DOI: 10.1111/j.1365-263X.2007.00868.x

Temperamental reactivity and negative emotionality in uncooperative children referred to specialized paediatric dentistry compared to children in ordinary dental care

KRISTINA ARNRUP[1], ANDERS G. BROBERG[2], ULF BERGGREN[3] & LENNART BODIN[4]

[1]Department of Pedodontics, Postgraduate Dental Education Center, Örebro, Sweden, [2]Department of Psychology, Göteborg University, Göteborg, Sweden, [3]Unit of Dental Behavioural Science, Institute of Odontology, Sahlgrenska Academy, Göteborg University, Göteborg, Sweden, and [4]Department of Statistics, Örebro University, Sweden and Clinical Research Centre, Örebro University Hospital, Örebro, Sweden

International Journal of Paediatric Dentistry 2007; 17: 419–429

Background. Current treatment of children with dental behaviour management problems (DBMP) is based on the presupposition that their difficulties are caused by dental fear, but is this always the case?
Objective. The aim of this study was to study temperamental reactivity, negative emotionality, and other personal characteristics in relation to DBMP in 8- to 12-year-old children.
Methods. Forty-six children referred because of DBMP (study group) and 110 children in ordinary dental care (reference group) participated. The EASI tempramental survey assessed temperamental reactivity and negative emotionality, the Child Behaviour Questionnaire internalizing and externalizing behaviour problems, and the Children's Fear Survey Schedule general and dental fears. Cluster analyses and tree-based modelling were used for data analysis.
Results. Among the five clusters identified, one could be characterized as 'balanced temperament'. Thirty-five per cent of the reference group compared to only 7% of the study group belonged to this cluster. Negative emotionality was the most important sorting variable.
Conclusions. Children referred because of DBMP differed from children in ordinary dental care, not only in dental fear level, but also in personal characteristics. Few of the referred children were characterized by a balanced temperament profile. It is important to consider the dual impact of emotion dysregulation and emotional reactivity in the development of DBMP.

Introduction

Children's uncooperativeness in dentistry has been conceptualized in different ways. The construct dental fear/dental anxiety (DF) is used to denote early signs of dental phobia (i.e. an excessive or unreasonable fear or anxiety with regard to the challenge/threat of dental examination and treatment, that influences daily living and results in prolonged avoidance of dental treatment)[1]. The term dental behaviour management problems (DBMP) is used to denote a variety of problematic behaviours that children display when confronted with dentistry. DBMP has, from a caregiver's perspective, been loosely defined as 'uncooperative and disruptive behaviours resulting in delay of treatment or rendering treatment impossible' (p. 54)[2]. Current behavioural and/or pharmacological treatment of children with DF/DBMP is based on the presupposition that their difficulties are caused by dental fear, but is this always the case? Limited overlap has been reported between DF and DBMP[3,4], suggesting other reasons than fear for children's lack of cooperation in paediatric dentistry. Thus, a further understanding of DF *and* DBMP is important in order to develop more effective treatments.

Difficulties approaching novel situations and unfamiliar people have been reported to characterize children with DF/DBMP[5–7]. Other studies report associations with characteristics described as 'negative mood', 'unhappy child', 'easily distressed' or 'impulsiveness'[8–10]. Blomqvist

Correspondence to:
Kristina Arnrup, Department of Pedodontics, Postgraduate Dental Education Center, PO Box 11 26, SE-701 11 Örebro, Sweden. E-mail: kristina.arnrup@orebroll.se

et al. studied children with attention deficit/hyperactivity disorder (ADHD) and found that DBMP was reported more frequently among these children compared with controls, while no differences concerning DF were revealed[11].

Taken together, these studies indicate that aspects of children's temperament are associated with DF/DBMP. Temperament is normally used as a collective term for a set of developing traits that (i) manifest in an organized fashion during early life; (ii) are relatively stable during significant periods of life; (iii) are relatively consistent across situations; (iv) have characteristic neurophysiological underpinnings; and (v) are partially heritable[12]. One way of conceptualizing temperament is in terms of two broad dimensions: reactivity and regulation[13]. Children vary in terms of the intensity and promptness of their reactions to different stimuli (e.g. frustration) as well as in their ability to regulate or control their responses 'automatically' (reactive control) or consciously (voluntary or effortful control)[14,15]. Theoretical development regarding emotion regulation in childhood[16], as well as studies relating temperament to child psychopathology (e.g. anxiety disorders, ADHD and oppositional defiant disorder; see Nigg for an overview[17]) indicate the need for more specific studies of the relation between different aspects of temperament and the development of DF/DBMP in childhood.

Following a hypothesis of heterogeneity within the group of uncooperative child dental patients (see, for example, Klingberg & Broberg[7] and ten Berge *et al*.[18]), a previous study has identified four subgroups (based on cluster analysis of measures of dental and general fear, temperament, internalizing and externalizing problems, and verbal ability) among 4- to 12-year-old children referred because of DBMP[19]. Fear (dental and general) was pronounced in two subgroups with different temperamental characteristics. One of them had average scores on temperament and behaviour ratings, whereas the other was characterized by shyness, negative emotionality, and an internalizing behaviour profile (fearful, inhibited). A small but distinct subgroup of children, who showed moderate dental fear, was characterized by an externalizing behaviour profile. They also scored high on attention problems, negative emotionality, and impulsivity (the externalizing, impulsive group). The largest group was less distinct but, somewhat surprisingly since they were referred because of DBMP, according to parental reports they neither showed high levels of fear, nor any temperamental or behaviour problems.

To increase our understanding of the aetiology of DF/DBMP, the next step is to compare clusters of children with DF/DBMP with children who have not developed such problems, in order to learn more about aspects of temperament that most clearly distinguish children who have developed DBMP.

Following the hypothesis that different aspects of temperament contribute to the development of DBMP/DF, the study reported here is a comparison of personal characteristics between a sample of 8- to 12-year-old children referred because of DBMP and a reference group of same aged children from ordinary dentistry. Our general aim was to deepen the exploration of the importance of temperament in children with DF/DBMP. The specific aims were: i) to further investigate the heterogeneity in personal characteristics (i.e. fear, temperament, and behavioural symptoms) in our study group as compared to a reference group of ordinary child dental patients by searching for subgroups and their representation in a pooled sample of study and reference group children; and ii) to explore the relative importance of different aspects of temperament for differentiating study group patients from patients in ordinary dentistry.

Materials and methods

Subjects and procedures

Fifty-three children, were referred to the specialist paediatric dental clinic in the County of Örebro, Sweden, because of DBMPs in combination with a need for restorative dental treatment constituted this study group. The Children were 7.5–12 years at referral. Children with a history of communicative disorders or psychiatric diagnoses according to *DSM-IV*[1] were not included. The referrals were made by the treating dentists at any of the 24 public dental clinics in the County of Örebro.

Patients were only included if their accompanying parent managed an interview in Swedish at the beginning of the treatment period. Fifty child–parent pairs completed the introductory baseline assessments. Subjects with missing data on key measures ($n = 2$) and subjects identified as outliers ('no-neighbours'; $n = 2$, and excluded due to current practice in cluster analytic theory[20]) in previous cluster analyses were excluded, leaving 46 subjects (25 girls; mean age 9.8 years, SD 1.6) in the study group.

To serve as a reference group, 132 consecutive children (aged 8–12 years) and their accompanying parents were asked to participate, as they presented according to the recall protocols and in conjunction with the children's visits for routine examination at three public dental clinics in the County of Örebro. The public dental clinics were selected to represent both urban and rural areas as well as areas of different socioeconomic structure. One hundred and seventeen child–parent pairs agreed to participate and 110 of these (51 girls; mean age 10.2 years, SD 1.4) presented data valid enough (i.e. complete data on key psychometric measures) to be included in the analyses. The reference group children had no known DBMP.

The parents answered a questionnaire dealing with aspects of their children's dental care, fears, temperament and behaviour problems. Study group parents completed the assessments at the first or second visit at the specialist paediatric dental clinic, while reference group parents filled in the questionnaire when visiting the ordinary public dental clinic with their children. All child–parent pairs requested to participate received both oral and written information about the aims and procedures of the study, and were informed that participation was voluntary. Approval from the Research Ethics Committee of Örebro County Council was obtained prior to the study.

Most of the responding parents were mothers (73%), with similar proportions (74% vs. 73%) between groups. As a measure of socioeconomic status (SES), the mother's occupation was assessed using the Hollingshead index of occupational status[21] (range 1–9), modified for use in Sweden by Broberg ('Swedish adaptation of the Hollingshead four factor index of social position', unpublished paper from the Department of Psychology, Göteborg University, Göteborg, Sweden, 1992). In the analyses, the occupation score was dichotomized to indicate low socioeconomic status (SES low; scores 1–3) or not. SES low was significantly more frequent in the study group as compared to the reference group (59% vs. 29%; $P = 0.001$). Furthermore, only 52% of study group children were living together with both parents (cohabitation) while 79% of reference group children did so ($P = 0.001$).

Key psychometric measures

Children's dental fear was assessed by the parents using a Swedish version[22] of the 15-item Dental Subscale of the Children's Fear Survey Schedule (CFSS-DS). The response format ranges from 1 (not afraid at all) to 5 (very afraid), giving a score range from 15 to 75. Scores of 38 and above have been used as indicative of high dental fear[22]. Cronbach's alpha for the current sample was 0.92.

General fear was assessed using a Swedish parental version[3] of the Short Form of the Children's Fear Survey Schedule (CFSS-SF) containing 18 items to be rated from 1 (not afraid at all) to 5 (very afraid), giving total scores ranging from 18 to 90. Cronbach's alpha was 0.88.

Children's temperament was measured by the 25-item EASI temperamental survey[23] translated into Swedish by Hagekull and Bohlin ('The Swedish translation of the EASI temperamental survey', unpublished paper from the Department of Applied Psychology, Uppsala University, Uppsala, Sweden, 1990). The 25-item EASI scale measures five temperaments using 5-item subscales where each item is rated on a 5-point scale (from not at all like my child to very characteristic of my child): *Negative emotionality* is defined in terms of easily aroused expression of irritability or aggression when frustrated, using the following items: cries easily, tends to be somewhat emotional, often fusses and cries, gets upset easily, and reacts intensely when upset. Cronbach's alpha was 0.75. *Activity* (alpha 0.71) corresponds to the child's characteristic tempo and vigour. *Sociability* (alpha 0.59) measures a child's general tendency to prefer the presence

of others (children and adults) to being alone. *Shyness* (alpha 0.82) is the tendency to be inhibited or 'slow to warm up' in new situations or when meeting new people. *Impulsivity* (alpha 0.74) describes impatience and lack of perseverance.

For assessments of general behaviour problems, the Swedish parental version[24] of the Rutter Child Behaviour Questionnaire (CBQ)[25] was used. The CBQ consists of 19 items describing different behaviour and emotional problems in children. In the current version, the original three-step response format is modified to a Likert-type scale from 1 (not at all like my child) to 5 (very much like my child). The CBQ also contains 13 items describing common somatic complaints or 'psychosomatic' problems to be rated on a frequency scale from 1 (never) to 5 (daily). In accordance with Elander and Rutter[25], 17 items were used to form subscale scores (means ranging from 1 to 5) of internalizing behaviour problems (6 items), externalizing problems (8 items) and attention problems (3 items). Cronbach's alpha was 0.64 for the internalizing, 0.77 for the externalizing, and 0.82 for the attention problems subscales.

Statistical methods

Variable-based approach. Group differences were analysed using Student's *t*-test for two independent groups, univariate analysis of variance (ANOVA) or χ^2-test. Multivariate comparisons were performed using logistic regression analysis with group (study or reference) as outcome and selected measures as potentially discriminatory variables. Odds ratios (OR) with 95% confidence intervals (CI) were given.

Person-based approach. The hypothesized heterogeneity in personal characteristics was analysed, using sequences of cluster analyses[20], in the merged sample of study and reference groups. Included variables were those assessing general fear, temperamental dimensions and behavioural problems. The first step was Ward's hierarchical procedure, which revealed initial estimates of the number of clusters as well as estimates of seed points. Those seed points were then used as start values in the next step, the relocation procedure with an optimizing K-means algorithm. Dental fear was excluded from cluster analyses to allow a purer personal characterization relevant for both study and reference group children.

To facilitate the understanding of the structure of the clusters and to estimate rapid and simplified prediction rules for classifying individuals into the clusters, we used tree-based modelling or recursive partitioning[26,27]. The algorithm was applied on raw scores of the same variables as were used for the cluster analysis. Tree-based modelling forms rules based on optimized cut-offs for the set of prediction factors, and these cut-offs successively split the study sample into smaller and smaller sets (nodes) of higher homogeneity, i.e. most of the subjects in the subset belong to one of the five clusters. The algorithm is applied until a prespecified minimum size of the subsets is obtained. Tree-based modelling is an alternative to discriminant analysis and has the advantage of not being dependent on linear additive functions of the predictor variables. The result of the tree analysis is most often visualized in graphs and tables of estimated probabilities for correct classifications.

The level of statistical significance was set at 5%, that is $P < 0.05$. Analyses were performed with SPSS version 12.0.1 or the S-PLUS 2000 package for statistical and mathematical models.

Results

Variable-based comparisons between the study and the reference groups

As shown in Table 1, the study group children had higher mean values on dental fear as compared to reference group children. They also had higher scores on negative emotionality and impulsivity, and more internalizing behaviour problems as assessed by their parents. However, when all key measures were analysed simultaneously in a logistic regression analysis, only impulsivity differentiated between the two groups ($P = 0.002$ and OR = 3.0 for group difference). The result was the same when background assessments (SES, cohabitation status and child gender) were entered in the analysis.

Table 1. Key measures by group. Group differences by univariate (Student's *t*-test) and multivariate (logistic regression) analyses.

	Study group (n = 46)		Reference group (n = 110)		*P*-values for difference between study group and reference group	
	Mean	SD	Mean	SD	*P*-value*	*P*-value**
Dental fear (DF)	37.6	10.2	23.8	6.5	< 0.001	–
General fear (GF)	40.2	11.1	37.2	9.5	0.10	0.67
Negative emotionality (NEGEM)	2.9	0.8	2.4	0.7	0.001	0.20
Activity (ACT)	3.7	0.7	3.8	0.8	0.53	0.69
Shyness (SHY)	2.0	0.9	2.0	0.8	0.72	0.56
Sociability (SOC)	3.8	0.6	3.7	0.7	0.37	0.74
Impulsivity (IMP)	2.6	0.7	2.1	0.7	< 0.001	0.002
Externalizing (EXT)	1.5	0.6	1.4	0.4	0.11	0.84
Internalizing (INT)	1.9	0.6	1.7	0.5	0.03	0.21
Attention problems (ATT)	1.9	1.0	1.7	0.9	0.27	0.09

*Student's *t*-test.
**Multivariate logistic regression with nine key variables included simultaneously in the model, dental fear not included.

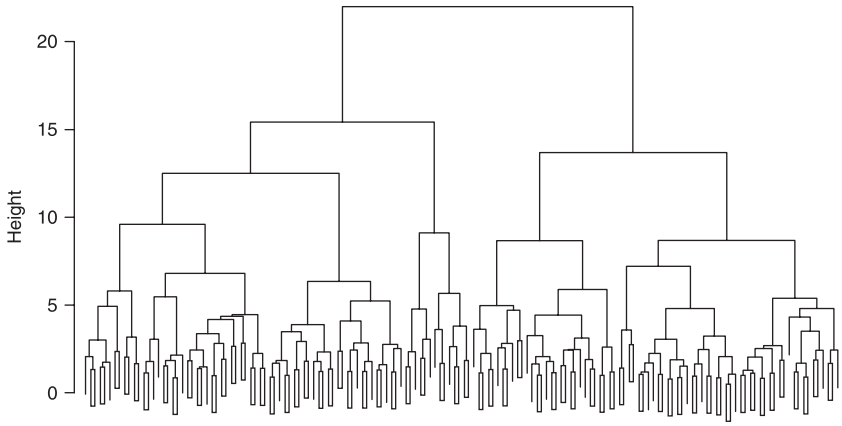

Fig. 1. Dendrogram of the hierarchical cluster analysis of 156 children in a pooled sample from study (n = 46) and reference (n = 110) groups. Nine variables analysed with Ward's method. Height on vertical axis refers to scaled distance between clusters at the point of agglomeration.

Person-based analyses

Cluster analysis. Initial hierarchical cluster analysis indicated that the two-, three-, or five-cluster solutions were good divisions of the data (see dendrogram in Fig. 1) and subsequent non-hierarchical analyses were performed. Profiles over the nine z-transformed variables (general fear, negative emotionality, activity, shyness, sociability, impulsivity, externalizing, internalizing and attention problems) for clusters of the final five-cluster solution are shown in Fig. 2.

The first cluster (n = 26) showed high values for fear (cluster mean raw score 45.3) and negative emotionality (3.3), low shyness (1.5) and mean-level values on impulsivity and behaviour problems. The second cluster (n = 32) peaked on shyness (score 2.9), while values of activity (2.9) and sociability (3.3) were the lowest. The third cluster (n = 19) paralleled the first in high values of fear (45.8) and negative emotionality (3.4) but revealed a multiproblem profile with outstandingly high values of impulsivity (3.3) and behaviour problems (2.2, 2.5 and 3.3 on the CBQ subscales). Cluster 4 (n = 42) qualified for the label of balanced temperament, with only activity reaching the mean level, and a lack of behaviour problems. Finally, cluster 5 (n = 37) showed an extrovert, outgoing profile, low in fear (33.2), high in activity (4.3) and sociability (4.2), and low levels of behaviour problems.

Differences between clusters regarding background variables were tested with ANOVA

Table 2. Dental fear scores for cluster affiliations stratified for study and reference groups. Differences between groups and clusters as well as the interaction group/cluster analysed by a two-factor analysis of variance model.

	Study group			Reference group			Group and cluster differences analysed simultaneously by analysis of variance
	n	Mean	SD	*n*	Mean	SD	
Cluster 1	11	40.4	10.3	15	27.5	7.3	By group; $P < 0.001$
Cluster 2	12	38.3	9.0	20	25.4	6.4	
Cluster 3	8	38.1	10.3	11	30.7	6.5	
Cluster 4	3	42.3	18.1	39	21.0	5.0	
Cluster 5	12	32.9	9.1	25	21.7	4.7	
			By cluster; $P = 0.003$				Interaction group*cluster; $P = 0.16$.

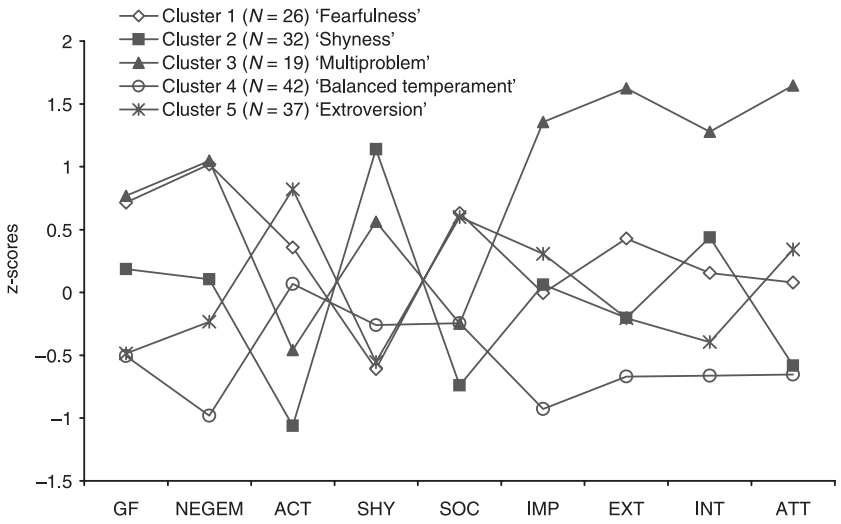

Fig. 2. Profiles of personal characteristics in the five-cluster solution for the pooled sample of 8- to 12-year-old children from study and reference groups ($n = 156$). Abbreviations on the x-axis refer to the nine variables included (GF, general fear; NEGEM, negative emotionality; ACT, activity; SHY, shyness; SOC, sociability; IMP, impulsivity; EXT, externalizing; INT, internalizing; ATT, attention problems). Height on the vertical axis refers to z-scores, per definition with the group mean 0.0 for each variable.

and χ^2-test, respectively. Girls were over-represented in cluster 2 (62% vs. 38%) and boys in clusters 3 (74% vs. 26%) and 5 (65% vs. 35%) [χ^2 (sex*cluster) 10.43; d.f. 4; $P = 0.034$]. Other differences (data not shown) were nonsignificant.

Study group children were more frequently allocated to the first (fearful) and third (multiproblem) clusters, while reference group children clearly dominated the balanced temperament cluster ($\chi^2 = 14.7$; d.f. = 4; $P = 0.005$). Study/reference group ratios (based on percentage distribution) in the five clusters were 1.76, 1.43, 1.74, 0.18 and 1.15, respectively.

The level of parent-rated dental fear differed significantly between clusters ($P = 0.003$), as well as between study and reference group ($P < 0.001$), and study group children scored higher than reference group children within each cluster. We could not verify a statistically significant interaction between cluster and group affiliation ($P = 0.16$), but we noted that for cluster 4 (balanced temperament) the three study group children had a surprisingly high parent-rated dental fear score (Table 2).

Tree analysis. In the tree-based modelling of the nine key variables used in cluster analyses (general fear, negative emotionality, activity, shyness, sociability, impulsivity, and externalizing, internalizing and attention problems), negative emotionality emerged as the first and most important sorting variable for classifying children (study and reference group) into the five clusters (Fig. 3).

When negative emotionality was high, the next sorting variable was shyness, while activity was the second predictor when negative emotionality was low. Allowing the classification process to proceed until subsets included a minimum of five individuals, 19 terminal nodes were revealed, with an overall probability of correct classification of 87%. All included

Table 3. Classification table from tree-based modelling with a minimum set size of 20. The table shows probabilities for the five clusters when the specified cut-off points of the predictor variables are applied.

Cut-offs for predictor variables*	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	*n*
NEGEM < 2.9						
ACT < 3.7						
SHY < 2.3	4.3	13.0	0	**78.3**	4.3	23
NEGEM < 2.9						
ACT < 3.7						
SHY > 2.3	0	**85.7**	9.5	4.8	0	21
NEGEM < 2.9						
ACT > 3.7						
IMP < 2.1	0	3.4	0	**75.9**	20.7	29
NEGEM < 2.9						
ACT > 3.7						
IMP > 2.1	11.4	0	8.6	2.9	**77.1**	35
NEGEM > 2.9						
SHY < 2.1	**76.9**	0	11.5	0	11.5	26
NEGEM > 2.9						
SHY > 2.1	4.5	45.4	**50.0**	0	0	22

*The cut-offs are defined from the statistical algorithm of the tree-based modelling to maximize the conditional probabilities of correct classifications into the five clusters. (NEGEM, negative emotionality; ACT, activity; SHY, shyness; IMP, impulsivity.)

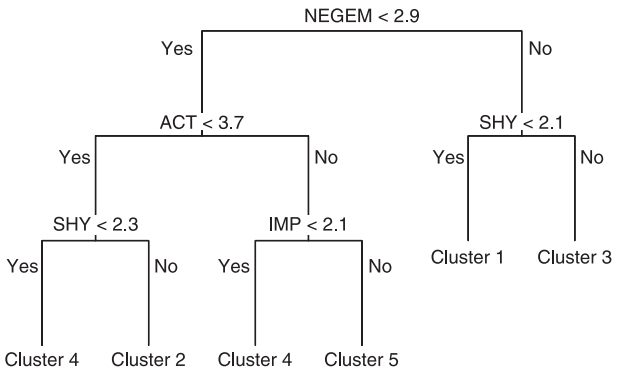

Fig. 3. Tree-based modelling with a minimum size of the final subsets (terminal nodes) of 20 subjects. Percentage of correct classification 75%. Fulfilment of the classification criterion leads to the left, non-fulfilment leads to the right. (NEGEM, negative emotionality; ACT, activity; SHY, shyness; IMP, impulsivity. Illustration of an application of the tree diagram: A subject with NEGEM smaller than 2.9, ACT higher than 3.7 and IMP higher than 2.1 is classified to cluster 5.)

variables except externalizing had predictive value in that classification process. By pre-specifying the minimum size of subsets to 20 subjects, thus reducing sampling variability, the tree modelling was restricted to three levels (correct classification 75%), still with negative emotionality followed by shyness and activity, respectively, as the strongest predictors (Fig. 3). High negative emotionality and low shyness in combination clearly predicted placement in cluster 1 (probability 76.9; Table 3). Most children high on negative emotionality belonged to cluster 1 or 3 (Fig. 3; Table 3). The probability for cluster 4 (balanced temperament) was zero in each combination with high negative emotionality (Table 3). Placement in cluster 4 was equally well predicted by two out of four branches following low negative emotionality, while the other two branches showed high probabilities for cluster 2 and 5, respectively (Fig. 3; Table 3).

Discussion

Although the level of dental fear differs between children referred because of DBMP and children in ordinary dental care, the results from this study add further support to a multifactorial model where dental fear alone does not suffice as a predictor of DBMP. The variable-based comparison showed that impulsivity, which can be seen as a relative lack of

effortful control[28], most clearly differentiated between study and reference groups. The study group children also showed more internalizing behaviour problems than the reference group from ordinary dental care. Our person-based analyses revealed that study group children were over-represented in two clusters. Both of these had high scores on negative emotionality and general fearfulness. One of the clusters can be characterized as a multiproblem profile with much higher problem scores than all other clusters, and in addition high scores on shyness. The relationship between negative emotionality and internalizing and externalizing scores is well in line with what was found by Eisenberg and coworkers in a longitudinal study of children[29]. Reference group children, in contrast, dominated the cluster with a balanced profile, indicating optimal regulation, at least with regard to reactive control. It is interesting to note that the proportion of reference group children allocated to this cluster (39 out of 110; 35%) is well in line with the percentage of infants with an 'easy' temperament reported by Thomas *et al*. in their famous NYLU study[30], as well as the number of 'uninhibited' infants reported by Kagan *et al*.[31]. In the tree analysis, negative emotionality emerged as the most important sorting variable for classifying children into the different clusters.

Girls were over-represented in cluster 2 (peak on shyness) and boys in clusters 3 (extroversion) and 5 (multiproblem), which is in line with traditional studies of child temperament and psychopathology [inhibited/shy temperament and internalizing psychopathology are more common among girls, whereas impulsivity and externalizing problems are more common among boys]. Recent studies underscore, however, the importance of studying subgroups of girls and boys across childhood rather than looking at mean differences at different ages. Some boys are more like some girls in their developmental pathway with regard to temperament and psychopathology[32].

As previously reported by Arnrup *et al*.[19], there were subgroups of children with DBMP who had only slightly increased dental fear scores, as compared to normative data. An interesting finding of the present study was, however, that *within* each cluster, children with DBMP consistently showed higher levels of dental fear than children from the reference group in the same cluster. Notably, the high scores of parent-rated dental fear for the three study group children in cluster 4 indicate a small group of children who, although having a balanced temperament, develop high dental fear, which should be further investigated. Thus, the dental fear scores must be evaluated individually and with temperament and other personal characteristics taken into account in order to diagnose which child needs special treatment. This result underscores the usefulness of a person-based approach to data analysis, within a developmental psychopathology framework. Such an approach enables us to study the interplay between different aetiological factors within and between fairly homogeneous groups of children[33].

Our results also indicate that combining a temperament and a behaviour problem questionnaire could be helpful in identifying children in need of special attention in dental care. If this result can be replicated in other samples, it could yield clinical cut-off scores and thus help dentists identify children who, because of their emerging personality characteristics, are at risk of developing negative reactions to dental treatment.

For clinicians, it is, however, not enough to learn more about why some children develop behaviour management problems in the dentist's office. We also seek ways of lessening those problems. Although a child's temperament is not written in stone, temperamental reactivity is relatively stable over time and situations[34], and it is not easily changed by interventions in the dentist's office.

Every child has, however, to learn ways to regulate his or her emotions, and to cope with challenging situations. From a functionalist perspective, emotions are not only responses to be regulated, but also themselves regulators of environmental interaction[35]. This view of the organizing function of emotions provides a framework for studying adaptive or maladaptive responses, and how they influence the completion of a particular developmental milestone. Emotion regulation also serves to organize attention processes and to allow the

child to adjust to the challenges of a particular situation. As children acquire more complex, psychologically orientated concepts of emotion, their strategies for the self-regulation of emotion increasingly involve the internal redirection of attention; for example, thinking pleasant thoughts during a distressing or frightening experience or self-coaching that focuses on positive outcomes[36]. To focus more on emotion regulation, and thereby control aspects of temperament, brings the study of temperament much closer to research on emotion- vs. problem-focused coping, as well as to concepts used in cognitive and cognitive-behavioural therapy and to a more general clinical understanding of emotional and behavioural disorders in childhood[17,37].

Measures to help children cooperate with challenging situations must be tailored to the specific aspect of the situation that the individual child is challenged by. It goes well beyond the scoop of this article to suggest new treatment guidelines for children with DF or different types of DBMP. We do, however, consider the results as an important first step in constructing and evaluating different treatments for different subgroups.

The strength of this study is the person-based approach and the exploratory objective, generating hypotheses for further research, rather than testing for statistical inference. From that point of view, the obvious limitations, mainly in sample size and distinction, are not crucial but should be acknowledged. Since study group inclusion was primarily based on referral forms (i.e. many different dentist's opinions and expressions of the children's fear and lack of cooperation), a great variability in DBMP within the group must be assumed. However, by allowing that variability, the study clearly reflects clinical practice, thus favouring clinical relevance.

Furthermore, it is important to bear in mind that our reference group is not a norm group, since 'no known DBMP' was one of the inclusion criteria. The limited and unequal sample sizes, the different sampling methodology and the differences in background characteristics between groups call for a replication before a conclusion can be drawn with regard to the generalizability of our findings.

In future studies of children's adaptation to dental treatment, emotion regulation/dysregulation, in terms of both reactive and effortful control, should be considered as important as temperamental reactivity, and thus adequately assessed.

It is important to bear in mind that our results are based only on parental assessments. The validity of parental reports, especially with regard to children's internalizing problems, has been questioned[38] and preliminary data from our own research group indicate that for children aged 8 years and above, self-ratings of DF should complement parental ratings.

In addition, future studies should take advantage of the possibility of recording and analysing the interaction between child, parent, and dentist in order to further our understanding of effective means of emotion regulation in challenging situations. Attention should also be paid to the impact of previous dental experiences, oral health status, and treatment need.

Nevertheless, we find our results promising in indicating that routine use of some fairly simple questionnaire instruments for parental and child self-rating could contribute to better and more differentiated diagnosis of dental fear and dental behaviour management problems among children, thus forming a prerequisite for tailored treatment interventions.

Finally, we emphasize the usefulness of the quasi-experimental dental situation for studying temperament using a developmental psychopathology framework. A visit to the dentist's office is structured and challenging (especially for fearful children and children with inhibited or overactive temperaments). It thus resembles a visit to the developmental psychologist's laboratory, but compared to the laboratory the dental situation is far more ecologically valid.

In conclusion, the group of children referred because of dental behaviour management problems differed from children in ordinary dental care, not only in dental fear level, but also in personal characteristics. Few of the referred children were characterized by a balanced temperament profile. The strategies children use to regulate their emotions, given their emotional/temperamental reactivity, should be the focus for future studies of children's behaviour in challenging situations.

What this paper adds

- This paper adds information on how children referred because of dental behaviour management problems (DBMP) differ from ordinary child dental patients both in relation to cluster placement and with regard to dental fear within the same cluster.
- It also points to the importance of different aspects of temperament in the development of DBMP.
- By distinguishing between temperamental reactivity and regulation it gives incitement to further study the strategies children use to regulate their emotions in challenging situations.

Why this paper is important to paediatric dentists

- This paper helps in understanding different types of DBMP, a dominant part of the clinical practice for paediatric dentists.
- Routine use of fairly simple questionnaire instruments can contribute to differentiate diagnosing DBMP, which will help in tailoring treatments to the benefit of the patient and the profession.
- The paper discloses the need for cooperation between paediatric dentists and psychologists.

Acknowledgements

This study was supported by the Swedish Research Council, the Swedish Dental Society, the foundation Swedish Patent Revenue Fund for Research in Preventive Odontology, Göteborg University, and Örebro County Council.

References

1 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Washington DC: American Psychiatric Press, 1994.
2 Klingberg G, Raadal M. Behavior management problems in children and adolescents. In: Koch G, Poulsen S (eds). *Pediatric Dentistry. A Clinical Approach*. Copenhagen, Denmark: Munksgaard, 2001: 53–70.
3 Klingberg G. Dental fear and behavior management problems in children. A study of measurement, prevalence, concomitant factors, and clinical effects. *Swed Dent J* 1995; (Suppl. 103): 1–78.
4 Baier K, Milgrom P, Russell S, Mancl L, Yoshida T. Children's fear and behavior in private pediatric dentistry practices. *Pediatr Dent* 2004; **26**: 316–321.
5 Williams JM, Murray JJ, Lund CA, Harkiss B, de Franco A. Anxiety in the child dental clinic. *J Child Psychol Psychiatry* 1985; **26**: 305–310.
6 Holst A, Schroder U, Ek L, Hallonsten AL, Crossner CG. Prediction of behavior management problems in children. *Scand J Dent Res* 1988; **96**: 457–465.
7 Klingberg G, Broberg AG. Temperament and child dental fear. *Pediatr Dent* 1998; **20**: 237–243.
8 Liddell A. Personality characteristics versus medical and dental experiences of dentally anxious children. *J Behav Med* 1990; **13**: 183–194.
9 Radis FG, Wilson S, Griffen AL, Coury DL. Temperament as a predictor of behavior during initial dental examination in children. *Pediatr Dent* 1994; **16**: 121–127.
10 Quinonez R, Santos RG, Boyar R, Cross H. Temperament and trait anxiety as predictors of child behavior prior to general anesthesia for dental surgery. *Pediatr Dent* 1997; **19**: 427–431.
11 Blomqvist M, Holmberg K, Fernell E, Ek U, Dahllöf G. Oral health, dental anxiety, and behavior management problems in children with attention deficit hyperactivity disorder. *Eur J Oral Sci* 2006; **114**: 385–390.
12 Rothbart MK, Derryberry D. Development of individual differences in temperament. In: Lamb ME, Brown AL (eds). *Advances in Developmental Psychology*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1981: 37–86.
13 Rothbart MK, Ahadi SA, Evans DE. Temperament and personality: origins and outcomes. *J Pers Soc Psychol* 2000; **78**: 122–135.
14 Derryberry D, Rothbart MK. Reactive and effortful processes in the organization of temperament. *Dev Psychopathol* 1997; **9**: 633–652.
15 Eisenberg N, Morris AS. Children's emotion-related regulation. *Adv Child Dev Behav* 2002; **30**: 189–229.
16 Bridges LJ, Denham SA, Ganiban JM. Definitional issues in emotion regulation research. *Child Dev* 2004; **75**: 340–345.
17 Nigg JT. Temperament and developmental psychopathology. *J Child Psychol Psychiatry* 2006; **47**: 395–422.
18 ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. Behavioural and emotional problems in children referred to a centre for special dental care. *Community Dent Oral Epidemiol* 1999; **27**: 181–186.
19 Arnrup K, Broberg AG, Berggren U, Bodin L. Lack of cooperation in pediatric dentistry – the role of child personality characteristics. *Pediatr Dent* 2002; **24**: 119–128.
20 Everitt BS, Landau S, Leese M. *Cluster Analysis*, 4th edn. London: Arnold, 2001.
21 Hollingshead A. *The Four Factor Index of Social Position*. New Haven, CT: Department of Sociology, Yale University, 1975.
22 Klingberg G. Reliability and validity of the Swedish version of the Dental Subscale of the Children's Fear Survey Schedule, CFSS-DS. *Acta Odontol Scand* 1994; **52**: 255–256.
23 Buss AH, Plomin R. *Temperament: Early Developing Personality Traits*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1984.
24 Andersson G, Olsson E, Rydell A-M, Larsen HC. Social competence and behavioural problems in children with hearing impairment. *Audiology* 2000; **39**: 88–92.
25 Elander J, Rutter M. Use and development of the Rutter parents' and teachers' scales. *Int J Methods Psychiatr Res* 1996; **6**: 63–78.
26 Breiman L, Friedman JH, Olshen RA, Stone CJ. *Classification and Regression Trees*. Monterey, CA: Wadsworth and Brooks/Cole, 1984.

27 Zhang H, Singer B. *Recursive Partitioning in the Health Sciences*. New York: Springer, 1999.
28 Rothbart MK, Ahadi SA, Hershey KL, Fisher P. Investigations of temperament at three to seven years: the Children's Behavior Questionnaire. *Child Dev* 2001; **72**: 1394–1408.
29 Eisenberg N, Sadovsky A, Spinrad TL *et al*. The relations of problem behavior status to children's negative emotionality, effortful control, and impulsivity: concurrent relations and prediction of change. *Dev Psychol* 2005; **41**: 193–211.
30 Thomas A, Chess S, Birch HG, Hertzig ME, Korn S. *Behavioral Individuality in Early Childhood*. New York: New York University Press, 1963.
31 Kagan J, Reznick JS, Snidman N. The physiology and psychology of behavioral inhibition in children. *Child Dev* 1987; **58**: 1459–1473.
32 Sterba SK, Prinstein MJ, Cox MJ. Trajectories of internalizing problems across childhood: heterogeneity, external validity, and gender differences. *Dev Psychopathol* 2007; **19**: 345–366.
33 Magnusson D. The logic and implications of a person approach. In: Cairns RB, Bergman LR, Kagan J (eds). *Methods and Models for Studying the Individual*. Thousand Oaks, CA: Sage, 1998: 33–64.
34 Kagan J, Snidman N. *The Long Shadow of Temperament*. Cambridge, MA: Harvard University Press, 2004.
35 Campos JJ, Mumme DL, Kermoian R, Campos RG. A functionalist perspective on the nature of emotion. In: Fox NA (ed.). *The Development of Emotion Regulation: Biology and Behavioral Considerations*. Monographs of the Society for Research in Child Development, 1994: 284–303.
36 Band E, Weisz JR. How to feel better when it feels bad: children's perspectives on coping with everyday stress. *Dev Psychol* 1988; **24**: 247–253.
37 Weems CF, Silverman WK. An integrative model of control: implications for understanding emotion regulation and dysregulation in childhood anxiety. *J Affect Disord* 2006; **91**: 113–124.
38 Myers K, Winters NC. Ten-year review of rating scales. I: overview of scale functioning, psychometric properties, and selection. *J Am Acad Child Adolesc Psychiatry* 2002; **41**: 114–122.