Dental fear in children: prevalence, etiology and risk factors

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CHAPTER 2

REVIEW OF LITERATURE
Chapter 2

Introduction

The aim of this chapter is to outline some major theoretical and practical issues in research on child dental fear. An overview of theories and relevant studies on factors associated with child dental fear is provided covering the period from 1980 until 2000, from a theoretical perspective. Several theories on the acquisition of clinical fears or phobias have been postulated in the literature. Rachman (1977) proposed a three-pathway model of fear acquisition: directly through classical conditioning and indirectly, via vicarious exposure (modelling) or through transmission of negative information. Several important refinements have been made to the conditioning approach: e.g., the notion of preparedness and of neo-conditioning (Lubow, 1973; Rachman, 1991; Seligman, 1971). The non-associative account, on the other hand, claims that fear can be aroused by stimuli without previous direct or indirect associative learning (Menzies & Clarke, 1995). In this view, fears are innate or predictable at set stages of development, and habituation processes eventually cause a reduction in these fears. The individual approach considers that individual differences exist in the way people react to specific situations, and that individual and temperamental characteristics may exacerbate a child's tendency to acquire fears. Cognitive biases have, for example, been associated with this process. In this chapter relevant theories (i.e., Rachman's three-pathway model and the individual approach) will be discussed and an overview of studies concerning childhood dental fear will be presented. Only theories and mechanisms empirically studied in relation to dental fear will be discussed: an extensive discussion of all the proposed theories is beyond the scope of this thesis. The non-associative theory, for example, will therefore not be discussed further.

It should be noted that the focus in this review is specifically on etiological theories and factors in child studies. Furthermore, it is important to note that no exhaustive enumeration of published articles will be listed. A large number of practically oriented studies on features and consequences of child dental fear has been published, often lacking a theoretical framework or involving inadequate methodological standards, thus not contributing meaningfully to research. Therefore, only relevant and important studies with respect to empirical results or contributing to the development of theories will be discussed. In this review a distinction will be made between dental fear and behaviour management problems whenever possible. Table 1 shows a chronological summary of relevant studies on child dental fear (p. 25-26) and Table 2 on behaviour management problems (p. 28). Studies of a descriptive nature are not included in these tables but will be discussed in the text. In these tables, the nature and size of study samples are shown, as well as instruments and methods

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1 see for general reviews Merckelbach, De Jong, Muris & Van Den Hout (1996); Ollendick, Hagopian & King (1997)
used and different factors incorporated in the studies. If demonstrated, the direction of a relationship is indicated, and the most important conclusions are shown. In addition, to illustrate the complex and interactive nature of related factors, a nomological network will be presented at the end of this chapter (p. 36). For a comprehensive discussion and analysis of earlier studies on child dental fear and uncooperative behaviour we refer to Winer's extensive review (1982).

**Conditioning theory (Rachman's pathways)**

**Direct pathway: classical conditioning**

Classical conditioning refers to the association formed between an unconditioned stimulus (UCS) and a neutral stimulus. If an aversive UCS is paired with a neutral stimulus during a number of trials, this neutral stimulus (CS) alone can become sufficient to elicit a negative emotional reaction (UCR, CR). In the dental situation this means that pain experienced during a dental visit can cause a patient to associate the dental situation in general with pain, leading to aversive feelings and fear, and potentially also avoidance of the situation. Negative dental experiences other than pain may also cause such associations to develop. However, this conditioning theory does not seem to explain the acquisition of phobias entirely: the underlying mechanisms seem more complex. Some revisions have therefore been suggested. Seligman (1971) proposed the “preparedness” hypothesis. According to this hypothesis, aversive conditioning interacts with evolutionary processes in producing fear. Certain stimuli may be more easily transformed into phobic stimuli than others. An association, which is readily acquired, is defined as “prepared” and one, which is acquired with difficulty as “unprepared”. Dental fear might be seen as a readily acquired one, taking into account aspects such as lying on one's back in the dental chair (or losing control), sharp instruments in one's mouth and being examined by a stranger (Kent, 1997). Another revision to the conditioning theory is that of neo-conditioning, which states that the conditioning process is not a reflexive but a cognitive process (e.g., Rachman, 1991). An important and in the context of dental fear relevant aspect of this neo-conditioning is a phenomenon called “latent inhibition”. According to this “latent inhibition” theory, an association between a conditioned stimulus (CS) and an unconditioned stimulus (UCS) is formed less likely when the CS is presented alone on several occasions before it is paired with the UCS, than when there were no CS-alone trials before conditioning (Davey, 1989a; Lubow, 1973). In the dental situation, this might mean that a history of positive or neutral dental experiences might serve as a “defence” against the development of “traumatic” associations or experiences, and subsequently against the acquisition of extreme fears or phobias. Another interesting, though less studied revision to the conditioning theory is that of “UCS inflation” (Davey, 1989b).
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Briefly, this phenomenon refers to exposure to pairings of a CS and a mild UCS resulting in a weak conditioned fear response, which in a subsequent phase can become ‘inflated’ after exposure to a more aversive UCS than previous experience suggested.

Studies examining Rachman’s three-pathway model in common childhood fears have provided support for all the proposed pathways, although the direct conditioning pathway was most frequently mentioned in the onset of several childhood fears. As to medical fears, most children attributed it to conditioning while none of the children reported modelling experiences as the cause of their fear (Muris, Merckelbach & Collaris, 1997). It was noted by some authors that results depend on survey techniques and the nature of the fears studied (King, Eleonora & Ollendick, 1998; Muris et al., 1997).

Child dental studies

In dental research many studies have reported a relation between dental fear and negative dental experiences. It has even been suggested that this conditioning pathway is particularly prominent in child-onset of dental fear (Locker, Liddell, Dempster & Shapiro, 1999a). It is, however, important to note that reported results depend on the method of assessing this conditioning. Most studies providing support for this pathway have been conducted retrospectively, often among adult patients (Bernstein, Kleinknecht & Alexander, 1979; De Jongh, Muris, Ter Horst & Duyx, 1995; Kleinknecht, Klepac & Alexander, 1973; Locker, Shapiro & Liddell, 1996). Studies among child patients using different research methods have yielded more inconsistent results. Most support for direct conditioning again stems from retrospective or ‘subjective’ reports on children’s dental experiences, by using parental interviews or (self-report) questionnaires. Other studies assessing conditioning by using ‘objective’ measures such as treatment records or dental pathology indices did not confirm this. To illustrate, below studies using ‘subjective’ and ‘objective’ reports are discussed.

Negative dental experiences - Most of the child and adolescent interview or questionnaire studies have reported a relation between dental fear in children and negative or painful dental experiences (Winer, 1982; see Table 1). A relation between these experiences and uncooperative behaviour has also been reported (see Table 2). Experiences reported not only refer to re-called painful dental procedures, but also to negative dentist’s behaviour perceived by children. These experiences also include invasive medical experiences in general (e.g., Alwin, Murray & Niven, 1991; Holst, Schröder, Ek, Hallonsten & Crossner, 1988; Holst, Hallonsten, Schröder & Ek, 1993; Mejàre, Ljungkvist & Quensel, 1989; Veerkamp, Gruythuysen, Van Amerongen & Hoogstraten, 1992). For example, Liddell (1990) studied the relative contribution of personality characteristics versus medical and dental
experiences by using parental structured interviews, and concluded that the type (or invasiveness) of dental treatment (i.e., in hospital) was most important, although personality characteristics also were found to contribute to dental anxiety. Townend, Dimigen and Fung (2000) examined Rachman’s pathways of fear acquisition and suggested that subjective dental experiences may be decisive in the acquisition of dental fear, more important than dental pathology or maternal state anxiety. These subjective dental experiences were measured by parent reports on the number of “traumatic” visits and by child reports on perceived dentists’ empathy. In open-ended interview studies parents also most frequently attributed their child’s fear or uncooperative behaviour to previous treatments or dentists’ behaviour (Alwin et al., 1991; Holst & Crossner, 1984; Mejäre et al., 1989; Veerkamp et al., 1992). It should be noted that results of these interview studies depend on the source of information. That is, most parents (54%) attributed the child’s uncooperative behaviour to previous dental treatment while the dentist often (44%) ascribed it to family attitudes or upbringing (Mejäre et al., 1989). In an interview-study among children themselves, they indicated as the cause of their fear: a painful experience (30%), a traumatic experience (24%), general fearfulness (22%), maternal dental fear (14%) and medical fears (Prins, 1985).

Support for the “latent inhibition” theory has been provided, although mostly by retrospective studies among adult patients (Davey, 1989a; De Jongh et al., 1995). Only Townend et al. (2000) did actually study this mechanism among children and reported that fearful children experienced their first traumatic visit earlier in their dental history than non-fearful children. Other studies, however, have reported no relation between dental anxiety or uncooperative behaviour in children and invasive treatment during their first dental visit (Liddell, 1990; Williams, Murray, Lund, Harkiss & DeFranco, 1985). Liddell (1990) suggests that ‘this protection (by latent inhibition) could be destroyed by particularly intense experiences’ (p. 192).

Studies based on treatment records or using dental pathology indices have resulted in inconsistent findings. Several reported a positive relation between oral health (DMFT) and subsequent potential invasive procedures on the one hand and dental fear on the other hand (see Table 1). Others compared the oral health of children showing uncooperative behaviour with normative data and indicated uncooperative children to have higher mean DMFT values (Mejäre et al., 1989; Klingberg & Berggren, 1992; see Table 2). Most studies examining the relative contribution of variables, however, showed other factors such as perceived dentists’ behaviour, general fears or maternal anxiety to be more important in the actual acquisition of dental fear than objective dental pathology (Klingberg, Berggren, Carlsson & Norén, 1995; Townend et al., 2000). Moreover, Tuutti & Lahti (1987) indicated parental dental
fear to be more closely related to the child’s DMFT than the child’s own level of dental fear. Only Milgrom, Mancl, King and Weinstein (1995a) concluded that oral health is a highly important predictor of childhood dental fear, next to modelling factors. Interestingly, Klingberg, Sillén and Norén (1999) compared etiological processes of dental fear and uncooperative behaviour (BMP). The results showed that fear was more strongly related to non-dental variables while behavioural management problems seemed more connected to dental variables. Dental fear and behavioural management problems thus should be considered as distinct phenomena. Behavioural management problems may be a manifestation of state anxiety or pain, while dental fear seems to concern more than situational dental aspects.

Other studies have shown a reverse relation between dental fear in children and dental health. For example, Poulton, Thomson, Davies, Kruger, Brown and Silva (1997) found caries experience at the age of 15 to be positively related to dental fear at age 18, while a ratio of caries severity (DMFS) was inversely related to this dental fear. The authors suggested that relatively brief dental treatment occasioned by low levels of dental disease might result in the incubation of dental fear in some individuals while longer periods of treatment may facilitate fear habituation. In addition, a longitudinal study over a 3-year period reported children who did not receive invasive treatments to be more fearful than children who did experience such treatment (Murray, Liddell & Donohue, 1989). Moreover, it was concluded that ‘receiving invasive treatment in the context of regular attendance may provide the best climate for the emotional processing of aversive dental experiences’ (p. 319), implying that exposure might act prophylactically. Similar results were reported by other authors (Brown & Wright, 1987; Brown, Wright & McMurray, 1986b). Although Klingberg et al. (1995) reported a positive relation of dental fear with carious surfaces this relation was reverse for experience of restorative treatment. Other authors, on the other hand, did not establish a significant relation between dental fear and children’s oral health status (see Table 1). Interestingly, Schwarz (1990) found no relation with DMFS-index, but did find self-assessed dental health to be an important predictor of dental anxiety, again indicating that subjective aspects may be more important. When interpreting these inconsistent results, it should be taken into consideration that reported results might depend on the specific measure of objective conditioning experiences (i.e., using oral health status (DMFT, DMFS) versus restorative treatment experience). In his proposed model of pain and anxiety associated with dental procedures, Litt (1996) also criticised the use of oral health status as a method of assessing conditioning, since it does not automatically involve a similar, linear increase in frequency of invasive procedures experienced.
Table I. Relevant child studies on factors associated with dental fear.

<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>Age</th>
<th>Instrument*</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Methods</th>
<th>Most important factors; conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wright, 1980a</td>
<td>200</td>
<td>7-13</td>
<td>P-DAS</td>
<td>x</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>Oral examinations, child questionnaires</td>
<td>Memory of pain, ethnic background and attended school predictors</td>
<td></td>
</tr>
<tr>
<td>Wright et al, 1980b</td>
<td>307</td>
<td>5-9</td>
<td>P-DAS</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>Child–parent questionnaires</td>
<td>Relation with age, sex, grade and paternal occupation</td>
<td></td>
</tr>
<tr>
<td>Prins, 1985</td>
<td>40</td>
<td>8-12</td>
<td>Likert scale (dentist)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>Child interview (open), parent-dentist-interviewer ratings</td>
<td>Relation with negative self-speech, not with self-regulation</td>
<td></td>
</tr>
<tr>
<td>Brown et al, 1986</td>
<td>243</td>
<td>7-11</td>
<td>P-DAS</td>
<td>+/-</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>DMFT, child questionnaires</td>
<td>General anxiety and gender predictors (positive), and deciduous dmft and frequency of visits (negative)</td>
<td></td>
</tr>
<tr>
<td>Tuutti &amp; Lahti, 1987</td>
<td>113</td>
<td>7-12</td>
<td>question</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td>DMF, parent questionnaire, child question</td>
<td>Child DMF stronger related to parental fear than child fear</td>
<td></td>
</tr>
<tr>
<td>Lahti et al, 1989</td>
<td>158</td>
<td>11-12</td>
<td>DAS (?)</td>
<td>+/-</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>DMF, child-parent questionnaires</td>
<td>Relation fear with child caries, but also relation child caries- parental fear</td>
<td></td>
</tr>
<tr>
<td>Murray et al, 1989</td>
<td>223</td>
<td>&lt;9 (f-u, 3 years)</td>
<td>DAS</td>
<td></td>
<td></td>
<td>+/-</td>
<td></td>
<td></td>
<td>Dental records, child questionnaire</td>
<td>Receiving invasive treatment in context of regular attendance best climate; exposure may act prophylactically</td>
<td></td>
</tr>
<tr>
<td>Chellappah et al, 1990</td>
<td>505</td>
<td>10-14</td>
<td>CFSS-DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires</td>
<td>Relation with child state anxiety, not with trait anxiety</td>
<td></td>
</tr>
<tr>
<td>Liddell, 1990</td>
<td>179</td>
<td>12</td>
<td>DAS</td>
<td>+ (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Parent interviews, child questionnaires x (b) questionnaires</td>
<td>Dental treatment in hospital more important than general fears; gender differences</td>
<td></td>
</tr>
<tr>
<td>Schwarz, 1990</td>
<td>697</td>
<td>16</td>
<td>=&gt;19 DAS</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dental records (DMFS), child questionnaire</td>
<td>Earlier expressed anxiety and negative self-assessment of dental health most important predictors</td>
<td></td>
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<tr>
<td>Vignesha et al, 1990</td>
<td>505</td>
<td>10-14</td>
<td>CFSS-DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Oral examinations, child questionnaire</td>
<td>No relation with oral health</td>
<td></td>
</tr>
<tr>
<td>Neversien &amp; Backer</td>
<td>163</td>
<td>10-12</td>
<td>DAS, DAQ</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires, behavioral rating</td>
<td>Relation with optimism-pessimism, as well as with previous dental experience</td>
<td></td>
</tr>
<tr>
<td>Bedi et al, 1992a</td>
<td>1103</td>
<td>13-14</td>
<td>DAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires / Idem and dental examinations</td>
<td>Relation with missing tooth, last dental visit more likely result of pain / Time since last visit and no. fearful people known by the child predictors</td>
<td></td>
</tr>
<tr>
<td>Bedi et al, 1992b</td>
<td>1103</td>
<td>13-14</td>
<td>DAS</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td></td>
<td>x</td>
<td>Child-parent questionnaires, examiner rating</td>
<td>Small beneficial influence of mothers' presence on child behaviour, not on anxiety</td>
<td></td>
</tr>
<tr>
<td>Koplik et al, 1992</td>
<td>80</td>
<td>6-12</td>
<td>CFSS-DS, FT</td>
<td>x</td>
<td>+</td>
<td>trait</td>
<td></td>
<td></td>
<td>Child questionnaires</td>
<td>Control, recency last visit and painful treatment predictors</td>
<td></td>
</tr>
<tr>
<td>Milgrom et al, 1992</td>
<td>1564</td>
<td>13-15</td>
<td>DFS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires</td>
<td></td>
<td></td>
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*if not otherwise indicated: self-report
<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>Age</th>
<th>Instrument</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
<th>6</th>
<th>Methods</th>
<th>Most important factors; conclusions</th>
</tr>
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<tbody>
<tr>
<td>Veerkamp et al., 1992</td>
<td>52</td>
<td>6-11</td>
<td>Referral</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open-ended interview (parents)</td>
<td>Fear most frequently associated with pain and bad dental experiences</td>
</tr>
<tr>
<td>Alvesalo et al., 1993</td>
<td>828</td>
<td>13 median</td>
<td>CFSS-DS</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DMFT, child-parent questionnaires</td>
<td>Relation fear with DMFT (boys only)</td>
</tr>
<tr>
<td>Corkey &amp; Freeman, 1994</td>
<td>60</td>
<td>6</td>
<td>VPT</td>
<td>x</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mother-child interviews</td>
<td>Recent disruptive behaviour, psychological development and maternal factors predictors</td>
</tr>
<tr>
<td>Milgrom et al., 1994</td>
<td>70</td>
<td>5-15</td>
<td>CFSS-DS (parent)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Parent questionnaires, observer rating</td>
<td>CFSS-DS valid parental measure of child dental fear</td>
</tr>
<tr>
<td>Neverien, 1994</td>
<td>94</td>
<td>10-12</td>
<td>DAS, DAQ</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires</td>
<td>Treatment experience and optimism pessimism no predictor anxiety change (note: drop-out group significantly more dental experiences)</td>
</tr>
<tr>
<td>Klingberg et al., 1995</td>
<td>320</td>
<td>4-6, 15-17</td>
<td>CFSS-DS (parent)</td>
<td>+/-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dental records, parent questionnaires</td>
<td>General fears, maternal fear and age important etiological factors</td>
<td></td>
</tr>
<tr>
<td>Milgrom et al., 1995</td>
<td>895</td>
<td>5-11</td>
<td>CFSS-DS</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Oral health status, child-interview, parent-</td>
<td>Conditioning and modelling predictors</td>
</tr>
<tr>
<td>Raadal et al., 1995</td>
<td>895</td>
<td>5-11</td>
<td>CFSS-DS</td>
<td>+/-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>questionnaires</td>
<td></td>
</tr>
<tr>
<td>Bergius et al., 1997</td>
<td>288</td>
<td>13-18</td>
<td>DAS</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaires</td>
<td></td>
</tr>
<tr>
<td>Poulton et al., 1997</td>
<td>780</td>
<td>5-15</td>
<td>DIS</td>
<td>+/-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DMFT/S, child interview</td>
<td>Brief dental treatment may result in fear incubation, longer treatment may facilitate fear habituation</td>
</tr>
<tr>
<td>Thomson et al., 1997</td>
<td>691</td>
<td>15-18</td>
<td>DAS</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Child questionnaire, oral examinations</td>
<td>Episodic dental visits (Incident) and DMFS (Never) related to anxiety change, DAS co-predictor (subgroups) / Anxiety predictor of caries experience</td>
</tr>
<tr>
<td>Kruger et al., 1998</td>
<td>649</td>
<td>15-18</td>
<td>DAS</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DMFT, child-parent interviews, observation (referred)</td>
<td>Subjective dental experiences more important predictor than objective pathology and maternal state anxiety</td>
</tr>
<tr>
<td>Townend et al., 2000</td>
<td>60</td>
<td>7-10, 11-14</td>
<td>likert scale (dentist), PAS</td>
<td>+/-</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1: oral health, restorative treatment (objective)  
2: painful or traumatic experiences, negative dentists' behaviour (subjective)  
3: parental fear  
4: general fearfulness, temperament  
5: negative information, number of fearful people known by child  
6: parental presence / behaviour  

+ : positive relation  
- : negative relation  
+/- : partially demonstrated, or inconsistent results  
x : no relation
Review of literature

Dentists' behaviour - As mentioned before, dentists' behaviour has been reported to be the cause of dental fear and uncooperative behaviour in children (e.g., Alwin et al., 1991; Mejåre et al., 1989; Milgrom, Vignesha & Weinstein, 1992; Townend et al., 2000; Veerkamp et al., 1992). Townend et al. (2000) even concluded that perceived dentists' behaviour is more decisive in the acquisition of dental fear than objective dental pathology. Most of these results, however, were based on retrospective or subjective reports. Studies on the immediate effect of specific dentists' behaviour on children's fearful behaviour have provided a less clear picture. Several studies have indicated specific dentist's behaviours to influence children's (fearful) reactions such as direction, empathy and voice control (Greenbaum, Lumley, Turner & Melamed, 1993; Greenbaum, Turner, Cook & Melamed, 1990; Melamed, Bennett, Jerrell, Ross, Bush, Hill, Courts & Ronk, 1983; Prins, Veerkamp, Ter Horst, De Jong & Tan, 1987; Weinstein, Getz, Ratener & Domoto, 1982a). Providing immediate direction and specific reinforcement in combination with working contact, for example, is reported to have a fear-reducing effect on children. Coercing, coaxing and criticism, on the other hand, are found to have the opposite effect (Melamed et al., 1983; Weinstein et al., 1982a). Interestingly, it has been indicated that dentists often tend to respond to fear-related child behaviour with behaviour that seems counterproductive in reducing this fear, although this effect of course may depend on the child's age and level of dental fear (Alwin, Murray & Niven, 1994; Melamed et al., 1983; Weinstein, Getz, Ratener & Domoto, 1982b). A study controlling for auto-correlations, however, has indicated that a child's fearful behaviour is more closely related to its own previous behaviour than to this dentist's behaviour (Ter Horst, Prins, Veerkamp & Verhey, 1987). It should be noted that time lags in this study were very short (5 and 10 seconds), which of course may have influenced the auto-correlations found. Methodological problems thus seem to complicate the conclusions drawn from studying the specific relation between a dentist's and a child's behaviour. In addition, in many studies child and dentist behaviour were observed, while no information on the child's subjective perception of a dental visit or of the dentist's behaviour was included. Despite these inconclusive results, at least dentists' behaviour can be regarded as a mediator of perceived 'trauma' by patients. That is, the fear-eliciting effect of painful treatment seems to be mediated by the dentists' behaviour: pain inflicted by a dentist perceived as "caring" may have less negative impact than pain inflicted by a "cold" or "uncaring" dentist (Bernstein et al., 1979; Milgrom et al., 1992). In this context, also the effect of the lack of control on dental patients should be mentioned. That is, the perception of lack of control has been shown to have a negative effect on adolescent patients' level of arousal and perceived stress, and the use of strategies to enhance this sense of control by dental personnel was stressed.
Table 2. Relevant child studies on factors associated with *behavioural management problems (BMP)*.

<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>Age</th>
<th>Instrument</th>
<th>Method</th>
<th>Most important factors; conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bassin et al., 1982</td>
<td>93</td>
<td>2-6</td>
<td>Frankl’s scale</td>
<td>x</td>
<td>Dental records, observers rating. Age and ability to communicate with dentist (in English) predictors. No differences child accompanied by parent or by day-care personnel</td>
</tr>
<tr>
<td>Holst &amp; Crossner, 1984</td>
<td>45</td>
<td>4-17</td>
<td>BMP notes (referred) vs control</td>
<td>+</td>
<td>Child-parent interview (open), dental records. Painful dental treatment most frequently mentioned</td>
</tr>
<tr>
<td>Williams et al., 1985</td>
<td>25</td>
<td>8-14</td>
<td>refusers (ref.) vs control</td>
<td>x</td>
<td>Dental records, observer rating. Child-parent questionnaires. Refusers lower pain tolerance, negative mood and difficulties approaching novelty</td>
</tr>
<tr>
<td>Holst &amp; Crossner, 1987</td>
<td>2773</td>
<td>3-16</td>
<td>Kising &amp; Krebs</td>
<td>+/-</td>
<td>Dental records, observer rating. Treatment acceptance interrelated with treatment need, previous experience and age</td>
</tr>
<tr>
<td>Holst et al., 1988</td>
<td>101</td>
<td>3-16</td>
<td>BMP (ref.) vs control</td>
<td>+</td>
<td>Child-parent interviews. Previous problems medical visits, parental fear and anxiety unfamiliar people predictors</td>
</tr>
<tr>
<td>Mejare et al., 1989</td>
<td>186</td>
<td>4-6</td>
<td>BMP (referred) vs control</td>
<td>+/-</td>
<td>Reports dentist and parents on causes of dental fear differ substantially</td>
</tr>
<tr>
<td>Allwin et al., 1991</td>
<td>107</td>
<td>6-18</td>
<td>BMP vs control (ref.)</td>
<td>+</td>
<td>Child-parent interviews, video recording, behavioural ratings. Refusal combination of medical/dental environment and fear disposition. Open: dentist’s manner most mentioned</td>
</tr>
<tr>
<td>Varpio &amp; Wallfelt, 1991</td>
<td>146</td>
<td>3-13</td>
<td>BMP (referred)</td>
<td>+</td>
<td>Dental records. Social factors most important, followed by personality factors and previous experiences</td>
</tr>
<tr>
<td>Klingberg &amp; Berggren, 1992</td>
<td>99</td>
<td>3-18</td>
<td>BMP notes</td>
<td>+</td>
<td>Dental records. Relation parental fear and child BMP (children of parents with extreme dental fear); 45% of the children showed BMP</td>
</tr>
<tr>
<td>Fenlon et al., 1993</td>
<td>32</td>
<td>4-12</td>
<td>Frankl’s scale</td>
<td>x</td>
<td>Parent questionnaire, video-recording, examiners’ rating. No significant effect parental presence, age may be more important</td>
</tr>
<tr>
<td>Holst et al., 1993</td>
<td>273</td>
<td>3</td>
<td>Kising &amp; Krebs</td>
<td>+</td>
<td>Parent interview, examiners’ rating. Parents’ expectation of child’s reaction and child anxiety unfamiliar people predictors</td>
</tr>
<tr>
<td>Milgrom et al., 1994</td>
<td>70</td>
<td>5-15</td>
<td>behavioral rating (CB)</td>
<td>+</td>
<td>Parent questionnaires, observer rating. CFSS-DS valid parental measure of child dental fear (Chinese version)</td>
</tr>
<tr>
<td>Klingberg et al., 1999 (see 1995)</td>
<td>2257</td>
<td>4-6</td>
<td>BMP notes</td>
<td>+</td>
<td>Dental records, parent questionnaires. BMP more connected to dental variables, dental fear to non-dental variables</td>
</tr>
</tbody>
</table>

1: oral health, restorative treatment (objective)
2: painful or traumatic experiences, negative dentists’ behaviour (subjective)
3: parental fear
4: general fearfulness, temperament
5: negative information, number of fearful people known by child
6: parental presence / behaviour

Note: studies only focused on dentist-child interaction not included (see page 27)

+: positive relation
-: negative relation
+/-: partially demonstrated, or inconsistent results
x: no relation
Indirect pathway: modelling

The modelling pathway implies that fears of children can be acquired by observing significant others (e.g., their parents) reacting fearfully to a stimulus ('emotional contagion' hypothesis). Research has indeed demonstrated maternal fear level as well as the expression of fear to contribute to the general fearfulness of children (Muris, Steerneman, Merckelbach & Meesters, 1996). Also, in medical situations parental behaviour before and during stressful procedures has been found to influence the (coping) behaviour of children during these procedures (e.g., 'crisis parenting' model, Melamed & Siegel, 1985; for a review see Blount, Davis, Powers & Roberts, 1991). An interesting study on common childhood fears asking children retrospectively about their experiences indicated that although some of the children reported modelling experiences, none or only a small part of them actually ascribed the onset of their fear to this modelling (Muris et al., 1997). In light of these seemingly conflicting results, it was suggested that modelling might enhance general fearfulness in children but that it may play a relatively small role in the acquisition of specific fears.

Child dental studies

Parental dental fear - Many studies have reported support for the modelling pathway (Winer, 1982; see Tables 1 and 2). Several difficulties concerning the interpretation of this support, however, should be taken into consideration. Most of these studies were based on simple correlations between parental and child fear (or behaviour), thus providing no information on its causality. That is, often no information on actual parental behaviour during dental visits, or on the way parents express their fears was included (Litt, 1996). For example, Townend et al. (2000) found maternal state anxiety to be strongly related to a dentist’s rating of the child’s dental anxiety but suggested that this might essentially be a sign of maternal empathy with their child’s anxiety, instead of causing it. Another study reported that 45% of the children of parents with severe dental fear showed problem behaviours and the authors surprisingly concluded this to be indicative of a relation between child and parental dental fear (Klingberg & Berggren, 1992). Moreover, it should also be noted that reported relations often are not very strong. It has been suggested that the parental influence may be strongest among dentistly inexperienced children, and weakens or disappears as children have their own experiences to rely on (Winer, 1982). In his review, Winer (1982) stated that this relation might also be fragile because of moderating influences such as socio-economic variables. Furthermore, questions have also been raised whether the relation between parental and child dental fear may essentially be a shared genetic disposition, instead of a social learning process (Kent, 1997; Ollendick et al., 1997). Finally, the notion has been postulated that a fearful parent may be more sensitive to interprete his child’s fearful behaviour (Veerkamp,
Parental presence / behaviour - As opposed to general medical situations, research on the effect of parental presence on the child's behaviour during dental treatment is limited. In general, only small effects of parental presence or behaviour during treatment were found, although some inconsistency in findings does occur (Bassin, Davis & Colchamiro, 1982; see Fenlon, Dobbs & Curzon, 1993; Holst et al., 1993; Koplik, Lamping & Reznikoff, 1992; Liddell, 1990; Townend et al., 2000; Winer, 1982). Logically, parental effectiveness depends on the nature of the child-parent interaction, the nature of dental visits and on the parent's own anxiety level (Milgrom, Weinstein, Kleinknecht & Getz, 1995b).

In some studies the uncooperative behaviour of children has been attributed to family attitudes and upbringing (Holst & Crossner, 1984; Mejare et al., 1989; Varpio & Wellfelt, 1991). These results, however, stem from the dentists' point of view and were obtained by interviews or from dental records. Only one study actually provided empirical evidence for a relation of child rearing behaviour and child dental fear. It was reported that coping skills and stress tolerance in children were facilitated when the home environment was structured, mothers were responsive and self-assured, and parents set limits and provide ample rewards and punishments (Winer, 1982). It should be noted that the few empirical studies on this subject are old (conducted more than 20 or even 30 years ago) and reported no such relation for older children (Winer, 1982).

Indirect pathway: negative information
This indirect pathway refers to negative information about stimuli provided by significant others, books or television (Rachman, 1977). Several studies on common childhood fears have provided support for the role of negative information, by asking children retrospectively about their experiences (King et al., 1998; Muris et al., 1997).

Child dental studies
The importance of this pathway has been repeatedly mentioned (Bernstein et al., 1979; Kleinknecht et al., 1973), although few studies have actually attempted to demonstrate a relation between dental fear and negative information provided by others. Reports are limited and findings inconsistent: some did find a significant relation with the number of fearful people or family members known to the child (Bailey, Talbot & Taylor, 1973; see Tables 1 and 2) while others reported no such relation. Moreover, it should be noted that no data on actual transmission of negative information is included in these studies. This shortcoming in research methodology may be due to the notion that this pathway is more
Review of literature

difficult to study, since it is more implicit present in daily life. Milgrom et al. (1995a), for example, assumed that exposure to fearful images of dentists on television and in print are similar for all children, and concluded that there was no need to capture this aspect explicitly in their model.

Summary
Mixed results have been found with respect to the role of direct conditioning experiences, depending on methods of investigating this conditioning. In subjective reports dental fear repeatedly has been attributed to “traumatic” experiences, referring to painful, invasive treatment sessions or negative dentists’ behaviour. Objective reports based on dental records or dental pathology, however, did not confirm the role of painful procedures or restorative treatment. Furthermore, despite the fact that several studies have demonstrated a relation between dental fear and oral health, most studies eventually concluded other factors such as subjective dental experiences or general fearfulness to be more important in the acquisition of dental fear. In some studies it has even been suggested that, in the context of regular attendance, the experience of restorative treatment might act prophylactically. This inconsistency in results may be related to differences in methods used but may also be a consequence of the relation between dental fear and oral health being mediated by other factors such as perceived dentists’ behaviour or attendance pattern. This direct conditioning pathway thus does not seem to concern a simple linear relation between a child’s oral health status (and subsequent potentially invasive procedures) and its level of dental fear. Recent studies seem to indicate that a distinction may be necessary between ‘objective’ (e.g., oral health, invasive procedures) and ‘subjective’ (e.g., perceived dentists’ behaviour) dental experiences, and that the latter may be more important than the former in dental fear acquisition. Of the indirect pathways, modelling has been studied extensively: repeatedly a relation between child dental fear and parental dental fear has been reported. The relative contribution of this parental fear in the acquisition of dental fear, however, remains to be determined, due to the correlational nature of most studies. It has been proposed that parental influence may be limited to a child’s initial dental experiences and thereafter is outweighed by other factors, leaving it to play a more secondary, mediating role. Few studies have been conducted on the influence of parental presence during treatment, general child rearing behaviour and transmission of negative information. Available results of studies in the dental situation are not impressive.

Individual approach: Temperamental differences

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The individual view considers that individual or temperamental differences exist in people's reactions to invasive or threatening situations. Temperament refers to stable response dispositions that are evident in life, observable in a variety of settings and relatively persistent over time (Thomas & Chess, 1977). Several closely linked temperamental qualities associated with responses or initial reactions to unfamiliar people and situations such as introversion, shyness and behavioural inhibition have been found to be related to high levels of fear in children (Rosenbaum, Biederman, Bolduc-Murphy, Faroone, Chaloff, Hirshfeld & Kagan, 1995). Inhibited children tend to react with arousal and withdrawal to these unfamiliar settings, while uninhibited children seek out novelty, engage in conversation and explore the environment. Cognitive biases have also been indicated to be involved in the development of fears such as ‘attentional bias’: hyper-attention to threatening stimuli. Although this ‘attentional bias’ seems to be common among children, it has been suggested that non-fearful children learn to inhibit selective processing of threatening cues while in fearful children this bias may become more intense. Such cognitive biases may thus be involved in the maintenance of clinical fears in children and in potential transition from childhood fears into adult phobias (Kindt & Van Den Hout, 1999).

Child dental studies

Temperamental factors - When reviewing the literature on child dental fear, a similar cluster of temperamental traits comes forward. Particularly general fearfulness and general emotional status (e.g., introversion, negative emotionality and having difficulties coping with new situations or adapting to change) have been associated with high dental fear and uncooperative behaviour in children (Winer, 1982; see Tables 1 and 2). For example, Klingberg and Broberg (1998) found shyness in combination with negative emotionality to be a concomitant factor in the development of child dental fear and indicated this to be a risk factor. Beside this introversion or behavioural inhibition, other temperamental characteristics have been linked to dental fear in children. In light of the discussion of ‘attentional bias’, an interesting relation with distractibility and attention problems has been reported for dentally fearful children. It has been speculated that dental phobia and associated behaviour management problems may develop more easily in children with a lower attention span (Alwin et al., 1991; Liddell, 1990). In addition, children with uncooperative behaviour and higher dental fear were found to have increased pain expectations and lower pain tolerance. Others have found a significant positive correlation with emotional problems such as somatization, but concluded that this association is too weak to be regarded as a significant predictor of dental fear (Milgrom, Jie, Yang & Tay, 1994; Milgrom et al., 1995a; Raadal, Milgrom, Weinstein, Mancl & Cauce, 1995). Furthermore, it has also been postulated that
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behaviour management problems may be a matter of a child’s immaturity and its subsequent inability to cope (Holst & Crossner, 1984; Mejäre et al., 1989; Varpio & Wellfelt, 1991).

Closely associated to these temperament traits is the child’s use of (negative) coping styles. For example, fearful children seem more focused on the negative consequences of dental treatment (catastrophising) than on the positive ones and engage in a more negative self-speech, possibly reinforcing their fear level (Brown, O’Keeffe, Sanders & Baker, 1986a; Prins, 1985). In addition, the use of cognitive coping strategies such as reality-oriented “working through” and “cognitive reappraisal”, as well as the use of a greater variety and number of cognitive responses has been found to result in better adjustment to the dental situation. Behavioural strategies seem to have an opposite effect (Curry & Russ, 1985; Curry, Russ, Johnsen & DiSantis, 1988). Other authors have studied the relation between child dental fear and coping and control strategies, but have reported inconsistent results (Weinstein, Milgrom, Hoskuldsson, Golletz, Jeffcott & Koday, 1996). Finally, monitoring has also been associated with increased anxiety. It has, however, been suggested that coping behaviour may vary with type of stressor and treatment phase (Miller, Roussi, Caputo & Kruus, 1995; Rape, Bush & Saravia, 1988).

Based on the above-mentioned results no causal conclusions can be drawn, since most studies are correlational. As a consequence of this lack of causality, in the literature a debate exists about whether dental fear is part of patients’ general fearful nature or emotional status, or should be seen as a specific, isolated fear. It has been suggested that subgroups may exist within the adult fearful population. For example, Weiner & Sheehan (1990) made a distinction between endogenous and exogenous categories of fearful patients. The former refers to patients with a more general mood or anxiety disorder, while the latter refers to a simple conditioned fear. In addition, the Seattle system suggested four diagnostic types of adult patients: 1) simple conditioned fear, 2) anxiety about somatic reactions during treatment, 3) patients with generalised anxiety states and multiphobic symptoms and 4) distrust of dental personnel (Locker, Liddell & Shapiro, 1999b; Milgrom, Weinstein & Getz, 1995b). For child populations no such elaborated classifications have been proposed, although it has been suggested that subgroups of fearful children may exist within the child population (Klingberg et al., 1995; Klingberg & Broberg, 1998).

The role of age, gender and socio-economic status - The age and gender of the child also need to be considered. Despite inconsistent findings, increased dental fear has repeatedly been associated with younger age groups and female gender (e.g., Alvesalo, Murtomaa, Milgrom, Honkanen, Karjalainen & Tay, 1993; Bedi, Sutcliffe, Donnan & McConnachie, 1992b; Cuthbert & Melamed, 1982; Klingberg et al., 1995; Milgrom et al., 1994, 1995a; Wright et al.,
1980b). However, reported age effects are not always very strong, possibly because of other developmental aspects affecting it or because it may not be a linear relation (Cuthbert & Melamed, 1982; Milgrom et al., 1995a; Raadal et al., 1995; Rape et al., 1988; Townend et al., 2000; Wright et al., 1980b). Firstly, reported differences may well be associated with cultural factors or associated stigmas, i.e., being fearful still seems more socially accepted among younger children and girls. Secondly, it should be noted that the reported decline of fear with age seems to apply particularly to younger children while in late childhood and early adolescence opposite effects have been reported (Murray et al., 1989; Neverlien, 1994; Winer, 1982). Thirdly, other developmental aspects may be involved in this association. For example, Milgrom et al. (1995a) found an age effect in fear level in children without or with possible caries but no such effect in children with frank or emergent caries, indicating that dental experience is mediating this relation. Furthermore, lower fear levels in older children may essentially represent a general developmental change in children (Prins, 1994; Veerkamp, 1994; Winer, 1982). Increasing age in children is related to the development of cognitive abilities (Brown et al., 1986a; Curry & Russ, 1985), leading to a change in the expression of their fear. That is, children may learn to control the way they exhibit fear as they grow older, and subsequently, this may lead to the decrease of inappropriate behaviour perceived and reported by others (Prins, 1994; Veerkamp, 1994; Winer, 1982). The question therefore arises as to whether it may actually be a child’s developing coping abilities underlying this perceived decrease in fearful behaviour with increasing age, instead of an actual decrease in a child’s level of fear. Comparisons between behavioural measures and anxiety ratings in children indeed have shown such a discrepancy: fearful behaviour has been found related to age whilst reported anxiety was not (e.g., LeBaron & Zeltzer, 1984; Koplik et al., 1992; Mekarski & Richardson, 1997; Milgrom et al., 1994). In addition, it should be noted that dental fear is associated with age-related general fears or pre-occupations. For younger children, dental fear may essentially reflect some degree of separation anxiety while older children may be merely pre-occupied by bodily harms or social standards. Developmental aspects are also important to the extent that cognitive biases or mechanisms may begin to play a role in children’s fear acquisition or maintenance of this fear. Some studies have found a negative relation between socio-economic status and dental fear or uncooperative behaviour in children (Bedi et al., 1992b; Klingberg et al., 1995, 1999; Townend et al., 2000; Wright et al., 1980b). However, Townend et al. (2000) suggested that the strong relationship found between dental fear and social class may essentially be explained by another association. That is, this relation may be due to different dietary and dental habits, possibly leading to more invasive treatment. Others have not found a relation between dental fear and socio-economic status (Bergius, Berggren, Bogdanov & Hakeberg, 1997;
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Brown et al., 1986b; Corkey & Freeman, 1994; Lahti, Tuutti & Honkala, 1989; Koplik et al., 1992; Murray et al., 1989; Schwarz, 1990; Tuutti & Lahti, 1987; Wright, 1980a).

Summary
A specific cluster of temperamental traits associated with introversion and behavioural inhibition has been linked to dental fear in children. Subgroups of children may exist within the fearful population. For some children dental fear may be part of a general emotional status, while for others their fear may be a simple or specific conditioned fear. Dental fear in children also has been associated with moderating variables such as age, gender and socio-economic status.

Conclusion
Reviewing the literature, support for all the proposed pathways has been reported which seems to suggest that multiple pathways underlie a child’s dental fear acquisition. It is important to note, however, that for several pathways a causal relationship has not been demonstrated. The direct pathway is the only one that has been studied on a longitudinal and prospective basis. Support for the indirect pathways and temperamental factors mainly stems from correlational and interview studies. The discrepancy in results between ‘objective’ and ‘subjective’ reports on the direct conditioning process is therefore of interest. Most support for the conditioning pathway with respect to painful experiences comes from interview or questionnaire studies while several studies based on ‘objective’ treatment records did not confirm this relation. Some of these studies did indeed demonstrate a relation between child dental fear and oral health, while others reported an opposite effect and even concluded that invasive treatment might act prophylactically (see also p. 31). Moreover, recent studies seem to indicate that within this direct conditioning pathway, subjective dental experiences may be more important in the acquisition of dental fear than objective dental pathology. This discrepancy in results may be partly due to the variety of methods and instruments used in often-incomparable study populations. The need for studies using a universal assessment tool among children from comparable age ranges is therefore stressed. To summarise, the available research reports have most frequently provided support for the direct conditioning pathway in the acquisition of dental fear. Indirect learning experiences and temperamental characteristics (e.g., general fearfulness, negative emotionality) were also associated with dental fear in children, although evidence for a causal relationship still has to be demonstrated. A nomological model of childhood dental fear is presented below to provide an overview of factors associated with dental fear in children and to illustrate the interactive nature of the etiological process (see figure 1).
This model is based on theoretical assumptions derived from research reports previously discussed. It is meant to provide some insight into the possible contribution of variables rather than proposing a definite model. To further unravel the relative importance of different pathways and to be able to compare research results, more uniform research is needed. As indicated above, multiple pathways may interact and underlie the onset of high dental fear in children. From a practical point of view and for preventive purposes, however, it is important to distinguish causal and contributing factors. The following important issues therefore need to be addressed further. Most important, the direct conditioning pathway should be studied more extensively. Firstly, it needs to be investigated whether subjective dental experiences are more important in the acquisition of dental fear than objective dental experiences, i.e., the actual amount of experienced procedures or curative treatment. Secondly, the role of latent inhibition in this process should be examined. Thirdly, more information is also needed on the potential influence of parental dental fear or behaviour in (older) children with previous dental experiences. Fourth, the relation between child dental fear and temperamental characteristics needs to be studied more extensively in order to distinguish specific risk factors for acquiring dental fear. From this point of view we would like to emphasise that all above-mentioned aspects are of clinical relevance and may have direct consequences in the development of a protocol for the treatment of highly fearful children.
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