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Appraisal of Behavioral Measurement Techniques for Assessing Dental Anxiety and Fear in Children: A Review

Irene H. A. Aartman,[1,4] Ton van Everdingen,[3] Johan Hoogstraten,[1,3] and Albert H. B. Schuurs[2]

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The aim of this article is to review and evaluate behavioral and physiological measurement techniques frequently used to assess dental anxiety and fear in children. Attention is given to the data collected, the empirical findings obtained, and the availability of normative data. The main focus, however, is on the reliability and validity. Results show that all questionnaires are open to criticism. Of the behavioral measures, Melamed's Behavior Profile Rating Scale is to be preferred to Frankl's Rating Scale, Venham Rating Scales, and Visual Analogue Scales. The main reasons are that Melamed's BPRS measures the behavior of the child more precisely and that it has superior psychometric properties. Furthermore, because of their practical, conceptual, and psychometric problems, physiological measures at this stage are found to be less appropriate for assessing dental fear in children. It is concluded that a behavioral measure is not always the ideal, but often the only available technique for assessing dental fear in children.

KEY WORDS: dental anxiety; children; behavioral assessment.

[1]Department of Social Dentistry and Dental Health Education, Academic Centre for Dentistry Amsterdam (ACTA), Louwesweg 1, 1066 EA Amsterdam, The Netherlands.
[2]Department of Cariology and Endodontology, Academic Centre for Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands.
[3]Department of Methodology, Faculty of Psychology, University of Amsterdam, Amsterdam, The Netherlands.
[4]To whom correspondence should be addressed.

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INTRODUCTION

Dental anxiety and fear[5] of dental treatment have been recognized as a source of serious problems in patient management for many years. It has been found that dental anxiety underlies disruptive behavior during treatment (Kent & Blinkhorn, 1991) and negatively affects the attitudes and behavior of the dentist (Cooper, Watts, & Kelly, 1987). Moreover, dental anxiety may lead to avoidance of seeking needed dental care. In order to investigate causes and consequences of dental anxiety, many measurement techniques have been proposed. Some examples are drawings, observation of real behavior, ratings of dentists, and verbal–cognitive self-reports (Schuurs & Hoogstraten, 1993). Although some of these techniques are of questionable psychometric quality when used with adults (Schuurs & Hoogstraten, 1993), finding a reliable indicator of dental anxiety in children is even more problematic, mainly because many methods that are used successfully with adults cannot be used with children (e.g., some measurement techniques that rely on self-reports).

Regarding to the assessment of dental anxiety/fear in children, four main types of measures can be distinguished (Klingberg, Vannas Löfqvist, & Hwang, 1995): (1) psychometric scales (e.g., questionnaires with categorical response scales), (2) projective techniques (e.g., questionnaires with a continuous response scale), (3) physiological measures (e.g., heart rate), and (4) ratings of child behavior during dental visits. These four types can be clustered into measurement techniques that rely on some form of self-report (types 1 and 2) and techniques that rely on observations of reactions of the child by others (types 3 and 4).

The aim of this paper is to appraise the behavioral and, to a certain extent, physiological measures of dental anxiety in children and to review the results obtained using these measures. The way in which these measurement techniques is appraised follows the review of Schuurs and Hoogstraten (1993), in which the state of affairs concerning dental fear and anxiety questionnaires for adults is discussed. First, the pertinent measure is briefly described. Second, data and empirical findings obtained are summarized. Third, the measures are evaluated with respect to criteria based on the official norms for test construction, developed by the American Psychological Association (1985). These criteria are as follows.

[5]Fear is generally believed to be evoked by a real, specific stimulus. Anxiety, on the other hand, arises from within the patient's psyche. as a reaction to an undefined, unrealistic anticipated stressor. Some researchers do not distinguish between fear and anxiety. Dental anxiety is defined here as a situation-specific trait anxiety, i.e., as the disposition to experience anxiety in the dental situation (Stouthard, 1989).

The description of anxiety/fear given by the constructors and the specific concept they plan to measure.

The reliability of the measures. Of special interest here is information about the interobserver or interrater reliability (Do the judges agree in their ratings of behavior?) and, to a lesser extent, the test–retest reliability (How high is the correlation between scores on the same test, administered on two separate occasions?).

The validity of the measures. The relevant question here is whether the scales measure what they intend to measure. Considered are correlations with other measures of dental anxiety (convergent validity) and the effectiveness of measures to differentiate between groups that are expected to differ in anxiety. In the Discussion an overall assessment of the quality of the reviewed measures is given.

FRANKL'S RATING SCALE (FRANKL'S RS)

One of the most extensively used rating scales to assess dental anxiety in children in the dental setting was developed by Frankl, Shiere, and Fogels (1962). This scale, completed by the dentist, categorizes the child's behavior in different situations as either *definitely positive* (4), *positive* (3), *negative* (2), or *definitely negative* (1) (see Appendix A).

Originally, Frankl *et al.* rated the behavior of children at the following five occasions: upon separation from the parent, upon oral examination, and during prophylaxis, X-ray, and departure. In other studies, behavioral ratings were performed at similar occasions (Klorman, Ratner, Arata, King, & Sveen, 1978; Klorman, Michael, Hilpert, & Sveen, 1979). In most studies using Frankl's RS, ratings were made by two or more independent observers (Hosey & Blinkhorn, 1995). However, in some only the dentist's judgment was used (Koplik, Lamping, & Reznikoff, 1992).

Assessment of Frankl's RS

No empirical findings obtained with Frankl's RS are presented here. The reason for this is twofold. First, because some investigators using Frankl's RS made several modifications to either the descriptions of the categories of behavior (Johnson & Baldwin, 1968; Roberts, Wilson, Seale, & McWhorter, 1992) or the order of the categories and their names (Neverlien & Backer Johnsen, 1991), there actually is no such thing as *the* Frankl's RS. Basically these scales are all different scales. Thus, the original

and modified versions should be conceived of as a class of Frankl's Rating Scales.

Second, scores obtained with Frankl's RS can be dealt with in different ways, which affect the level of measurement of the obtained value. By simply summing the ratings an individual receives on different measurement occasions (Johnson & Machen, 1973; Machen & Johnson, 1974), the value obtained may be treated as a metric variable. Another way of processing the data is to give an overall rating of the child's behavior, based on the number of positive scores (score 3 and 4) and/or negative scores (score 1 and 2) the child receives at at least one measurement occasion (Frankl *et al.*, 1962). A third way of categorizing the child's behavior is to classify it as overall negative (positive) if any negative (positive) rating is observed (Machen & Johnson, 1974). The values obtained with the latter two methods can be treated only as nonmetric variables. Obviously, results obtained with these different scales cannot readily be compared.

Reliability

The interobserver reliability of Frankl's RS has been studied in several ways. We may add that in all studies raters were trained in completing the scale. Percentages of agreement among observers ranged from 84.5% to 99% (Frankl *et al.*, 1962; Johnson & Baldwin, 1968; Wright & Alpern, 1971; Bailey, Talbot, & Taylor, 1973; Roberts *et al.*, 1992; Fenlon, Dobbs, & Curzon, 1993). Del Gaudio and Nevid (1991) computed a Pearson correlation of .82 for the interrater reliability. In several studies (Koenigsberg and Johnson, 1972; Johnson & Machen, 1973; Machen & Johnson, 1974), high interjudge reliabilities, ranging from .91 to .98, were found using an analysis of variance formula adapted from Ebel (see Koenigsberg and Johnson). Recently, Hosey and Blinkhorn (1995) found poor agreement between observers in two- and four-judge evaluations using Cohen's kappa. With few exceptions, values in this study ranged from .13 to .85. On the whole, reliability for Frankl's RS, the original and modified versions, seems satisfactory.

Validity

Several studies showed that Frankl's RS is sensitive to conditions designed to change levels of disruptive behavior (Frankl *et al.*, 1962; Johnson & Machen, 1973; Machen & Johnson, 1974; Roberts *et al.*, 1992). Scores on Frankl's RS also correlated with variables expected to influence the behavior of the child in the dental situation, such as the anxiety level of the parent (Johnson & Baldwin, 1968, 1969; Wright & Alpern, 1971;

Koenigsberg & Johnson, 1972; Bailey *et al.*, 1973). In some studies, though, this relationship was absent (Fenlon *et al.*, 1993).

As shown in Table II, Frankl's RS correlated low to moderately with both self-report measures of dental anxiety and other behavioral scales. Based on these correlations the conclusion must be that the validity of Frankl's RS is moderate at best.

MELAMED'S BEHAVIOR PROFILE RATING SCALE (BPRS)

Melamed's BPRS was developed by Melamed, Weinstein, Hawes, and Katin-Borland (1975) to provide an objective measure of the behavior of the child in the dental situation. The scale consists of 27 child-related behaviors which are considered to be indications of dental anxiety or fear (see Appendix B, Table BI). An independent observer scores the frequency of these behaviors over 3-min intervals. Four of the items apply to behavior of the child upon separation of the mother. The other 23 statements assess office behavior, 2 of them concerning the dentist and the remaining 21 the behavior of the child.

Each of the 27 behaviors is weighted by a factor that reflects the degree of its disruptiveness as defined by Melamed, Weinstein, Hawes, and Katin-Borland (1975). The total BPRS score is obtained by multiplying the frequency at which a behavior in each category occurs (across 3-min intervals) by its weighted factor. These weighted frequencies are then added across categories and the sum is divided by the number of 3-min intervals. In this way, the total BPRS score is a measure of the average frequency of fear-related behaviors per 3-min interval.

Results Obtained with the BPRS

Data on samples are shown in Table I. Because of the absence of normative scores, nothing can be said about the meaning of the mean scores. The effect of age is somewhat dubious. Although the age range of examined children in the two studies by Melamed *et al.* and the study by Koplik *et al.* (1992) is comparable, the reported mean scores are substantially different. On the other hand, in the study by Vandermaas, Hess, and Baker-Ward (1993) the mean scores for young children are higher than the mean scores for older children. The latter study also shows an effect of seriousness of the treatment: mean scores are higher for children who are about to receive a dental treatment (referred to as the "operative" group)

Table I. Mean Scores with Standard Deviations (If Available) on Melamed's Behavior Profile Rating Scale

Authors	*n* (age, years)	Mean ± *SD*
Melamed, Hawes, Heiby, Glick (1975)	16 (5–11)	
	8 experimental group	2.67
	8 control group	5.59
Melamed *et al.* (1983)	42 (4–12)	2.50
Alwin *et al.* (1991)	107 (6–18)	
	65 study group	1.17 ± 1.42
	42 control group	.64 ± 1.14
Vandermaas *et al.* (1993)[a]	80 (4–8)	
	20 young "teeth-cleaners"	2.21 ± 2.89
	id older "teeth-cleaners"	.90 ± .77
	id young "operatives"	3.69 ± 3.71
	id older "operatives"	2.50 ± 2.11
Koplik *et al.* (1992)	80 (6–12)	.63 ± .74

[a]Only 20 behaviors were scored.

compared to children who receive a routine dental examination (the so-called "teeth-cleaning" group).

Assessment of Melamed's BPRS

Reliability

In a number of studies the interrater reliability of the BPRS has been assessed. Melamed, Weinstein, Hawes, and Katin-Borland (1975) compared the ratings of four observers using the Spearman rank correlation coefficient and found an interrater reliability coefficient of .98. In five other studies (Klorman *et al.*, 1978; Klingman, Melamed, Cuthbert, & Hermecz, 1984; Boj & Davila, 1989; Greenbaum, Lumley, Turner, & Melamed, 1993; Vandermaas *et al.*, 1993), interrater reliability coefficients ranging from .81 to .99 were computed. The interrater reliability for the BPRS thus seems satisfactory.

Validity

The BPRS proved useful in detecting behavior changes across conditions designed to alleviate anxiety or noncooperation (Melamed, Hawes, Heiby, & Glick, 1975; Klingman *et al.*, 1984; Alwin, Murray, & Britton,

1991) but was of no value in other situations (Melamed *et al.*, 1983; Boj & Davila, 1989). Moreover, the study by Vandermaas *et al.* (1993) showed that the mean scores on the BPRS for different effects are as expected: older children score significantly lower than young children and mean scores are higher for more disruptive treatments. Additional information about the validity of the BPRS is provided by correlations with other measures. Although the BPRS seems valid, correlations with self-report measures of dental anxiety tend to be low and nonsignificant (see Table II).

Table II. Correlations Between Questionnaires as Reported on the Literature

	Frankl's RS	Melamed's BPRS	Visual Analogue Scale (Simple)	Palmar Sweat Index
Melamed's BPRS	−.61** (20)			
CFSS-DS	−.22 (18) −.26* (17) −.68** (17)	.11 (28) .29** (28) .16 (18) .02 (17) .35** (17)		.31** (28)
CFSS		.11 (28) .20 (28)		.30* (28)
Venham Picture Test	−.36** (18) −.12 (17) −.15 (17)			
STAI-C state	−.05 (17) −.48** (17)	−.03 (17) .20 (17)	.90** (33)	
STAI-C trait	.04 (17) .43** (17)	.05 (17) −.16 (17)	.41** (33)	
Dental Anxiety Scale	.44** (31)		.47** (33)	
Dental Anxiety Question	.41** (31)			
Visual Analogue Scale (Complex)			.88** (42)	
Other measures				
Dentist's rating 1–5	−.35* (17) −.73** (17)	.58* (18) −.04 (17) .23 (17)		
Mother's rating 1–5	.01 (17) −.29 (17)	.36 (18) −.07 (17) .33* (17)		
Fear Thermometer	−.49** (20)	.45** (20)		

Note. The numbers in parentheses refer to corresponding article numbers.
*$p < .05$.
**$p < .01$.

Correlations with other behavioral measures are higher but not impressive. Overall, the validity of Melamed's BPRS as a measure of dental anxiety in children is not completely convincing.

VENHAM RATING SCALES (VRS)

Venham Rating Scales are developed to assess the anxiety of the child during dental treatment. Both the Venham Clinical Anxiety Rating Scale (VCARS) and the Venham Cooperation Behavioral Rating Scale (VCBRS) are 6-point rating scales, ranging from 0, indicating no anxiety or very cooperative behavior, to 5, indicating high anxiety or very uncooperative behavior (Venham, Bengston, & Cipes, 1978) (see Appendix C). As with most behavioral rating scales, the behavior is rated by independent judges. Usually this behavior is analyzed using videotapes of the child's behavior in the dental operatory during treatment (e.g., Venham, 1979).

Results Obtained with the VRS

Mean scores on the VRS were used to discriminate between anxious and nonanxious children in studies analyzing the effect of sequential dental visits and applied procedures (Venham, Bengston, & Cipes, 1977; Venham & Quatrocelli, 1977), the effect of the parent's absence or presence in the dental operatory (Venham *et al.*, 1978; Venham, 1979), and the effect of nitrous oxide on dentally anxious children (Nathan, Venham, Stewart West, & Werboff, 1988; Veerkamp, Gruythuysen, van Amerongen, & Hoogstraten, 1993). In other studies correlations between the VCARS and child-rearing variables and personality factors were used in an attempt to identify variables that mediate dental anxiety (Venham, Murray, & Gaulin-Kremer, 1979a, b).

Reported mean scores on the scales are relatively low, with few exceptions almost always between 0 and 2 (Venham *et al.*, 1977; Venham & Quatrocelli, 1977; Veerkamp *et al.*, 1993). Because samples and procedures in the reviewed studies are too specific and diverse, normative scores cannot be given.

Assessment of the VRS

Reliability

In most studies correlations between the ratings of the trained judges ranged from .78 to .98 (Venham *et al.*, 1978, 1979a, b, 1993). In one study

they ranged from .63 to .83, but the sample in that study consisted of only four children. The interrater reliabilities for the VRS are satisfactory.

Validity

In the studies by Venham *et al.* (1977) and Venham and Quatrocelli (1977), the VCARS and the VCBRS were able to differentiate between low- and high-fear children. On the other hand, the scales proved incapable of discriminating between levels of fear in children whose parents were absent or present in the dental operatory (Venham *et al.*, 1978; Venham, 1979). Apart from a positive relation with heart rate (Venham *et al.*, 1979a, b), no correlations with either behavioral or self-report measures of anxiety are available. Because of these mixed results and the absence of correlations with other measures of anxiety, the validity of the VCRS remains to be proven.

VISUAL ANALOGUE SCALES (VAS)

The visual analogue scale was adapted by Aitken (see Swallow & Sermet, 1972) for the measurement of feelings as an alternative to the aforementioned categorical rating scales. The scale consists of a 100-mm line drawn horizontally on a page, with its boundaries clearly defined as the extremes of the feeling in question. The observer is expected to mark a point on this line that corresponds best with the feeling the observed child is believed to experience at that moment. It is assumed that this graphic scale allows for relative freedom of rating the feelings of the child by the observer, eliminates the necessity of being confined to categories, and in this way also disposes of any anchoring effects that are liable to occur with categorical scales (Swallow & Sermet, 1972).

For the Simple Scale the boundaries denote anxiety and nonanxiety. The Complex Scale, used by Swallow and Sermet (1972) and Parkin (1988, 1989), is based on Frankl's original work (Frankl *et al.*, 1962). Aspects of his general description of child behavior were isolated by Swallow and Sermet, after which they selected nine pairs of polar extremes of behavior which represented most of the behaviors children displayed in the dental operatory. These nine subscales denote components of anxiety-related behaviors (see Appendix D).

In the studies by Swallow and Sermet (1972) and Parkin (1988), three observers rated the behavior of the children. In the studies by Parkin (1989), Sermet (1974), and Shaw (1975), only one person rated the behavior.

Results Obtained with the VAS

Sermet (1974) and Shaw (1975) used the VAS to check whether a division between highly anxious children and a group of children never manifesting dental anxiety in the past was successful. Parkin (1989) tried to assess the clinical validity of the Simple Scale, whereas Swallow and Sermet (1972) and Parkin (1988) investigated the relationship of the Complex Scale with the Simple Scale as well as their reliabilities. Finally, Lindsay and Roberts (1980) used the Simple Scale to assess the difference between children treated under relative analgesia and children treated with an air placebo.

Most studies using the VAS do not report mean scores and standard deviations. The few studies reporting them denote a diversity of feelings at the extremes. Therefore, and because normative data are not available, means are not mentioned here.

Assessment of the VAS

Reliability

Swallow and Sermet found correlations of .69 and .85 between two observers using the Simple Scale. For the same scale, Parkin (1988) found a median correlation of .43 for the relationship between the ratings of three observers. For the total score on the Complex Scale, no statistically significant interrater correlations were found. When the score on the Simple Scale was added to this total score, the correlations did reach statistical significance, with a median correlation of .67. Lindsay and Roberts (1980) computed a correlation of .94 between two observers who scored the behavior of nine subjects. Finally, the study by Hosey and Blinkhorn (1995) showed close agreement between the ratings of two well-trained observers (r = .76). Overall, the interrater reliability for the VAS seems moderate, and training observers seems to raise the reliability of the assessments.

In one instance, the test–retest reliability for the Simple Scale was assessed. For a 50-hr interval, Parkin (1988) found a median correlation for three observers of .56. However, no conclusions about the test–retest reliability can be drawn on the basis of the results of just one study.

Validity

The VAS was able to differentiate between groups expected to differ in anxiety (Sermet, 1974; Shaw, 1975; Lindsay & Roberts, 1980; Alwin *et*

al., 1991). In the study by Lindsay and Roberts, only the dentist's rating showed a significant effect, but he was aware of group assignment.

In several studies the visual analogue scale has been correlated with other measures of (dental) anxiety. Correlations with the STAI-C trait and Corah's Dental Anxiety Scale were low. High correlations were found in the study by Parkin (1989), who used the STAI-C state and computed a correlation coefficient of .90, and in the study by Swallow and Sermet, who correlated the Simple Scale with the Complex Scale (r = .88). Alwin *et al.* report moderate correlations between the dentist's and the parent's rating of the child's anxiety and cooperation (r = .42 and .66, respectively). It seems warranted to say that the VAS have at least a moderate validity.

OTHER RATING SCALES

In many studies 5- or 10-point rating scales are used to supply the researcher with extra information about the anxiety state of the child (Melamed, Hawes, Heiby, & Glick, 1975; Melamed, Weinstein, Hawes, & Katin-Borland, 1975; Melamed *et al.*, 1983; Klorman *et al.*, 1978, 1979) or as a means for discriminating between anxious and nonanxious children. Occasionally, 4-, 6-, and 7-point scales are used (Johnson & Baldwin, 1968; Rowland, Lindsay, Winchester, & Zarkowska, 1989; Siegel, Smith, Cantu, & Posnick, 1992). Because of the different behaviors/feelings measured by these scales, a comparison among studies is extremely difficult, if not impossible. Moreover, all these scales have the same drawback of consisting of only one item. Psychometrically this means that the reliability can never be high, which in turn implies a restriction on the validity of the scale (Cronbach, 1990). Therefore, no assessment is made of these X-point rating scales.

As outlined in the introduction, physiological measures also belong to the class of scales that measure reactions of the child. One of the most extensively used physiological measures is heart rate. The assumption is that an increase in arousal during the dental visit will be attributed to dental procedures, which in turn makes the heart rate an index of the patient's response to dental stimuli (Venham *et al.*, 1977). In most studies heart rates are scored as beats per minute and scores are compared with baseline scores. For exact measurement, specific apparatus is required. Another, less frequently used, measure is the Palmar Sweat Index (PSI) (Melamed, Hawes, Heiby, & Glick, 1975; Melamed, Yarcheson, Fleece, Hutcherson, & Hawes, 1978; Melamed, Bennett, *et al.*, 1983). In order to be able to use the measure, special materials and equipment are required [see Lore (1966) for an extensive description of procedures].

Heart rates and the PSI share the same problems when used to assess dental anxiety in children. Both measures require special apparatus. The application of these devices obviously interrupts the dental treatment, yet it is not clear what effect this application has on the anxiety levels of the children. Furthermore, little is published on the issues of reliability and/or validity. All in all, it is unclear whether heart rates and the PSI are specific measures of (dental) anxiety or more general measures of arousal. Both physiological measures need further research.

Occasionally, still other physiological measures are used. Examples are skin resistance, respiration rate, hemoglobin oxygen, blood pressure (Melamed *et al.*, 1978; Venham *et al.*, 1978; Klingman *et al.*, 1984; Stark *et al.*, 1989; Roberts *et al.*, 1992), and cortisol levels in the saliva (Mayer & Weber, 1992). Results obtained with these measures were not encouraging (e.g., Roberts *et al.*, 1992) or too few studies were conducted to investigate their conceptual and psychometric qualities.

DISCUSSION

A general disadvantage of using behavioral measures with children is that they often focus on cooperativeness of the child: uncooperativeness is often seen as an indication of anxiety. But with children aged 4 to 6 years, many other sources besides anxiety can contribute to uncooperative behavior. Young children may just be anxious to be separated from their mother or be afraid of the new situation. An example of the fact that uncooperativeness and levels of anxiety as assessed by the dentist do not always agree is given by Mejàre, Ljungkvist, and Quensel (1989).

Another complicating factor in the assessment of dental anxiety in children when using a behavioral measure is that behavioral expressions of fear and anxiety may vary considerably between children, depending not only on the extent to which the child perceives the fear, but also on the child's motivation to cope with it (Mejàre *et al.*, 1989). It thus seems that (un)cooperativeness is not an optimal operationalization of (dental) anxiety, which leads to the conclusion that behavioral measures that use this operationalization are not appropriate for measuring dental anxiety in children. With this conclusion we arrive at a stalemate situation: because preschool children lack the cognitive ability to complete the questions of self-report measures, the only measures left are behavioral ones. However, in this group some behavioral scales do not always measure anxiety because of its operationalization as uncooperative behavior. Of course, uncooperative behavior such as movement of the child may be a more serious concern to the dentist than the child's level of anxiety. The researcher should decide

what operationalization is most suitable. An alternative is to develop different operationalized definitions of anxiety.

Obtaining physiological data from children is controversial. From a practical point of view these measures are dubious because the recording of the data requires specific apparatus. Besides, these measures are highly sensitive to artifacts associated with movement, which is an even greater problem when studying children. Interpretation of the data is further complicated because the effects of using "strange" procedures and machines on the anxiety levels of children are insufficiently investigated: the sensor may provoke even more anxiety. Finally, information about the validity and reliability of these scales is virtually absent. However, we are not inclined to conclude that physiological measures in a general sense are not appropriate for assessing dental anxiety in children, since they in fact may be appropriate in studying preverbal children or children who cannot cognitively express their fears.

Of the behavioral rating scales, Frankl's RS and the Venham Rating Scales are easiest to administer. Moreover, both scales seem to be reliable. However, a major drawback of Frankl's RS is the lack of uniformity in the use of the scale in the reviewed studies: it appears that there are as many modified Frankl Rating Scales as there are studies using this scale, making results incomparable. On the other hand, the Venham Rating Scales suffer from a lack of information on the issue of the validity of the scales. Although the scale is reliable, it is not clear what is being measured.

Besides suffering from relatively low validity coefficients, the Visual Analogue Scales also seem to lack reliability. With only moderate reliability and validity, it is advisable not to use the scales until more research on these topics is conducted.

The advantage of Melamed's Behavior Profile Rating Scale over the others is that—although this scale is harder to administer and score—it measures the behavior of the child more precisely. Instead of categorizing children on the basis of an overall impression (e.g., Frankl's RS), Melamed, Weinstein, Hawes, and Katin-Borland (1975) clearly specify which (components of) reactions of the child will include fear-induced ones. Also, the occurrence of these reactions is recorded at short time-intervals. This breakdown of displayed behavior in both concept and time makes it possible to pinpoint the part(s) of the dental procedure a child is most afraid of, which in turn is useful when trying to reduce the anxiety of the child. But the BPRS is not perfect, because it lacks decisive proof of its validity, although poor correlations of behavioral rating scales with children's self-report measures can be the result of their unreliability. Moreover, although the interrater reliability is by far the most important form of reliability for this sort of rating scale, additional information about the test–retest reli-

Table III. Assessment of the Reliability and Validity of the Reviewed Measures

	Reliability	Validity
Frankl's Rating Scale	+	±
Melamed's BPRS	+	±
Venham Rating Scales	+	?
Visual Analogue Scales	±	±

Note. (+) High; (±) moderate; (–) low; (?) insufficiently investigated.

ability would give the scale more credibility. However, it should be noted that this criticism applies to all reviewed measures, not just the BPRS. Table III shows our overall assessment of the reliability and validity of the reviewed measures.

In conclusion, from both a theoretical and a psychometric point of view, Melamed's BPRS is the preferred behavioral measure of dental anxiety in children, though it should be noted that the scale is not completely satisfactory.

APPENDIX A

Frankl's Rating Scale

1. *Definitely negative*
   Refusal of treatment, crying forcefully, fearful, or any other overt evidence of extreme negativism

2. *Negative*
   Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced, i.e., sullen, withdrawn

3. *Positive*
   Acceptance of treatment; at times cautious, willingness to comply with the dentist, at times with reservation, but follows the dentist's directions cooperatively

4. *Definitely positive*
   Good rapport with the dentist, interested in the dental procedure, laughing and enjoying the situation

APPENDIX B

Table BI. Melamed's Behavior Profile Rating Scale

	Successive 3-min observation period						
	1	2	3	4	5	6	Etc.
Separation from mother							
(3) Cries							
(4) Clings to mother							
(4) Refuses to leave mother							
(5) Bodily carried in							
Office behavior							
(1) Inappropriate mouth closing							
(1) Choking							
(2) Won't sit back							
(2) Attempts to dislodge instruments							
(2) Verbal complaints							
(2) Overreaction to pain							
(2) White knuckles							
(2) Negativism							
(2) Eyes closed							
(3) Cries at injection							
(3) Verbal message to terminate							
(3) Refuses to open mouth							
(3) Rigid posture							
(3) Crying							
(3) Dentist using loud voice							
(4) Restraints used							
(4) Kicks							
(4) Stands up							
(4) Rolls over							
(5) Dislodges instruments							
(5) Refuses to sit in chair							
(5) Faints							
(5) Leaves chair							

The numbers in parentheses are the weights each item receives. This weight is based on the degree of disruptiveness as determined by the ratings of dentists.

APPENDIX C

A. Venham Clinical Anxiety Rating Scale (VCARS)

0. Relaxed, smiling, willing and able to converse.

1. Uneasy, concerned. During stressful procedure may protest briefly and quietly to indicate discomfort. Hands remain down or partially raised to signal discomfort. Child willing and able to in-

terpret experiences as requested. Tense facial expressions, may have tears in eyes.

2. Child appears frightened. Tone of voice, questions, and answers reflect anxiety. During stressful procedure, verbal protest, (quiet) crying, hands tense and raised, (not interfering much; may touch dentist's hand or instrument, but not pull at it). Child interprets situation with reasonable accuracy and continues to work to cope with his anxiety.

3. Shows reluctance to enter situation, difficulty in correctly assessing situational threat. Pronounced verbal protest, crying. Using hands to try to stop the procedure. Protest out of proportion to threat. Copes with situation with great reluctance.

4. Anxiety interferes with ability to assess situation. General crying not related to treatment. More prominent body movement. Child can be reached through verbal communication, and eventually with reluctance and great effort it begins the work of coping with the threat.

5. Child out of contact with the reality of the threat. General loud crying, unable to listen to verbal communication, makes no effort to cope with threat. Actively involved in escape behavior. Physical restraint required.

B. Venham Cooperation Behavioral Rating Scale (VCBRS)

0. Total cooperation, best possible working conditions, no crying or physical protest

1. Mild, soft verbal protest or (quiet) crying as a signal of discomfort, but does not obstruct progress. Appropriate behavior for procedure, i.e., slight start at injection, "ow" during drilling, if hurting, etc.

2. Protest more prominent. Both crying and hand signals. May move head around making it hard to administer treatment. Protest more distracting and troublesome. However, child still complies to requests to cooperate

3. Protest presents real problem to dentist. Complies with demands reluctantly, requiring extra effort by dentist. Body movement

4. Protest disrupts procedure, requires that all of the dentist's attention be directed toward the child's behavior. Compliance even-

tually achieved after considerable effort by dentist, but without much actual physical restraint. (May require holding the child's hands or the like to start.) More prominent body movement

5. General protest, no compliance or cooperation. Physical restraint is required

APPENDIX D

Boundaries of the Complex Scale

LAUGHING Relaxed, smiling, actually laughing	CRYING Tearful, noisy or silent sobbing
NOISY Chatty, quite often distracting	QUIET Silent, speaks only when spoken to
DOCILE Quiet and cooperative	TANTRUM Noisy, screaming, fussing and complaining
CURIOUS Questioning, interested in the surroundings	WITHDRAWN Bored, disinterested, sullen
SELF-SUFFICIENT Indifferent to mother, answered questions themselves	DEPENDENT Clinging to mother. Refusing to sit alone, letting mother answer questions
COOPERATIVE Helpful, does what is asked of him	UNCOOPERATIVE Refuses to open mouth and to comply with demands
RELAXED Completely unworried, at ease	TENSE Clenching fists, contraction of body muscles
COMPLIANT Trusting and exhibiting positive acceptance	CAUTIOUS Needs coaxing, reassurance and asking guarded questions
PASSIVE Would not climb into chair, limp	ACTIVE Climbs in chair, opens mouth, exhibits a lot of bodily movement

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