European Journal of Oral Sciences

Eur J Oral Sci 2012; 120: 82–88
DOI: 10.1111/j.1600-0722.2011.00924.x
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European Journal of Oral Sciences

Assessing the relative efficacy of cognitive and non-cognitive factors as predictors of dental anxiety

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Carrillo-Diaz M, Crego A, Armfield JM, Romero-Maroto M. Assessing the relative efficacy of cognitive and non-cognitive factors as predictors of dental anxiety. Eur J Oral Sci 2012; 120: 82–88. © 2012 Eur J Oral Sci

Although previous research has successfully tested the usefulness of cognitive and non-cognitive factors to predict dental anxiety, they have rarely been jointly analysed. This study therefore aimed to compare the relative predictive power of a set of cognitive and non-cognitive factors in accounting for dental anxiety scores. A sample of 167 Spanish undergraduate students (81.4% women; mean age 21.2 yr) completed a questionnaire comprising measures of dental anxiety, non-cognitive antecedents of dental anxiety (i.e. past aversive dental experiences, exposure to dentally fearful relatives, and trait-based negative mood), and cognitive variables (i.e. dental-related cognitive vulnerability, probability/aversiveness expectancies, and dental cognitions and beliefs). In multiple linear regression analyses, cognitions were found to significantly increase the proportion of variance accounted for in dental fear scores (ΔR^2 = 0.15, maximum ΔR^2 = 0.35). Cognitive factors were found to be the best individual predictors of dental fear (β-values ranging from 0.23–0.66). Furthermore, scores for past aversive treatment experiences and negative mood were not significant predictors of scores for dental anxiety when cognitive variables were included in the models. The analysis of cognitive mechanisms involved in dental anxiety is revealed as a potentially important point in better understanding this problem.

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Key words: cognitions; dental anxiety; negative affect; treatment experiences

Accepted for publication October 2011

Dental fear and anxiety is one of the main barriers to the use of dental care services and in treatment compliance. The prevalence of dental anxiety is high (1–5) and it has also been found to be associated with a poorer oral health status and impaired oral health-related quality of life (6–9). Therefore, extending the knowledge of those factors that are involved in the development of dental fear should be considered a priority task.

Previous research has identified some antecedents of dental fear, and the role of traumatic experiences at the dentist has received much attention as a determinant of dental fear. Several studies have found that dental fearful patients often refer to early aversive dental experiences as the origin of their treatment-related anxiety (10–13).

Individual characteristics are also associated with dental anxiety. For instance, personality traits, such as neuroticism or high negative mood, as well as other anxiety disorders, have been found to be more prevalent among dental fearful patients (14). Trait anxiety also appears to predict a person's predisposition to dental anxiety (15). Moreover, women usually exhibit a higher level of dental anxiety than do men (4, 16–18) and gender therefore also seems to have an effect on dental anxiety. Furthermore, previous research has indicated that patients' levels of dental anxiety are connected to that of their relatives (19). This finding has been proposed as a rationale for a mechanism of modelling or 'emotional contagion' of dental fear among family members (20), and also as a basis for the incorporation of a genetic component in the origins of dental fear (21).

Recent reasearch has highlighted the influence of cognitive factors as determinants of dental anxiety. The Cognitive Vulnerability Model (5, 22) proposes that the key point is the automatic activation of a vulnerability schema when the fearful patient is exposed to dental stimuli, although previous learning experiences and factors such as personality traits or biological dispositions may play a role in dental fear responses. The vulnerability schema comprises appraisals of the dental event as being uncontrollable, unpredictable, potentially dangerous or harmful, and disgusting. Consistent with this model, the extent to which patients perceive a lack of control during dental treatments has been repeatedly pointed out as a factor involved in dental anxiety (23, 24). Cognitive research has also identified differences in the way that dentally fearful and dentally non-fearful patients process information about dental events. Dentally anxious people tend to overestimate the likelihood of something going wrong during treatments, and to anticipate a greater aversiveness for potentially negative dental events (25, 26). Finally, negative thoughts about oneself, dental care professionals, and dental treatments are frequent among dental fearful patients (27–29), who exhibit a cognitive style called 'dental pessimism' (30).

Although it seems likely that both cognitive and non-cognitive factors are involved in dental anxiety etiology, recent work has raised a question regarding whether anxiety is best explained by experiences or by cognitive vulnerability perceptions. ARMFIELD (31) noticed that the development of dental fear is quite independent from having suffered a traumatic dental event, and found that uncontrollability, unpredictability, dangerousness, and disgustingness appraisals were appreciably better predictors of dental anxiety than were aversive dental experiences.

In an effort to deepen knowledge regarding the etiology of dental fear, we will compare the relative efficacy of non-cognitive factors (such as having experienced a negative dental event, being exposed to fearful relatives, and trait-based negative mood) and cognitive factors in accounting for dental anxiety. The cognitive factors investigated will be subjective appraisals of dental-related events being potentially threatening, as well as negative assessments of dentists' and one's own performance during treatments.

Material and methods

Participants were 167 undergraduate students attending psychology courses at Rey Juan Carlos University (Madrid, Spain). Data were gathered by means of a Web-based questionnaire survey. The potential participants comprised a total of 238 students registered in psychology courses who received an email inviting them to voluntarily participate in a study on 'dental experiences and attitudes' conducted at the university. They were all provided with basic instructions to access and complete the online survey, and were also informed that all their data would be registered in an anonymous way. The online survey was launched in March 2011 and questionnaire submissions were admitted for 2 weeks. As 71 of the students who were approached did not participate in the survey, the response rate was 70.2%.

Ethical approval for this study was obtained from the Rey Juan Carlos University Committee for Ethics in Research.

Participants completed a questionnaire comprising measures of basic socio-demographic data (gender, age, nationality, household members, and number of siblings), frequency of use of dental services, dental anxiety, cognitive factors, and non-cognitive variables. Cognitive factors referred to a person's thoughts, beliefs, or appraisals of a dental-related situation (5, 10, 24–31). Non-cognitive factors encompassed a set of variables that previous research has found to be associated with dental fear, such as previous dental experiences (10–13), personality (14, 15), and family influence on anxiety (19).

Dental anxiety was assessed by means of the widely used five-item Modified Dental Anxiety Scale (MDAS) (32). It asks respondents how they would feel in five dental situations such as 'going to your dentist for treatment tomorrow' and 'being about to have a tooth drilled'. Participants rated their dental treatment-related levels of anxiety on a five-point Likert-like scale, from 1 (Not worried/relaxed) to 5 (Very worried/very nervous). The final scores for this scale were calculated by averaging responses to the five MDAS items. The Cronbach's alpha reliability was 0.93.

The cognitive factors measured were cognitive vulnerability (5, 22), expectancies of the likelihood and aversiveness of negative dental events (25), negative dental thoughts (29), and dental beliefs concerning dentists' professionalism and professional-patient interaction during treatments (33). Following previous work (5, 22), we developed a scale for measuring dental-related cognitive vulnerability. The scale comprised 10 items representing assessments of dental treatments as being uncontrollable (e.g. not feeling in control when the dentist is working on one's teeth or mouth), unpredictable (e.g. not knowing what could happen when being at the dentist), dangerous (e.g. expecting to be hurt when the dentist is treating one's teeth or mouth), and disgusting (e.g. feeling nauseous or retching when being at the dentist). The response format used a four-point Likert-like scale, from 1 ('Not agree') to 4 ('Strongly agree'). Participants' cognitive vulnerability scores were obtained by averaging their answers to the items comprising this scale. Higher total scores indicated higher dental-related cognitive vulnerability. Cronbach's alpha was 0.80.

Participants' expectations regarding the probability/aversiveness of negative dental events were measured by means of the negative events items devised by KENT (25). These four items represent possible negative experiences at the dentist (e.g. being criticized by the dentist, or finding the drilling extremely painful) and participants were requested to assess to what extent they considered each of these scenarios as likely and as aversive. The response format for likelihood estimations was a three-point Likert-like scale, with 1 standing for 'Absolutely unlikely', 2 for 'Possible', and 3 for 'Absolutely certain'. A five-point Likert-like scale was used to measure perceived aversiveness of possible negative dental events, with one meaning that the event was not assessed as bad at all, and five meaning that it would be a horrible experience. Two average scores, corresponding to estimations of both probability and aversiveness of negative dental events, were calculated from the participants' answers to the items. The Cronbach's alpha values for the probability and aversiveness measures were 0.45 and 0.80, respectively.

The Dental Cognitions Questionnaire (DCQ) (29) is a 38-item measure of negative thoughts about one's dental treatment-related behaviour (e.g. 'I am someone who can't bear pain'), dentists (e.g. 'Dentists don't care when it hurts'), and dental treatments (e.g. 'This treatment will hurt'). The response format uses a four-point Likert-like scale, from 1 (Not agree) to 4 (Strongly agree). Participants' final scores were calculated by averaging their answers to the items comprising the scale. Higher scores reflect a higher level of negative thoughts about the dentist's and one's own dental treatment-related behavior. Cronbach's alpha for this scale was 0.94.

The 15-item Dental Beliefs Survey (DBS) (33) was used to gather information on the patients' appraisals of their interactions with dentists. It explores aspects such as communication, trust, belittlement, and lack of control during dental treatments. Examples of items are 'I believe dentists do not like it when patients ask questions' and 'I feel that dentists do not listen to what I am saying'. The response format uses a four-point Likert-like scale, from 1 (Not agree) to 4 (Strongly agree). Higher total scores represent a more negative view of dentists' professionalism and how dental treatments are provided. Cronbach's alpha for this scale was 0.90.

A yes/no question was used to ask participants whether they had ever suffered a negative experience (such as pain, discomfort, or gagging) at the dentist. Data on the incidence of dental fear among family members were gathered by asking participants to indicate from a list of relatives which

ones they believed to be afraid of going to the dentist. A total score was calculated by summing the number of relatives marked as fearful. Finally, the negative affect subscale of the Positive and Negative Affect Schedule (PANAS) (34) was used as a trait-based measure of negative mood states (e.g. guilt, fear, anger, nervousness, contempt, or disgust), which has been found to be related to the anxiety/neuroticism personality dimension (35). Respondents indicated the extent to which they usually experience each of 10 negative moods using a five-point Likert-like scale, from 1 (Never) to 5 (Many times). Higher total scores indicate greater negative-mood trait. Cronbach's alpha for this measure was 0.82.

All the measurement scales mentioned (MDAS, items for assessing probability/aversiveness of negative dental events, DCQ, DBS, and the negative affect subscale of PANAS) were adapted from the original scales to the Spanish language by means of a forward and backward translation procedure.

Descriptive statistics (distribution of frequencies, means, and SD) were calculated. To examine the role played by cognitive and non-cognitive factors as predictors of dental anxiety, a series of four multiple linear regression analyses (with variables entered in three steps) were carried out. The dental fear score was considered as the dependent variable. Preliminary regression diagnostics revealed a possible problem with multicollinearity as condition indexes of >15 were obtained. However, tolerance and variance inflation factor indexes yielded acceptable values. Transforming predictors' direct scores into z-scores successfully fixed this problem. Therefore, z-score-transformed values of predictors were used in regression analyses. All the methodological assumptions required in order to perform multiple regression analyses (36) were met. In Step 1 of the regression analyses, gender and age, which were considered as control variables, were included in the model. Non-cognitive factors (having had a negative experience at the dentist, number of fearful relatives, and negative affect) were introduced as predictors at Step 2. Finally, in Step 3 of each of the four regression models, each of the cognitive constructs considered (cognitive vulnerability, expectancies, negative thoughts, and dental beliefs) were added separately. Probability expectancies and aversiveness expectancies were jointly included in the second regression model, as previous research (25) has taken them together when analyzing their influence on dental fear.

The linear regression approach outlined above allowed us to assess the relative power of cognitive factors in explaining dental anxiety, as compared with non-cognitive factors. Such evaluations were carried out on the basis of the β-coefficients (standardized regression coefficients) and on the significance level obtained for each individual predictor, as well as by examining possible improvements in the variance of MDAS scores accounted for (R^2, ΔR^2, and F change significance level) when shifting from Step 2 to Step 3 in the regression analyses. ΔR^2 in Step 3 of the regression analyses represents the proportion of variance in dental fear scores that is accounted for by cognitive variables beyond that accounted for by the control variables and non-cognitive factors included in Step 2.

A complementary series of regression analyses were also conducted, in which cognitive factors (i.e. cognitive vulnerability scores, probability/aversiveness scores, DCQ scores, and DBS scores) were separately included in Step 2 of the regression models, and non-cognitive factors were included in Step 3. This procedure allowed us to determine how much variance in dental fear scores was accounted for by non-cognitive factors beyond that accounted for by the control variables and the cognitive factors. All data analyses were carried out by means of the statistical software IBM SPSS 19 (IBM, Armonk, NY, USA).

Results

The mean ± SD age of participants (81% women) was 21.2 ± 2.92 yr (range, 18–29 yr). Participants, mainly Spaniards (97.6%), were living in the southern part of the Community of Madrid in households including their parents and brothers/sisters (58.7%), parents (25.7%), friends (7.2%), or other relatives (4.8%), or were living alone (3.6%). They had an average of 1.2 ± 0.78 siblings. More than half of the participants (51.5%) reported that one or two of their relatives were dentally fearful, 19.2% of participants identified three or more relatives as dentally fearful, while 29.3% reported not having any dentally anxious relatives. The mean ± SD number of relatives identified as dentally fearful was 1.4 ± 1.34.

Concerning their use of dental care services, 15.6% said that they visited the dentist every 6 months, 34.7% visited the dentist once a year, and 47.7% visited the dentist sporadically or only when they had a problem or pain. Two (1.2%) persons had never been to the dentist. More than a half (58%) of the participants reported that they had suffered a negative experience at the dentist.

The distribution of scores and descriptive statistics for the study variables are presented in Fig. 1 and Table 1, respectively. Participants' average levels of dental anxiety (mean ± SD = 3.02 ± 1.15) and negative affect (mean ± SD 2.55 ± 0.63) were moderate. The cognitive

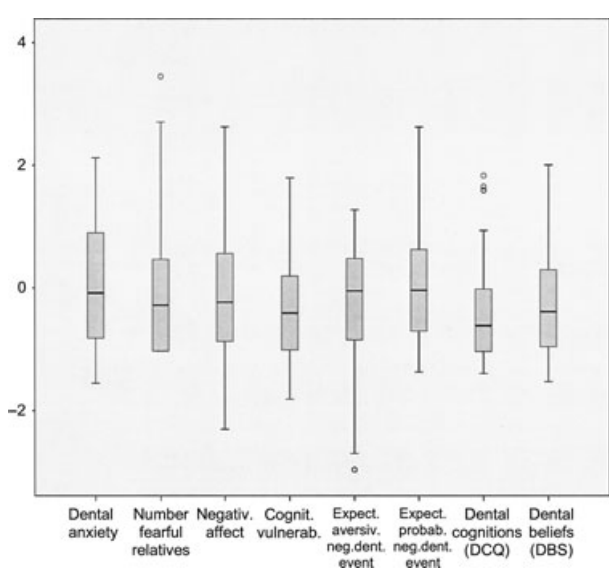

Fig. 1. Box-and-whisker plots showing the distribution of the z-scores (presented in the y-axis) for the study variables. Dental anxiety: Modified Dental Anxiety (MDAS); Negativ. affect: Negative Affect subscale of the Positive and Negative Affect Schedule (PANAS); Cognit. vulnerab.: Cognitive vulnerability measure; Expect. aversiv. neg. dent. event: Expected aversiveness of negative dental events; Expect. probab. neg. dent. event: Expected probability of negative dental events; Dental cognitions: Dental Cognitions Questionnaire (DCQ); Dental Beliefs: Dental Beliefs Survey (DBS).

Table 1

Descriptive statistics for the study variables

Variable	Total (n = 167)			Male participants (n = 31)		Female participants (n = 136)	
	Median	Mean	SD	Mean	SD	Mean	SD
Number of dental fearful relatives	1.00	1.38	1.34	1.42	1.43	1.37	1.33
Negative affect (score range 1–5)	2.50	2.55	0.63	2.48	0.53	2.57	0.65
Cognitive vulnerability (score range 1–4)	1.80	1.90	0.49	1.90	0.48	1.90	0.49
Expected aversiveness of negative dental events (score range 1–5)	4.00	3.82	0.94	3.50	0.70	3.89	0.97
Expected probability of negative dental events (score range 1–3)	1.50	1.52	0.37	1.59	0.39	1.50	0.37
Negative dental cognitions (DCQ) (score range 1–4)	1.55	1.64	0.43	1.62	0.48	1.64	0.43
Dental beliefs (DBS) (score range 1–4)	1.87	1.90	0.59	1.92	0.60	1.89	0.59
Dental anxiety (MDAS) (score range 1–5)	3.00	3.02	1.15	2.65	1.10	3.10	1.16

Table 2

Results of multiple linear regression analyses of dental anxiety scores regressed on non-cognitive and cognitive factors

	Step 1	Step 2	Step 3a	Step 3b	Step 3c	Step 3d
Variables						
Gender	−0.14	−0.14	−0.14*	−0.12	−0.13*	−0.16*
Age	−0.11	−0.09	−0.05	−0.06	−0.06	−0.07
Non-cognitive factors						
Negative experience at dentist		0.15*	0.05	0.10	0.02	0.10
Number of dental fearful relatives		0.18*	0.10	0.17*	0.16**	0.19**
Negative affect		0.22**	0.11	0.09	−0.02	0.05
Cognitive factors						
Cognitive vulnerability			0.60**			
Expected aversiveness of negative dental events				0.23**		
Expected probability of negative dental events				0.31**		
Negative dental cognitions (DCQ)					0.66**	
Dental beliefs (DBS)						0.51**
Model and change statistics						
R^2	0.03	0.16	0.49	0.32	0.52	0.40
ΔR^2	0.03	0.13	0.33	0.15	0.35	0.23
F change	2.89	8.49**	103.66**	17.74**	118.21**	60.86**

Data are presented as standardized regression coefficients (β) for variables, and as model and change statistics.
Dependent variable: dental anxiety (MDAS); scores for predictors variables were standardized before analyses.*$P < 0.05$; **$P < 0.01$.

variables had mean values near the midpoint of their respective scales, except for the expected aversiveness of negative dental events, which had a higher mean value (mean = 3.82 ± 0.94). In relation to the distribution of the sample, the median values for MDAS scores, negative affect, probability expectations, DCQ scores, and DBS scores were also near to the midpoint of their respective response ranges. However, negative dental events were assessed as highly or extremely aversive by 50% of participants, with a median value of 4.00 for this scale.

Output of the regression analyses series is shown in Table 2. After controlling for the effects of gender and age, all non-cognitive factors analyzed (i.e. negative experiences at the dentist, number of fearful relatives, and negative affect trait) were significant predictors of dental anxiety (Step 2 of the regression analysis). The model comprising demographic variables and non-cognitive factors alone explained 16% of the variance in dental anxiety scores ($P < 0.01$). In relation to individual factors, negative affect ($\beta = 0.22$, $P < 0.01$) was the best predictor of dental anxiety among the non-cognitive factors.

The amount of variance accounted for was greatly increased when any of the cognitive factors considered was entered into the regression model (Steps 3a–d). Adding a cognitive predictor to the regression equation resulted in models explaining 32–52% of the variance in MDAS scores ($R^2 = 0.32$ for Step 3b; $R^2 = 0.40$ for Step 3d; $R^2 = 0.49$ for Step 3a; $R^2 = 0.52$ for Step 3c). Therefore, when compared with the non-cognitive model (Step 2), the inclusion of cognitive factors in the regression model (Steps 3a–d) provided an increase of between 15% and 35% in the proportion of variance in MDAS scores accounted for. Entering the cognitive variables at Step 3 of the regression models altered the predictive power of the non-cognitive variables, whose β-values dropped to non-significant levels in some cases (i.e.

Table 3

Model and change statistics for multiple linear regression analyses of dental anxiety scores regressed on cognitive factors (included in Step 2) and non-cognitive factors

	Model I (cognitive vulnerability scores included in Step 2)			Model II (aversiveness/probability scores included in Step 2)			Model III (DCQ scores included in Step 2)			Model IV (DBS scores included in Step 2)		
Step	R^2	ΔR^2	F change	R^2	ΔR^2	F change	R^2	ΔR^2	F change	R^2	ΔR^2	F change
2	0.47	0.43	131.60**	0.26	0.23	25.20**	0.50	0.46	149.33**	0.34	0.30	75.18**
3	0.49	0.03	2.99*	0.32	0.05	4.27*	0.52	0.02	2.72*	0.40	0.05	5.02*

Dependent variable: dental anxiety (Modified Dental Anxiety Scale); statistics for gender and age introduced at Step 1 are presented in Table 2; non-cognitive variables (included in Step 3) were negative experience at the dentist, number of fearful relatives, and negative affect.
DBS, dental beliefs survey; DCQ, dental cognitions questionnaire.
*$P < 0.05$; **$P < 0.01$.

negative affect and negative experience in Steps 3a–d; and number of fearful relatives in Step 3a).

When non-cognitive variables were included in the regression models after the cognitive variables (Table 3), the increases in R^2 from Step 2 (i.e. inclusion of cognitive variables in the model) to Step 3 (i.e. inclusion of non-cognitive variables) were low, but statistically significant. Non-cognitive factors accounted for only 2–5% of the variance in MDAS scores beyond the models comprising control and cognitive variables.

Discussion

This study highlights the potential relevance of cognitive factors in the understanding of dental fear. Consistent with previous research, the non-cognitive factors analysed in our study appear to be linked to dental anxiety (4, 14–19). Having experienced a traumatic event during dental treatment, being exposed to the influence of dental fearful relatives, or presenting a dispositional tendency to negative mood states might predispose a person to be afraid of going to the dentist. However, cognitive elements, such as assessments of dental events as being uncontrollable, unpredictable, potentially harmful, or disgusting, the anticipation of negative dental events as being likely or highly aversive, and negative thoughts about oneself, the dentist's behaviour or how the dental treatment will be provided, appear as better predictors of the patients' anxiety levels. Explanatory models that include cognitive factors could therefore represent a significant improvement in accounting for variations in dental fear.

Cognitive vulnerability, probability and aversiveness expectancies, DCQ scores, and DBS scores were found to account for an additional 33%, 15%, 35%, and 23%, respectively, of the variance in dental fear scores beyond a model consisting of only demographic and non-cognitive variables. In contrast, non-cognitive variables could only explain between 2% and 5% of the variance in dental fear scores beyond that accounted for by the cognitive variables. These results are consistent with a study by Armfield (31), who found that cognitive vulnerability perceptions accounted for 46.3% of the variance in dental fear scores beyond that accounted for by demographic variables and aversive dental experiences, whereas dental experiences accounted for $<1\%$ of the variance in dental fear scores beyond that accounted for by cognitive vulnerability.

Moreover, the cognitive variables in our study also deprived some of the non-cognitive variables of their statistical significance as predictors of dental anxiety. For instance, none of the non-cognitive elements analysed retained statistical significance as predictors when vulnerability appraisals were taken into account. Only the number of dental fearful relatives remained a significant predictor of dental fear after controlling for expectancies of probability/aversiveness, DCQ scores, and DBS scores. This is also consistent with results reported by Armfield (31).

The role played by the patient's gender and exposure to dental fearful relatives deserves additional discussion, as these variables were demonstrated as being significantly associated with dental fear. A gender- or family-based explanation for dental anxiety would involve a biology-laden description of dental fear assuming a genetic component (21). However, gender differences in dental anxiety could be also the effect of different socialization patterns (37). Furthermore, a contagion of fear responses (e.g. by imitation or implicit learning) and a greater access to negative information on dental treatments would be also possible in 'fearful families' (38–40). In any event, all of these explanations are also compatible with cognitive explanations of dental fear.

Some lines for future research can be drawn from our results. First, the changes in the predictive power of non-cognitive factors when cognitive scores are included in explanatory models suggest that these two types of factors might play different roles. For instance, our findings could be taken as a point of departure to explore a possible mediational role of cognitive elements in the relationship between non-cognitive factors and dental anxiety. Second, the analysis of the processes that link non-cognitive and cognitive factors also emerge as an appealing issue. For instance, it is plausible that patients' cognitions may be altered as a consequence of their experiences, family influences, or as a result of trait dispositions. How non-cognitive and cognitive elements

involved in dental anxiety are related to each other remains a topic for future studies.

The contributions of this study must be considered in light of its limitations. First, we analysed the role played by a set of cognitive and non-cognitive variables in dental anxiety, but these represent only some of the many factors that might exert an effect on dental fear in individual subjects. For instance, possible differences among participants in their levels of anxiety-related physiological activation were not taken into account. Second, our sample was a convenience one, coming from a particular slice of the Spanish population (university students and mainly composed of women), and this might limit the generalizability of the results. However, we obtained a moderate mean value in dental anxiety scores, which is partially consistent with previous Spanish studies that found moderate or low levels of dental fear (15, 17). Concerning the distribution of dental anxiety scores, previous Spanish research (18) found that only a quarter of the sample exceeded the midpoint of the scale. In our sample, half of the participants exceeded the midpoint of the possible MDAS response range. These differences could be caused by the use of different instruments of measurement or by the characteristics of the sample. For instance, our sample was mainly composed of women and, as already noted, women usually report higher levels of dental anxiety. A third limitation comes from the use of self-report measures that could be affected by memory biases. Fourth, the reliability coefficient of the expected probability scale that we used was low. This might represent a methodological limitation, as it appears to indicate a problem with the scale's internal consistency. However, as SCHMITT (41) concluded, measures with (by conventional standards) low alpha coefficients might still be useful. In our view, the items comprising the probability of negative dental events measure are more akin to a checklist instrument than to a scale aiming to measure a psychological concept. KENT's items (25) allow us to know the extent to which a person assesses negative dental events as probable. Of course, different events (items) might be considered to have a different likelihood. Thus, internal consistency concerns might be of secondary concern here.

The use of the item 'Number of dentally fearful relatives' deserves further comment as it has not, to the authors' knowledge, been used in previous studies. We designed this variable inspired by biomedical data, gathering protocols where the prevalence of a (physical) disease among the patient's relatives is frequently used as a predictor of the patient's predisposition to suffer from it. As stated earlier, previous research has proposed family-based mechanisms to explain the origins of dental fear. However, the use of the number of dentally fearful relatives as a variable must be interpreted with caution as it only quantifies the prevalence of dental fear in a family, not the intensity or the impact of the exposure to a dental fearful relative. For instance, it could be argued that close or frequent contact with a single dental fearful relative could exert an impact upon a person's fear levels. However, this variable presents some advantages, as respondents can easily understand it, it is meaningful, and it was related as expected to the other measures that were used.

Cognitive models appear to provide an improvement in our understanding of dental anxiety. Moreover, they offer a promising way to plan interventions aiming to prevent or treat dental anxiety. Past aversive dental experiences, biological or personality dispositions, and past or current exposure to an anxiogenic social environment are, to a great extent, unmodifiable aspects of a person's life. Cognitions, however, have a high plasticity, and pessimistic dental thoughts could potentially be turned into positive thoughts. Our study suggests how dentists might go about fostering this change (i.e. by enhancing patients' appraisals of dental events as controllable, predictable, and not threatening, helping them to correct inadequate expectancies about dental situations, and encouraging patients' self-efficacy as well as one's professionalism during dental treatments).

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

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