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GOOD TEETH, BAD TEETH AND FEAR OF THE DENTIST

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Summary—Studies of dental fear and oral disease suggest that conditioning processes are important in the acquisition of dental fear. At this time, however, definitive conclusions are premature as all research on the etiology of dental fear has been retrospective in design, with most confined to analogue or clinic samples. This study redressed these limitations by prospectively investigating the relationship between oral health (i.e. caries experience) at age 5 and 15 yr and the report of dental fear at age 18 in a large, unselected birth cohort. Caries experience at age 5 was not related to the development of dental fear in late adolescence. In contrast, caries experience at age 15 was significantly, and specifically, related to the report of dental fear at age 18. A ratio of caries severity at age 15, indicating the extent of multi-surface involvement, was inversely related to dental fear at age 18. This intriguing finding suggests that relatively brief dental treatment occasioned by low levels of dental disease may result in the incubation of dental fear in some individuals and that longer episodes of treatment may facilitate fear habituation. Theoretical and practical implications of these findings are discussed. © 1997 Elsevier Science Ltd

INTRODUCTION

Visiting the dentist can be a frightening experience for many people. Studies from industrialised countries indicate that more than 50% of the population report at least some fear of dental treatment (e.g. Gatchell, Ingersoll, Bowman, Robertson & Walker, 1983; Green & Green, 1985; Milgrom, Fiset, Melnick & Weinstein, 1988; Stouthard & Hoogstraten, 1990), with 5–15% reporting extreme fear and avoidance of treatment altogether (e.g. Freidson & Feldman, 1958; Milgrom *et al.*, 1988). This type of phobic avoidance can have serious consequences for oral health and general well-being (e.g. McGlynn *et al.*, 1990; Hakeberg, Berggren & Grondahl, 1993; Moore, Brodsgaard & Birn, 1991; De Jongh, Muris, Schoenmakers & Ter Horst, 1995).

High levels of dental fear are most often attributed to aversive conditioning experiences, usually occurring during childhood, with a smaller percentage attributed to vicarious learning/modelling (Bernstein, Kleinknecht & Alexander, 1979; Berggren & Meynert, 1984; Lautch, 1971; Milgrom *et al.*, 1988; Milgrom, Fiset, Melnick & Weinstein, 1995; Shoben & Borland, 1954). For example, Ost and Hugdahl (1985) found 69% of 51 dental phobics ascribed the onset to conditioning experiences, 12% to vicarious experiences and 6% to transmission of information/instruction. Additionally, Milgrom *et al.* (1995) found that both conditioning and parent modelling factors were significant independent predictors of fear level in children aged 5–11 yr after controlling for gender, age and attitudinal factors. It appears, therefore, that conditioning processes play an important role in the acquisition of dental fear, particularly in young children.

However, a number of methodological problems with previous studies prevent definitive conclusions regarding the significance of conditioning events in the acquisition of dental fear. First, most studies have used either samples of college students or routine dental patients; one of the few studies that attempted to obtain a sample representative of the general population examined children aged 5–11 yr (Milgrom *et al.*, 1995). Second, all studies of dental fear have relied upon retrospective self-report to determine mode of acquisition. Such a methodology is often inadequate or invalid because of faulty memory, retrospective bias, and/or destruction of old records (Loeber & Farrington, 1994). Finally, definitions of conditioning have varied among stu-

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dies and measures of uncertain reliability and validity have been employed (cf. Menzies & Clarke, 1993).

To more accurately determine the role of conditioning factors in the acquisition of dental fear, a longitudinal sampling frame is necessary. Assessment of the dependent (dental fear) and independent variables (treatment experience indexed by disease level) should be conducted prospectively and, where possible, incorporate clinical dental examination. Measures that represent direct contact with dental treatment are regarded as good indicators of conditioning experience and have been found to predict dental fear in young children (Milgrom *et al.*, 1995). That is, individuals with more disease tend to receive more aversive and emergency dental treatment (Weinstein, 1990; Milgrom *et al.*, 1995; Thomson, Stewart, Carter & Spencer, in press), thereby increasing the likelihood of aversive conditioning.

This study examines the relationship between prevalence of dental fear at age 18 and dental caries scores at age 5 and 15 yr in a representative birth cohort. A diagnostic control group consisting of individuals who reported clinically significant non-dental fears was included along with a no-fear group to investigate the specificity of the hypothesised relationship between treatment of oral disease and dental fear.

METHOD

Participants

The sample were members of the Dunedin Multidisciplinary Health and Development Study, a longitudinal investigation of young people's health, development and behaviour from birth to adulthood. The study and sample members have been described in detail elsewhere (Silva & Stanton, in press). Briefly, the Dunedin sample has been assessed with a diverse range of psychological, medical and sociological measures with high rates of participation at age 3 (n = 1037), 5 (n = 991), 7 (n = 954), 9 (n = 955), 11 (n = 925), 13 (n = 850), 15 (n = 976), 18 (n = 1008), and most recently 21 (n = 992). The present data are from assessments conducted at ages 5, 15 and 18.

Caries (DMFT and DMFS)

Dental caries is a chronic, progressive disease which may ultimately result in the loss of teeth if allowed to progress unchecked. Teeth which have been irreversibly affected by caries can be either restored to normal form and function by the placement of dental fillings, or extracted. In dental epidemiology, the DMF (decayed, missing and filled) index (Klein, Palmer & Knutson, 1938) is used to provide a point estimate of the dental caries experience of an individual, and can be presented using whole teeth (DMFT) or tooth surfaces (DMFS) as the units of analysis (for the deciduous dentition lower-case dmf is used). It is computed by summing the number of decayed, missing and filled teeth (or surfaces, usually scoring 5 surfaces per posterior tooth and 4 per anterior tooth). For example, a tooth which is affected by caries (or is restored) on three surfaces contributes 3 to the DMFS score for that individual, but only 1 to the DMFT score. The DMFS/DMFT ratio can be used as a crude indicator of the amount of multi-surface caries that an individual has experienced.

Dental assessment at age 5 and 15

In the dental survey in 1978, 923 children were examined within 4–6 weeks of their 5th birthday. The children were examined in a dental chair using standardised fibre-optic lighting, disposable dental mirrors, and sickle explorers (Evans, Beck & Brown, 1980). Diagnosis and recording of dental caries was made according to standard criteria (World Health Organization, 1977). In 1987–88 at age 15, 780 adolescents were examined using the same standard methods and criteria.

Dental fear

As part of the Mental Health Assessment at age 18, sample members were administered a modified version of the Diagnostic Interview Schedule (DIS). The four modifications made to the DIS for the Dunedin study were:

(1) to limit questions to the assessment of DSM-III-R criteria only;
(2) to limit the assessment of symptoms to those occurring within the past 12 months;
(3) to limit assessment to only the most commonly occurring diagnoses in this age group; and
(4) to limit response options to 'no', 'yes, sometimes', and 'yes, definitely'. A response of 'yes, definitely' was required before a diagnosis could be made (Feehan, McGee, Nada Raja & Williams, 1994).

As part of the DIS interview sample members were asked if, in the preceding 12 months, they had had a strong, unreasonable fear, that either resulted in avoidance or extreme discomfort when they thought about 'going to the dentist'. Sample members who responded 'yes, definitely' to this question were included in the dental fear group (n = 96).

Non-dental fear

Sample members were asked if, in the preceding 12 months, they had had a strong, unreasonable fear, that either resulted in avoidance or extreme discomfort when exposed to the following objects or situations: heights, seeing blood, any kind of insect; dogs, birds, rats or other animals; storms, thunder or lightning; getting an injection, being in an open space, being in water. Sample members who responded 'yes, definitely' to any of these specific fears were included in the non-dental fear group (n = 301). A no-fear control group was also included (n = 539).

RESULTS

The frequency distributions of dmft and DMFT scores at ages 5 and 15 respectively can be seen in Figs 1 and 2 (the distributions of dmfs and DMFS scores were essentially the same and are not presented here). Fifty-four percent of *Ss* were caries-free (had a dmft score equal to zero) at age 5 (Fig. 1). The frequency distribution of DMFT scores at age 15 was bimodal. These distributions indicate that at both ages, two distinct dental caries experience groups were apparent; those for whom dmf and DMF scores equalled zero (i.e. the caries-free group), and those whose dmf and DMF scores were greater than zero (i.e. those with or having experienced caries). Further, 292 (46%) of those having experienced caries at age 15 had a DMFS/DMFT ratio equal to one (caries involved just one surface per tooth), and 341 (54%) had a DMFS/DMFT ratio greater than one (caries involved more than one surface per tooth).

To determine if DMFT and DMFS scores were significantly and specifically related to dental fear, odds ratios were calculated. A control group of *Ss* with non-dental fears was also included. The results presented in Table 1 indicate that dmft and dmfs scores at age 5 were not associated with dental fear at age 18. At age 15, sample members with caries experience (DMFT scores greater than zero) were almost five times more likely to report dental fear at age 18 than their caries-free peers. DMFS scores at age 15 were not related to dental fear at age 18. Further, the relationship between DMFT scores at 15 and dental fear at 18 was specific to dental fear; that is, there was no association between DMFT scores at age 5 or 15 and non-dental fears at age 18. Similar results were obtained when the odds ratios were recomputed for the sample split according to DMFT scores less than or equal to four (low caries experience), and greater than four (high caries experience).

To investigate how the DMFT and DMFS scores affected the probability of reporting dental fear at age 18, a hierarchy of logistic regression models were fitted, with dental fear as the dependent variable. DMFT scores at ages 5 and 15, and the ratio of DMFS/DMFT at ages 5 and 15 were the continuous independent variables. A stepwise model-fitting procedure was

applied using the likelihood ratio statistic. A model was considered to be *better* than a sub-model if the change in deviance between the two models was significant at the 0.05 level. This stepwise procedure resulted in the age 5 dmft and dmfs/dmft scores being excluded, with age 15 DMFT and DMFS/DMFT scores being retained. The age 15 DMFT score provided a positive logistic regression coefficient, whereas the age 15 DMFS/DMFT ratio provided a negative coefficient—higher DMFT scores at age 15 increased the chance of dental fear at age 18, but higher numbers of DMF surfaces per DMF tooth at age 15 decreased the likelihood of being fearful of the dentist at age 18. The probability of suffering from dental fear at age 18, as predicted by the best model, is presented in Fig. 3.

To determine if the four independent variables possessed any *direct* predictive ability for dental fear at age 18, the changes in deviance between the univariate models and the null model were inspected. The univariate model with DMFT at age 15 as the independent variable was the only univariate model significantly better than the null model. That is, the age 5 independent variables had no predictive ability for dental fear at age 18. Further, the ratio DMFS/DMFT provided no useful information about who was likely to report dental fear at age 18 when the sample was examined as a whole. However, when this ratio was restricted to only sample members with caries experience (DMFT of one or more), the ratio successfully predicted the probability of reporting dental fear at age 18.

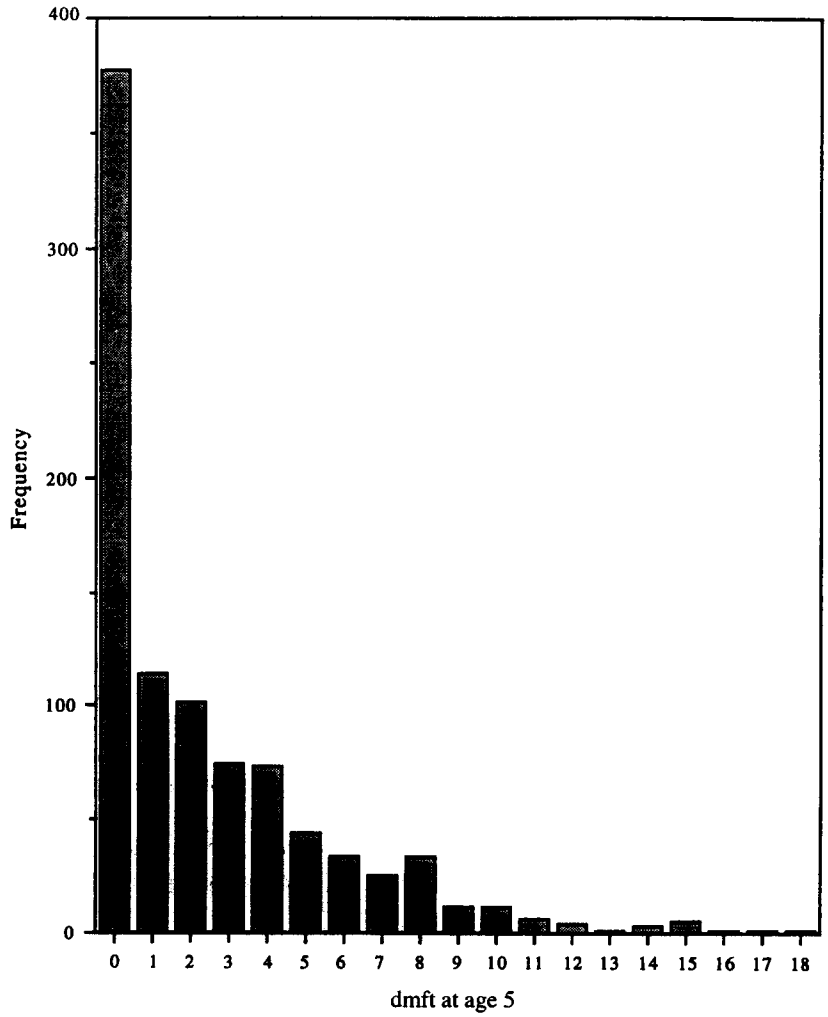

Fig. 1. Frequency distribution of dmft scores at age 5 in a longitudinal birth cohort.

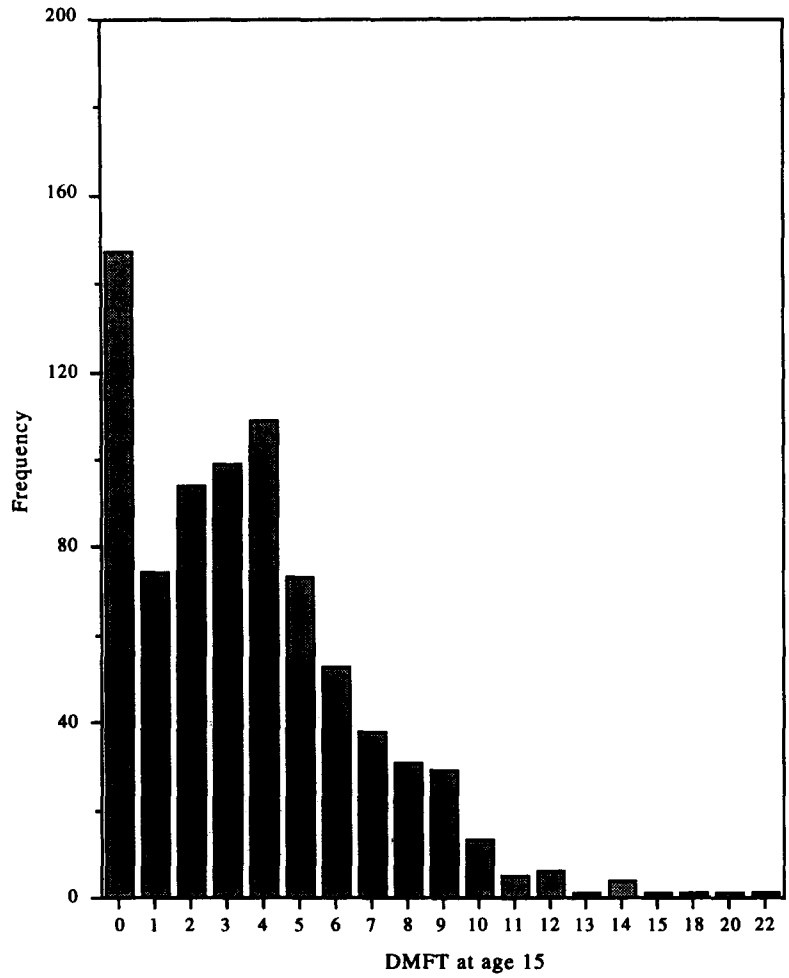

Fig. 2. Frequency distribution of DMFT scores at age 15 in a longitudinal birth cohort.

DISCUSSION

This study examined the relationship between oral health during early childhood and adolescence and the report of dental fear at age 18. A measure of conditioning experience (operationalised as caries level) was obtained from dental examinations conducted at age 5 and 15 yr. The dmfs and dmft scores at age 5 were not related to the report of dental fear at age 18. Potentially aversive dental experience up to the age of 5, therefore, did not appear to be associated with the development of dental fear later in life. In contrast, dental caries experience at age 15 was significantly and specifically related to dental fear at age 18—that is, those with greater caries experience at age 15 were more likely to report dental fear, but *not* other fears, at age 18.

Table 1. Odds ratios* (with 95% confidence intervals) for dental and non-dental fear and caries prevalence at age 5 and 15 yr in a longitudinal birth cohort

	Dental fear at age 18		Non-dental fear at age 18	
	OR	95% CI	OR	95% CI
Deciduous caries experience (dmft > 0 at age 5)	1.05	0.67–1.66	1.08	0.80–1.46
Permanent caries experience (DMFT > 0 at age 15)	4.78	1.72–13.29	0.81	0.56–1.18

*A value greater than one indicates that a *S* whose dmf/DMF score was zero is less likely to be fearful than a *S* who scores dmf/DMF > 0. Likewise, an odds ratio less than one indicates that a *S* who scores dmf/DMF = 0 is more likely to be fearful than a *S* who scores dmf/DMF > 0, and a value of one means that the *S*'s fear is not related to whether the *S* has a dmf/DMF score equal to or greater than zero.

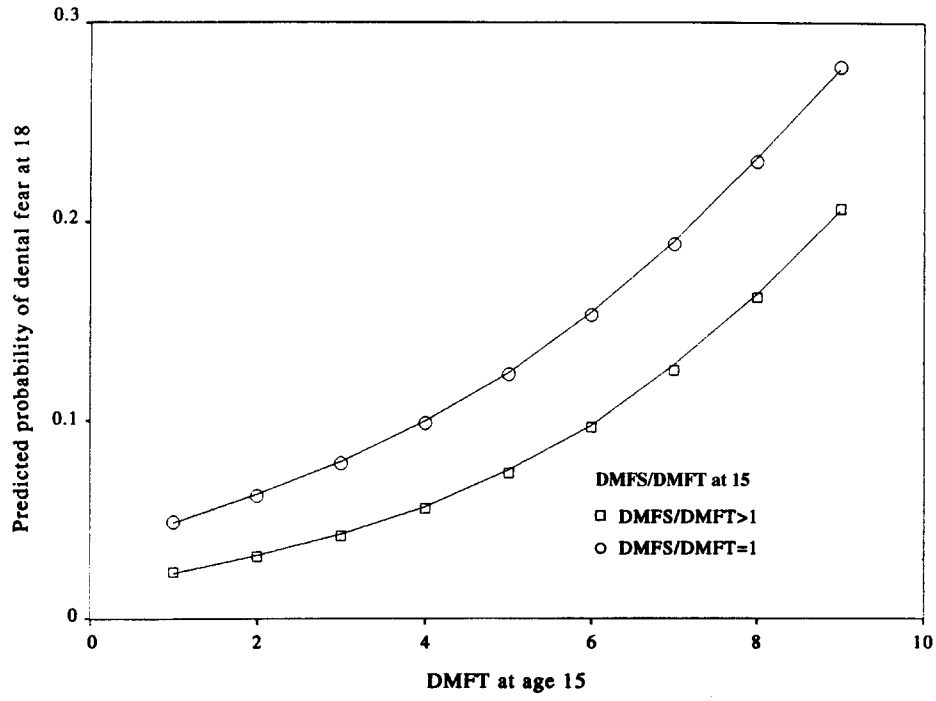

Fig. 3. Predicted probability of dental fear at age 18 vs DMFT scores at age 15 in a longitudinal birth cohort.

This indicates that poor dental health during middle childhood and early adolescence (necessitating more extensive dental work with concomitant potential for aversive conditioning) was related to the onset of dental fear.

Interestingly, the ratio measure of DMFS/DMFT at age 15, which was derived to function as a measure of severity of decay, was inversely related to the likelihood of reporting dental fear at age 18. That is, a greater number of surfaces involved per tooth (a putative measure of poorer oral health) was associated with less dental fear. To understand this somewhat anomalous finding one must consider the type of dental treatment indicated by different levels of decay. Multi-surface dental restorations invariably require more time than single-surface restorations (Woodward, Csima, Leake, Ryding & Main, 1995). It is possible, therefore, that longer treatment may facilitate fear habituation, whereas shorter duration, single-surface treatment may actually sensitise an already mildly anxious patient by not allowing sufficient time for habituation to occur.

Sensitisation occurring during relatively brief treatment is consistent with the fear incubation hypothesis advanced by Eysenck (1976). That is, following an initial conditioning episode, subsequent non-traumatic dental visits, characterised by CS-alone presentation (e.g. anticipatory anxiety) but not aversive treatment (UCS), may result in an enhancement of fear (CR). A key feature of Eysenck's position is that incubation is more likely to occur when the CS-only presentation is of relatively short duration. Hence, shorter treatments with less probability of aversive events (i.e. CS-only), may lead to an increase in dental fear over time whereas longer duration treatment (i.e. exposure to the feared situation) may ameliorate dental fear via habituation processes.

The present findings suggest that poor dental health may result in aversive dental experiences which, in turn, can lead to the development of dental fear. A primary consideration during dental treatment is to ensure minimal discomfort and pain. However, for patients who have developed some degree of dental anxiety or fear, expeditious and relatively pain-free dental treatment may only serve to incubate fear and ultimately exacerbate fearful responding. Consistent with exposure principles (and the present findings), dental patients should be encouraged to cope with mild levels of discomfort for longer periods of time, an outcome that often occurs with more extensive dental treatment. This may facilitate habituation and help fearful dental patients

reevaluate the UCS (painful dental experience) favourably and lead to a reduction of anxiety surrounding treatment (Davey, 1989).

From the public health perspective, it may prove useful to increase awareness among consumers regarding the 'vicious' cycle associated with poor oral health and the increased likelihood of more extensive treatment resulting in the development of high levels of fear. Additionally, dental practitioners should be made aware that longer and more extensive treatment may have beneficial effects for those most likely to avoid the dentist (i.e. those with high levels of dental fear), particularly where this is undertaken on an elective rather than emergency basis. Perhaps not surprisingly, lengthy exposure to the feared situation may be the most effective approach to overcoming fear and ensuring good oral health.

Interpretation of these findings in terms of etiological theory is limited as no attempt was made to examine all possible etiological factors relevant to dental fear (i.e. the roles played by vicarious learning or information/instruction were not examined). Rather, we sought to elucidate the role played by conditioning experiences in the acquisition of dental fear from a developmental perspective. As such, this study may be the first to prospectively examine the relationship between oral health early in life and the subsequent development of dental fear in a longitudinal–epidemiological sample.

This approach offers a number of methodological advantages over previous retrospective studies and permits some tentative conclusions regarding the importance of conditioning processes in the development of dental fear. That is, unlike other specific fears (e.g. fear of heights), the present findings are clearly consistent with associative accounts of fear acquisition (cf. Menzies & Clarke, 1993). Thus, it is possible that different acquisition processes underpin the development of different types of fear. Until a similar study is conducted on, for example, people with height fear, the ubiquity of conditioning processes in the development of specific fears remains unknown. An important finding was that acquisition of dental fear appears to be strongly influenced by oral health habits established in mid–late childhood and early adolescence. Good oral selfcare during this time may be important if dental fear is to be avoided. When dental fear does develop, controlled exposure to *all* aspects of treatment should be attempted, as avoidance of the 'realities' of dental treatment may only serve to maintain dental fear.

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