically significant difference in the case of DBS scale. The values of disabled male subjects and control male subjects differed significantly in case of DAQ and DBS scales, while disabled female subjects and healthy female subjects differed significantly in values of STAI-T only. The difference between disabled males and disabled females appeared to be significant in case

of Expectation scale. Males and females of the control group did not differ significantly in any sales.

Our data suggest that being disabled has an effect on basic formal parameters of drawings. The tendency of higher dental fear scores of disabled person (especially the significantly higher DBS values) can play a role in this situation as 5 of the parameters in case of person drawings, 5 of the parameters in case of tooth drawings, and 1 of the parameters in case of mouth drawings showed significant connection with dental fear.

In case of person-drawings being disabled influenced two drawing parameters: position and line quality. Interestingly in case of tooth drawings we found five parameters in connection with being disabled: symmetry, torque, line quality, repeating, and transparency. In case of mouth drawings being disabled influenced three drawing parameters: line quality, detailing, color.

Analyzing the whole sample percentage distribution of various parameters of person-drawings, tooth drawings and mouth drawings it can be concluded that in this study the person-drawings are more detailed than other drawings, however distortion is more common. In case of tooth drawings the lines are less definite but repeating and transparency appears more frequently.

Tooth drawings and mouth drawings were evaluated according to additional (content) parameters as well. In case of tooth drawings two parameters (representation of roots, realistic vs. unrealistic) were in connection with the sample group (disabled vs. control) and one parameter (upper or a lower tooth) was in connection with gender in case of control males and females. In case of drawing mouth two parameters (smiling vs. not, plumped vs. a linear shaped mouth) were in connection with the sample group (disabled vs. control) and two parameters (opened vs. closed, teeth are present in the mouth or not) were in connection with gender in case of the control group. Interestingly the categories mentioned above had no connection with dental fear or anxiety scales in any of the drawings.

Relationship between dental fear, salivary parameters and basic drawing and writing parameters

30 subjects participated in this group (male: 13, female: 17, mean age: 31,1±11,1 yrs.). Dental fear values of the examined group were in good correlation with previous results from Hungary.

From the measured salivary parameters in our study protein concentration had significant relationship with dental fear (DAS). Interestingly none of the measured salivary parameters had significant connection with anxiety scales.

Evaluating the subject's basic tooth drawing parameters three of them (size, detailing, and torque) related to DAS and two of them (size and torque) related to DFS. Considering the anxiety values one parameter (torque) was in connection with STAI-S scale. One of the basic writing parameters of free associations as to the teeth had significant correlation with STAI-T.

Effects of photo-acoustic, photic and acoustic stimulation

Phenomenology

In this study the effects of photo-acoustic, separately used photic and separately used acoustic stimuli on phenomenological parameters were detected. Three phenomenological parameters such as appearance of complex (“lifelike”, “true”) imaginations, appearance of subjective trance experience and appearance of day-dreaming like imaginations were measured. These parameters were measured with numerical analogue scales in relation to the stimulation phases only. As the questions were the same in case of photo-acoustic, separately used photic and separately used acoustic stimuli, were summarized in relation with the stimuli below:

in case of *photo-acoustic* simulation significant differences were found between the stimulation phases in the case of *day-dreaming like imaginations*. In this relation the values of the first and the second stimulation phases differ significantly comparing to those of the fourth stimulation phase, which may be an indication of a cumulative effect of repeated stimulations.

- in case of *photic* simulation significant differences appeared between the stimulation phases in the case of *trance experience*. In this relation the values of the first stimulation phase differ significantly comparing to those of the second and the third stimulation phase.

- in case of *acoustic* simulation significant differences were detected between the stimulation phases in the case of *complex imaginations* and *trance experience*. In case of the appearance of complex imaginations the first stimulation phase differed significantly from the second, third and the fourth stimulation and the second stimulation values differed from the first, third and fourth stimulation values. In case of trance experience very similarly the values of the first stimulation differed significantly from the second, third and fourth stimuli, and the second stimulation phase values from the first, third and fourth.

Flow rate

Investigating the effects of photo-acoustic, photic or acoustic stimulation it is obvious that secretory rate strongly decreases during the stimulation phases and returns to the baseline in the poststimulation phases. Values of the stimulatory phases significantly differ from their poststimulation values and from control values, and the poststimulation values do not differ significantly from the control values. There is no significant cumulative effect of repeated stimulation on this secretory parameter.

Evaluating the effect of different stimulation patterns on salivary flow rate pattern specific effect appeared only in case of poststimulation phases of photo acoustic stimulation. In this relation

the poststimulation values of the third stimulation pattern (increase from 1 Hz to 15 Hz followed by a decrease from 15 Hz to 1 Hz at half time) differ significantly comparing to those of the second (decrease from 15 Hz to 1 Hz) and fourth (decrease from 15 Hz to 1 Hz followed by an increase from 1 Hz to 15 Hz at half time) stimulation patterns.

Protein concentration

Changes of protein concentration during photo-acoustic, photic or acoustic stimulation were similar. Total protein concentration slightly decreases during the stimulation phases and slightly surpasses baseline in the poststimulation phases. Values of the stimulatory phases significantly differ from their poststimulation values and from control values.

There is no significant cumulative effect of repeated stimulation on this parameter neither in case of photo-acoustic, nor photic, nor acoustic stimulation. Calculating the values of each of the divergent stimulation patterns, no significant pattern specific effect appeared.

Protein output

Protein output drastically decreases during the stimulation phases and slightly surpasses baseline in the poststimulation phases. Values of the stimulatory phases significantly differ from their poststimulation values and control values investigating photo-acoustic, photic or acoustic stimuli.

In case of repeated photo-acoustic stimulation the values of the first stimulation phase differ significantly comparing to those of the fourth stimulation phase and the values of the second stimulation phase differ significantly comparing to those of the third and fourth stimulation phases, which may indicate cumulative effect of repeated stimulations. Evaluating the effects of photic and acoustic stimuli no cumulative effect was found. Calculating the values of each of the divergent stimulation patterns (or their poststimulation phases) no significant pattern specific effect in relation with this parameter.

Amylase concentration

Using the three different methods (photo-acoustic, photic or acoustic stimulation) amylase concentration displayed similar changes. Amylase concentration decreases during the stimulation phases and returns to the baseline in the poststimulation phases. Values of the stimulatory phases significantly differ from their poststimulation values and from control values. There is no recognizable cumulative effect of repeated stimulation on amylase concentration. Calculating the values of each of the divergent stimulation patterns (or their poststimulation phases), no significant

pattern specific effect in relation to this parameter neither in photo-acoustic, nor photic or acoustic stimulation.

Amylase output

Changes of amylase output during photo-acoustic, photic or acoustic stimulation had similar directions. Amylase output decreases drastically during the stimulation phases and returns to the baseline in the poststimulation phases. Values of the stimulatory phases significantly differ from their poststimulation values and from control values.

In case of acoustic stimulation there is a significant cumulative effect of repeated stimulation on amylase output. Effect of the second stimulation differed from the fourth, and the values of the second poststimulation phase differed from the third and the fourth poststimulation values. Calculating the values of each of the divergent stimulation patterns (or their poststimulation phases), there is no significant pattern specific effect in relation to this parameter.

5. Conclusions

Conclusions about the relationship between dental fear and basic parameters of hand drawings and hand writings

Investigations of detailed morphological characteristics of hand drawings and hand writings and their connection with dental fear and anxiety were carried out. There were significant differences in relation to that, which particular dental fear related or anxiety related scale was used.

- According to our data it can be *concluded* that drawing and writing parameters measured in this study are not suitable for diagnostic or screening purposes neither in relation to dental fear nor in relation to anxiety, because they are somewhat uncertain. Nevertheless it can also be *concluded* that more drawing parameters and writing parameters had significant connections with dental fear than with anxiety. As a result of the detailed evaluation of these hand drawings and hand writings it is obvious that the most connection we found in relation with dental fear and not with anxiety.

Conclusions about dental fear, body-scheme and basic drawing parameters

Dental fear and anxiety levels of physically disabled volunteers and their drawing parameters we evaluated in case of person, tooth and mouth drawings.

- According to the values of dental fear surveys that they fulfilled, disabled subjects scored higher in all the scales than healthy controls. The increased values of the DBS scale should be highlighted because it suggests that the participants living with physical disability have a

more negative opinion of the patient-dentist relationship than the subjects of the control group.

- Evaluating all these data it can be *concluded* that there is an important difference between the relationship of person-, tooth- and mouth-drawing parameters and scores of dental fear and anxiety. Interestingly, the influence of being a disabled person was the strongest in case of tooth-drawings (and not person-drawings), and the influence of dental fear on drawing parameters was stronger than that of anxiety.

Conclusions about the relationship between dental fear, salivary parameters and basic parameters of hand drawings and hand writings

The study was performed to find out the connection between the level of dental fear and certain salivary parameters known to be in good correlation with psycho-emotional stress.

- According to our data one of the measured salivary parameters, the *protein concentration* had significant connection with the values of DAS scale. Based on our preliminary study it was concluded that the level of dental fear is related to protein concentration of saliva and the anxiety scales had no connection with any of the salivary parameters measured in this study.

Conclusions in relation with photo-acoustic, separately used photic and separately used acoustic stimulation

The photo-acoustic, separately used photic and separately used acoustic stimulation has a prompt and significant effect on salivary flow rate, protein concentration, protein output, amylase concentration and amylase output values during the examination. The effect of diverse stimulation patterns on the parameters mentioned above were investigated.

- Data indicate that certain *specific photo-acoustic stimulation patterns have significant effect on salivary flow rate*. This pattern specific effect in case of photo-acoustic stimulation appears in the poststimulation phases only. As mentioned above it is rather difficult to find out what kind of autonomic regulatory pathways could be hypothesized behind this effect. However, even if we do not know what kind of autonomic signaling appeared, *it is possible to conclude that the autonomic signaling during the recovery in the poststimulation phases can be different if different stimulation patterns are used*. It may also be hypothesized that there are not only prompt but also delayed effects of the stimulation.
- In relation with salivary parameters a significant *cumulative effect* of repeated stimulation appeared. In case of *photo-acoustic* stimulation salivary protein output and in case of

acoustic stimulation salivary amylase output indicated a cumulative effect. In case of *photic* stimulation none of the measured salivary parameters indicated cumulative effect.

- In relation with *phenomenological* parameters a significant *cumulative effect* of repeated stimulation appeared of day dreaming during *photo-acoustic* stimulation, of trance experience in case *photic* stimulation and of trance experience and complex imaginations in case of *acoustic* stimulation. The appearance of cumulative effect in relation with phenomenological parameters may indicate a deepening of the altered state of consciousness and/or arousal level in the course of the experiment.

6. Bibliography of the candidate's publications

Publications related to the subject of dissertation

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