Lack of cooperation in pediatric dentistry – the role of child personality characteristics

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Abstract

Purpose: This study aimed to investigate fear, temperament, behavioral symptoms and verbal intelligence in a study group of uncooperative child dental patients, partly in comparison with a reference group of ordinary child dental patients. A second aim was to explore a hypothesis of heterogeneity by searching for subgroups within the study group.
Methods: Parents of 86 study group children (36 aged 4-to 7- years and 50 aged 8- to 12-years) and 117 reference group children (8- to 12-years) answered a questionnaire concerning dental and general fear, temperament and general behavior. Study group children performed a vocabulary test to measure verbal intelligence. Data were analyzed with a variable-based and a person-based approach.
Results: In addition to dental fear, a higher level of impulsivity most clearly discriminated study group from reference group children. Cluster analyses revealed four different fear and personality subgroups within the study group.
Conclusions: Uncooperative child dental patients constitute a heterogeneous group. Subgroups with different fear, temperament and behavior problem profiles can be identified. These subgroups could be presumed to benefit from different treatment regimens, which should be further investigated.*(Pediatr Dent 24:119-128, 2002)*

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The etiology of childhood dental fear and/or dental behavior management problems (BMP) has been discussed in a multifactorial context with reference to predisposing, triggering or exaggerating and maintaining factors of different origins.[1-5] A relationship between general fearfulness and dental fear has been shown in several studies.[3,5-7] However, in a recent study of 60 children in a pediatric dental consultation clinic in Scotland, the level of general fear did not discriminate between dentally anxious and non-anxious children.[8]

Some studies have found temperamental aspects to be associated with dental fear and behavior in dentistry.[9-13] Temperament is defined as an emotional quality that varies individually but is relatively stable over time.[14,15] It may be seen as a moderator of the children's perceptions of stressful events.[16] Liddell concluded that although temperamental factors appeared to contribute, unpleasant dental experiences might be crucial for the development of dental fear.[9] In a Swedish sample of 124 children, shyness and negative emotionality were scored higher among children with dental fear as compared to those without such fear.[13]

Contradictory findings regarding the impact of general behavior problems have been presented.[3,17-19] Raadal et al (1995) observed no relationship between dental fear and such problems among 5- to 11-year-old U.S. children from low-income families.[19] Girls with clinical as compared to non-clinical scores on somatic complaints or thought problems, however, had higher dental fear scores.[19] Attention problems have been associated with refusal of dental treatment.[20] A recent study from the Netherlands [21] revealed higher scores of behavioral and emotional problems in a group of children with high dental fear as compared to a norm group.

Intelligence can be expected to have a significant impact on children's understanding of causes and consequences, information and instructions. It may also influence their ability to communicate feelings or distress and to behave adequately[22] in the dental situation. Almost 30 years ago Rud and Kisling

(1973) concluded that children with low IQ (< 68) needed a significantly longer time (25%-30% more) to accept the dental treatment situation.[22] In a Spanish study, general intelligence was found to be more strongly associated with children's dental anxiety at their first dental visit than were personality factors.[23] With this exception, intelligence has not been studied in relation to dental fear or BMP among children within the normal range of intelligence (ie, IQ ≥ 70).

In view of the complex network of potential causes or concomitants underlying dental fear and/or BMP, it is reasonable to assume that children referred because of uncooperative behavior in dentistry exhibit varying backgrounds and individual combinations of etiologic factors. Viewing these patients as one group with similar characteristics might contribute to an "illusion of homogeneity" [24] that does not exist. On the contrary, previous inconsistencies in characterizing this group might be explained by heterogeneity in fear, personal characteristics, experiences and demographics.

The traditional multivariate variable-based approach to investigate relationships among variables does not fully acknowledge the fact that the interplay between variables takes place within individuals. To come closer to an understanding of the individual as a totality, analyses with a person-based approach are valuable complements. In such analyses, individuals are studied on the basis of their unique pattern (profile) of values for variables that are relevant to the research question.[25]

Following a multifactorial approach to the etiology of uncooperative behavior in child dental patients, we anticipated heterogeneity among our patients. To search for subgroups of individuals in whom dental fear might be separable from other personal characteristics associated with the uncooperative behavior became a research focus.

The aims of the present study were:

1. To investigate fear, temperament, behavioral symptoms and verbal intelligence in a study group of child dental patients referred because of BMP in dentistry, and to compare these children with ordinary child dental patients of similar age, and
2. To explore a hypothesis of heterogeneity within the group of referred children by searching for subgroups with different profiles of fear, temperament, behavioral symptoms and verbal intelligence.

Methods

Subjects and procedures

The study group was comprised of a random selection of 94 accompanying parents and their children, among those who were referred to the specialist pediatric dental clinic in the County of Örebro, Sweden, because of dental BMP in combination with a need for restorative dental treatment. The referrals were made by the treating dentists at any of the 24 public dental clinics in the County of Örebro. Patients were included only if their accompanying parent managed an interview in Swedish at the beginning of the treatment period.

Children with known communicative disorders or psychiatric diagnoses, according to DSM IV,[26] were excluded before data collection began. The children were at least 4, but not yet 13, years of age at the time of referral. In some analyses children were separated into younger and older study groups according to age at referral (41 patients 4-to 7- years, and 53 patients 8- to 12-years). The analyses were based on the 86 children (91%) whose parents completed the introductory baseline assessments. Of these, there were 36 children aged 4-7 years, with a response rate for that age group of 88%, and 50 children aged 8- to 12-years, with a response rate of 94%.

In addition, 132 regular child dental patients, aged 8- to 12- years, and their accompanying parents were selected to serve as a reference group to the older study group, and 117 parent/child dyads (89%) agreed to participate. These reference children were recruited consecutively as they presented for routine examination according to recall protocols at three public dental clinics in the county of Örebro. The clinics were selected to represent both urban and rural areas as well as areas of different socioeconomic structure. The reference group children had no known dental BMP.

The parents answered a questionnaire dealing with aspects of their children's dental care, fears, temperament and behavior problems. Study group parents completed the assessments at the first or second visit at the specialist pediatric dental clinic, while reference group parents filled in the questionnaire when visiting the ordinary public dental clinic. The study group children performed a vocabulary test, as a measure of verbal intelligence. All parent/child dyads requested to participate received both oral and written information about the aims and procedures of the study, and

Table 1. Sample Characteristics

	Total study group (4-12 yrs; n=86)			Older study group (8-12 yrs; n=50)			Reference group (8-12 yrs; n=117)		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Age & gender									
Boys	41	8.5	2.2	24	10.0	1.8	65	10.1	1.5
Girls	45	8.4	2.2	26	9.8	1.6	52	10.2	1.2
Total	86	8.4	2.2	50	9.9	1.7	117	10.1	1.4
Mother's occupation score	76	3.5	2.1	43	2.8	1.7	110	4.6	2.0
Cohabitation status (% of children living with both parents)	80	48%		44	50%		113	81%	

were informed that participation was voluntary. Approval from the Research Ethical Committee of the Örebro County Council was obtained prior to the study.

Sample characteristics

The total study group comprised 41 boys and 45 girls with a mean age of 8.4 years (Table 1); 24 boys and 26 girls (mean age 9.9 years) constituted the older study group, to be compared with the reference group of 65 boys and 52 girls, 10.1 years old (Table 1). Most of the responding parents were mothers, with a similar proportion (74%) between groups. The socioeconomic status (SES), indicated by the mother's occupation score and the cohabitation status (proportion of children living with both parents), are shown in Table 1.

Measures

As a measure of socio-economic status, the mother's occupation was assessed using the Hollingshead index (range1-9) of occupational status [27] modified for use in Sweden by Broberg 1992. In the logistic regression analyses, the occupation score was dichotomized to indicate low socioeconomic status (SES; scores 1-3) or not. The cohabitation status of the parents was used rather than marital status, since many Swedish parents live together as married although they are not legally so.

The levels of the children's dental fear were assessed by the parents using a Swedish version [28] of the 15-item Dental Subscale of the Children's Fear Survey Schedule (CFSS-DS).[29] The response format ranges from 1 (not afraid at all) to 5 (very afraid) giving a total score ranging from 15 to 75. Scores of 38 and above have been used as indicative of dental fear.[28,30,31] The reliability of the scale has been shown to be satisfactory, and normative data for both Swedish[31] and other populations are available.[32]

General fear was assessed using a Swedish parental version[4] of the Short Form of the Children's Fear Survey Schedule (CFSS-SF),[33] containing 18 items to be rated from 1 (not afraid) to 5 (very afraid), giving total scores ranging from 18 to 90.

The children's temperament was measured by the EASI temperamental survey,[34] translated into Swedish by Hagekull and Bohlin.[35] It has been used with Swedish children from the age of 3 years.[13, 36] The version used contains 25 items describing different characteristics of the child to be assessed by the parent on a Likert-type scale from 1 (not at all like my child) to 5 (very much like my child).

The EASI measures five temperaments. Negative emotionality is defined as being in a state of high autonomic arousal expressed as irritability or aggression. Activity corresponds to tempo and vigor. Sociability stands for a tendency to prefer the presence of others to being alone. Shyness is the tendency to be inhibited or slow to "warm up" in new situations or when meeting new people. It is not simply the opposite of sociability; most shy persons enjoy the company of others once they have "warmed up" to them. Impulsivity describes impatience and lack of perseverance. Each temperamental dimension is measured by 5-item subscales of the EASI instrument, giving mean scores ranging from 1 to 5 for every single dimension.

For assessments of general behavior problems among school children in the study and reference groups, a Swedish version[37] of the Rutter behavior questionnaire for completion by parents was used.[38,39] The Rutter scale consists of 19 items describing detailed child behavior problems. The original 3-steps response format was modified to a Likert-type scale from 1 (not at all like my child) to 5 (very much like my child). In addition, the scale contains 13 items describing common psychosomatic complaints or behavior problems to be rated on a frequency scale from 1 (never) to 5 (daily). Subscale scores of internalizing behavior problems (6 items; alpha=0.70), externalizing problems (8 items; alpha=0.78) and attention problems (3 items; alpha=0.80) were computed as subscale means ranging from 1 to 5. For preschool children in the study group, the 23-item Preschool Behavior Questionnaire (PBQ) [40] translated into Swedish and modified by Hagekull & Bohlin[41,42] was used, and subscale scores comparable to subscales on the Rutter questionnaire were computed as means from seven (alpha=0.79), 13 (alpha=0.84) and two items, respectively.

The Peabody Picture Vocabulary Test (PPVT) measures vocabulary as one important facet of general intelligence, and has been shown to be a good single index of school success.[43] It includes 175 test plates with four pictures each, of which one correctly illustrates a corresponding word presented by the examiner. The testing was performed according to the manual,[43] giving each subject a raw score. From this score an age equivalent could be derived, which was then divided by the chronological age and multiplied by 100 to give an individual "verbal intelligence quotient" (VIQ).

Statistical analyses

Variable-based approach

Univariate between group differences were tested with t-tests (independent groups) or one-way analyses of variance (ANOVA). When nominally scaled variables were analyzed, the chi-square test was used. Multivariate comparisons of 8- to 12-year-old children from study and reference groups were performed using logistic regression analysis with group (study or reference) as outcome and selected measures as potentially discriminatory variables. Both forward and backward selection was used in the stepwise selection procedure.

A set of background characteristics, based on univariate relationships, was forced to enter the model. The analysis was performed for the total merged sample of 8- to 12-year-olds from study and reference groups as well as for boys and girls separately. Some of the variables are measured on a scale that is not entirely consistent with the usual distributional and metric assumptions associated with our statistical methods. We therefore supplemented the t-test analyses with the

Table 2. Fear and Personal Characteristics. Descriptives and Univariate Differences Between the Older Study Group (8-12 yrs; n=50) and the Reference Group

		Total study group (4-12 yrs; n=86)		Older study group (8-12 yrs; n=50)				Reference group (8-12 yrs; n=117)	
						vs Ref group			
		Mean	SD	Mean	SD	t	*P* value	Mean	SD
Fear (sum scores)									
Dental fear (CFSS-DS)	Boys	36.2	11.5	37.6	11.0	5.50	<0.001	24.1	6.9
	Girls	37.2	10.4	38.5	10.2	6.75	<0.001	23.6	5.8
	Total	36.7	10.9	38.1	10.5	10.52	<0.001	23.9	6.4
General fear (CFSS-SF)	Boys	40.0	11.3	40.3	11.8			36.6	10.2
	Girls	39.6	11.0	41.4	10.9			38.5	9.0
	Total	39.8	11.1	40.9	11.2		ns	37.5	9.7
Temperament (EASI; means)									
Negative emotionality	Boys	3.2	0.8	3.0	0.9	2.29	0.024	2.5	0.8
	Girls	3.0	0.8	2.9	0.7	3.02	0.003	2.4	0.7
	Total	3.1	0.8	2.9	0.8	3.62	<0.001	2.5	0.7
Activity	Boys	3.8	0.8	3.6	0.8			3.8	0.8
	Girls	3.8	0.8	3.6	0.7			3.7	0.7
	Total	3.8	0.8	3.6	0.7		ns	3.7	0.8
Shyness	Boys	2.1	0.9	2.1	1.0			2.0	0.8
	Girls	2.0	0.9	2.1	1.0			2.0	0.7
	Total	2.1	0.9	2.1	1.0		ns	2.0	0.8
Sociability	Boys	3.8	0.7	3.7	0.8			3.8	0.6
	Girls	3.8	0.6	3.8	0.6			3.7	0.7
	Total	3.8	0.6	3.8	0.7		ns	3.7	0.7
Impulsivity	Boys	2.9	0.8	3.0	0.8	4.02	<0.001	2.3	0.7
	Girls	2.4	0.7	2.5	0.7	3.24	0.002	1.9	0.7
	Total	2.7	0.8	2.7	0.8	4.77	<0.001	2.1	0.7
Behavior problems (Rutter/PBQ; means)									
Externalizing	Boys	1.7	0.6	1.7	0.7		ns	1.5	0.5
	Girls	1.5	0.5	1.5	0.5	2.36	0.021	1.3	0.3
	Total	1.6	0.6	1.6	0.6	2.05	0.044	1.4	0.4
Internalizing	Boys	2.0	0.8	2.1	0.9	2.19	0.031	1.7	0.5
	Girls	1.9	0.6	2.0	0.7	1.89	0.062	1.7	0.5
	Total	2.0	0.7	2.0	0.8	2.89	0.004	1.7	0.5
Attention/ concentration problems	Boys	2.1	1.0	2.3	1.1			2.0	0.9
	Girls	1.6	0.8	1.6	0.8			1.5	0.7
	Total	1.8	0.9	1.9	1.0		ns	1.8	0.8

Mann-Whitney U-test, and ANOVAs with the Kruskal-Wallis test. Deviant results given by the supplemented analyses will be mentioned in the text.

Person-based approach

To investigate the hypothesized heterogeneity in the study group, we performed exploratory cluster analyses in three steps. First, we used the cluster program Sleipner[44] to identify outliers, the "no-neighbors." After exclusion of outliers,[45] the second step was Ward's hierarchical procedure. This method was used to obtain initial estimates of the number of clusters as well as estimates of seed points to use as start values in the third step, the relocation of individuals with an optimizing K-means algorithm. Methodological validation was performed by examining the cluster solution stability by repeated analyses, using only subsets of original variables selected on the basis of explorative factor analyses.[46]

Results

A variable-based approach — descriptive, and univariate analyses of differences between the older (8- to 12-years) study group and the reference group

Means by group and sex for dental fear, general anxiety, temperamental dimensions (5 subscales) and general behavior problems (3 subscales) are presented in Table 2. In addition to the expected difference in dental fear scores, the older study group children scored significantly higher than the reference group on negative emotionality, impulsivity and externalizing and internalizing behavior problems. Separating the sample into boys and girls revealed that the group difference in externalizing behavior was significant only among girls, while boys differed significantly regarding internalizing behavior. Table 2 shows t and *P* values from student's t-tests. Mann-Whitney U tests gave similar results except for externalizing behavior where the significance for totals disappeared (*P*=0.069).

A variable-based approach — the older (8- to 12-yrs) study group children as compared to the reference group children in multiple logistic regression analyses

Fear, temperament and behavior measures were entered into a sequence of multiple logistic regression analyses. According to relationships found in univariate analyses, child gender (significant for impulsivity and for externalizing and attention problems), cohabitation status of parents (significant for dental fear and externalizing behavior) and low SES (indicated by mother's occupation score≤3; significant for dental and general fear) were forced into these analyses. Age showed only weak and non-significant correlations with the variables under investigation, and was therefore not included.

To avoid statistical errors due to inclusion of too many variables, sequential exclusion of those which in the univariate analyses did not differ significantly between the older study group and reference group (Table 2) was made.

All stepwise models confirmed the difference in dental fear and, nearly significant, in the temperamental dimension impulsivity, while no subscale of general behavior problems discriminated between the groups in these multivariate analyses (ie, when gender, SES and cohabitation status were considered). The result of the final model (R^2=0.63) for the total group is shown in Table 3, after exclusion of the temperamental dimensions sociability and activity. When boys and girls were analyzed separately, the models were limited to a maximum of 8 variables because of the decreased number of individuals (72 of each sex). These analyses revealed a significant contribution from negative emotionality in the girls, while impulsivity failed to discriminate between the groups in these sex-specific analyses.

Table 3. Multiple Logistic Regression Model for Assignment to Study Group 8-12 Years (Step 3)

Aspect	Variable	Odds ratio	95% CI	*P* value
Sample characteristics (forced into the model)	Sex (cat)	0.3	0.1-0.9	0.035
	Low SES (cat)	3.2	1.0-9.5	0.042
	Cohabitation status (cat)	2.8	0.9-8.8	0.080
Fear	Dental	1.2	1.1-1.3	<0.001
	General	0.9	0.9-1.0	0.022
Temperament	Impulsivity	2.3	1.0-5.3	0.055

The model is based on complete data for 144 children (72 boys and 72 girls; 41study group and 103 Reference Group). Variables that did not enter the model: negative emotionality, shyness, externalizing, internalizing, attention problems. cat = categorical; CI = confidence interval.

A person-based approach — cluster solutions for the entire (4- to 12-years) study group

Owing to missing data, mainly on the dental fear scale (CFSS-DS), the maximum number of study group patients available for cluster analyses was 78. Four outliers were excluded and will be described separately from the cluster solutions. For the study group, the initial hierarchical cluster analysis with the 74 remaining individuals and the 11 z-transformed variables (dental fear, general anxiety, negative emotionality, activity, shyness, sociability, impulsivity, externalizing, internalizing, attention problems and VIQ) indicated that 2-, 3- or 4-cluster solutions were good divisions[46] of the data. Non-hierarchical analyses (K-means) were performed for these three solutions.

The final 2-cluster solution (Fig 1) separated the study group into one cluster (n=51) where all variables except activity and sociability had values below the mean, and a second cluster (n=23), where the reverse was true. Examination of the final 3-cluster solution revealed that all clustering variables produced statistically significant effects, and these were therefore interpreted as contributing adequately to the solution (ANOVA; data not shown). The first cluster (n=48) showed the lowest values for fear, impulsivity, negative emotionality, shyness and behavioral subdimensions, and the highest for sociability, activity and also VIQ, thus exhibiting an extrovert, outgoing temperamental profile. This was mirrored by the second cluster (n=18), which showed two peaks for shyness and internalizing, and high values also for the fear variables, thus displaying a fearful, inhibited tendency. The third cluster (n=8) peaked on externalizing and attention problems in addition to showing a high level of negative emotionality and impulsivity, constituting a group with an externalizing, impulsive profile.

In the 4-cluster solution all clustering variables except VIQ produced significant effects (ANOVA; data not shown). It was shown that the extrovert, outgoing cluster from the 3-cluster solution split mainly into one cluster with low dental and general fear as measured by the questionnaires (non-fearful, extrovert, outgoing; n=31) and one cluster with the highest fear ratings but still no indications of temperamental or behavioral problems (fearful, extrovert, outgoing; n=19), and also showing the highest level of VIQ. The fearful, inhibited cluster was relatively stable and the externalizing, impulsive cluster remained unaffected between the 3- and 4-cluster solutions (Fig 1).

Analogously to these cluster analyses, we conducted analyses on a subset of five variables (general fear, shyness, internalizing, externalizing, and verbal intelligence), selected after explorative factor analysis. These analyses indicated similar 2-4-cluster solutions. The overall agreement in cluster distributions between the 4-cluster solutions from 11 versus five variables was 74%.

Profiles, based on the z scores of the different clusters in the 4-cluster solution, are shown in Figure 2. Descriptive statistics of the clusters and also of the "group" of four excluded outliers are shown in Table 4, from which it is clear that the outliers exhibited multiple problems with even higher scores for fears, negative emotionality, impulsivity and internalizing behavior. Differences between clusters regarding age, sex, cohabitation status and SES, were tested

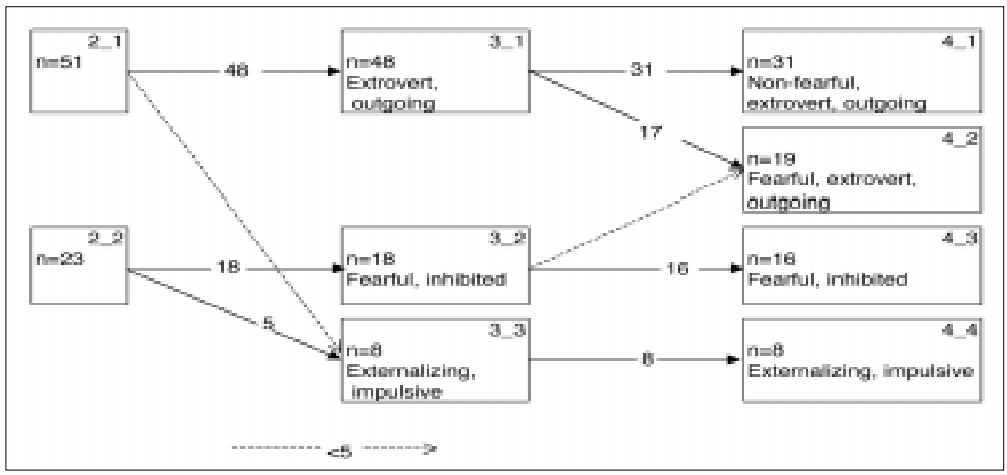

Fig 1. An illustration of the final 2-, 3- and 4-cluster solutions in the entire study group (4-to 12-years) after exclusion of 4 outliers. Seventy-four individuals and 11 variables were included in the clustering process. The cluster labels and number of individuals in each cluster are shown in the boxes. The arrows show the number of individuals moving between clusters in different solutions.

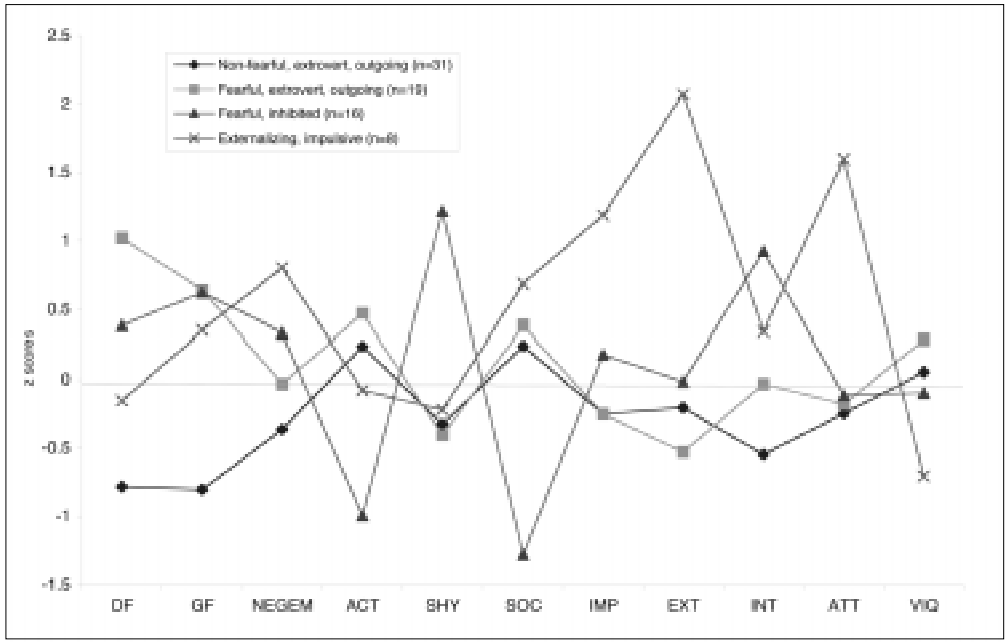

Fig 2. Fear and personality profiles in the 4-cluster solution for the entire study group (4- to 12-years; n=74). Abbreviations at the x-axis refer to the 11 variables included (Dental Fear, General Fear, NEGative EMotionality, ACTivity, SHYness, SOCiability, IMPulsivity, EXTernalizing, INTernalizing, ATTention problems and Verbal Intelligence Quotient). Height on vertical axis refers to z-scores, per definition with the group mean 0.0 for each variable.

with ANOVA and chi-square tests respectively (Table 4), and were all found non-significant.

Discussion

This study has shown that children referred because of dental BMP differ from ordinary child dental patients in temperament and behavior and constitute a heterogeneous group regarding fear, temperament, behavior and intelligence. Variable-based analyses should be complemented with analyses following a person-based approach to contribute to an understanding of the individual as a total. Cluster analysis, a person-based method for exploring a data set in order to identify subgroups, is well explained by Everitt.[46] It is important to bear in mind that the technique is descriptive and exploratory but non-inferential.[47] The solutions depend on the variables used and the variables have to be selected in the light of clinical and theoretical knowledge, which makes the technique subjective rather than objective.

When formulating our first aim, we assumed that despite an expected heterogeneity in the study group there would be some variables or combinations of variables in the investigated fear, temperamental, behavioral or intelligence dimensions that would differ between children referred because of BMP and a reference group of ordinary child dental patients of similar age. Logistic regression analysis was chosen as the most adequate and robust method to discriminate between study and reference group children given the mixed scale quality of our data.[48] The variable-based approach showed that the 8- to 12-year old children referred because of BMP, in addition to a higher level of dental fear, differed from ordinary child dental patients in both temperamental and general behavior aspects.

The impact of impulsivity in pediatric dentistry has not been investigated previously. However, since the dental situation requests patience, cooperation and immobility on the part of the patient, it seems natural that at least BMP should be associated with impulsivity. Negative emotionality has been described as a risk factor for psychopathology,[49] and in previous studies on Swedish children [13] it has been found to be associated with dental fear. In this study, negative emotionality was positively correlated with impulsivity (r=0.47; $P<0.01$). This may partly explain why it failed to discriminate between groups in the logistic regression analyses when impulsivity was simultaneously entered. Externalizing behavior

Table 4. Descriptive Statistics by Cluster and for Outliers, Study Group 4- to 12-years, Cluster Analysis Performed on 11 Variables and 74 Individuals

Clustering variables in italics	Non-fearful, extrovert, outgoing		Fearful, extrovert, outgoing		Fearful, inhibited		Externalizing, impulsive		Outliers (excluded from cluster analyses)	
Number of individuals	31		19		16		8		4	
Boys %	52		47		31		62		100	
Cohabitation status (% living with both parents)	53		56		43		67		50	
Low SES (%)	44		50		50		83		100	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	8.1	2.1	8.6	2.1	9.5	2.4	8.0	2.1	9.5	3.6
Fear (sum scores)										
Dental	27.7	7.0	46.8	6.9	40.1	6.5	34.4	9.2	49.5	11.1
General	30.7	6.2	46.3	8.8	46.1	10.0	43.2	7.2	53.4	10.0
Temperament (EASI; means)										
Negative emotionality	2.7	0.7	3.0	0.8	3.3	0.6	3.6	0.9	4.4	0.8
Activity	4.0	0.6	4.1	0.5	3.1	0.6	3.8	0.9	3.7	1.5
Shyness	1.8	0.7	1.7	0.6	3.1	0.6	1.8	0.6	3.0	1.4
Sociability	4.0	0.4	4.1	0.4	3.2	0.4	4.2	0.4	3.1	1.7
Impulsivity	2.4	0.7	2.4	0.7	2.7	0.7	3.5	0.6	4.6	0.7
Behavior problems (Rutter/PBQ; means)										
Externalizing	1.5	0.3	1.3	0.4	1.6	0.4	2.7	0.4	2.6	0.5
Internalizing	1.6	0.4	1.9	0.4	2.5	0.7	2.1	0.3	3.5	1.3
Attention problems	1.6	0.8	1.6	0.7	1.7	0.7	3.3	1.1	2.5	0.9
Verbal intelligence (PPVT;VIQ)	96.4	18.8	101.5	25.2	93.1	21.6	79.8	20.2	83.2	23.8

problems and attention problems were to a certain extent related to gender and also to socio-demographics, which differed between the study and reference group. These relations could at least partly explain the lack of significance for behavioral subdimensions in the logistic regression analyses.

The results indicate that clinicians should consider children's temperament and general behavior tendencies as well as parental SES and cohabitation status, since they may all contribute to the development of BMP in pediatric dentistry. We take the results regarding temperamental and personality characteristics of our study group patients as if children who are referred because of BMP may share emotional regulation problems. Some of the children show their difficulties modulating emotional reactivity by anxious behavior (ie, classic dental fear patients). Other patients, however, display their emotion regulation difficulties by externalizing and impulsive behaviors. The capacity to modulate emotional reactions to aversive stimuli and situations is partly under genetic influence. This is indicated by, for example, differences in emotional arousal, self-quieting activities and readiness to be soothed in response to heel pricking, that can be observed already during the first days of life.[50]

With increasing age, however, emotion regulation becomes an increasingly relational activity. Using social referencing[51] the infant learns to evaluate a potentially dangerous situation, and regulate emotion accordingly, by looking at the parent and reading her/his facial expression and vocal tone. Still later in development, a child who has developed a secure attachment [52] to her/his caregiver will be able to use that person as "haven of safety"[53] in potentially dangerous situations. The securely attached child regulates emotions flexibly and is able to react to a "friendly stranger" (ie, the dentist or dental nurse) with concerned curiosity rather than with fear, aggression or indiscriminate friendliness. The type and degree of emotional dysregulation seen in pediatric dentistry will, therefore, be the end product of a complex interplay between genetically influenced temperamental traits and the child's relational history with her/his caregivers.

To evaluate the parent-child relationship is especially important for children with emotional regulation problems. Some children will be able to use the parent as a "haven of safety" to overcome, or at least reduce, emotion regulation problems. For other children the parent is more part of the problem, than part of the solution.

The results using a person-based analysis approach clearly supported the hypothesis of heterogeneity in the study group. Four subgroups were identified among the referred children when we simultaneously considered fear, temperamental, behavioral and intelligence data. Dental fear was part of the problem in most, but not all, of the subgroups. In the late 1990s, Ten Berge et al[21] and Klingberg & Broberg[13] speculated on the possibility of subgroups with different sets of characteristics among children with dental fear and/or BMP.

However, only the distinction between dental fear and BMP has been further investigated.[54] The present identification of as many as four subgroups with different profiles of fear and other personal characteristics is, to our knowledge, new. Our theoretical validation process focused on the profile constructs and was based on psychological theory regarding child temperament and behavior problems. The classification was also methodologically validated through repeated cluster analyses with a reduced variable number, and the agreement of 74% indicates that the four subgroups, according to these fear and personality characteristics, are valid constructs. It also indicates that children can be identified as belonging to one or the other subgroup using a limited number of short and robust psychological measures.

If these subgroups benefit from different treatment regimens, which should be further investigated, this study offers a potential of clinical pretreatment classification of children referred because of BMP to optimize their treatment. Also, after further investigating the etiology of BMP in the different subgroups, attention to these temperamental, behavioral and intelligence factors might help in preventing the development of BMP.

Our study group consisted of children with a wide age span (4- to 12-years), and the comparisons with the reference group were restricted to those aged 8- to 12-years. Although age is a well-documented factor in the prevalence of dental fear as well as BMP,[7,31] it was found to be of limited importance both in our comparisons of children within the age range 8- to 12-years and in the different subgroups of the whole 4- to 12-year-old study group. Temperament[14,15] and intelligence[55] have been shown to be relatively stable over time after the age of four years. It is, therefore, not surprising that the relationship between these factors and dental fear and/or BMP does not change over time.

The 8- to 12-year old study group patients differed from those of the reference group regarding dental fear, impulsivity and behavior problems, the last a finding, which seemed to be explained by the different socioeconomic and cohabitation status between the groups. We also found that study group patients formed four rather different clusters of children with regard to personality characteristics. In the light of the exploratory character of the cluster analyses used in this study, we urge others to replicate these findings. Further research should also focus on the etiology of dental fear and/or BMP in different subgroups. In addition, different combinations of psychological and pharmacological treatment techniques in dentistry should be investigated in relation to subgroups.

It must be kept in mind that several other factors, eg, dental experiences and parental dental fear, which have been shown to be important for the development of dental fear and/or BMP,[4,8,9] were not taken into consideration in the present exploratory part of this investigation. It remains to be seen if these factors differ between the subgroups of pediatric dental patients identified in this report.

Conclusions

1. Impulsivity and negative emotionality discriminate children referred because of BMP from ordinary child dental patients.
2. Behavior problems associated with BMP are related to family risk factors (ie, SES and cohabitation status), which are more common among child dental patients referred because of BMP as compared to ordinary child dental patients.
3. Children referred because of BMP constitute a heterogeneous group. For most, but not all, dental fear is part of the problem. General fear, temperament, behavioral symptomatology and verbal intelligence all contribute to the characteristics of particular subgroups.

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Abstract of the Scientific Literature

Changes in the Masticatory Cycle Following Treatment of Posterior Unilateral Crossbite in Children

The chewing cycle shape and duration was assessed in 14 patients with functional unilateral posterior crossbites both pre- and post -treatment. The mean age of the patients was 8.8 years and all were treated with rapid maxillary expansion, and retained for 6 months. Subjects were asked to chew normally for 20 cycles, chew on the crossbite side only for 20 cycles and chew on the noncrossbite side only for 20 cycles. Mandibular kinematics was recorded and a special computer program selected the 10 most representative cycles from each series and computed an average duration and an average maximum excursion along 3 orthogonal axes. Before treatment, the patients chewed more slowly than did the controls. Treatment shortened their cycle duration to equal control values. Before treatment, the patients also had larger maximum excursions than did the controls and exhibited a reverse-sequence cycle shape when chewing on the crossbite side. Treatment did not alter the patients' abnormal cycle shape. These results suggest that some features of the masticatory kinematics respond to orthodontic treatment alone, but others do not.

Comments: Early expansion treatment in patients with functional posterior unilateral crossbite will eliminate asymmetries, however the type of chewing pattern is not altered within 6 months of treatment. It will be interesting to follow these patients to observe if the chewing cycle alters over a longer period of time. **AOC**

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39 references