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Treatment experience, frequency of dental visits, and children's dental fear: a cognitive approach

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Cognitive elements play a key role in dental anxiety. Nevertheless, relatively little is known about how dental treatments and frequency of visits to the dentist are related to dental fear and its cognitive antecedents. This study aimed to explore the relationships between dental visits, past treatment experiences, expectations on the aversiveness/probability of negative dental events, and dental fear in children. The participants were 147 children (60% female; mean age = 12.0 yr) who completed a questionnaire comprising measures of dental treatment-related experience (attendance, fillings, and extractions), perceived aversiveness and probability of dental events, and dental anxiety. Bivariate correlations and multiple linear regression analyses were used to analyze the data. A higher frequency of dental visits was associated with less dental fear and a decreased belief in the probability of negative events occurring during treatment. The type of treatments received was not directly linked to dental fear. However, having received fillings was significantly associated with the perceived probability of negative dental events, whereas extractions were positively associated with these expectations but negatively associated with the perceived aversiveness of possible dental events. Regular dental visits, as well as dental treatments, can influence, in different ways, cognitive elements associated with dental anxiety in children.

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Dental anxiety is a common problem in the child population (1, 2). It is associated with a lower use of dental care services, treatment avoidance, and uncooperative behavior during consultation (3–7). Moreover, dental anxiety is not only a 'psychological' problem but also a dental health problem. Children fearful of going to the dentist have been found to present with more untreated caries, a worse periodontal condition, and a higher number and probability of missing teeth (8–13).

Dental fear, treatments, and frequency of attendance at the dentist seem to be connected. Child dental fear has been found to be associated with a lower use of dental care services (14). In contrast, regular check-ups, providing children with multiple safe and positive dental experiences, could contribute to a progressive familiarity with dental care events and 'inoculate' young children against the future development of dental anxiety (15, 16). Frequent asymptomatic dental visits seem to act in a prophylactic way concerning dental anxiety. For instance, previous research has found that children who participate in preventive programs exhibit a lower level of dental fear (17). Consistent with these ideas, early visits to dentists should not be motivated by urgent dental problems such as pain, trauma, or caries (9), because problematic first visits are linked to the development of dental anxiety in children (18). Rather, frequent exposure to dental experiences might be a positive factor in helping to reduce patients' anxiety levels (9). Regular visits to the dentist might provide an optimal climate for the emotional processing of aversive events associated with invasive dental procedures (19) and contribute to a reduction in the potentially anxiogenic effects of a problematic dental visit (18).

Some evidence has been established concerning the relationship between treatments and dental fear in the child population. Rantavuori *et al*. (20) found that treatments experienced in previous years were only weak predictors of dental fear, with other variables, such as parents' or siblings' fear levels, offering greater predictive power. Nicolas *et al*. (9) found that children with fillings are less fearful than those who have not experienced any dental treatment. In contrast, other studies have found no association between fillings and child dental anxiety (13, 16, 21, 22). The results seem clearer as regards the effects of dental extractions on dental anxiety, as previous research has identified exposure to this treatment as a predictor of dental anxiety in children (16, 21–24). However, Ten Berge *et al*. (16) warn that the relationship, although significant, between the number of extractions and dental fear seems to be weak, and the

contribution of invasive procedures to explain dental fear is highly variable among studies. These authors concluded that the key point in the acquisition of dental fear is not whether a concrete treatment is painful or invasive but rather the child's subjective perception of dental visits.

Consistent with this suggestion, recent research on the elements involved in the development of dental fear indicates that specific dental experiences (and, in particular, 'bad experiences') are insufficient to explain a patient's current level of dental fear (25, 26). Certainly, subjective and cognitive factors such as negative thoughts, appraisals, expectations or explanatory style, have been demonstrated to be decisive in explaining dental anxiety, at least in adult research (15, 27, 28). For instance, catastrophic thoughts about dental treatments (e.g. concerning expected pain or the drill slipping) are frequent and significant components of dental anxiety (29). A non-realistic view of treatment seems to be characteristic of dentally fearful patients, who show a tendency to anticipate more pain and anxiety than they really experience during treatment sessions (30). Although the role of cognitions for a wide range of anxiety problems in children is also well established (31), few attempts have been made to apply this knowledge to explain child dental anxiety (32).

It is important to further understand how cognitive elements may be operating in child dental anxiety, and how they could interact with dental visits and treatments. In this regard, we have taken as a point of departure the work by KENT (27) on adults' dental fear and tried to transfer his contribution to the field of child dental anxiety. KENT has explored the relationships between dental patients' attendance pattern (regular vs. irregular) and their perceptions of the likelihood and aversiveness of various dental events. As expected, irregular attenders perceived these events as more likely and were more anxious than were the regular attenders.

Our study aimed to explore the relationships between frequency of dental visits, experience with treatments (fillings and extractions), cognitive expectations of the probability and aversiveness of negative dental events, and dental fear in children. In particular, we aimed to explore the antecedents of child dental anxiety by jointly analyzing the effects of both dental experiences (i.e. the frequency of dental attendance and past treatments) and cognitive expectations relevant to dental anxiety. Furthermore, we hypothesized that children's previous dental experiences would affect not only dental anxiety but also children's assessments of the likelihood and aversiveness of possible negative events occurring in dental settings.

Material and methods

The participants were a convenience sample of 147 children (59 boys, 88 girls) living in the southern area of the Community of Madrid, Spain, who attended the Rey Juan Carlos University Dentistry Clinic in March 2011. Their average (SD; range) age was 12 (1.81; 8–16) yr. They were studying in state schools and comprised students from a middle-class stratum. All had previous experience at the dentist, although this was their first visit to the University Clinic.

The University Dentistry Clinic offers common dental care services such as preventive treatments, check-ups, caries treatment, and orthodontia to children and adults. Participation in the study was scheduled in the course of programmed educational visits of groups of schoolchildren to the clinic. During their visit, information on oral health habits and dental check-ups were freely provided to every child. Dental examinations were carried out using a flat-surface mouth mirror, gauze, sponges, and compressed air, under adequate conditions of artificial light. The index for decayed, missing, and filled permanent teeth (DMFT) was calculated.

Data were gathered by means of a questionnaire that the children filled in at the beginning of their visit to the clinic. Instructions to complete it were provided by a member of the research team. Previously, informed consent from parents and school staff had been obtained. Ethical approval for this study was obtained from the University Rey Juan Carlos Committee for Ethics in Research.

The main study variables were children's frequency of attendance at the dentist, past dental treatments experienced, dental anxiety, expected aversiveness of dental events, and expected likelihood of the occurrence of the negative dental events. They were measured as follows.

- Frequency of dental attendance and experience with dental treatments was assessed by means of three items whereby children reported how often they go to the dentist (three-point Likert-like scale, where 1 = 'Sporadically', 2 = 'Every year', and 3 = 'Every 6 months'), and whether they had previously received fillings (0 = 'No', 1 = 'Yes') and/or extractions (0 = 'No', 1 = 'Yes').
- Dental anxiety was assessed using an adaptation to the Spanish language of the five-item Modified Dental Anxiety Scale (MDAS) (33). Children reported their dental anxiety for each item using a five-point Likert-like scale ranging from 1 = relaxed/not worried to 5 = very nervous/worried. To ensure understanding of items by child participants, and following the work of Howard & Freeman (34), we used pictorial representations of faces corresponding to the anxiety gradation of the response format. Total scores for this scale were obtained by adding the child's answers (range from 5 to 25, with higher scores indicating higher dental anxiety). The internal consistency of the scale, assessed using Cronbach's alpha, was 0.81.
- The perceived aversiveness of dental negative events could be considered as a measure of the cognitive bias of 'catastrophizing', as it required the children to rate the aversiveness of a number of potentially negative events (e.g. being criticized by the dentist or needing several fillings that require extensive drilling). We used a Spanish translation of the four items (see Appendix S1) of the negative events scale elaborated by KENT (27). Participants responded on a five-point Likert-like scale, where 1 = 'this event would not be bad at all' and 5 = 'this event would be horrible'. A total score was calculated by adding the child's answers to each item, producing a score range from 4 to 20. Higher scores represented a higher tendency to catastrophize (i.e. a higher perceived aversiveness of the dental events). Cronbach's alpha = 0.67.

- The expected probability of negative dental events was used to measure the child's expectation of the likelihood of negative events occurring at the dentist. We used the above-mentioned translation of the four items elaborated by KENT (27), changing the question in the scale's instructions to 'How likely would it be that…?' The response format was a three-point Likert-type scale, where 1 = 'I think this event would not happen to me' and 3 = 'I am sure this event would happen to me'. A total score, ranging from 4 to 12, was obtained by summing the child's response to each item. Higher scores corresponded to a higher expected probability of negative events occurring at the dentist. Cronbach's alpha = 0.48.

Descriptive statistics (distribution of frequencies, mean, and SD) were calculated. Independent sample *t*-tests were used to compare differences between group means [i.e. gender (female/male), fillings (no/yes), and extractions (no/yes)] concerning dental anxiety and the probability and aversiveness of dental events. ANOVA and *post-hoc* tests (Bonferroni, Scheffé) were carried out to analyze differences between mean values for these variables on the basis of the children's frequency of dental attendance (sporadically/every year/every 6 months). Bivariate correlations (Pearson's *r*) among study variables were calculated to obtain an initial indication of the pattern of relationships between dental anxiety and the assessments of the probability and aversiveness of negative dental events. A multiple linear regression analysis (with all variables entered in a single step) was carried out in order to test whether the frequency of dental visits, the dental treatment experiences, and/or the expected probability and aversiveness of dental events, significantly predicted children's dental anxiety. The same technique was used to test whether the frequency of visits and/or dental treatments previously received by the child were significant predictors of the cognitive elements of perceived probability and aversiveness of negative dental events. The use of multiple linear regression (method: enter) was selected as we aimed to analyze the effect of every predictor when the effects of the rest were controlled for, and our outcome variables were measured in an interval level. All analyses were performed using the statistical software IBM SPSS Statistics 19 (IBM, Armonk, NY, USA).

Results

The mean ± SD values for dental anxiety (12.57 ± 4.98), for perceived aversiveness of negative dental events (13.50 ± 3.59), and for expected probability of negative dental events (6.60 ± 1.67) were around the midpoint of their respective scoring ranges. Using an MDAS score of ≥19 as a cut-off point for defining high dental fear (33), 13.6% of participants could be considered as dental-fearful patients. Concerning their use of dental care services, 40.1% of participants reported that they sporadically attended the dentist, 19.7% said that they visited their dentist every year, and 40.1% reported visiting every 6 months. Almost half (45%) of the sample had experience with receiving fillings, and approximately one-fifth (18%) had previously received a dental extraction. The mean value for their current DMFT index was 2.27 ± 2.47) and 65.3% of participants had a DMFT of >0.

The results showed some gender differences. Girls reported a higher level of dental anxiety than boys, with these differences being statistically significant ($t = 3.23$, d.f. = 138.40, $P < 0.01$). Furthermore, girls and boys also differed in their assessments on the aversiveness of negative dental events ($t = 2.20$, d.f. = 145, $P < 0.05$), with girls having a higher tendency to catastrophize.

Children's mean values for dental fear ($F = 6.03$, $P < 0.01$) and expectations on the likelihood of negative dental events ($F = 9.05$, $P < 0.01$) differed significantly on the basis of their frequency of visits to the dentist (Table 1). *Post-hoc* test data revealed that children in the group of less frequent attendees exhibited higher dental fear and perceived a higher likelihood for the occurrence of negative dental events than those children who visited their dentist every 6 months.

Receipt of dental treatments was not significantly associated with children's dental fear scores. However, as shown in Table 1, participants with fillings showed a lower expectancy of a, negative dental event occurring ($t = 3.00$, d.f. = 145, $P < 0.01$). In contrast, children who had received dental extractions tended to overestimate the probability of negative experiences at the dentist relative to children with no extractions ($t = -2.57$, d.f. = 145, $P < 0.05$) but, at the same time, they also tended to think that these events were less negative ($t = 2.31$, d.f. = 145, $P < 0.05$)

Correlations between dental anxiety and the cognitive aspects analyzed in the study were significant. Higher expectancies of aversiveness ($r = 0.30$, $P < 0.01$) and probability ($r = 0.30$, $P < 0.01$) of dental events were associated with increased dental fear.

To determine whether the bivariate correlations were statistically significant after controlling for the possible confounding effect of other variables, we conducted a series of multiple linear regression analyses. As seen in Table 2, the regression analysis confirmed that previous dental treatments were not statistically significant predictors for dental anxiety. The frequency of attendance at the dentist ($\beta = -0.23$, $P < 0.01$), the perceived aversiveness ($\beta = 0.35$, $P < 0.01$), and the perceived probability of negative dental events ($\beta = 0.26$,

Table 1

Descriptive statistics for the main study variables

	Dental fear	Probability of negative dental events	Aversiveness of negative dental events
Frequency of dental visits			
Sporadic	14.17 (5.14)	7.19 (1.68)	12.95 (4.25)
Every year	12.31 (4.46)	6.72 (1.98)	13.59 (2.50)
Every 6 months	11.10 (4.64)	5.94 (1.25)	14.00 (3.29)
Fillings			
No	12.92 (4.80)	6.96 (1.77)	13.17 (3.85)
Yes	12.13 (5.19)	6.15 (1.44)	13.89 (3.22)
Extractions			
No	12.37 (5.05)	6.43 (1.57)	13.81 (3.63)
Yes	13.48 (4.60)	7.33 (1.94)	12.07 (3.06)

Results are given as mean (SD).

Table 2

Dental anxiety regressed on gender, age, dental treatments (fillings and extractions), frequency of dental attendance, and expectancies on aversiveness and the probability of negative dental events

					95% CI for *B*	
	B	SE	*β*	*t*	LL	UL
Constant	13.20	0.61		21.71	12.00	14.41
Gender	−1.82	0.74	−0.18*	−2.46	−3.28	−0.36
Age	−0.27	0.36	−0.05	−0.77	−0.99	0.43
Fillings	−0.00	0.74	0.00	−0.00	−1.47	1.46
Extractions	0.86	0.95	0.07	0.90	−1.02	2.73
Frequency of visits	−1.14	0.38	−0.23**	−3.01	−1.89	−0.39
Aversiveness of negative events	1.71	0.37	0.35**	4.60	0.97	2.44
Probability of negative events	1.33	0.40	0.26**	3.30	0.53	2.13

Dental anxiety was the dependent variable.
$R^2 = 0.30$; *$P < 0.05$; **$P < 0.01$.
LL, lower limit; UL, upper limit.

$P < 0.01$) remained statistically significant predictors of dental anxiety after controlling for the effect of gender on dental fear ($\beta = -0.18$, $P < 0.05$).

Although dental treatment experiences did not demonstrate a significant relationship with dental anxiety, they were associated with its cognitive antecedents (Tables 3 and 4). The frequency of dental visits also seemed to be associated with the expectancies of the likelihood of negative dental events (Table 3). Children who had previously received fillings thought that negative dental events were less probable ($\beta = -0.18$, $P < 0.05$), whereas extractions had the opposite association ($\beta = -0.16$, $P < 0.05$). After controlling for the effects of dental treatments, the more frequently that children went to the dentist, the less probable they considered the occurrence of negative experiences while visiting the dentist ($\beta = -0.28$, $P < 0.01$).

A different pattern of relationships was obtained concerning the expectancies of the aversiveness of dental events. As the regression analysis demonstrates (Table 4), only gender ($\beta = -0.20$, $P < 0.05$) and having previously received extractions ($\beta = -0.18$, $P < 0.05$) were significant predictors of aversiveness expectations (with having received a filling and frequency of attendance at the dentist not being statistically significant). After controlling for the effect of other variables (and especially for the effect of gender, as girls showed higher levels of catastrophizing) those children who had received extractions tended to consider that bad dental experiences were less negative compared with children without extractions.

Table 3

Expected probability of negative dental events regressed on frequency of attendance at the dentist and dental treatments

					95% CI for *B*	
	B	SE	*β*	*t*	LL	UL
Constant	6.74	0.22		30.81	6.31	7.18
Gender	−0.01	0.26	−0.00	−0.05	−0.50	0.51
Age	0.08	0.13	0.05	0.59	−0.18	0.33
Fillings	−0.59	0.26	−0.18*	−2.24	−1.11	−0.07
Extractions	0.69	0.33	0.16*	2.05	0.02	1.35
Frequency of visits	−0.47	0.13	−0.28**	−3.60	−0.73	−0.21

Expected probability of negative dental events was the dependent variable.
$R^2 = 0.17$; *$P < 0.05$; **$P < 0.01$.
LL, lower limit; UL, upper limit.

Table 4

Perceived aversiveness of negative dental events regressed on frequency of attendance at the dentist and dental treatments

					95% CI for *B*	
	B	SE	*β*	*t*	LL	UL
Constant	14.17	0.49		28.91	13.20	15.14
Gender	−1.45	0.59	−0.20*	−2.47	−2.61	−0.29
Age	−0.34	0.29	−0.09	−1.17	−0.91	0.23
Fillings	0.48	0.59	0.06	0.81	−0.69	1.64
Extractions	−1.66	0.75	−0.18*	−2.21	−3.14	−0.18
Frequency of visits	0.36	0.29	0.10	1.23	−0.22	0.94

Perceived aversiveness of negative dental events was the dependent variable.
$R^2 = 0.10$; *$P < 0.05$.
LL, lower limit; UL, upper limit.

Discussion

The study results highlight the possible relevance of cognitive elements as antecedents of dental fear in a child population. Both types of expectations considered – the estimated aversiveness and the perceived likelihood of negative events occurring during dental treatments – were associated with children's dental anxiety levels.

In this study we explored the role played by the children's past dental experiences (i.e. visits and treatment received) concerning dental anxiety. The results showed that children who sporadically visit their dentist report higher levels of dental fear than those who attend more regularly. This finding is in accordance with previous results obtained in child research, which have indicated a higher incidence of dental anxiety among less frequent attendees (9, 14) and pointed out that frequent, innocuous visits to the dentist could help to prevent or reduce children's dental fear (16, 18). Obviously, there is doubt concerning the direction of causality with this association, as more frequent dental visits could lead to a decrease in fear levels through habituation or other cognitive processes, just as children exhibiting higher anxiety levels could be more likely to avoid going to the dentist. Following the idea of a 'vicious circle' of dental fear (35, 36), it is also possible that both dental anxiety and avoidance of dental care reinforce each other.

This research helps to shed more light on the link between the frequency of visits and dental anxiety by incorporating the role played by cognitive elements. The frequency of dental visits was found to have a negative association with dental anxiety, but was also associated with expectations of a greater probability of negative dental events. More regular contact with dental services may well decrease the expected likelihood of the occurrence of negative experiences during consultation. This cognitive process could exert an effect on dental fear, in contrast to mere exposure to a dental setting, as both probability expectations and frequency of visits remained significant predictors of children's dental anxiety when they were included in the same regression model. Therefore, our results seem to indicate that the effect of frequency of visits on dental anxiety comes from a direct path (presumably the habituation of the anxiety response owing to a repeated exposure to dental events) as well as from an indirect path involving cognitive elements (i.e. probability expectations). It would be of great interest to know how these cognitive factors are connected with other appraisals involved in dental anxiety, such as the cognitive vulnerability schema (25) or negative thoughts (28, 29).

This study also contributes to an understanding of why female subjects tend to exhibit higher dental fear in comparison with male subjects. We found that girls' expectations on the probability of negative dental experiences were similar to those of boys. However, girls perceived negative dental events as significantly more aversive than boys. Girls do not think that dental negative events are more likely to occur than boys do; but when asked how bad a negative dental event would be, girls tend to perceive it in a more catastrophic way. These findings are similar to those obtained by Kent (27) in an adult population.

We did not find a direct connection between either of the two dental procedures considered – having fillings and extractions – and child dental anxiety. This result is consistent with the conclusions of research among adults: dental treatments do not increase or decrease dental anxiety by themselves, but the key point is the patient's subjective experience before, during, and after these interventions (25). While research on the influence of treatments on children's dental anxiety has been less conclusive, our results are compatible with the conclusion of Ten Berge *et al*. (16) that dental treatments seem to play a minor role as predictors of children's dental anxiety. Moreover, we have identified some interesting possibilities about how dental treatments could indirectly affect dental anxiety levels. Previous studies found that patients with fillings were less fearful than patients who had not experienced this treatment (9, 24). While this result was not confirmed in the present study, it did reveal that children who have fillings are significantly more inclined to think that negative events at the dentist are less probable.

The impact of having experienced an extraction is particularly interesting, as it was associated, but in different directions, with both types of expectations considered in this study. Children with extractions tended to think that negative dental events were more likely, but at the same time they assessed these dental events less negatively. The experience of receiving an extraction may provide children with an opportunity to obtain a 'realistic' or more balanced view of dental events: negative things sometimes happen during dental treatments, but these things are not so bad. For patients who had not experienced an extraction, and using the expression of Arntz *et al*. (30), we could affirm that 'the fear of any expected evil is worse than the evil itself'.

It is worth noting that other variables could also modulate the relationships found in our study. These include: the severity of patients' symptoms, the reasons for having received an extraction (e.g. caries or orthodontia), the use of different anesthesia procedures during treatments, the objective characteristics of dental treatment sessions (e.g. duration and amount of work to be done), or even the communication skills of dental care professionals who carry out the treatments. These points remain as open questions for future research.

It is important to recognize some limitations in this study. First, the representativeness of our convenience sample could be questioned. However, the gender of participants was reasonably balanced in our sample, and the prevalence of dental fear among participants was within the range reported in previous studies that have been conducted in a child/adolescent population (2). Furthermore, the percentage of participants with a DMFT of >0 and the mean value for DMFT in our sample were within the range found in previous oral health surveys carried out in Spain (37). The age of participants deserves further comment. Rantavuori *et al*. (20) found that the effects of having received dental treatments on dental anxiety were dependent on a child's age. In particular, having experience with treatments was a relevant predictor of anxiety for the group of 12-yr-old children in that study. However, as our sample was composed of children of 8–16 yr of age, with a mean age of 12 yr, age was used as a control variable.

A second possible limitation is the use of self-reported measures, which may be affected by memory biases and socially desirable responding. It is possible that children's recollection of their past dental treatments may be incomplete or inaccurate. Third, the study's cross-sectional design means that we cannot adequately grasp the nature of the dynamic interplay between the sequence of children's dental visits, the kind of treatments (e.g. preventive, invasive procedures, etc.) received, and the evolution of the dental anxiety response. A longitudinal analysis would certainly be useful to clarify relationships among variables, and especially to identify how anxiety levels can be altered following dental sessions and specific interventions. Fourth, concerning our measurement instruments, the expected probability scale yielded a very low reliability coefficient, indicating a low internal consistency for the scale. However, several elements may be involved in this outcome. The items comprising the scale reflect events of a very different likelihood, and the scale is not designed to measure a unitary concept. Also, the limited number of items (only four) in the scale may result in lower internal consistency. Finally, the use of

only a three-point Likert-type scale response format, which was employed to secure children's understanding of the response alternatives, may have affected the scale's reliability coefficient. Nevertheless, and consistent with the views of SCHMITT (38), we believe that measures with low internal consistency can still be useful and their use could be acceptable, especially because the scale presents a meaningful content coverage.

This research has some relevant implications for dental practice. In order to reduce children's dental fear, two approaches seem to be necessary. First, it is important to promote the 'habituation' of possible anxiety responses through the frequent exposure to dental events. This could be achieved by encouraging preventive treatments and regular check-ups (36), not only because of their effects on children's oral health but also for their capacity to decrease dental anxiety levels (18). For those attending on a non-regular basis, this strategy could also be implemented during the course of a dental treatment session, for instance by promoting a child's familiarity with dental instruments (39) or extending the time before and after a dental intervention (e.g. chatting with the patient). The key point would be to allow any anxiety to decrease (by mere exposure) before leaving a treatment session, in order to avoid the child's sensitization. Furthermore, repeated innocuous visits could improve behavioral habituation.

The second and complementary approach is a cognitive one. Derived from our results, two expectations should be addressed to help reduce children's potential anxiety: the belief that it is probable that something bad will happen during a dental session, and the belief that if something bad happens it will be horrible. It is important for dental care professionals to be able to identify these negative thoughts and then be capable of reducing them by giving the children an idea about what is going to happen during sessions. To correct castastrophizing biases, they can also provide children with realistic information concerning likely treatment outcomes (e.g. saying to children that most patients imagine that a treatment is worse than it is really). Again, 'reality tests' and exposure to dental events could be an effective way to confront irrational beliefs on dental treatments (40).

In short, by analyzing the role played by cognitive elements together with dental care experiences in the child population, our study sheds light on the mechanisms involved in the early development of dental fear. From our results, it seems clear that children's expectations of the likelihood and aversiveness of dental events are two key points that should be addressed to understand the development of dental fear in childhood. Dentists could decisively contribute to reducing children's dental anxiety by taking into account their expectancies during treatments, providing them with realistic information, and discouraging biased negative thoughts. This would be expected to result in the child gaining positive perceptions of the dental environment. The role of a history of positive dental experiences must be also emphasized (16, 18).

Conflicts of interest –The authors declare no conflicts of interest.

References

1. RANTAVUORI K. *Aspects and determinants of childrens' dental fear [PhD Thesis]*. Oulu: University of Oulu, Finland, 2008.
2. KLINGBERG G, BROBERG AG. Dental fear/anxiety and dental behaviour management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *Int J Paediatr Dent* 2007; **17**: 391–406.
3. KLINGBERG G. Dental fear and behavior management problems in children. A study of measurement, prevalence, concomitant factors, and clinical effects. *Swed Dent J* 1995; **103**(Suppl): 1–78.
4. WOGELIUS P, POULSEN S, SØRENSEN HT. Prevalence of dental anxiety and behavior management problems among six to eight years old Danish children. *Acta Odontol Scand* 2003; **61**: 178–183.
5. SKARET E, BERG E, KVALE G, RAADAL M. Psychological characteristics of Norwegian adolescents reporting no likelihood of visiting a dentist in a situation with toothache. *Int J Paediatr Dent* 2007; **17**: 430–438.
6. ARNRUP K, BROBERG AG, BERGGREN U, BODIN L. Lack of cooperation in pediatric dentistry – the role of child personality characteristics. *Pediatr Dent* 2002; **24**: 119–128.
7. GUSTAFSSON A, BROBERG A, BODIN L, BERGGREN U, ARNRUP K. Dental behaviour management problems: the role of child personal characteristics. *Int J Paediatr Dent* 2010; **20**: 242–253.
8. KLINGBERG G, BERGGREN U, CARLSSON SG, NOREN JG. Child dental fear: cause-related factors and clinical effects. *Eur J Oral Sci* 1995; **103**: 405–412.
9. NICOLAS E, BESSADET M, COLLADO V, CARRASCO P, ROGER-LEROI V, HENNEQUIN M. Factors affecting dental fear in French children aged 5–12 years. *Int J Paediatr Dent* 2010; **20**: 366–373.
10. PRAMILA M, KRISHNA-MURTY A, CHANDRAKALA B, RANGANATH S. Dental fear in children and its relation to dental caries and gingival condition: a cross sectional study in Bangalore city, India. *Int J Clin Dent Sci* 2010; **1**: 1–5.
11. LAHTI S, TUUTTI H, HONKALA E. The relationship of parental dental anxiety and child's caries status. *ASDC J Dent Child* 1989; **56**: 191–195.
12. BEDI R, SUTCLIFFE P, DONNAN P, BARRETT N, MCCONNACHIE J. Dental caries experience and prevalence of children afraid of dental treatment. *Community Dent Oral Epidemiol* 1992; **20**: 368–371.
13. TOWNEND E, DIMIGEN G, FUNG D. A clinical study of child dental anxiety. *Behav Res Ther* 2000; **38**: 31–46.
14. MILGROM P, MANCL L, KING B, WEINSTEIN P, WELLS N, JEFFCOTT E. An explanatory model of the dental care utilization of low-income children. *Med Care* 1998; **36**: 554–566.
15. DE JONGH A, MURIS P, HORST G, DUYX M. Acquisition and maintenance of dental anxiety: the role of conditioning experiences and cognitive factors. *Behav Res Ther* 1995; **33**: 205–210.
16. TEN BERGE M, VEERKAMP JS, HOOGSTRATEN J. The etiology of childhood dental fear: the role of dental and conditioning experiences. *J Anxiety Disord* 2002; **16**: 321–329.
17. GREMBOWSKI D, MILGROM PM. Increasing access to dental care for Medicaid preschool children: the access to baby and child dentistry (ABCD) program. *Public Health Rep* 2000; **115**: 448–459.
18. RANTAVUORI K, ZERMAN N, FERRO R, LAHTI S. Relationship between children's first dental visit and their dental anxiety in the Veneto Region of Italy. *Acta Odontol Scand* 2002; **60**: 297–300.
19. MURRAY P, LIDDELL A, DONAHUE J. A longitudinal study of the contribution of dental experiences to dental anxiety in children between 9 and 12 years of age. *J Behav Med* 1989; **12**: 309–320.
20. RANTAVUORI K, TOLVANEN M, HAUSEN H, LAHTI S, SEPPÄ L. Factors associated with different measures of dental fear among children at different ages. *J Dent Child (Chic)* 2009; **76**: 13–19.
21. KARJALAINEN S, OLAK J, SÖDERLING E, PIENIHÄKKINEN K, SIMELL O. Frequent exposure to invasive medical care in early childhood and operative dental treatment associated with

dental apprehension of children at 9 years of age. *Eur J Paediatr Dent* 2003; **4**: 186–190.
22. Milsom KM, Tickle M, Humphris GM, Blinkhorn AS. The relationship between anxiety and dental treatment experience in 5-year-old children. *Br Dent J* 2003; **194**: 503–506.
23. Milgrom P, Mancl L, King B, Weinstein P. Origins of childhood dental fear. *Behav Res Ther* 1995; **33**: 313–319.
24. Van Waaijen D, Ten Berge M, Veerkamp JS. Dental fear in children: dental experiences during childhood. *Ned Tijdschr Tandheelkd* 2001; **108**: 466–469.
25. Armfield JM, Slade GD, Spencer AJ. Cognitive vulnerability and dental fear. *BMC Oral Health* 2008; **8**: 1–11.
26. Armfield JM. Towards a better understanding of dental anxiety and fear: cognitions vs. experiences. *Eur J Oral Sci* 2010; **118**: 259–264.
27. Kent G. Cognitive processes in dental anxiety. *Br J Clin Psychol* 1985; **24**: 259–264.
28. Wardle J. Dental pessimism: negative cognitions in fearful dental patients. *Behav Res Ther* 1984; **22**: 553–556.
29. De Jongh A, Horst G. What do anxious patients think? An exploratory investigation of anxious dental patients' thoughts *Community Dent Oral Epidemiol* 1993; **23**: 170–172.
30. Arntz A, Van Eck M, Heumans M. Predictions of dental pain: the fear of any expected evil is worse than the evil itself. *Behav Res Ther* 1990; **28**: 29–41.
31. Muris P, Field A. Distorted cognitions and pathological anxiety in children and adolescents. *Cognition Emotion* 2008; **22**: 3.
32. Chapman HR, Kirby-Turner NC. Dental fear in children: a proposed model. *Br Dent J* 1999; **187**: 408–412.
33. Humphris G, Morrison T, Lindsay S. The Modified Dental Anxiety Scale: validation and United Kingdom norms. *Community Dent Health* 1995; **12**: 143–150.
34. Howard KE, Freeman R. Reliability and validity of a faces version of the Modified Child Dental Anxiety Scale. *Int J Paediatr Dent* 2007; **17**: 281–288.
35. Armfield JM, Stewart JF, Spencer AJ. The vicious cycle of dental fear: exploring the interplay between oral health, service utilization and dental fear. *BMC Oral Health* 2007; **7**: 1.
36. Weinstein P. Breaking the worldwide cycle of pain, fear, and avoidance: uncovering risk factors and promoting prevention for children. *Ann Behav Med* 1990; **12**: 141–147.
37. Bravo-Pérez M, Casals-Peidró E, Cortés-Martinicorena FJ, Llodra-Calvo JC. Encuesta de Salud Oral en España 2005. *RCOE* 2006; **11**: 409–456.
38. Schmitt N. Uses and abuses of coefficient alpha. *Psychol Assessment* 1996; **8**: 350–353.
39. Holst A, Crossner CG. Direct ratings in acceptance of dental treatment in Swedish children. *Community Dent Oral Epidemiol* 1987; **15**: 258–263.
40. Chapman HR, Kirby-Turner NC. *Getting through dental fear with CBT: a young person's guide*. Oxon: Blue Stallion Publications, 2006.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Negative dental events scale's items according to Kent (27).

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