

The Influence of Sequence of Impressions on Children's Anxiety and Discomfort

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Abstract

Purpose: Laboratory studies with adults and children have found lower pain reports when pain proceeds from high to low rather than from low to high. However, pediatric dentists often ease children into difficult procedures (from easiest to most difficult). This study investigated the influence of order during a clinical procedure that involved taking maxillary and mandibular alginate impressions.

Methods: Subjects were 24 children aged 5 to 6 years (preoperational stage) and 24 children aged 9 to 10 years (concrete operational stage). Children were randomly assigned to either start with the mandibular (presumed to be easier) or start with the maxillary (presumed to be harder) impressions. Discomfort during the sequence of impressions was measured using the "Affective Facial Scale." A telephone interview was conducted 2 weeks later to evaluate the memory of discomfort.

Results: The results indicated that the older children who started with the mandibular (easier) impression and ended with the maxillary (more uncomfortable) impression reported significantly lower discomfort than older children who started with the maxillary impression and ended with the mandibular (Mann-Whitney U, $Z=-2.08$; $P<.037$). The same tendency was noted 2 weeks later on a telephone interview. By phone, 92% of the older children who started with the mandibular impression rated the sequence of impressions as "not at all bad," while only 58% of the older children who started with the maxillary impression rated the overall experience as "not at all bad" ($\chi^2=3.56$, $P<.059$). The younger children did not show any significant difference in their ratings of discomfort at either of the assessment periods.

Conclusions: Consistent with clinical practice, this study observed that older children benefit from beginning an appointment with an easier procedure and working up to a more difficult one. (*Pediatr Dent.* 2003;25:357-364)

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The order in which one experiences a series of events can have a profound influence on how such events are remembered. Several studies using paper and pencil assessments in adults have demonstrated that adults prefer experiences that proceed from bad to good (improving) to experiences that proceed from good to bad (worsening).¹⁻⁵ Other studies have examined this phenomenon using experimental pain and in patients receiving

actual medical procedures.^{2,3,5-7} A laboratory study with adults and children found lower pain reports when experimental pain was experienced in an improving sequence (from high to low) rather than in a worsening sequence (from low to high).⁸ Children and adults in that study were exposed to both a worsening sequence and an improving sequence of cold pressor pain. Both children and adults preferred the sequence that began with the more painful

experience and ended with the less painful experience and also reported less pain in the improving sequence.⁸ This laboratory study demonstrated that children, like adults, are sensitive to order effects in pain.

Contrary to this finding, many pediatric dentists report that they most often try to ease children into difficult procedures (moving from easiest to most difficult). One version of this technique is called systematic desensitization and was first developed by Wolpe⁹ in an effort to treat phobics. It has been used effectively in treating dentally anxious patients by presenting them gradually at first with the least fear-provoking procedure and at the end with the most fear-provoking procedure.^{10,11} During this process of gradual exposure, usually taking place over a number of visits, the patient is taught coping skills. Interviews with dentists following this pattern indicate that they feel this is a useful and effective method for helping young children cope with difficult procedures. As no clinical studies in children have explicitly examined order effects, work is warranted on this topic.

When faced with a stressful situation, adults vary in their responses.¹² They may try to change the stressful circumstances (eg, escape and screaming, termed primary control coping), they may try to adjust by using a variety of strategies (eg, distraction or paced breathing, termed secondary control coping) or they may show no attempt to change the situation nor do they try to adjust (relinquished control). A study of 6-, 9-, and 12-year-old children found that in stressful medical circumstances as the child's age increased, the self-reports of primary coping decreased and the self-reports of secondary coping increased.¹² The researchers suggested that as children mature, there is a developmental tendency for coping to progress from primary to secondary. This was confirmed in a study by Weinstein et al¹³ in which younger children expressed a greater need for active control compared to older children.

The psychology of pain and discomfort has also been shown to differ by age.¹⁴ Children 5 years and older can be categorized into 3 groups depending on the definitions, descriptions, and understanding of causality of pain.¹⁴⁻¹⁶ These categories follow the Piagetian preoperational stage (up to 7 years), concrete operational stage (8-10 years), and formal operational stage (11-14 years). The youngest group tends to concentrate on physical factors, believing their senses rather than abstracting from the experience. Eight- to 10-year-old children show a developing awareness of the psychological association with pain and begin using affective, qualitative, and physical analogies in describing pain, however, they do not have a clear understanding of a causation of pain.¹⁴⁻¹⁷ Thus, developmental issues may influence how children experience and remember uncomfortable procedures as well as how they are able to use different coping strategies in unpleasant situations.¹⁸ Because coping and understanding of pain both show developmental changes, order effects may reasonably be expected to differ between children and adults.

Taking dental impressions on children can be challenging as it may cause a gagging sensation. The gagging feeling is especially common during the maxillary impression, because the impression material touches the soft palate. The choking feeling has been reported to be one of the most common dental fears that children report.^{19,20} The purpose of this study was to examine the perception of discomfort in children and the influence of order patterns on children's discomfort and preference for procedures within a clinical dental situation. Specifically, this study examined whether children experience less discomfort during an improving sequence of dental impressions, and whether or not they report a preference for an improving vs a worsening sequence of uncomfortable dental procedures.

In this study, children received dental impressions for study models (1 mandibular impression and 1 maxillary impression). To increase perceived differences between the 2 impressions, fast-set alginate was used during the mandibular impression, and a longer setting-time alginate was used during the maxillary impressions. Each child received only 1 sequence of impressions: either a worsening sequence (the mandibular impression followed by the maxillary impression) or an improving sequence (the maxillary impression followed by the mandibular impression). Based on the previous laboratory study,⁸ it was expected that, contrary to clinical experience, children would report less discomfort after the improving sequence than after the worsening sequence. Children of ages consistent with both Piaget's preoperational and concrete operational stages were tested.

The study tested the following hypotheses:

1. Children receiving impressions in an improving sequence would report lower discomfort than those receiving impressions in a worsening sequence.
2. When given a choice of order for a future appointment, the majority of children in both groups would select an improving sequence for next time.
3. Anxious children would report more discomfort and would be more likely to refuse to go through the procedure, particularly when beginning with the maxillary impression.
4. After a delay of 2 weeks, children would remember the discomfort experienced during the improving sequence as more tolerable than the discomfort experienced during the worsening sequence.

Methods

Sample

A total of 48 children were recruited from the Pediatric Dental Clinic at the University of Washington. Of these, 24 children were aged 5 and 6 years old (consistent with the preoperational stage), and 24 children were between 9 and 10 years old (consistent with the concrete operational stage). The children included in the study were healthy and functioning at the normal school grade level.

Only children who spoke English as their first language were accepted into the study. This research was reviewed and approved by the Institutional Review Board of the University of Washington. The procedures, including possible discomforts or risks, as well as possible benefits, were explained fully to the children and their guardians. Their informed consent was obtained prior to beginning study procedures.

Procedure

Before the study procedures began, a parent or guardian of the child was asked to fill out a health history questionnaire and the parental version of the Dental Fear Survey Schedule for children (see instrumentation section). The child's previous experience with dental impressions was evaluated. The parent or the guardian was also asked to sign the consent form that the researcher had reviewed with them. Following a thorough explanation of the study, the child was asked to sign an assent form and was then taken to the dental operatory. The parent or guardian remained in the waiting area.

Older children, once seated, were asked to fill out a State-Trait Anxiety Inventory (STAI) for children (see instrumentation section). All children received practice in the dental operatory using the Affective Facial Scale (AFS) for reporting discomfort (see instrumentation section) with the Children's Pain Inventory (CPI) scenarios. The impression procedures were explained and conducted with all the children in the same manner. Only 1 person was involved in taking impressions. The same provider was used with all the children. An impression of each child's finger was first taken to demonstrate the procedure. A script was used to keep the operator's language consistent.

A total of 2 oral impressions were taken for each child (maxillary and mandibular). To increase perceived differences between the 2 impressions, fast-set alginate was used during the mandibular impression, and a slower-set alginate was used during the maxillary impression. Based on a randomization schedule, either the maxillary impression or the mandibular impression was taken first. If the maxillary one was the first impression, then the second impression taken was the mandibular impression (and vice versa). Following these 2 impressions, the child was asked to report the discomfort (using AFS) he/she felt during the sequence in which the impressions were taken. The child was also asked to decide which of the impressions he/she would prefer to start with next time. Finally, the child was asked to state which of the impressions (maxillary or mandibular) was harder to do. The study procedures took about 15 minutes. The setting of the mandibular impression took approximately 30 seconds, and the setting of the maxillary impression took approximately 2 minutes.

During the experiment, the child's behavior was assessed by an observer using the Visual Analogue Scale (VAS) for anxiety and discomfort, Frankl Behavioral Rating Scale (FBRS), and Behavior Profile Rating Scale (BPRS; see in-

strumentation section). The experiment was also videotaped and subsequently evaluated by a second observer.

At the end of the experiment, the children were given \$10 as a gift for being in the study. After the experiment, the children continued with a regular dental examination, radiographs (if indicated), a rubber cup prophylaxis, and a fluoride treatment. Two weeks following the experiment, the children were telephoned and surveyed to assess their memory of the procedures.

Instrumentation

Children: The AFS was used to help children self-report discomfort during the impressions. The AFS consists of a series of 9 faces that vary in the amount of distress they reflect from neutral to distress.²¹ The faces are assigned numerical values (.04, .17, .37, .47, .59, .75, .79, .85, .97). These numerical values were assigned by McGrath based on work with children aged 5 to 17 years. Intervals between faces are unequal because children do not perceive the faces as varying equally in affective magnitude.²¹ To make sure that the children in the study understood how to use AFS, subjects practiced before the experiment began by completing a brief task called the Children's Pain Inventory (CPI).²¹ This inventory provides hypothetical pain situations varying in intensity, and children respond to each scenario by pointing to the appropriate face.

Each child's anxiety level was characterized prior to the clinical procedures using the STAI²²—a measure of situational (state) and general (trait) anxiety. The STAI consists of 40 items, 20 items measuring state anxiety and 20 items measuring trait anxiety. The scales range from 20 to 60, where the score 60 indicates maximal anxiety. This scale has established reliability, validity, and internal consistency.²² The authors conducted a pilot study, which indicated that children in the preoperational stage were not able to answer the STAI, therefore STAI was used only in the older age group.

Parents: Most often the mother was the parent bringing the child to the dental office. On rare occasions when both parents accompanied the child, the mother filled out the questionnaires. Few children came with their father only. In those few cases, the father was asked to complete the questionnaires.

A parental version of the Dental Fear Survey Schedule (DFSS) was used to determine the parent's assessment of their child's level of dental fear.^{24,25} This survey included 15 items about common dental procedures and situations, such as "being touched by a stranger," "injection," and "choking." Parents were asked to assess their child's level of dental fear on a 5-point scale varying from "not at all afraid" (1) to "very much afraid" (5). The total score ranged from 15 to 75, where 75 indicated the highest amount of fear. The measure has been demonstrated to be reliable and valid.²⁴ In cases of missing items, mean substitution was employed for this scale.

Each parents' own overall dental anxiety was measured using the Dental Anxiety Scale (DAS or Parent Scale).²⁶ This instrument contains 4 items (anxiety experienced about a dental appointment if it occurred tomorrow, anxiety in a dentist's waiting room, anxiety while waiting for a tooth cleaning, anxiety while waiting for drilling). Items are scored from 1 to 5 and are totaled (4-20) for analysis. A higher score indicates greater anxiety about the dental treatment. The cut-off score 13 or higher to indicate high dental anxiety is well established in dental literature.^{27,28} The DAS has been used widely for both clinical and research purposes and has proven to be a reliable and valid measure of dental anxiety in adults.²⁸

Parents were also asked to fill out their child's health history, demographic information (child's age, gender, race), and the highest level of education that the child had completed. In addition, parents were questioned about their child's prior experience with dental impressions.

Observers: Two observers assessed the children's behavior from a videotape of the procedure. One of the observers watched the video "live" as it was being recorded, while the other observer viewed the videotape later. Observers were calibrated prior to the study in the use of 3 different behavioral scales: (1) VAS, (2) BPRS, and (3) FBRS.

The observers used the VAS to evaluate children's overall behavior during the procedure. The observers based their VAS ratings on specific observations noted using the other measures. The VAS for anxiety is a 100-mm horizontal line with one end of the continuum labeled "low anxiety" and the other end labeled "high anxiety." Similarly, the VAS for discomfort is a line with labels "low discomfort" and "high discomfort" at either end. The VAS has been proven to be a valid and reliable instrument for assessing a child's anxiety during a dental appointment.²⁹

The BPRS was used to assess the occurrence of anxiety-related behaviors at specific points during the procedure.³⁰ This measure was modified to fit the purposes of this study. Instead of the usual recording (presence or absence) of 22 child-related behaviors, 21 items were used. The injection item was deleted. Disruptive behavior was rated during each procedure separately (questionnaires, mixing the alginate, finger impression, mixing the alginate, first dental impression, mixing the alginate, second dental impression). The validity and the reliability of this scale have also been established.³⁰

The FBRS was used to characterize the children's overall behavior during the procedure.²⁹⁻³¹ It is the most frequently used measure in behavioral pediatric dental research and was selected to provide comparison with other studies. The FBRS divides observed behavior into four categories varying from definitely negative to definitely positive.³¹ The definitely negative category (--) includes behaviors such as "refusal of treatment," "crying forcefully," "fearful," or "any other obvious evidence of negative behavior." The negative category (-) includes behaviors such as "reluctance to accept treatment," "uncooperative," and

"some evidence of negative attitude," but not withdrawal. The positive category (+) is used when the child accepts the treatment but is sometimes cautious and when the patient follows the dentist's directions cooperatively and is willing to comply with the dentist although sometimes with reservation. The definitely positive category (++) is used when the child has a good rapport with the dentist, is interested in the dental procedures, is laughing, and is enjoying the appointment.

Telephone interview: Memory of the impression procedures was assessed 2 weeks following the appointment. An investigator conducted the interview by telephone. The child was asked to describe what happened during the appointment. The child was then asked to rate the discomfort experienced during the sequence of impressions on a 3-point scale from "not at all bad" (1) to "very bad" (3). Following this, the child was asked "Which mold was the most uncomfortable?" Finally, the child was asked to state the order of preference for taking impressions during the next appointment. ("Which mold would you like to do first at your next visit to the dentist?")

Analyses

Simple descriptive statistics on the levels of demographic data and on the levels of parental, child, and observer measures were obtained using the Statistical Package for the Social Sciences.³² Nonparametric methods (Mann-Whitney U) were used to test for differences in discomfort rating between children experiencing the improving sequence vs the worsening sequence. Analyses were conducted separately for older and younger children. Data from 2 children who quit during the first impression were omitted from the data analyses. For the analyses, the AFS ratings were multiplied by 100. The ratings by the observer, who watched the study procedures from the video "live" as it was being recorded, were used in the primary analyses.

The FBRS was analyzed by scoring the definitely positive behavior as "4," the positive behavior as "3," the negative behavior as "2," and the definitely negative behavior as "1." BPRS data were analyzed by summing all the disruptive behaviors during each procedure. Spearman rank correlation was used to assess the relationship between levels of parental, child, and observer measures and ratings of discomfort. Chi-square analysis was used to compare the difference between categorical variables (between the memory of pain experience and order effects).

Results

Subjects

A total of 48 children were included in the study. Twenty-four of the children were of ages consistent with the Piagetian preoperational developmental stage, and 24 were of ages consistent with the concrete operational stage. Eleven of the 24 younger children were female, while 13 of the 24 older children were female. The mean age in the

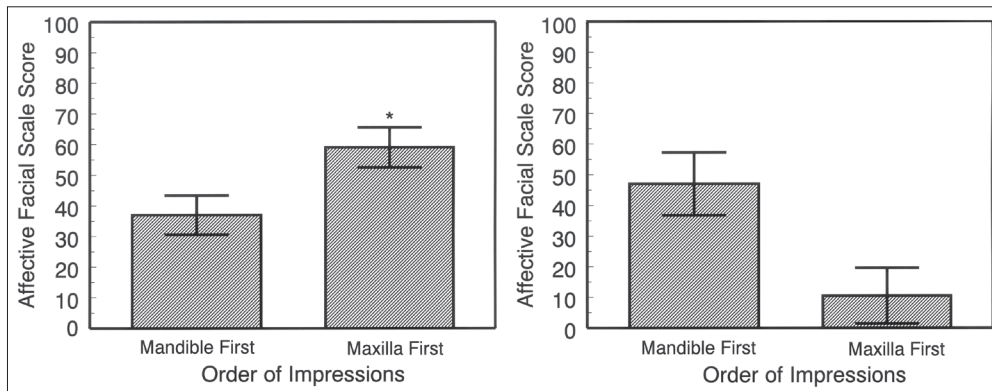


Figure 1. Median scores (SE) of Affective Facial Scale reported by 9- to 10-year-old children (left) and 5- to 6-year-old children (right) after either a worsening (starting with mandibular) or an improving (starting with maxillary) sequence of dental impressions. Higher scores indicate greater discomfort. *Indicates statistically significant difference between groups.

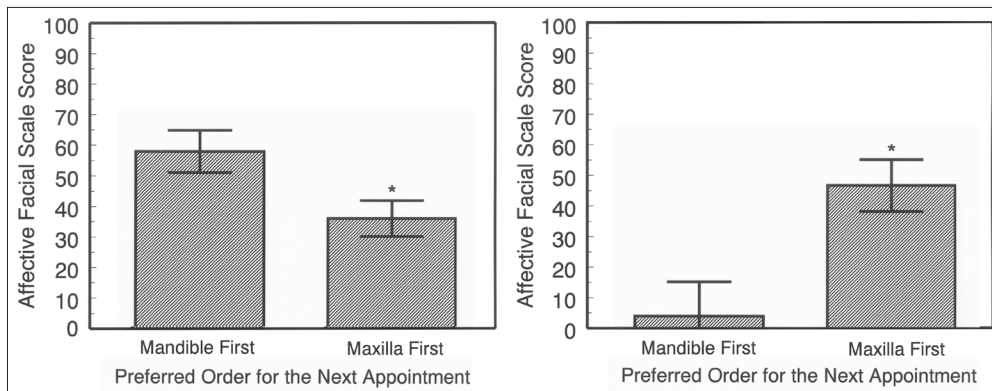


Figure 2. Median scores (SE) of Affective Facial Scale reported by 9- to 10-year-old children (left) and 5- to 6-year-old children (right) who stated they would prefer either a worsening (starting with mandibular) or an improving (starting with maxillary) sequence of dental impressions if the impression sequence was to be repeated on their next appointment. Higher scores indicate greater discomfort. *Indicates statistically significant difference between groups.

preoperational stage was 6.1 years (range 5.3 to 6.8 years), while the mean age in the concrete operational stage was 9.7 years (range 9-10.8 years). The guardians of 2 children declined to reveal racial information. Most of the remaining children were white (22/46); 9 children were African-American; 7 were Asian or Pacific Islanders; 3 were Native Americans; and 1 child was of Hispanic origin. The guardians of 4 of the 46 children indicated "other" for racial background. Five children in the younger age group and 4 children in the older age group had dental impressions taken prior to the study.

Children with prior experience were evenly distributed across age groups and experimental conditions. Two children in the younger age group withdrew during the first impression and did not perform the second impression. These 2 children were omitted from the data analyses.

Both of these children started their sequence with the maxillary impression.

Influence of order and preference

When asked which impression was harder to do, 74% of the children selected the maxillary impression (binomial

test, $P < .002$). This confirmed that the study was successful in creating impressions that differed in aversiveness. Older children who started with the mandibular impression and ended with the maxillary (worsening) reported significantly less discomfort (median=37, range=4-75) than older children who started with the maxillary impression and ended with the mandibular (improving; median=59, range=17-75; Mann-Whitney $U=36.5$; $Z=-2.08$; $P < .037$; Figure 1). However, the order did not significantly influence the discomfort ratings given by younger children (Figure 1). The median discomfort score reported by younger children who started with the mandibular impression and ended with the maxillary impression was 47 (range=4-97), compared to the median discomfort rating of 10.5 (range=4-75) for the children who started with the maxillary impres-

sion and ended with the mandibular impression (Mann-Whitney $U=48.0$, $Z=-.836$; $P < .403$).

Children were also asked to state their preference for order of impressions if the impression procedures were to be repeated on their next appointment. A total of 54% of older children and 63% of younger children stated they would prefer to begin with the maxillary impression (NS). Older children who preferred to start with the mandibular impression and end with the maxillary impression on the next appointment reported significantly higher discomfort ratings (AFS median=59, range=17-75) than the older children who preferred to start with the maxillary impression and end with the mandibular impression (AFS median=37, range=4-75; Mann-Whitney $U=33.5$; $Z=-2.2$; $P < .025$; Figure 2). The preference was reversed in younger children. Younger children who preferred to start with the mandibular impression and end with the maxillary impression reported lower discomfort rating (AFS median=4, range=4-59) than the younger children who preferred to start with the maxillary impression and end with the mandibular impression (AFS median=47, range=4-97; Mann-Whitney $U=26.5$; $Z=-1.9$; $P < .05$; Figure 2).

Child and parental anxiety and order

The average DFSS score was 23.2±6.5 in older children and 27.5±13.1 in younger children. Among older children, 8% met published standards for being highly fearful and 23% of younger children were highly fearful. All the highly fearful children finished the study. There was no significant association between the DFSS scores and the order preference for the next time.

The average STAI-trait score was 36.8±7.6, and the STAI-state averaged 29.2±6 in 9 to 10 year olds. These measures were not used in 5 to 6 year olds. The average scores of STAI-trait anxiety and STAI-state anxiety did not differ in children exposed to a worsening or improving sequence. However, older children who preferred to start with the mandibular impression on the next appointment reported significantly higher mean STAI-state anxiety (32.6±5.4) compared to the older children who preferred to start with the upper impression (26.3±4.9; $t=3$; $P<.007$).

The mean value of the parental DAS was 7.9±3.4 for older children and 7.7±3.7 for younger children. One parent of a younger child and 2 parents of the older children met the published guidelines for being highly fearful.

Spearman rank correlations between the anxiety measures and AFS score of discomfort are presented in Table 1. Older children's discomfort ratings correlated significantly with parental anxiety and state anxiety. The children with higher state anxiety reported higher discomfort after the sequence of dental impressions. Similarly, the children whose parents reported higher anxiety scores had higher discomfort ratings after the impressions. DFSS was expected to be higher in children with higher discomfort ratings, however this result did not reach statistical significance.

Observer assessments

The interrater reliability scores for the observer measures varied across the measures but were good overall, except for BPRS during the second impression. The interitem correlation was .78 for VAS discomfort, .58 for VAS anxiety, .59 for FBRS, .79 for BPRS during the first impression and .41 for BPRS during the second impression.

There was no difference between the observed discomfort and the order of impressions in either younger or older children, nor was there a difference between observed anxiety and the order of impressions in these 2 age groups of children. Spearman rank correlations between observed behavioral scores and AFS are presented in Table 1. Self-reported AFS positively correlated with observed anxiety (VAS anxiety) in older children and discomfort (VAS discomfort) in both younger and older children. Similarly, children who reported greater discomfort (AFS) were observed to exhibit a greater number of anxiety-related behaviors.

For the older children, the average observer-rated discomfort was 15.7±2.6 during the worsening sequence and 21.7±6.3 during the improving sequence (NS). For the younger children, the average observer-rated discomfort was 26.3±21.6 during the worsening sequence and

Table 1. Correlation Between Anxiety/Observer Measures and Affective Facial Scale (AFS) in Older and Younger Children*

Measures	AFS (older children)	AFS (younger children)
State anxiety	.63 ($P<.001$)*	-
Trait anxiety	.26 ($P<.22$)	-
Dental Fear Survey	.37 ($P<.08$)	.28 ($P<.21$)
Parent's scale	.46 ($P<.03$)*	.06 ($P<.78$)
VAS discomfort	.64 ($P<.006$)*	.46 ($P<.04$)*
VAS anxiety	.55 ($P<.006$)*	.38 ($P<.09$)
Frankl scale	-.30 ($P<.15$)	-.42 ($P<.06$)
1st behavior rating	.76 ($P<.000$)*	.43 ($P<.05$)*
2nd behavior rating	.53 ($P<.008$)*	.40 ($P<.08$)

*Statistical significance <0.05 .

Spearman rank correlations presented; Parent's scale=Parent's Dental Anxiety Scale; VAS=Visual Analogue Scale; Frankl Scale=Frankl Behavior Rating Scale; 1st behavior rating=Behavior Profile Rating Scale during 1st impression; 2nd behavior rating=Behavior Profile Rating Scale during the 2nd impression.

21.6±14.2 during the improving sequence (NS). The mean observer-rated anxiety for the older children was 16.9±4.1 during the worsening sequence and 19.4±4.4 during the improving sequence (NS). The mean observer-rated anxiety for the younger children was 23.0±21.3 during the worsening sequence and 21.6±14.8 during the improving sequence (NS). On average, the FBRS score was 4.0±0.2 in older children who started with the mandibular impression and ended with the maxillary impression and 3.8±0.2 in older children who started with the maxillary impression and ended with the mandibular impression (NS). The mean FBRS score in younger children was 3.5±1.0 during the worsening sequence and 3.7±0.5 during the improving sequence (NS).

Older children who preferred to start with the mandibular impression on the next appointment had significantly higher observed anxiety scores (VAS=25.9+16.8) compared to anxiety scores of older children who preferred to start with maxillary impressions (VAS=11.6+7.7; $t=2.7$; $P<.01$). No similar differences were found in younger children.

Memory effects

During the phone interview, 92% of the older children who started with the mandibular impression rated the sequence of impressions as "not at all bad," while only 58% of the older children who started with the maxillary impression rated the overall experience as "not at all bad" ($\chi^2=3.56$; $P<.059$). The younger children did not show any significant difference in their ratings of discomfort at the telephone interview. A total of 42% of the younger children who started with the mandibular impression and ended with the maxillary impression (worsening sequence) rated the experience as "not at all bad." However, 58% of younger children who started with the maxillary impression and ended with the mandibular impression (improving

sequence) rated the sequence as “not at all bad.” Overall, 63% of both older and younger children remembered the maxillary impression as having been the more difficult one to do (binomial test, NS).

Discussion

The majority of children stated that the maxillary impression was harder to endure than the mandibular impression. This confirms that the authors were successful in creating procedures that differed in the level of discomfort produced and suggests that the sequence of maxillary and mandibular impressions can be used to evaluate order effects in a clinical situation.

Children were hypothesized to feel less discomfort after the improving sequence than after the worsening sequence. However, consistent with clinical judgement, the current study found that the older children reported less discomfort if they started with the mandibular impression and ended with the maxillary impression (worsening sequence) compared with the older children exposed to the reverse order. The results contradict the authors' hypothesis, which was based on the results from a laboratory study of order effects and cold pressor pain in adults and children.⁸ Several other studies have tested the influence of order in hypothetical situations, using experimental pain in adults and testing adults undergoing actual painful medical procedures.^{2,3,5,7} These studies found that adults prefer improving sequences of events across a wide range of situations.

In the current study, children were exposed to an uncomfortable, rather than an explicitly painful, experience. This may account for some of the differences in the results of this study and the authors' previous laboratory investigation with children. In the cold pressor study, children were exposed to a painful stimulus for a very short time (40 seconds), compared to the current study in which the overall study procedures took 15 minutes. It may be that, during the longer procedure, children have more time to employ coping skills. Other studies on order effects have included only adults as participants. There may be some developmental issues that influence the difference between adults and children. On the other hand, the authors' results are congruent with the common clinical practice of pediatric dentists to start the appointment with the easiest procedure and work up to the more difficult.

There may be more anxiety experienced in a real clinical situation compared to a laboratory study. Systematic desensitization and gradual exposure therapy have been used as techniques in treating fearful and anxious dental patients.^{33,34} In these techniques, patients are gradually exposed to more difficult procedures and taught coping skills to help in dealing with the procedure. It may be that the older children in this study were better able to learn coping skills during the worsening sequence, where they are

gradually exposed, moving from an easier to a more difficult procedure.

Children differed in their stated preference for the sequence they would prefer to receive if the impressions were to be repeated in their next appointment. Older children who preferred to start with the mandibular impression and end with the maxillary impression (worsening sequence) reported higher discomfort during the actual sequence of impressions. These children also reported significantly higher state anxiety compared to the older children who preferred the improving sequence. This suggests that anxiety plays a role in order preferences. Anxiety may contribute to a need to gradually ease into difficult situations.

The preference for the order was reversed in younger children. Younger children who preferred an improving sequence had higher discomfort ratings during the initial sequence. The results suggest that, for younger children, the experience and feeling at the end of the procedure is more important. They may not yet be able to easily learn coping skills during the gradual exposure (worsening sequence). The results suggest that children in the preoperational and concrete operational stage may differ in their responses to order preference. More clinical research is needed.

It was expected that fearful children would be more likely to withdraw from the experiment because fear and anxiety are known to affect how people manage to do difficult tasks (Rachman, 1990). However, all the fearful children finished the study procedures. Parental dental anxiety correlated significantly with the older children's report of experienced discomfort. Higher discomfort scores were related to higher parental anxiety. Children's dental fear, as reported by the parent, did not correlate significantly with the children's self-reported scores of discomfort. The reason may be that many of the children in the study had not received restorative treatment before. Because of this, parents may have had difficulty estimating their child's level of fear toward specific dental situations or instruments. Observer-rated discomfort and anxiety were positively correlated with the children's self-reported discomfort levels. Similarly, children's self-reported state anxiety correlated positively with their reported discomfort scores. This confirms that anxiety does play a role in the level of discomfort experienced.

No differences were observed in the observer ratings. This is probably due to the fact that order influences one's own perception of things. However, the amount of discomfort one perceives may not be obvious to an outsider.

Conclusions

Consistent with clinical practice, this study observed that older children benefit from beginning an appointment with an easier procedure and working up to a more difficult one.

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