

The Cognitive Vulnerability Model and its role in dental anxiety acquisition and maintenance

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Objective: To further explore the Cognitive Vulnerability Model (CVM) in relation to the acquisition and maintenance of dental anxiety/phobia. Within this, a key aim was to develop a more comprehensive questionnaire for both the aetiology and maintenance of dental anxiety in relation to the CVM. **Methods:** An opportunity sample of 378 participants was recruited in Cyprus. They completed a standardised dental anxiety measure; two scales designed specifically to assess the four components of the CVM (uncontrollability, unpredictability, dangerousness, and disgustingness) in the acquisition and maintenance of their fear; and an open-ended question asking participants' perceived origins of their dental anxiety. **Results:** There was preliminary support for the psychometric properties of the newly developed questionnaire. Forced Entry regression analysis revealed that the CVM variables were all significant predictors of the dental anxiety maintenance, explaining 36% of the variance. However, unpredictability was not found to have a significant independent relationship with current dental anxiety. Content analysis for the open-ended responses showed that almost all of the responses could be categorised into CVM components. Regression analysis revealed that only unpredictability had a significant relationship with how participants perceived they acquired their fear. These findings show further support for the role of the CVM in maintaining dental anxiety. However, support for the CVM as a model of dental fear acquisition needs further investigation. **Conclusion:** Specific cognitive vulnerability components are important indicators of current dental fear. Efforts to alleviate dental fear should focus on addressing these cognitions to help dentally anxious individuals to access regular dental care.

Key words: Anxiety, cognitive vulnerability, dental fear

BACKGROUND

Dental fear and anxiety is prevalent in many western countries (Lahti *et al.*, 2007; Oosterink *et al.*, 2009; UK Health and Social Care Information Centre, 2010) and has been shown to cause significant physical, psychological and social problems for sufferers (Locker, 2003). Individuals who have high levels of dental fear and anxiety tend to avoid attending the dentist, and as a result have poorer oral health (Locker, 2003; Schuller *et al.*, 2003; Armfield *et al.*, 2007). Consequently, highly fearful and anxious people are more likely to have low self-esteem because of their dental appearance (Schuurs *et al.*, 1988). In addition, individuals' social relationships can be affected by their psychological distress (Locker, 2003) and they tend to isolate themselves socially due to the embarrassment of having poor oral health (Berggen, 1993; Abrahamsson *et al.*, 2000).

Given the high prevalence of dental anxiety and the detrimental physical, psychological and social consequences of this fear, there is a need to understand how and why dental fear/anxiety develops, and how it is maintained, in order to direct efforts to alleviate individuals' dental fear and to identify those at risk of developing it.

The most popular explanation for why dental anxiety develops is that it results from an unpleasant and painful past experience during a dental visit. That is, a routine dental appointment should not elicit a fear response but if an individual experiences a traumatic or painful event at the dental clinic, then they will associate the dental clinic with the negative event and a fear response will be developed. Therefore, the individual has been

conditioned to be fearful when faced with visiting the dentist. There has been support for direct conditioning with dental fear related to invasive or painful dental treatment experienced in childhood (Milgrom *et al.*, 1995; Locker *et al.*, 1999).

While the conditioning model has provided considerable evidence for some cases of dental fear, it remains unclear why some people develop dental fear and others do not. Indeed, many people have experienced dental treatment which may cause some pain, yet only a few individuals develop an anxiety (Ten Berge *et al.*, 2002). In addition, it has been shown that individuals may have a fear of the dentist and avoid attending, even though they have never had or cannot recall a traumatic dental experience (De Jongh *et al.*, 2002).

The Cognitive Vulnerability Model

In an attempt to address some of the problems of the conditioning model in explaining specific fears, Armfield (2006) has proposed the Cognitive Vulnerability Model (CVM). Within this model, an individual's cognitions are the central focus, rather than their experiences. The CVM proposes that perceptions of dangerousness, disgustingness, unpredictability and uncontrollability interact and create a schema of vulnerability (Armfield, 2006). That is, perceiving a stimulus as dangerous, disgusting, unpredictable and uncontrollable will create a vulnerability schema, with the individual eventually developing fear towards that stimulus.

Recently, researchers have applied this model to dental fear. Armfield and his colleagues (2008) conducted a large-scale

study in Australia investigating the association between dental fear and perceptions of uncontrollability, unpredictability and dangerousness. They found that uncontrollability and dangerousness were independently associated with dental fear, whilst unpredictability was not found to be predictive of dental anxiety after controlling for the other two vulnerability-related perceptions. As a preliminary study, it provided some support for the CVM and dental fear. However, there were several limitations of the study. For instance, they used single-item measures of dental fear, uncontrollability, unpredictability and dangerousness and the disgustingness component was not included at all. In addition, they only investigated participants' current perceptions of dental situations and procedures; as the CVM is a model of fear acquisition it seems necessary to explore all of the CVM components in the context of how dentally fearful individuals believe their fear was acquired.

Armfield (2010) attempted to address some of these limitations by using two validated measures of dental anxiety and fear and an expanded set of items measuring each of the four components of CVM (i.e. three questions for each vulnerability-related perception). The results revealed strong associations between each of the vulnerability-related perceptions and dental fear. This study provided further support for the role of the CVM in dental fear and has addressed some of the limitations of Armfield *et al.*'s (2008) research. However, there is still some discrepancy between the findings and conclusions drawn as he only investigated participants' current perceptions of dental situations. Therefore, these findings only highlight the importance of the four vulnerability-related perceptions to be important within participants' current dental fear.

Edmunds & Buchanan (2012) recruited a sample of dentally anxious individuals from two online support groups to explore the role of all of the CVM components in both dental anxiety acquisition and maintenance. The results revealed that initial perceptions of uncontrollability, unpredictability and dangerousness may play a key role in the onset of fear, however once the anxiety is established disgustingness may become equally important while unpredictability may diminish as a result of becoming accustomed to the situation and fear.

Whilst this study provides some useful evidence regarding the role of the CVM in both dental fear aetiology and maintenance, it is not without limitations. For example, the authors used only a single item for each of the four CVM components regarding dental anxiety acquisition. Also, they acknowledge that using different types of questions when exploring dental fear aetiology and maintenance may explain why there were differences across aetiology and maintenance. That is, when they were investigating the importance of CVM components in relation to the maintenance of dental fear, they used questions with specific examples/illustrations regarding different aspects of the components. However, for dental fear aetiology, they asked participants to what extent they felt each of the components were important in the acquisition of their dental fear (rather than giving specific examples). Thus, they contend that acquisition questions may have appeared more 'abstract' for participants, compared to the maintenance questions which were put into context.

The present study

The overall aim of the present study was to use mixed methods (quantitative and qualitative) to examine the relationship of the CVM components with the aetiology and maintenance of dental fear by addressing the discussed limitations of previous studies (Armfield *et al.*, 2008; Edmunds & Buchanan, 2012). Within this, a key aim was to develop a more comprehensive questionnaire for both the aetiology and maintenance of dental anxiety in relation to the CVM.

MATERIALS AND METHODS

Participants

Participants were recruited from members of the general public in Cyprus. Of the 397 Turkish Cypriot participants who agreed to participate, 19 were eliminated from the analyses due to missing data, leaving 378 questionnaires for subsequent analyses. Of the 378 respondents, 60.6% were women and 39.4% were men, with an age range of 16-76 years ($M = 31.4$, $SD = 10.8$).

Procedure

Ethical approval for this study was granted by the Ethics Committee of the authors' Institution. For selecting the participants, an opportunity sampling technique was used. The questionnaire was distributed to friends, family and acquaintances in Cyprus by giving a brief explanation about the research and its aims. If they agreed to participate in the study, the questionnaire was given to them to complete in their own time. Also, an online version of the questionnaire was created to recruit more participants from social networking websites (e.g. Facebook). A message was posted to these social networking websites with the link to the online survey and with a short introduction briefly explaining the research and its aims. Of the 378 respondents, 171 participants were recruited through social networking websites. All participants were provided with information concerning the purpose of the study and their rights as a participant in the research process. Participants had to give their consent before they could participate in the study by clicking/ticking their agreement to a series of statements (e.g., that they understood they could withdraw at any time). Contact information on appropriate referral sources was provided for participants who felt they needed further information/support with respect to dental anxiety.

All the materials were originally developed in English and then translated into Turkish. To ensure the equivalence between the original and the translated forms, the back-translation method was used, in which the materials were translated into Turkish by one researcher who is fluent in both languages, and then back into English by another bilingual researcher.

Materials

Participant information. The first section of the survey asked for demographic details such as gender, age, employment status, their dental visiting schedule, whether they considered themselves dentally fearful and if so their age of onset of dental fear,

and their use of any kind of support for their fear. Participants were also asked whether or not they have ever had a bad experience at the dentist, and whether or not they have missed or cancelled appointments with their dentist due to fear or anxiety.

Dental anxiety. The Turkish Version of the Modified Dental Anxiety Scale (MDAS), which was originally developed in English by Humphris, Morrison and Lindsay (1995), was used to assess dental anxiety. The standardisation and validation of Turkish MDAS was conducted by Ilguy *et al.* (2005). The MDAS consists of five items related to dental experiences (e.g., “If you went to your dentist for treatment tomorrow, how would you feel?”) and is rated on a 5-point scale ranging from ‘Not anxious’ to ‘Extremely anxious’. Overall scores range from 5 to 25 with a cut-off score of 19 or higher indicating a strong likelihood of dental phobia (Humphris *et al.*, 1995). The MDAS has good psychometric properties with a high internal consistency of .88 (Turkish Version) (Ilguy *et al.*, 2005).

Dental fear maintenance. To determine the extent to which participants perceived the four CVM components to be involved in the maintenance of their dental fear, 44 statements related to dental experiences were initially developed; 5 of which were taken from Armfield *et al.*'s (2008) and Edmunds & Buchanan's (2012) study (e.g., ‘control’ item “I don't feel in control when I'm in the dental chair”). The remaining 39 statements were generated for the purpose of this study from Edmunds and Buchanan's (2012) qualitative findings on the aetiology of dental fear, and from reviewing the online dental anxiety forums where people with dental anxiety/phobia share their experiences (e.g., ‘disgustingness’ item “I find having the dentist put his/her hands in my mouth unpleasant”). The statements required agreement or disagreement on a five-point scale ranging from ‘Strongly disagree’ to ‘Strongly agree’. The newly-developed questionnaire (comprising 44 questions) was piloted with 15 participants, who had a mean dental anxiety score of 15.6 (SD = 5.64) on the MDAS. The participants received brief definitions of each CVM component and were asked to complete the questionnaire and give feedback on whether the items fitted into the CVM components. Twelve items were deleted after receiving feedback and some of the items were revised, leaving 32 statements in the final Dental Fear Maintenance Questionnaire (DFMQ; 8 items for each of the CVM components; see Appendix A for the complete questionnaire). The internal consistency of this newly devised questionnaire was found to be excellent, with a Cronbach's Alpha of .91. All CVM subscales of the maintenance questionnaire had high internal consistency, ranging from .80 to .83.

Dental fear acquisition. This part was only completed by those participants who considered themselves to be dentally anxious/fearful. In order to gain broader insight into participants' own perceptions of why they developed dental anxiety (before asking them CVM-specific questions), an open-ended question was asked: “Can you indicate why you think you developed your dental anxiety?”

Following this, to determine the extent to which participants perceived the four CVM components to be involved in the

acquisition of their dental fear, another 44 items were generated. All of the acquisition statements were generated from the maintenance questions. For example, the ‘maintenance-control’ item “I feel helpless when I am in the dental chair” was transformed into “I felt helpless when I was in the dental chair” as an ‘acquisition-control’ item. Participants were asked to indicate the extent to which they felt the items caused them to start feeling anxious about the dentist on a five-point scale ranging from ‘Not at all’ to ‘Extremely’. These items were also piloted with the same participants in the previous pilot study and revised according to their feedback, leaving 32 items in the final Dental Fear Acquisition Questionnaire (DFAQ; 8 items for each of the CVM components; see Appendix B for the complete questionnaire).

Internal consistency of the Dental Fear Acquisition Questionnaire was also found to be excellent, with a Cronbach's Alpha of .95. Each of the CVM subscales also showed high internal consistency, ranging from .84 to .92.

Analyses

Principal Components Analysis was conducted to examine the underlying dimensions of the dental fear maintenance and acquisition questionnaires. Furthermore, in order to examine whether CVM components are related to the aetiology and maintenance of dental fear, initial correlations and forced entry regression analyses were conducted on the participants' overall MDAS score and the components of the CVM as predictor variables.

Analysis of Variance tests were also employed to examine the differences in the ratings of CVM components among those who have different levels of dental anxiety. For this purpose, participants' MDAS scores were categorised into three categories. Participants with MDAS scores between 5-10 were considered ‘Not/slightly anxious’, those who had scores between 11-18 as ‘Moderately anxious’ and those who scored between 19-25 as ‘Extremely anxious’. The Statistical Package for the Social Sciences (SPSS), 18th Edition, was used for the analyses.

Content analysis was conducted on the open-ended question regarding dental fear acquisition. A top-down approach was employed to identify the extent to which the CVM components are evident in participants' own accounts of how they acquired their fear.

RESULTS

Participant characteristics

The majority of the participants stated that they visited the dentist only when they felt they needed treatment (64%); 20.7% visited their dentists at least once per year. Three participants stated that they had had a negative experience at the dentist, and had not attended since. 21.7% of the participants reported that they had either missed or cancelled appointments due to fear or anxiety. Furthermore, participants were asked the age at which their dental fear first started. Among those who considered themselves as dentally anxious (N = 189), the majority (78.8%) indicated it had started as a child (under 18 years old). Additionally, only 10% of the sample who considered themselves as dentally anxious expressed that they were trying to cope with/lessen their fear.

There were no differences between those recruited via social networking sites (and thus completing the questionnaires online) and those recruited face-to-face (paper format).

Dental anxiety. The mean dental anxiety score was 12.13 (SD = 5.5). 48.4% of participants had anxiety scores of 5 to 10 indicating that they were not/slightly anxious ($M = 7.4$, $SD = 1.9$), 33.9% had scores between 11 and 18 suggesting that they were moderately anxious ($M = 14.2$, $SD = 2.3$), and 17.7% scored 19 or above suggesting a strong likelihood of dental phobia ($M = 21.0$, $SD = 1.9$). Participants were also asked whether they had experienced a negative dental event. Only 29.6% reported having had a bad experience. The mean age when the negative dental experience occurred was 16.1 years ($SD = 10.8$). An independent samples t-test was conducted to explore whether participants who reported experiencing a negative dental event, had higher dental anxiety scores. The results revealed that participants who had negative experiences had higher anxiety scores ($M = 14.5$, $SD = 6.1$) than those who did not ($M = 11.2$, $SD = 5.0$), $t(376) = 5.53$, $p < .001$.

Questionnaire development. Principal Component Analyses (PCA) with Varimax (orthogonal) rotation were conducted to provide validity evidence for the two newly developed questionnaires concerning dental anxiety maintenance and acquisition. The Kaiser-Meyer-Olkin verified the sampling adequacy of maintenance and acquisition questionnaires for the analyses, $KMO = .87$ and $KMO = .88$, respectively. Bartlett's test of sphericity $\chi^2(496) = 4875.20$ ($p < .001$) for the maintenance questionnaire, and $\chi^2(496) = 3227.47$ ($p < .001$) for the acquisition questionnaire indicated that correlations between items were sufficiently large for PCA. Initial analyses were run to obtain eigenvalues for each component in the data.

For the maintenance questionnaire, seven components had eigenvalues over Keiser's criterion of 1. The scree plot was slightly ambiguous and showed inflexions that would justify retaining both components 5 and 7. On the basis of the scree plot and the percentage of variance accounted for by each factor, retaining 5 factors was judged to be the most appropriate solution. These 5 components accounted for 50.43% of the variance. Two items (item 1 and item 15) were removed from the dataset due to their non-meaningful contribution at face value to the factors they loaded onto, and PCA was rerun by retaining only 5 factors. Factor loadings over .40 was accepted as a cut-off score for retaining the item in the factor they clustered around. *Table 1* shows the factor loadings after rotation. The items that clustered on the same components suggest that the retained 5 components represent disgustingness (item 25 and items 27-32), unpredictability (items 9-14 and item 16), uncontrollability (items 2-8), specific dangerousness (items 19-24 and item 26) and general dangerousness (item 17 and item 18). The dangerousness items were clustered around 2 factors. They were given the names 'specific' and 'general' because some items were very specific examples of the dangers that might happen in a dental clinic, such as "I believe that the steel probe may get stuck in my mouth" and others were more general in terms of dangerousness of the situation, such as "I believe I might feel pain when I go to the

dentist". Although this distinction is noteworthy, it was decided to combine these to form an overall dangerousness score for the remainder of the analyses.

For the acquisition questionnaire, six components had eigenvalues over Keiser's criterion of 1. However, on the basis of the scree plot and the percentage of variance accounted for by each factor, five factors were retained. These components accounted for a total of 66.26% of variance. Two items (item 7 and item 19) were removed from the dataset due to their non-meaningful contribution to the factors they loaded onto at face value, and PCA was rerun by retaining only 5 factors. Factor loadings over .40 was accepted as a cut-off score for retaining the item in the loaded factor. *Table 2* shows the factor loadings after rotation. The items that clustered on the same components suggested that components represent disgustingness (items 25-32), unpredictability (items 9-16), uncontrollability (items 1-6 and item 8), specific dangerousness (items 20-24) and general dangerousness (item 17 and item 18).

Cognitive vulnerability and dental fear

Table 1. Summary of exploratory factor analysis results for dental fear maintenance questionnaire

Item No	Rotated Factor Loadings					Corrected item-total correlation
	Disgust	Unpredictable	Control	Dangerous (Specific)	Dangerous (General)	
Item 1						
Item 2			.49			.33
Item 3			.73		.31	.63
Item 4			.54			.48
Item 5			.59			.48
Item 6			.71			.61
Item 7			.62		.35	.57
Item 8			.73			.63
Item 9		.56	.36			.51
Item 10		.64				.54
Item 11		.68				.59
Item 12		.74				.59
Item 13		.75				.65
Item 14		.75				.66
Item 15						
Item 16		.61				.58
Item 17					.81	.80
Item 18					.78	.80
Item 19				.48	.47	.48
Item 20				.55	.46	.58
Item 21				.67		.56
Item 22			.43	.45		.48
Item 23			.34	.70		.63
Item 24				.77		.69
Item 25	.61					.50
Item 26				.71		.53
Item 27	.71					.59
Item 28	.78					.67
Item 29	.79					.66
Item 30	.58					.54
Item 31	.73					.64
Item 32	.66					.60
Eigenvalues	3.83	3.67	3.64	3.28	2.22	
Variance (%)	12.76	12.22	12.14	10.94	7.40	
α	.84	.84	.80	.82	.89	

Note. Factor loadings over .40 appear in bold. Coefficients below .30 were not shown. Items 1 & 15 were removed from the dataset due to their non-meaningful contribution at face value to the factors they loaded onto.

Cognitive vulnerability and dental fear

Table 2. Summary of exploratory factor analysis results for dental fear acquisition questionnaire

Item No	Rotated Factor Loadings					Corrected item-total correlation
	Disgust	Unpredictable	Control	Dangerous (Specific)	Dangerous (General)	
Item 1			.72			.69
Item 2		.36	.71			.74
Item 3			.85			.82
Item 4			.70			.70
Item 5		.36	.71			.72
Item 6			.82			.80
Item 7						
Item 8	.35	.73	.69			.73
Item 9		.73	.30			.76
Item 10		.62			.34	.74
Item 11		.55				.68
Item 12		.68	.41			.65
Item 13		.79			.39	.65
Item 14		.76				.78
Item 15		.65				.68
Item 16	.33					.71
Item 17					.89	.85
Item 18					.85	.85
Item 19						
Item 20		.33		.68		.67
Item 21		.52		.52		.62
Item 22				.58	.39	.51
Item 23			.32	.74		.67
Item 24		.31		.80		.76
Item 25	.77					.74
Item 26	.50			.34		.47
Item 27	.87					.83
Item 28	.86					.80
Item 29	.78					.72
Item 30	.76					.75
Item 31	.77					.72
Item 32	.75					.72
Eigenvalues	5.40	5.02	4.81	2.94	2.23	
Variance (%)	17.99	16.73	16.04	9.80	7.44	
α	.91	.91	.92	.84	.92	

Note. Factor loadings over .40 appear in bold. Coefficients below .30 were not shown. Items 7 & 19 were removed from the dataset due to their non-meaningful contribution at face value to the factors they loaded onto.

Cognitive vulnerability and dental fear

Dental fear maintenance. The responses to the items that loaded onto the same component in the maintenance questionnaire were combined to obtain an overall score for that component for the subsequent analyses. The two dangerousness components were combined together for the purposes of this study, obtaining an overall dangerousness score. Regression analysis was conducted to explore which CVM variables predict dental anxiety. The initial correlations between all variables were displayed in *Table 3*. Each of the CVM components showed a moderate linear relationship with MDAS scores, $p < .001$.

Forced entry regression analysis revealed that all the CVM variables were significant predictors of current dental anxiety scores, explaining 35.8% of the total variance, $R = .60$. The Analysis of Variance (ANOVA) revealed that the model including all the variables was significant, with $F(4, 355) = 49.44$, $p < .001$. Disgustingness ($\beta = .24$, $p < .001$), uncontrollability ($\beta = .35$, $p < .001$) and dangerousness ($\beta = .16$, $p < .01$) were found to have a significant independent relationship with the current dental anxiety. However, unpredictability

($\beta = .02$) was not a significant independent predictor of the current dental anxiety.

One-way ANOVA tests were also conducted to examine the differences in the ratings of CVM components among those who have different levels of dental anxiety. *Table 4* represents the mean scores, standard deviations and F-scores of CVM components for each category of dental anxiety. Dental anxiety levels differed significantly across each of the CVM component ratings, $p < .001$. However, the *post hoc* analyses revealed no significant difference between those who were moderately anxious and those who were extremely anxious on their ratings of disgustingness and unpredictability, all the other differences were significant, $p < .001$, indicating that participants who were not/slightly anxious were less likely to perceive the dental experience as uncontrollable, unpredictable, dangerous and disgusting than those who were moderately or extremely anxious.

Table 3. Correlations between MDAS, and CVM components for dental fear maintenance

	MDAS	Disgust	Uncontrollable	Unpredictable
Disgust	.41*	-		
Uncontrollable	.51*	.27*	-	
Unpredictable	.32*	.35*	.39*	-
Dangerous	.46*	.41*	.54*	.46*

Note. * $p < .001$

Table 4. Mean scores, standard deviations and F-scores of CVM components for each category of dental anxiety.

	Not slightly Anxious		Moderately Anxious		Extremely Anxious		df (between,within)	F
	M	SD	M	SD	M	SD		
Disgust	22.8	6.4	25.9	4.7	27.4	5.7	2, 361	31.08*
Uncontrollable	15.6	5.0	18.1	5.2	23.7	6.1	2, 361	57.40*
Unpredictable	19.0	6.1	22.5	5.2	23.2	5.6	2, 362	18.50*
Dangerous	22.5	6.2	25.6	5.7	30.3	6.7	2, 359	40.04*

Note. * $p < .001$

Cognitive vulnerability and dental fear

Dental Fear Acquisition. 73% of the participants who considered themselves dentally anxious, provided a response to the open-ended question regarding how they acquired their fear. These responses were analysed using top-down content analysis to explore whether they could be categorised into CVM components. Multiple explanations were often extracted from each response thus the frequency refers to the occurrence of the factors, rather than per individual response. As *Table 5* illustrates, most of the responses could be attributed to one or more CVM component.

The most frequent CVM component that emerged from the data was ‘dangerousness’, evident in the responses of 37.5% of the participants. Almost all of these responses had pain as a central focus with many participants relating these to dentist incompetence or carelessness. The next most common CVM component that emerged from data was ‘unpredictability’, with 24.1% of responses categorised into this component. Participants described unpredictable events (e.g., unexpected pain, complications, and treatments), again with pain often central to the acquisition of their fear.

Lack of control was also coded frequently (16.6%) from participant responses as a reason for developing dental fear. Some participants reported that they did not feel in control when they were in the dental chair, or that they felt powerless when they were not involved in the decision process. In addition, participants often described physical restraint, and the associated lack of control, in their fear acquisitions.

Disgustingness was reported by 13.1% of the respondents as an important reason for acquiring their dental anxiety. Some respondents reported that they disliked the smell and taste of blood and/or medication or that the dentist without any gloves or mask on was unpleasant. The ‘Other’ category was created to cluster the themes that were found to be of importance within dental fear aetiology but did not relate to (or specifically indicate) components of the CVM. They were: unsympathetic dentist, fear of needles, and the sight/sound of the tools.

In addition to the open-ended question looking at participants’ onset of dental anxiety, the newly developed Dental Fear Acquisition Questionnaire asked participants to indicate the extent to which each CVM component was related to their fear acquisition. Initial correlations showed that each of the four components showed linear relationships with the MDAS score, $p < .01$ (*Table 6*).

Forced Entry regression analysis revealed that the variables entered into the regression model were all significant predictors of dental anxiety score, explaining 21.5% of the total variance, $R = .46$. The ANOVA statistic revealed that the model including all the variables was significant, with $F(5, 129) = 8.82$, $p < .001$. However, only unpredictability ($\beta = .42$, $p < .001$) was found to have a significant independent relationship with dental anxiety. Disgustingness ($\beta = .02$), uncontrollability ($\beta = .04$) and dangerousness ($\beta = .02$) were not found to be significant independent predictors of dental anxiety.

Table 5. Frequencies of the factors extracted from the open-ended responses.

CVM Factor	Number (%)	Example response
Dangerousness	129 (37.5)	<i>‘Impressions got stuck while I was gagging and it was really painful’</i> (Participant 294)
Unpredictability	83 (24.1)	<i>‘I didn’t know what to expect the first time I had a filling and that scared the hell out of me’</i> (Participant 123)
Uncontrollability	57 (16.6)	<i>‘I felt anxious because I felt I had no control over the dentist’</i> (Participant 281)
Disgustingness	45 (13.1)	<i>‘The smell of the gas was horrible’</i> (Participant 137)
Other	30 (8.7)	<i>‘I hated the shrill sound of the drill’</i> (Participant 136)

Cognitive vulnerability and dental fear

Table 6. Mean scores, standard deviations and F-scores of CVM components for each category of dental anxiety.

	MDAS	Disgust	Uncontrollable	Unpredictable
Disgust	.23*	-		
Uncontrollable	.46**	.45**		
Unpredictable	.29**	.47**	.55**	
Dangerous	.34**	.44**	.68**	.59**

Note. * $p < .01$, ** $p < .001$

DISCUSSION

The present study provides further support for the CVM as an explanatory model for maintaining current dental anxiety; however its role as a model for dental anxiety acquisition is still not fully established. Moreover, the results of the principal component analysis provide preliminary support for the psychometric properties of the newly developed Dental Fear Maintenance Questionnaire (DFMQ) and Dental Fear Acquisition Questionnaire (DFAQ).

Both questionnaires were found to comprise mainly five factors; three factors representing disgustingness, uncontrollability, unpredictability, and the other two were judged to be representing two dimensions of dangerousness (perceived specific dangerousness and general dangerousness of dental situations). The two dimensions of the dangerousness component may have resulted from the differences between the questions posed. The questions comprising Factor 5 are more general in nature, highlighting the painfulness of the dental visits in general (e.g., "I believe I might be hurt when I'm in the dental chair."). However, the questions comprising Factor 4 indicate specific dangerous dental situations that might cause pain or harm. For instance, the item "I believe that the dentist's hand may slip with the drill" specifies a dangerous situation that will probably hurt but does not mention pain explicitly. However, as the both types of questions indicate perceiving dental situations as dangerous, they were combined together for the analyses.

Dental anxiety maintenance. The results showed that whilst uncontrollability, dangerousness and disgustingness are predictive of maintaining dental anxiety, unpredictability was not found to be an independent predictor of participants' current dental fear. Similarly, Armfield *et al.* (2008) and Edmunds & Buchanan (2012) found that unpredictability did not have a significant independent relationship with dental anxiety maintenance. In addition, we found that participants who are moderately or extremely anxious about visiting dentist are more likely to perceive dental situations as uncontrollable, unpredictable, dangerous, and disgusting than those who were not/slightly anxious. These findings provide further support for the CVM's role in maintaining current dental anxiety.

Dental anxiety acquisition. This study also investigated the role of CVM components in the acquisition of dental fear. An open-ended question was asked to the participants who considered themselves dentally anxious, to specify their own explanations for the origins of their dental anxiety. Almost three quarters of the participants could provide an explanation for why they had become fearful, and one third described one or two specific negative experiences that were significant in developing their fear. Although dental fear has often been described as a conditioned reaction to a negative dental experience (e.g., Moore *et al.*, 1991), we found elements of CVM components inherent within this experience which may have created a vulnerability schema that then resulted in the development of the dental fear. For example, one participant emphasised that she developed her fear after a bad experience. However, when the essence of her experience was examined, there were cognitive vulnerability-related factors apparent within it. Accordingly, it could be suggested that dental anxiety is multi-factorial in nature and is related to both cognition and conditioning experiences (Abrahamsson *et al.*, 2000).

The top-down content analysis of open-ended responses revealed that all four components of the CVM were apparent in participants' accounts of the beginning of their dental fear. Interestingly, almost all responses could be categorised into CVM components. Dangerousness was perceived to be of greatest importance in dental fear acquisition, followed by unpredictability. Disgustingness was apparent across a number of responses, but was the least common explanation. It should be noted that some responses included more than one CVM component, and this was most often the case for dangerousness and unpredictability. As such, dangerousness and unpredictability components may not be distinct when considering the aetiology of dental fear.

The newly developed Dental Fear Acquisition Questionnaire (DFAQ) further examined participants' onset of dental anxiety in relation to the CVM components. Findings showed that although every CVM component had a positive significant relationship with dental anxiety, only unpredictability was found to be an independent predictor for dental fear acquisition. Interestingly, unlike Edmunds & Buchanan's (2012) findings, uncontrollability

was not found to have a significant independent relationship with fear acquisition. However, the results from the open-ended responses showed that uncontrollability was a common factor that played a role in perceived fear acquisition. These conflicting and inconsistent findings regarding uncontrollability may be due to the comprehensiveness of the DFAQ. For example, one of the most commonly perceived uncontrollability factors from the open-ended responses was that of physical restraint. This was categorised under the uncontrollability component as it limits a person's control over the situation. However, there were no items relating specifically to physical restraint in the acquisition questionnaire. Therefore, a more comprehensive assessment of uncontrollability could be made by adding 'physical restraint' to the acquisition questionnaire to have a more definitive conclusion on the importance of uncontrollability in dental fear acquisition.

The present findings support the results of Edmunds and Buchanan's (2012) study in which they found some discrepancy between CVM components that are perceived to be important in maintaining fear and those perceived as important in acquiring fear. Specifically, these findings might indicate that perceiving dental situations as unpredictable, dangerous and uncontrollable may be particularly important in developing the anxiety. However, once the fear has developed, disgustingness might also become important, while the importance of unpredictability might diminish. Edmunds and Buchanan (2012) suggested that this decrease in importance of unpredictability may be a result of becoming familiarised with the dental situations.

Dental fear prevalence. The results of the present study showed that the prevalence of dental fear is high in this Cypriot sample, with more than half of the participants indicating that they felt moderately or extremely anxious about going to the dentist. Moreover, almost a fifth of the sample had scores indicating the likelihood of dental phobia. As there is a paucity of research exploring dental anxiety/phobia in Cyprus it is difficult to tell whether this is a self-selection bias (anxious participants more likely to take part in the study), or is actually reflected in the wider Turkish Cypriot population. It should also be noted that the number of participants recruited in this study was relatively small; therefore these results could only be an indication to the actual case. In addition, the study recruited participants from similar social groups (i.e. friends, family, acquaintances and social networking websites) through opportunity sampling, therefore these individuals may have unique characteristics to these social groups which could limit the generalisability. Future research should recruit a much larger sample, employing a formal sampling technique in order to have reliable prevalence indicators of dental anxiety/phobia in Cyprus.

It should be noted that, due to the cross-sectional nature of this study, causal associations between cognitions and dental anxiety cannot be determined. It could be argued that the association between dental anxiety and cognitive vulnerability-related perceptions is a result of dental anxiety causing negative cognitions rather than the other way around. Moreover, we should also note that we are only investigating participants' perceptions of

how their dental anxiety started, which is based on retrospective recall. Experimental or longitudinal studies are required to establish the direction of causality between dental fear and CVM components. However, it has been noted that this is difficult to do in the context of developing fear (Edmunds & Buchanan, 2012).

In summary, the findings show moderate support for three of the vulnerability-related cognitions in maintaining dental fear (uncontrollability, dangerousness, and disgustingness). However, support for the CVM as a model of dental fear acquisition requires further research. Additionally, the results show preliminary support for the psychometric properties of the newly developed DFAQ and DFMQ questionnaires. It would be useful for future studies to validate the questionnaires with a sample of dentally phobic individuals, as well as including them as assessment tools in future CVM longitudinal/experimental studies.

CONCLUSION

In conclusion, this research further demonstrated the importance of individuals' cognitions and perceptions in relation to dental fear. As a result, efforts to alleviate dental fear should focus on people's perceptions of vulnerability. For instance, the effectiveness of traditional cognitive behavioural therapy techniques might be increased by exploring and focusing on vulnerability-related perceptions. Moreover, to prevent the development of dental anxiety, dentists should emphasise a sense of patient control, as well as predictability and safety in relation to treatment.

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Appendix A

Dental Fear Maintenance Questionnaire

Please indicate the extent to which you agree or disagree with the following statements by checking the appropriate box.

- 1= Strongly Disagree
- 2= Disagree
- 3= Neither Agree Nor Disagree
- 4= Agree
- 5= Strongly Agree

	1	2	3	4	5
1. I don't feel in control when I'm in the dental chair.					
2. I don't feel that I am able to tell the dentist to stop if I feel uncomfortable.					
3. I feel helpless when I'm in the dental chair.					
4. I feel that the dentist will do what he wants, no matter what I say.					
5. I don't feel I can stop for a rest during treatment if I feel the need.					
6. I feel like I am trapped in the dentist's chair/clinic.					
7. I don't feel that I can be involved in the decision process of which treatment I would like to have done.					
8. I feel vulnerable when I lie in the dental chair.					
9. I don't feel like I know what's going to happen next when I'm in the dental chair.					
10. I don't feel like I know the intensity of pain that I may have during treatment.					
11. I don't feel like I know what the dentist will do (e.g. injection, drilling) while undertaking dental procedures (e.g. root canal treatment).					
12. I don't feel like I know why the dentist inserts a certain dental tool in my mouth and what it is used for.					
13. I don't feel like I know whether I will be in pain after the treatment.					
14. I don't feel like I know if I will have any complications after the treatment.					
15. I don't feel like I know if I will lose any of my teeth during treatment.					

16. I don't feel like I know what's happening in my mouth.					
17. I believe I might be hurt when I'm in the dental chair.					
18. I believe I might feel pain when I go to the dentist.					
19. I believe I might have complications (e.g. infection, heavy bleeding) after/during the dental procedure.					
20. I believe that the dentist's hand may slip with the drill.					
21. I believe that the dentist may perform unnecessary treatment.					
22. I believe that the anaesthetic may not be effective to alleviate the pain.					
23. I believe I might choke or suffocate during dental treatment.					
24. I believe that the steel probe may get stuck in my mouth.					
25. I find the smell of the dentist's room unpleasant.					
26. I believe I might be contaminated with germs.					
27. I find the taste and/or smell of the medications (e.g. antiseptic) used during dental procedure unpleasant.					
28. I find spitting saliva and/or blood unpleasant.					
29. I find the smell and/or taste of blood unpleasant.					
30. I find having the dentist put his/her hands in my mouth unpleasant.					
31. I find the smell and/or taste of the burning tooth enamel while dentist drills the tooth unpleasant.					
32. I find the water spray put in my mouth unpleasant.					

Appendix B

Dental Fear Acquisition Questionnaire

Please indicate to what extent you feel the statements below caused *you to start feeling* anxious about the dentist. Some of the items may appear similar to those asked in the previous section, but this time we are specifically asking about factors that you feel first contributed to you becoming fearful of the dentist.

Please only answer this part if you consider yourself to be dentally anxious/fearful. If you *don't* consider yourself to be dentally anxious/fearful, please skip to the next part.

- 1= Not at all
- 2= A little
- 3= Moderately
- 4= Quite a bit
- 5= Extremely

	1	2	3	4	5
1. I didn't feel in control when I was in the dental chair.					
2. I didn't feel that I would be able to tell the dentist to stop if I felt uncomfortable.					
3. I felt helpless when I was in the dental chair.					
4. I felt that the dentist would do what he wanted, no matter what I said.					
5. I didn't feel I could stop for a rest during treatment if I felt the need.					
6. I felt like I was trapped in the dentist's chair/clinic.					
7. I didn't feel that I could be involved in the decision process of which treatment I would like to have done.					
8. I felt vulnerable when I was in the dental chair.					
9. I couldn't predict what's going to happen next when I was in the dental chair.					
10. I couldn't tell beforehand, the intensity of pain that I might have during treatment.					
11. I couldn't tell beforehand, what the dentist would do (e.g. injection, drilling) while undertaking dental procedures (e.g. root canal treatment)					
12. I couldn't tell why the dentist inserted a certain dental tool in my mouth and what it was used for.					
13. I couldn't tell whether I would be in pain after the treatment.					

14. I couldn't tell if I would have any complications after the treatment.					
15. I couldn't tell if I would lose any of my teeth during treatment.					
16. I couldn't predict what's happening in my mouth.					
17. I was hurt when I was in the dental chair.					
18. I felt pain when I was at the dentist.					
19. I had complications (e.g. infection, heavy bleeding) after/during the dental procedure.					
20. I felt like the dentist's hand was slipping with the drill.					
21. I felt like the dentist was performing unnecessary treatment.					
22. I felt like the anaesthetic was not effective.					
23. I felt like I was choking or suffocating during dental treatment.					
24. I felt like the steel probe was getting stuck in my mouth.					
25. I found the smell of the dentist's room unpleasant.					
26. I was afraid of being contaminated with germs.					
27. I found the smell and/or taste of the medications (e.g. antiseptic) used during dental procedure unpleasant.					
28. I found spitting saliva and/or blood unpleasant.					
29. I found the smell and/or taste of blood unpleasant.					
30. I found having the dentist put his/her hands in my mouth unpleasant.					
31. I found the smell and/or taste of the burning tooth enamel while dentist drilled the tooth unpleasant.					
32. I found the water spray put in my mouth unpleasant.					