

Development of a measure of childhood information learning experiences related to dental anxiety

U. Klages, T. Einhaus, Y. Seeberger and H. Wehrbein

Department of Orthodontics, Johannes Gutenberg-University, Mainz, Germany

Objective The aim of this study was to develop a measure of childhood information learning experiences related to dental anxiety according to Rachman's theory of fear acquisition entitled "Dental Information Learning History Questionnaire (DILHQ)" and to determine its test quality with regard to factorial validity, reliability, divergent, discriminant, and predictive validity. **Method** Sample 1 included 228 dental patients, answering a 17-item-pool of the DILHQ, the Dental Anxiety Scale (DAS; Corah, 1969), and the Self-Consciousness Scale by Fenigstein *et al.* (1975). A second sample of 197 patients filled in the final 12-item test version, the DAS and the state version of the State-Trait Anxiety Inventory (Spielberger *et al.*, 1970). Ninety-five participants constituting the third sample answered the DILHQ twice with a 14-days interval. **Results** An exploratory study using the first sample resulted in two dimensions underlying the DILHQ-answers after removal of the unique loading items. The two-factorial structure was confirmed in the second sample. The factor-analytically derived Danger Information and Acceptance Information subscales showed sufficient internal consistency ($\alpha=0.87$ and 0.72) and temporal stability ($r_t=0.77$ and 0.76). Dentally fearful patients remembered being exposed to more danger information and less acceptance information about dentistry during childhood than low-fearful patients did ($p<0.001$ each). Danger information and acceptance information predicted anxious response to the following dental procedure in opposite directions ($r=0.29$ and $r=-0.29$). **Conclusion** The results suggest that the DILHQ fulfils criteria of good construct validity. Exposure to threatening information about dentistry during childhood may increase the risk for dental fear acquisition and for exaggerated anxious response to treatment, while acceptance information might have a protective effect.

Key words: Dental anxiety, factor analysis, information learning, test development, validity

Introduction

Dental anxiety is defined as a response to a perceived threat or danger in expectancy of dental treatment. Trait anxiety or fear of dentistry reflects a stable tendency to respond anxiously in anticipation of dental encounters, while state anxiety refers to the short-term actual response while under treatment. Perceived threat relates to possible injury, dentist-patient interaction, or physical arousal (Klages *et al.*, 2008). Dental fear is associated with avoidance of dental treatment and can negatively affect dental care and oral health condition (Schuller *et al.*, 2003).

Fear of dentistry is a widespread condition in western societies with prevalence estimates between 8% and 24%, depending on definition and measurement (Locker *et al.*, 1996). The perception of dental treatment as threatening has not decreased over the last five decades in spite of the fact that progress in instrumentation and anaesthesia has ameliorated the aversiveness of dental procedures (Smith and Heaton, 2003). Patient personality dispositions like anxiety sensitivity have been discussed to explain why patients perceive exaggerated pain, which is not related to the invasiveness of the dental procedure (Klages *et al.*, 2006).

Another origin of dental fear may be found in patients' past learning experiences. According to Rachman's (1977) theory of fear acquisition three pathways have to be considered: (1) conditional learning by direct negative treatment experiences; (2) model learning through

observing significant others' anxious response to dental procedures; (3) informational learning through exposure to threatening information about the harmfulness of dental procedures.

With regard to the conditioning pathway patients generally explain their apprehensive appraisal of dental treatment by negative experiences (Litt, 1996). However, the majority of patients do not develop fears after exposure to painful or frightening dental episodes (Locker *et al.*, 1999). Instead, research suggests that learning by observation or the verbal transmission of danger expectancies increases one's vulnerability to fear acquisition through later negative experience (Davey, 1992).

Several studies reporting a high coincidence of dental fear among family members have been interpreted as support of the modeling pathway. Of patients unable to tolerate conventional dental treatment, 55% reported fear in other members of the family (Berggren and Meynert, 1984). Among patients, applying for treatment of dental phobia a familial coincidence rate of 63% was found (Moore *et al.*, 1991). A large-scale community study showed that 56% of respondents with childhood onset of dental anxiety had a family member who was afraid of dental procedures (Locker *et al.*, 1999). The concept of model learning, however, requires the direct observation of anxious behaviour. No evidence has been presented that children really watched their anxious parents in the dental chair (Litt, 1996). It seems more realistic to assume that children learn negative expectancies of dentistry from parents' reports on aversive dental events.

The information pathway of fear acquisition has been supported in several studies including children and adults. A retrospective study on origins of children's common fears (Ollendick and King, 1991) found that children attributed their anxiety mostly to learning by information and instruction (89%) and to a lesser degree to observational or experiential learning (50% and 35%, respectively). Using a prospective learning paradigm Field and Lawson (2003) showed that negative and positive information about an unknown animal each had strong and opposite effects on primary school children's reported fear and behavioural avoidance. Retrospectively reported parental information transmission on the harmfulness of physical symptoms and instructions to take care of them were found to be associated with panic disorder (Ehlers, 1993), fear of physical arousal, and hypochondriacal concerns (Watt and Stewart., 2000) in young adults. The purpose of this investigation was to develop an instrument assessing retrospectively reported childhood information learning experiences related to dental anxiety with the working title "Dental Information Learning History Questionnaire (DILHQ)". The following procedures were performed to determine the quality of the questionnaire.

An exploratory factor analysis was conducted to investigate the dimensionality of the item pool in one patient sample.

The stability of the factorial structure was tested by a confirmatory factor analysis using a second patient sample. The reliability of the resulting subscales was assessed with regard to internal consistency and temporal stability. Divergent validity was investigated by studying associations with theoretically unrelated traits of private and public self-consciousness and social anxiety.

To determine discriminant validity, patients with high and low dental trait anxiety were compared in their information learning history.

Predictive validity was studied by relating information learning history to the anxious response during following dental treatment.

Methods

Three participant samples were included in the study. The first two samples consisted of patients awaiting their treatment in two different dental clinics. They were approached in the respective waiting rooms. The purpose of the study, as explained to patients, was to investigate communication about dentistry in the family of origin and its relation to present dental fear or distress. They were assured that the participation was voluntary and that their decision had no impact on treatment. Provisions for anonymity in data analysis were explained.

The first patient sample included 228 participants. Mean age was 42.1 years (SD=15.4). Fifty-nine percent were females. They answered the preliminary DILHQ 17-item pool, the Dental Anxiety Scale (DAS) and the Self-Consciousness Scale (see below).

Sample 2 comprised 197 voluntary patients. Mean age was 39.8 years (SD=14.4). Fifty-nine percent were females. They filled in the final 12-item version of the DILHQ and the DAS. After treatment termination, they indicated their just-experienced anxious tension using the

state form of the State-Trait Anxiety Inventory. Procedures were restorative (27%), crown preparation (14%), extraction (14%), calculus removal (17%), periodontal (16%), and endodontic (12%).

A convenience sample including students of the local university was used to study the test-retest reliability of the final DILHQ 12-item version. They were approached in teaching or recreation rooms and asked to participate in a two-stage questionnaire study on familial communication about dentistry. It was explained to them that the aim of this research was to investigate the reliability of a measurement device. After first administration of the questionnaire, an appointment was made for a fortnight later. A coding system was used to provide anonymity. Ninety-five volunteers participated on both occasions. Their mean age was 25.7 years (SD=2.9). Thirty participants were males.

The following measures were used:

DILHQ item development. A team of three dentists and one clinical psychologist generated a pool of 25 survey items comprising information delivered by family members, which might exaggerate anxiety about dentistry or ameliorate it. These items were derived from the study of the literature and the authors' own clinical experience. A five-point Likert-type answering format was provided with 0='never', 1='seldom', 2='sometimes', 3='often', and 4='very often'. After presenting them to a preliminary sample of 50 respondents, the items were reevaluated and 17 of them were judged appropriate for the purpose of the instrument. In the next step, the 17-item instrument was answered by patient sample 1. Based on an exploratory factor analysis, 5 items were excluded and twelve of them remained in the final version of the DILHQ.

Self-Consciousness Scale (SCS). The questionnaire by Fenigstein *et al.* (1975) includes three factor-analytically derived subscales. A five point answering format is provided. Private Self-Consciousness (10 items) pertains to habitual awareness of one's feelings and thoughts; Public Self-Consciousness (7 items) refers to the awareness of the impression one makes on others; Social Anxiety (6 items) accounts for discomfort experienced in the presence of others. A good test quality of the SCS is supported by its factorial validity and high temporal stability.

Dental Anxiety Scale (DAS). The DAS is a measure of dental trait anxiety (Corah, 1969). Participants are asked to indicate their anxious response to four treatment related situations. Five response alternatives of increasing severity are provided. Responses are summed across items to arrive the total score, which can range from 4 to 20. Measures of internal consistency and of test-retest reliability are high. The DAS is a widely used instrument in epidemiological and clinical research. A score above 12 is considered to indicate high dental fear. (Locker *et al.*, 1996, 1999; Smith and Heaton, 2003).

State-Trait Anxiety Inventory-State Scale (STAI-S). The state form of the STAI (Spielberger *et al.*, 1970) was applied to assess actually experienced anxiety during dental procedures. The test contains 10 anxiety-present and 10 reverse scored anxiety-absent items. A four-point Likert-type answering format is provided. The total score has a range from 20 to 80. A high internal consistency

Table 1. Factor loadings of the Dental Information Learning History Questionnaire test items after exploratory and confirmatory factor analyses (CFA), corrected item-total correlations (r_{it}), internal consistency of subscales (Cronbach's Alpha) and their test-retest reliability

<i>Item</i>	<i>Danger</i>	<i>Acceptance</i>	<i>CFA estimates</i>	<i>r_{it}</i>
1. People felt sorry for anyone in the family who had to go to the dentist.	0.69	0.08	0.59	0.51
2. People told their children that the dentist would have to bore deep holes in their teeth if they did not clean them.	0.62	-0.01	0.57	0.57
3. When I had to go to the dentist, I was threatened, admonished, or scolded.	0.64	-0.16	0.69	0.62
4. My family told each other about horrible experiences with the dentist.	0.69	-0.18	0.70	0.64
5. The children were threatened by saying they would be taken to the dentist if they did not clean their teeth.	0.74	-0.08	0.72	0.67
6. Dental treatment was described as something horrible to be frightened of.	0.74	-0.19	0.77	0.70
7. My family seems to have had a general distrust of dentists.	0.69	-0.12	0.66	0.61
8. They said you were helpless, at the dentist's mercy when you went there.	0.70	-0.01	0.67	0.63
9. Dental visits were talked about as an everyday experience.	-0.15	0.72	0.62	0.51
10. When a family member expressed fear about an upcoming dental treatment, it was explained in a matter of fact way.	-0.04	0.79	0.72	0.55
11. In my family pain and illness were treated as something normal, which would soon be over.	0.06	0.76	0.63	0.53
12. When I was in pain or sick, I was encouraged without being pitied.	-0.06	0.64	0.52	0.44
Percentage of variance	31.88	18.74		
Cronbach's α ($N=425$)	0.87	0.72		
Test-retest reliability ($N=95$)	0.77	0.76		

Table 2. Pearson correlation coefficients between Dental Information Learning History Questionnaire (DILHQ) subscale scores and Fenigstein's Self-Consciousness Scale (sample 1)

<i>DILHQ-subscale</i>	<i>Self-Consciousness</i>		<i>Social Anxiety</i>
	<i>Private</i>	<i>Public</i>	
Danger information	0.15	0.12	0.10
Acceptance information	0.08	0.02	-0.07

Table 3. Results of *t*-tests comparing DILHQ scale scores in high ($N=82$) and low ($N=93$) dentally fearful patients according to the Dental Anxiety Scale (DAS) using samples 1 and 2: means (M), standard deviations (SD), and *t*-statistics.

DILHQ-subscale	$DAS \leq 6$		$DAS \geq 13$		t
	M	SD	M	SD	
Danger information	4.37	5.18	9.39	6.78	5.44**
Acceptance information	9.98	3.24	7.91	3.06	4.34**

** $p < 0.001$

Table 4. Results of correlation analyses between DILHQ subscale scores and state anxiety (STAI-S) during dental treatment in 191 patients (sample 2): simple correlations (r_s), partial correlations (r_p) controlling for treatment invasiveness rating (TIR), for education, gender, and age (EGA), and for each of the respective other DILHQ subscale.

DILHQ-subscale	r_s	Controlling for			
		TIR	EGA	Danger	Acceptance
Danger information	0.29**	0.30**	0.30**	-	0.26**
Acceptance information	-0.29**	-0.22*	-0.29**	-0.26**	

* $p < 0.01$; ** $p < 0.001$

has been reported. The STAI-S is sensitive to situational factors showing an increase of test scores under stress conditions.

Treatment Invasiveness Rating (TIR). After treatment, the dentist evaluated the invasiveness of the procedure on an 11-point numerical rating scale from the medical point of view. Verbal anchors were 0%='no distress' and 100%='worst distress imaginable'. A previous study (Klages *et al.*, 2006) found the TIR to be associated with patients' pain perception during treatment (affective: $r=.38$, sensory: $r=.21$, and pain intensity: $r=.46$).

Data analysis

The linear structural modeling software AMOSTM5.0 was used in confirmatory factor analysis and SPSS12.0 in all other statistical procedures. An exploratory principal component analysis with orthogonal varimax rotation was performed on the pool of 17 information-learning items to determine their dimensional structure and to exclude unique loading items using the first patient sample (Floyd and Widaman, 1993). Based on the results suggesting two factors including twelve items, a confirmatory factor analysis (Floyd and Widaman, 1993) was conducted applying the structural equation modeling approach of AMOS V on the questionnaire answers of the second

patient sample. The unweighted least squares method was applied. Criteria for the acceptance of the hypothesized two-factor model were the adjusted goodness of fit (AGFI), the normed fit (NFI), and the relative fit (RFI) indices all ranging above 0.90. The root mean square residual (RFI) should be lower than 0.10 (Floyd and Widaman, 1993).

The internal consistencies of the factor-analytically derived subscales were determined by Cronbach's Alpha and corrected item-total correlations. The stability of the subscale scores over a 14-day period in the third sample was calculated by Pearsonian correlation coefficients. Divergent validity of the DILHQ was tested by correlations with Fenigstein's (1975) Self-Consciousness Scale in patient sample 1. Discriminant validity was investigated by comparing patients with high and low dental trait anxiety (samples 1 and 2) in their history of information learning using *t*-tests. Predictive validity was studied by correlation analyses of information learning history with later anxious response during treatment (sample 2). Partial correlations were calculated to control for treatment invasiveness and for demographic characteristics and to determine the contribution of each subscale controlling for the other one in explaining anxious tension.

Because of the large sample sizes the significance level was required to be $p < 0.01$ for rejecting the null-hypothesis.

Results

A preliminary principal component analysis of the 17-item DILHQ form using the first study group of 228 patients resulted in five factors with an eigenvalue > 1.00 according to the Kaiser-Guttman criterion (Floyd and Widaman, 1993). Five items with unique loadings were discarded. A principal component analysis was rerun with the 12 remaining items and orthogonally rotated. This analysis resulted in two dimensions explaining together 51% of the variance (table 1) indicating a good factor solution (Floyd and Widaman, 1993). The items in table 1 were arranged according to the factors they constitute. Items relating to negative information showed high loadings above 0.62 on factor 1, and only small loadings on the other dimension (all $< |0.20|$). The statements referred to catastrophising reports about dental experiences and distrust (items 4, 6-8), threatening instructions for dental care (items 2, 5) and frightening attention to dental visits (items 1, 3). This factor was characterized as "danger information". The second factor had high loadings > 0.64 on positive information items, which were independent from those in the first factor approaching zero (all $< |0.15|$). The items refer to explaining treatment and adversities as normal experiences (9, 11) and encouragement to tolerate dental treatment and aversive experience (10, 12). The second factor was interpreted as "acceptance information". A confirmatory factor analysis of the DILHQ-items was conducted using the second patient group ($N=197$) to investigate the stability of the factor structure across samples. The standardized regression estimators of the observational data on the latent constructs are presented in the third data column of table 1. All estimators were > 0.50 . The hypothesized factor model was confirmed by the fit-indices (Floyd and Widaman, 1993) AGFI=0.96, NFI=0.94 and RFI=0.93, and a root mean square residual RMR=0.09. The correlation between the two factors was low with $r = -0.14$.

The internal consistency of the two subscales was examined across both patient samples. The last column of table 1 shows the correlation of each item with scale score totals after the respective item had been removed (corrected item-total correlations). All coefficients were above 0.50, indicating that they measure the respective trait. Internal consistency was high in the danger information scale and sufficient in acceptance information. The temporal stability of the DILHQ-scores over a 14-day period was studied in the adjunctive sample 3 ($N=95$). In both scales repeated measurement correlations were above $r_{tt} = 0.70$ to be evaluated as sufficient on the individual measurement level.

Investigating relations between the DILHQ and demographical characteristics in both patient samples, we found danger and acceptance information not to be associated with age ($r_1 = -0.10$ and $r_2 = -0.06$). Acceptance information scores were higher in females than in males ($M_1 = 8.96$ and $M_2 = 8.05$; $t = 2.84$, $p < 0.01$), whereas danger information was not related to gender. Patients with higher educational levels remembered more acceptance informa-

tion ($M_1 = 9.34$, $M_2 = 8.38$, $M_3 = 7.73$; $F = 8.59$, $p < 0.001$), but did not differ in danger information.

To determine divergent validity the DILHQ-answers were correlated with the Self-Consciousness Scale scores (Fenigstein *et al.*, 1975) including patient sample 1 (table 2). Danger and acceptance information were independent of private and public self-consciousness and social anxiety (all $r < 0.16$).

For investigating discriminant validity, patients with DAS scores > 12 (Locker *et al.*, 1996) were defined as highly anxious ($N=93$). An approximately equal number of 82 patients ranged at the lower end of the DAS with scores < 7 . T-tests (table 3) revealed that dentally fearful patients remembered more danger information and less acceptance information during childhood than their counterparts did (both $p < 0.001$).

With regard to predictive validity (table 4) danger information was associated with later anxious response to treatment with $r = 0.29$. Acceptance information was inversely related to state anxiety ($r = -0.29$). Controlling for dentist-evaluated treatment invasiveness (TIR) did not diminish the effect in danger information, and had only a small effect in acceptance information resulting in a partial correlation at a level of $p < 0.01$. Controlling for demographic variables had no effect on the strength of the associations between learning history and predicted state anxiety.

Further partial correlations controlling each DILHQ-scale for the respective other one showed that acceptance information and danger information independently predicted anxious response during treatment.

Discussion

The purpose of this study was to develop a measure assessing childhood information learning related to dental anxiety (Dental Information Learning History Questionnaire, DILHQ) according to Rachman's theory of fear acquisition (1977).

Exploratory and confirmatory factor analysis suggested two dimensions underlying the items, namely danger information and acceptance information. Internal consistency and temporal stability of the two factor-analytically derived subscales were satisfactory. As hypothesized, subscale scores were not associated with self-consciousness (divergent validity). Retrospectively reported learning experiences differed between high and low dentally fearful patients (discriminant validity) and predicted anxious arousal during treatment (predictive validity). In sum, the results suggest satisfactory psychometric properties of the DILHQ.

With regard to demographic data, female patients and participants with higher education both reported they had received a higher level of acceptance information about dentistry. It would be of interest for further studies whether these results might reflect differential parenting behaviors (Turner *et al.*, 2003) towards girls versus boys and in families with higher versus lower educational background.

Two main findings relating childhood learning history with adulthood dental anxiety are worth noting. On the level of trait anxiety patients with high dental fear indicate that they had been exposed to increased elevated danger

information and low acceptance information. These results are in line with previous studies. Transmission of negative information has been found to increase. The results are in line with previous reports on impacts of early learning experiences on young adults' fears concerning anxiety related to physical symptoms (Ehlers, 1993; Watt and Stewart, 2000). In addition, children explained their common fears predominantly by information learning (Ollendick and King, 1991). On the other hand positive information has been found to predict fear reduction in children (Field and Lawson, 2003); and in adult chronic pain patients' acceptance of aversive experience was related to less attention to pain and more engagement in daily activities (Viane *et al.*, 2004).

The results suggest that exposure to threatening information about dentistry during childhood and adolescence may be one origin of dental fear in adulthood, while acceptance information may buffer against it.

Two caveats have to be taken in mind in interpreting the results. Regarding the retrospective nature of learning history assessment, memories of biographical events may be reconstructed from present mood, attitudes or attention styles (McFarland and Buehler, 1998). With respect to the latter, however, respondents' DILHQ-answers in this study appear not to be distorted by biases for private or public self-consciousness.

Another argument might be that the relationship between threat information emitted by family members and fear of the respondent reflects common genetic or biological factors. These could result in a shared disposition for fear acquisition. The specific content of fears, however, can only be explained by learning experiences (Turner *et al.*, 2003).

According to present results the missing link between familial coincidence of dental fear (Berggren and Meynert, 1984; Moore *et al.*, 1991; Locker *et al.*, 1999), which cannot be explained by model-learning (Litt, 1996), may originate in the transfer of threatening information by dentally fearful family members.

The second finding of main interest was that history of information learning predicted later anxious response to the critical situation of dental treatment. Participants reporting a high level of danger information later experienced elevated anxious arousal, whereas those having been highly exposed to acceptance information experienced low emotional distress. These results are less prone to the error of retrospective distortion. Following a suggestion by Ehlers (1993) the anxious response to dental treatment might be more determined by remembered events than by actual circumstances. Independent of its veridicality memories of danger communication episodes seem to sensitize for threatening aspects of dental procedures exaggerating anxious response. Positive information (Field and Lawson (2003) and history of accepting information learning may lead patients to be less attentive to potential threats ameliorating emotional distress (Viane *et al.*, 2004).

Processes of sensitization and distraction may also have been effective in patients' previous condition learning history. Early danger information may have instigated the patient to perceive a stressful treatment episode as "traumatic" to acquire a conditioned anxious response, while acceptance information may have protected against

it. Ollendick and King (1991) suggested that threat information and negative experience might have synergistic effects increasing the risk for anxiety acquisition. This assumption would be of interest to investigate in further research.

In sum, the present study suggests that information learning during childhood or adolescence may contribute to the acquisition of dental fear. Threatening expectations about dentistry established by information transfer at early ages might later be confirmed through perceived aversiveness during dental procedures. They may be a factor to explain why people do not cease in their apprehensive appraisal of treatment (Smith and Heaton, 2003).

With regard to prevention of dental fear and its impact on oral health (Schuller *et al.*, 2003), parents might be advised to self-critically observe their communication about dental treatment for implied threatening contents which may instigate danger expectancies. Furthermore, it might be advantageous to present instructions supporting the acceptance of aversive experience.

As far as clinical applications are concerned, the DILHQ may assist dentally anxious patients and their therapists to develop an understanding of possible origins of fear, to reevaluate the role of aversive experience (Davey, 1992), and to relate previous information learning in the family of origin to present dysfunctional cognitions about dentistry. Knowledge of biographical learning episodes may help to challenge the validity of negative dental beliefs by rational restructuring in a Socratic dialogue to establish new cognitions facilitating exposure to dental procedures (Thom *et al.*, 2000).

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