The behaviour of preschool children receiving fluoride varnish application in a community setting

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RESEARCH

IN BRIEF

- Documents a behavioural profile of preschool children undergoing a preventive oral health intervention.
- Provides recommendations on clinical practice for dental staff working with young children.
- Emphasises the importance of behavioural sequential analysis to examine possible causal relationships between nurse and child behaviours.

Background The behaviour of young children receiving mildly invasive dental preventive procedures in a community setting warrants more extensive research due to limitations in the literature. **Objectives** To document the behavioural profile of preschool children undergoing a preventive oral health intervention (fluoride varnish application) and to investigate this behaviour across children with different previous experience of the procedure, ages and initial anxiety states. **Method** Nurse-child interactions were video recorded and child behaviours coded and analysed using a specially developed coding scheme (SABICS). Behaviour frequency was measured and presented diagrammatically, followed by independent sample non-parametric tests to distinguish behavioural group differences. **Results** Three hundred and three interactions were coded out of 456 recorded application sessions. 'Nonverbal agreement' behaviour was observed most frequently compared to disruptive behaviours. Younger preschool children tended to exhibit 'interact with instrument' behaviour more frequently than older children regardless of whether they had had previous application experience. Children who showed signs of initial anxiety were likely to display more disruptive behaviours during the later stage of the procedure compared with non-anxious children. **Conclusions** Dental staff working with preschool children are recommended to use encouragement-centred strategies to promote nonverbal cooperative behaviours in children. In addition, procedure instruments could be considered as a tool to gain child cooperation. Evidence of an autocorrelation effect of child behaviour was found, indicating that the early presentation of child behaviour predicted the behaviour of the child at later stages.

INTRODUCTION

The paediatric literature is extensive on painful medical procedures, ranging from immunisation[1–3] and venipuncture[4–7] to more invasive dental[8–10] and cancer treatment.[5,11] Children's responses to these procedures are conventionally examined and understood from a perspective of assessment[12,13] and management[14] of anxiety and fearful behaviours. Considerable research effort has therefore been focused on identification of factors that might influence anxiety and behaviour in children undergoing painful procedures[7,15,16] and evaluation of the effectiveness of various distress-reduction interventions and techniques.[1–6,17,18] Regrettably, little attention has been paid to understanding the behaviour of the children who are receiving some type of oral health preventive care that does not involve severely invasive and painful procedures. This may be considered an omission as the frequency of minimal interventions with young children is likely to be much higher than more extreme invasive procedures. Furthermore, it can be argued that the experience of a young child receiving a mildly invasive procedure may be instructive and enable them to receive, where necessary, more complex and demanding treatment.

Preventive care targeting children and young people from low social economic background has been recognised as a priority to improve health conditions in various contexts.[19–21] For oral health promotion in Scotland, this priority has been reflected by the National Health Service initiative, known as Childsmile.[22] Important components of the Childsmile initiative, namely the toothbrush programme and fluoride varnish application intervention for preschool children, have provided young children from disadvantaged socioeconomic backgrounds with essential preventive oral care.[23] The programme offers these children an opportunity to engage in preventive procedures in a relaxed atmosphere and the potential to increase confidence to take care of their own oral health. Dental staff have reported to the research team that some children are overtly anxious on arrival to the dental nurse team for their fluoride varnish application. The frequency of this presentation and the type of behaviour elicited by children receiving the application is unknown. The behaviour of these young children engaging in the minimal invasive preventive oral healthcare procedure (fluoride varnish application) requires investigation to determine, by inference, the acceptability level and the challenge, if any, to staff and administrators in the implementation of programmes of this nature. Studies in this field are also required to bridge a gap in the paediatric literature which has focused

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Online article number E11
Refereed Paper – accepted 9 July 2013
DOI: 10.1038/sj.bdj.2013.990
©British Dental Journal 2013; 215: E11

almost exclusively on the investigation of fear and disruptive behaviours.

Paediatric dental staff internationally use behavioural management techniques relatively infrequently compared with pharmacological agents, especially when the latter are easily available.[24] Where behavioural management techniques are employed in the UK they tend to be less restraining than other countries, for example, compared with the USA.[25] Findings from our recent systematic review[26] indicated that certain routine clinical behaviours of dental staff have positive effects on child cooperation. Preschool children receiving the fluoride varnish application in nursery school settings provides an ideal scenario to study the behaviour of young children responding to routine clinical behaviour of dental staff in a community setting.

Research evidence has suggested that age and unpleasant previous experience of in the dental clinic, particularly their experience at their first dental visit, influence a child's dental cooperative behaviour.[10,15] In addition, the level of distress reported by children themselves as opposed to a parental estimate of their child's distress or anxiety during previous dental and medical experience was related to their fearful behaviour.[27] We are therefore interested in exploring the behaviour of children across different age groups, their previous experience and level of anxiety observed at the beginning of the procedure.

The purpose of this paper is to contribute to the understanding of how young children behave in response to a mildly invasive dental preventive intervention (fluoride varnish application) in a community setting (nursery schools). The specific aims were (a) to document the behavioural profile of preschool children undergoing a preventive oral health procedure and (b) to investigate this behaviour in children by various factors including previous procedure experience, age and initial anxiety state.

METHODS

Study design

An observational study was completed of the nurse-child interaction that occurred while a fluoride varnish was applied at nursery schools across three Scottish NHS health boards. The use of video recordings was a deliberate technique to enable a stable medium for the analysis of verbal and nonverbal communication behaviours. This approach has undeniable strengths in the ability to repeat coding and analysis, although it has the potential to bias interpretation as the presence of a camera may influence naturalistic performance by nurses. Evidence from our own work and elsewhere has demonstrated that studying children by video recording their communication with healthcare staff was unlikely to contribute to bias in analysing nurse-child interactions.[28,29]

Ethical approval

The study was independently reviewed by the Tayside Committee on Medical Research Ethics B, Scotland UK (approval number: 09/S1402/22). Participants (nursing staff and parents) provided written consent and were assured confidentiality. The local educational authority gave approval. The ClinicalTrials.gov identifier for the study is NCT00881790.

Participants

Thirty-six schools across three NHS health boards (NHS Fife, NHS Forth Valley and NHS Tayside) in Scotland were invited to participate over the duration of September 2009 to July 2010. These schools had already enrolled onto the Childsmile fluoride varnish application programme, known as Childsmile Nursery. The fluoride vanish application was delivered by specially trained dental nurses. They worked in pairs with one nurse taking the lead role of applying the fluoride varnish onto the teeth of three- to five-year-old nursery school children. This study was part of a larger study where the behaviour of these dental nurses was also examined.[30] The focus of the current study concerns the behaviour of the young children. The children were considered from a low socio-economic background as they attended priority nursery schools. 'Priority' is defined as the 20% of nursery and primary schools with the highest proportion of children living in the most deprived local quintile of postcode areas, identified through the Scottish Index of Multiple Deprivation (SIMD). The schools were recruited via an invitation letter addressed to the head teacher. A request was made from the research team to deliver a study information package to all parents who had consented to the Childsmile programme. Purposive sampling of participating schools across three NHS health boards was adopted to encourage heterogeneity in child behaviour and nurse encouragement styles. This approach enabled a wider generalisation of findings. There were, however, some constraints in school selection due to limited research resources that signalled the exclusion of children from very small nurseries and the limitations of school schedules. It is also important to note that the development of the Childsmile programme varied due to different stages of development across Scotland. However, the fluoride varnish application followed a strict protocol that was adhered to across all health boards.[31]

All parents of 2,079 nursery-school children from the sample schools received participation information. A total of 1,614, who had consented to the Childsmile programme, were eligible to participate and invited to consent their children to participate in this study.

Coding scheme

The St Andrews Behavioural Interaction Coding Scheme (SABICS) was designed specifically for this study to code nurse-child interactive behaviours.[32] Two members of the research team (YZ, GF) coded the video tapes supervised by the principal investigator (GH). The SABICS contains 48 codes of which 13 are related to child behaviour including six verbal behaviours (for example, 'crying', 'speech yes') and additional seven nonverbal behaviours (for example, 'shake head', 'interact with instrument'). The 'interact with instrument' behaviour is coded when a child holds, touches or plays with the dental instruments and/or materials, such as dental brush, dental mirror and cotton wool, regardless of whether the dental nurse or the child initiates the interaction. The full range of child behavioural items can be found in Figures 1 and 2 in the results section. All codes are defined and were developed from close observation of an initial pilot involving 54 nurse-child fluoride varnish application interactions. Conventional levels of inter-coder reliability and discriminant validity were obtained for this coding scheme. Details of the coding scheme development, frequently asked questions and specific codes are available at http://www.st-andrews.ac.uk/sabics/.

Table 1 Demographic information of the child participants

Variable		Recorded children (n = 456)	Coded children (n = 303)
Age (months)	Mean	50.2	49.35
	Mode	49 (n = 454)	49
	SD	6.91	6.84
	Below 48 months	192 (42.1%)	141(46.5%)
	Above 48 months	264 (57.9%)	162 (53.5%)
First time application	Yes	72 (15.8%)	72 (23.8%)
	No	384 (84.2%)	231(76.2%)
Red-flagged children	Yes	69 (15.1%)	69 (22.8%)
	No	387 (84.9%)	234 (77.2%)

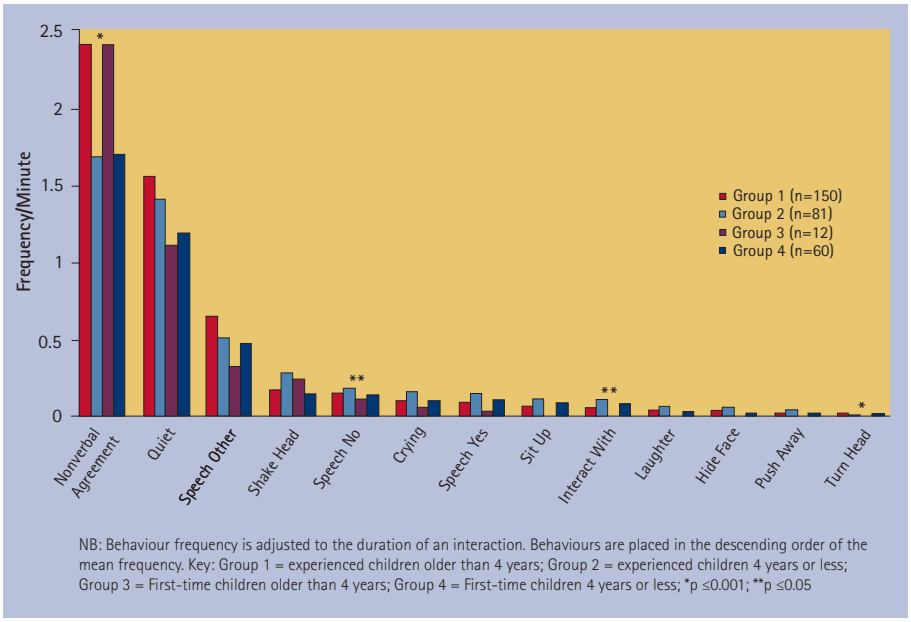


Fig. 1 Comparison of child behaviour frequency (application experience and age). *Indicates that a significant difference was found for that behaviour among the four groups of children

Analysis

We selected 303 video clips out of 456 recorded videos for coding and subsequent behavioural analysis. Coding priorities were given to: (i) unsuccessful applications; (ii) those children whose parents returned a separate posted survey; (iii) all initially anxious children; and (iv) those children matched for gender, age, school and dental nurses for unsuccessful applications, anxious children and survey-returners. Coding more extensive interactions where anxious and unsuccessful children were involved was expected to enhance our understanding of child behaviour. Matching relevant clips to those high priority videos improved the representativeness of the coded groups in relation to the recorded group. Details of comparability tests between priority and matched groups with additional information on sampling process can be found in our previous study.[30]

We defined those children who were anxious at the beginning of the nurse-child interaction before the fluoride varnish took place as 'red-flagged' children. Signs of anxiety were observable during the first 20 seconds of the interaction after the nurses' attention was directed to the child. These indicators of anxiety included: (i) anxious behaviours (for example, crying, covering face with hands, shaking head to treatment-related questions); (ii) other people's presence (for example, parent, teacher, siblings as helpers or examples); (iii) unusual positions different from required, that is, lying on the treatment chair or sitting on a beanbag (for example, sitting up on the dental chair, standing, sitting on the knees of a teacher/parent). The assignment of a 'red flag' was easily achieved in most cases. Where doubt was expressed by the coder, the initial part of the clip (20 seconds) was inspected by the other coder. An inter-rater analysis of the 'red flag' categorisation with 20 video clips (50:50 'red flag' *vs.* non-'red flag') showed excellent reliability (ICC = 0.91 with 95% confidence interval = 0.78–0.96).

The coding procedure was implemented through applying the SABICS on specialist behavioural coding software called The Observer XT™ system. Analysis took place in four steps:

1. Children were categorised into groups according to previous application experience, age and 'red flag' status
2. Mean frequency for all 13 child behaviours was calculated adjusting for the duration of an interaction
3. Bar charts were presented to visually compare the mean frequency of child behaviour among different groups
4. Average frequency of child behaviour (conducted on median for non-parametric tests) for selected child groups were compared using a non-parametric Kruskal-Wallis test allowing greater tolerance to sample size differences. If a significant difference was found among groups, a Mann-Whitney test was then followed to distinguish further differences between any two groups.

All tests were two-tailed. Statistical significance was set at 0.05 for all tests with the exception of multiple comparisons where the level was 0.01 to reduce type I error rate.

RESULTS

Consent rates and demographic information

School consent rate was 97% and 32% of the eligible parents consented for their children to take part. Ninety percent of these consented children had their fluoride varnish application sessions video recorded. More details of the consent rates and demographic information can be found in our previous study.[30] Table 1 provides relevant demographic information specific to the current study.

Frequency of child behaviour (application experience and age)

Figure 1 shows the comparison in the mean frequency of child behaviour for 303 coded children categorised into four different groups, depending on the child's previous application experience and age range of above or below four years old. Mean frequency for all 13 child behaviours was corrected for the duration of an interaction and displayed in a descending order. It can be seen from Figure 1 that in general the three most frequently exhibited behaviours were 'nonverbal agreement' (for example, nodding head), 'quiet' (a meaningful behaviour rather than a demarcation) and 'speech other' (for example, 'will my teeth be golden?'). Turning head away from the nurse to avoid treatment, coded as 'turn head', was the least frequently observed behaviour.

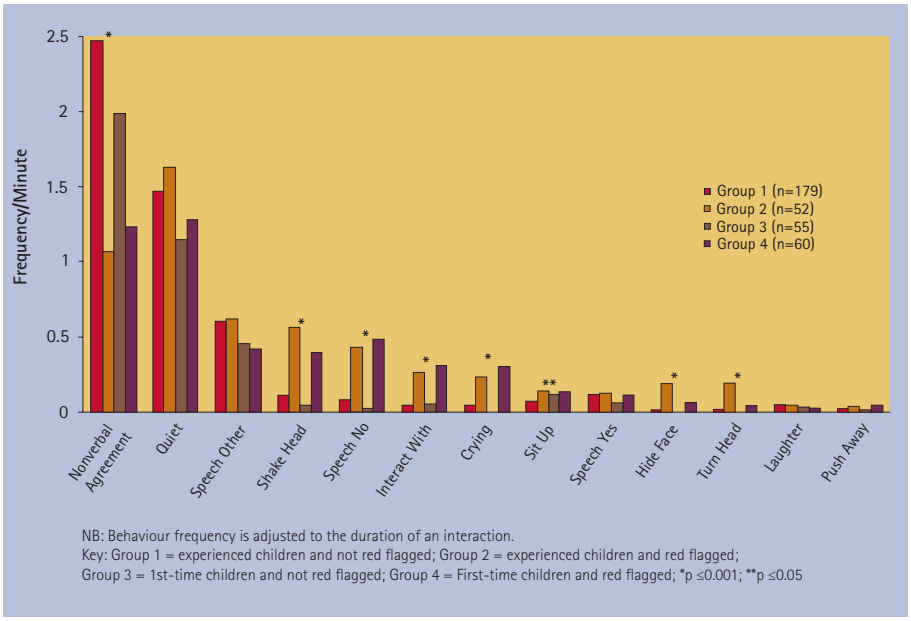
Table 2 presents the results of the Kruskal-Wallis test corresponding to the behaviours with an asterisk symbol in Figure 1. We can see from Table 2 that children behaved significantly differently in terms of observable behaviour frequency among the four groups concerning the following four behaviours: 'turn head' 'nonverbal agreement', 'speech no' and 'interact with instrument'. The follow-up Mann-Whitney test suggested that, for children who had previous experience of the fluoride varnish application, younger children (that is, four years old or less) interacted with the application instruments (for example, play with the brush or the mirror) more frequently than those children who were older than four years. Interestingly, within the group of older children (above four years), 'interact with instrument' behaviour was observed more frequently with those who had experience of application in the past.

Table 2 Results of average frequency in behaviours with significant differences among groups (application experience and age)

	Median Mean (SD)				Kruskal-Wallis test			Follow up Mann-Whitney test
Child behaviour	Group 1 (n = 150)	Group 2 (n = 81)	Group 3 (n = 12)	Group 4 (n = 60)	Chi-square	df	p	
Turn head	0.00 0.02 (0.15)	0.00 0.01 (0.06)	0.00 0.00 (0.00)	0.00 0.01 (0.10)	18.418	3	0.000*	NS
Nonverbal agreement	2.24 2.42 (1.70)	1.46 1.69 (1.41)	2,37 2.41 (1.36)	1.55 1.70 (1.20)	15.915	3	0.001*	NS
Speech no	0.00 0.15 (0.55)	0.00 0.18 (0.54)	0.0 0.11 (0.17)	0.00 0.14 (0.46)	9.159	3	0.027**	NS
Interact with instrument	0.00 0.06 (0.21)	0.00 0.11 (0.38)	0.00 0.00 (0.00)	0.00 0.08 (0.24)	8.908	3	0.031**	G2>G1, p = 0.013** G1>G3, p = 0.018**

NB: Only behaviours with a significant difference among groups are reported. Frequency of child behaviour is adjusted to the duration of an interaction.

Key: Group 1 (G1) – experienced children older than 4 years; Group 2 (G2) – experienced children 4 years or less; Group 3 (G3) – First-time children older than 4 years; Group 4 (G4) – First-time children 4 years or less; NS – not significant; *p ≤0.001; **p ≤0.05



NB: Behaviour frequency is adjusted to the duration of an interaction.
Key: Group 1 = experienced children and not red flagged; Group 2 = experienced children and red flagged; Group 3 = 1st-time children and not red flagged; Group 4 = First-time children and red flagged; *p ≤0.001; **p ≤0.05

Fig. 2 Comparison of child behaviour frequency (application experience and 'red flag' status)

Frequency of child behaviour (application experience and 'red flag' status)

Figure 2 displays the comparison in the mean frequency of child behaviour for four child groups with a combination of application experience and 'red flag' status. We can see from both Figure 2 (behaviours with an asterisk symbol) and Kruskal-Wallis test results in Table 3, regarding behaviour frequency, when 'red flag' status (that is, child's initial anxiety) was considered, significant differences among the four groups were found for most of the disruptive behaviours (for example, 'shake head', 'speech no', 'crying', 'sit up', 'hide face' and 'turn head'). Findings from the follow-up Mann-Whitney test in Table 4 showed that 'red-flagged' children who displayed signs of initial anxiety exhibited significantly more fear-related behaviours in the entire interaction than those children who did not show anxiety at the beginning of the interaction, regardless of whether this was their first time application or not. Another key finding shown in Table 4 is that 'nonverbal agreement' behaviour was more frequently observed with children who were not 'red flagged'.

DISCUSSION

This study is the first to provide a detailed behavioural profile of preschool children undergoing dental preventive procedures in a community setting. The 'nonverbal agreement' was found to be the behaviour exhibited most frequently by children, followed by being 'quiet' and 'speech other'. In our observation and coding, 'nonverbal agreement' was mostly coded for the following three scenarios: (i) nodding head to treatment-related questions and/or instructions; (ii) opening mouth when requested/instructed by a nurse for mouth examination and/or varnish application; and (iii) physically moving closer to the nurse(s) when asked as

Table 3 Results of average frequency in behaviours with significant differences among groups (application experience 'red flag' status)

	Median Mean (SD)				Kruskal-Wallis test		
Child behaviour	Group 1 (n = 179)	Group 2 (n = 52)	Group 3 (n = 55)	Group 4 (n = 17)	Chi-square	df	p
Nonverbal agreement[1]	2.31 2.48 (1.54)	0.54 1.07 (1.48)	1.79 2.00 (1.25)	0.96 1.24 (1.07)	41.28	3	0.000*
Shake head	0.00 0.11 (0.40)	0.19 0.57 (0.98)	0.00 0.04 (0.15)	0.00 0.39 (0.79)	53.28	3	0.000*
Speech no	0.00 0.08 (0.42)	0.00 0.43 (0.79)	0.00 0.01 (0.10)	0.00 0.48 (1.46)	61.91	3	0.000*
Interact with instrument[1]	0.00 0.04 (0.17)	0.00 0.26 (0.43)	0.00 0.04 (0.11)	0.00 0.31 (0.45)	31.27	3	0.000*
Crying	0.00 0.04 (0.45)	0.00 0.23 (0.59)	0.00 0.00 (0.00)	0.00 0.30 (1.11)	34.68	3	0.000*
Hide face	0.00 0.01 (0.07)	0.00 0.19 (0.37)	0.00 0.00 (0.00)	0.00 0.06 (0.25)	69.13	3	0.000*
Turn head[1]	0.00 0.01 (0.14)	0.00 0.19 (0.47)	0.00 0.00 (0.00)	0.00 0.05 (0.19)	66.31	3	0.000*
Sit up	0.00 0.07 (0.25)	0.00 0.14 (0.31)	0.00 0.12 (0.33)	0.00 0.13 (0.38)	11.78	3	0.008**

NB: Only behaviours with a significant difference among groups are reported. Behaviour frequency is adjusted to the duration of an interaction.

Key: Group 1 = experienced children and not red flagged; Group 2 = experienced children and red flagged; Group 3 = First-time children and not red flagged; Group 4 = First-time children and red flagged; *p ≤0.001; **p ≤0.05; [1] = behaviour frequencies with a significant correlation with child age, tests were therefore conducted on adjusted frequencies corrected for age effect; (Interact with instrument and age: r = 0.196, p = 0.001; nonverbal agreement and age: r = 0.137, p = 0.017; turn head and age: r = 0.128, p = 0.025)

Table 4 Follow-up Mann-Whitney test for child behaviour frequency difference between two groups (application experience and 'red flag' status)

	Group comparison with p value for Mann-Whitney test					
Child behaviour	G1 and G2	G1 and G3	G1 and G4	G2 and G3	G2 and G4	G3 and G4
Nonverbal agreement[1]	G1>G2; p = 0.000*	NS	G1>G4; p = 0.020**	G3>G2; p = 0.000*	NS	G3>G4; p = 0.047**
Shake head	G2>G1; p = 0.000*	NS	G4>G1; p = 0.044**	G2>G3; p = 0.000*	NS	G4>G3; p = 0.024**
Speech no	G2>G1; p = 0.000*	NS	NS	G2>G3; p = 0.000*	NS	G4>G3; p = 0.012**
Interact with instrument[1]	NS	NS	NS	G2>G3; p = 0.000*	NS	G4>G3; p = 0.049**
Crying	G2>G1; p = 0.000*	NS	G4>G1; p = 0.012**	G2>G3; p = 0.000*	NS	G4>G3; p = 0.010**
Sit up	G2>G1; p = 0.001*	NS	NS	NS	NS	NS
Hide face	G2>G1; p = 0.000*	NS	NS	G2>G3; p = 0.000*	NS	NS
Turn head[1]	G2>G1; p = 0.000*	NS	G4>G1; p = 0.000*	G2>G3; p = 0.000*	G2>G4; p = 0.001*	NS

NB: Only behaviours with a significant difference among groups are reported.

Key: Group 1 (G1) = experienced children and not red flagged; Group 2 (G2) = experienced children and red flagged; Group 3 (G3) = 1st-time children and not red flagged; Group 4 (G4) = 1st-time children and red flagged; *p ≤0.001; **p ≤0.05; NS = not significant; [1] = behaviour frequencies with a significant correlation with child age, tests were therefore conducted on adjusted frequencies corrected for age effect

part of the treatment preparation. In the coding scheme, six behaviours that can be considered as disruptive or fearful behaviour were rarely observed: 'shake head', 'speech no', 'crying', 'sit up', 'hide face', 'push away' and 'turn head'. Hence in response to our first aim, this was the first key finding. When receiving the fluoride varnish application at nursery school settings, three- to five-year-old nursery-school children tend to communicate in a nonverbal manner and exhibit more frequently cooperative behaviours as opposed to disruptive behaviours. These cooperative nonverbal behaviours, such as nodding head, were not necessarily procedure-specific. Consequently, working with young children in this type of context might be more effective if more efforts can be devoted to asking appropriate questions and giving proper instructions that would be more likely to elicit nonverbal cooperation. This type of working style may be more preferable to solely focusing on management of disruptive behaviours.

It should be stressed that verbal language development of three- to five-year-olds,[33] particularly interaction with unfamiliar adults, might explain at least in part, why nonverbal behaviour is observed more often than verbal behaviour. The dental staff behaviour, for example, encouragement-centred interaction style, might also have had some positive effect in promoting cooperative behaviour in children, which has already been featured in the literature.[26] This interactive process will be an important focus of our next stage of research.

The second aim of the study was to investigate the variation of the child behaviour across a number of pre-determined factors. The findings suggest that young children with different pre-visit behavioural or demographic characteristics displayed different behaviours with the fluoride varnish application. With regard to the coded behaviour, 'interact with instrument', if children have had previous experience of fluoride application, this behaviour was observed much more frequently with younger children of four years old or less, compared to those who were older than four years. Generally speaking, younger children are less confident and find it more difficult to engage themselves in an unfamiliar situation.[34] It is possible that the younger children were simply given more opportunity to 'play' with the procedure instruments (cotton wool, brush and mirror) by the dental nurses as a way to engage children who exhibited limited confidence in receiving the procedure. On the other hand, we have observed that playing with a mirror (for

example) for a lengthy duration delayed the 'mirror mouth check' procedure. Therefore, behaviour coded as 'interact with instrument' could be interpreted as an exhibition of avoidance behaviour by the child. Hence in these cases this would demonstrate an indication of being anxious about the on-going procedure. This observation was confirmed by our finding that 'red-flagged' children, who showed signs of anxiety at the beginning of an interaction, displayed more frequently the 'interact with instrument' coded behaviour during the later stages of the procedure. When older children between four and five years of age were observed, it was those experienced children who presented more frequently the 'interact with instrument' behaviour than those who were receiving the fluoride varnish application for the first time. We are not certain at this stage whether previous experience has made them more at ease with playing with instruments or if it is a tactic learned from their last application to delay the procedure. The limited sample size restricted the generalisability of this finding to a larger population. This was shown particularly by the large sample size difference between the two groups of children (experienced and non-experienced older children).

Playing with medical equipment/kits has been commonly recommended to parents by some children's hospitals to prepare ill children for hospitalisation.[35] In addition, the effect of the 'playing' element in reducing child anxiety has been explored and positively endorsed in the literature.[36] Our finding will draw attention to the theoretical and clinical significance for appropriate utilisation of treatment instruments as a tool to increase familiarity of the procedures and reduce fearful behaviours. Such an observation may support the management approach of tell-show-do.[37] On the other hand, when the practitioner might be pleased to see the child engaging him/herself in the procedure, they should be aware that the behaviour might also serve a separate function, such as a delaying tactic, to avoid the procedure. Careful observation and sensitive handling of this potentially rewarding approach would be required by dental staff.

With regard to 'red-flagged' children, we found that they generally displayed certain behaviours that can be interpreted as anxious or disruptive more frequently than other categories of children, irrespective of previous experience or age. This finding might not be surprising as 'red flag' status is defined by some of the disruptive behaviours at the beginning of the interaction, for instance, 'crying'. However, it does suggest that initial anxious state provided a good indication of the occurrence of anxiety-related behaviours for the later stage of the procedure. Furthermore, our data also suggest that absence of initial anxious behaviour (not 'red-flagged' children) were suggestive of occurrence of cooperative behaviours (nonverbal agreement) for the later stage. This finding is consistent with the existing research evidence called the 'autocorrelation' effect, that initial child behaviour impacts on their overall behaviour in the behavioural sequence.[38] We caution the ubiquitous use of the term 'red flag' and are aware of the pejorative nature of such labelling. However the research team were struck by the clear messages presented by staff who were adamant that this distinction was easily attained in the early stages of staff-child interaction before the start of the procedure. The finding that it was clearly predictive of subsequent child behaviour signalled the need to report this early presentational status of the child.

All findings drawn from the analyses should be interpreted in the light of the following limitations. As mentioned before, our sample size limitation will put constraints on generalisability of the findings to a wider population. However, this is the only study that we are aware of that has recorded nurse-child interaction in community settings, using a relatively large sample size. Therefore the data have good representation as far as the setting is concerned. In addition, we have no evidence to suggest that the children who consented are any different from other children who are attending the nursery schools. The SABICS coding scheme was purposively developed for this study and the behavioural codes applied to the children can be context-specific. In the future, researchers are encouraged to study child behaviour using modified codes for suitability in other clinical-related contexts. It was suggested in the literature that level of distress and anxiety at the previous medical and dental visit was related to distressful behaviour.[15] Our study was not longitudinal; therefore this potentially important factor was not explored. It would be ideal to study child behaviour taking account of their anxiety level in their previous visit, which can be examined in future studies. Finally child interactive behaviours cannot be fully understood in isolation of the behaviour of the nurses. In this study, no causal behavioural relationships between child and nurse were assumed; we only provided a behavioural profile of children as a first step to understand preschool children responding to a dental preventive procedure. The next stage of our research is to examine the complex behavioural associations using a multi-level sequential analysis approach.

CONCLUSION

Preschool children undergoing a dental preventive procedure in a community setting frequently exhibited nonverbal and non-disruptive behaviours. Dental staff working with young children might strengthen their use of encouragement-centred strategies that promote nonverbal cooperative behaviours in children. Younger preschool children, regardless of whether they have had previous experience or not, tended to engage themselves more often with the procedure instruments. This finding points to a focus for future research exploring the effects of introducing dental instruments or kits on child cooperation. A balance between providing some space or time for children to engage in this activity against the demands of completing the procedure in an efficient manner is a key question for future service provision. Where children can be seen to show some initial signs of anxiety this may alert the staff member to engage in early management procedures to prevent the occurrence of disruptive behaviours during the later stages of the procedure. The 'autocorrelation' effect of child behaviour appears to be powerful and early intervention to positively interfere in these processes requires further investigation.

DISCLAIMER

This work was undertaken by University of St Andrews, which received funding from the Childsmile Programme; the views expressed in this article are those of the authors and not necessarily those of the funders.

This study was supported by the NHS Fife in the pilot stage and the Scottish Government, via the Childsmile Evaluation Board, provided funding for the main study. We thank all nursery schools, dental nurses, parents and children who participated in this study.

1. Manimala M R, Blount R L, Cohen L L. The effects of parental reassurance versus distraction on child distress and coping during immunizations. *Child Health Care* 2000; **29:** 161–177.
2. Cohen L L, Blount R L, Cohen R J, Schaen E R, Zaff J. A comparative study of distraction versus topical anaesthesia for paediatric pain management during immunizations. *Health Psychol* 1999; **18:** 591–598.
3. Cohen L L, Blount R L, Cohen R J, Johnson V C. Dimensions of paediatric procedure distress: children's anxiety and pain during immunizations. *J Clin Psychol Med S* 2004; **11:** 41–47.
4. Kolk A M, van Hoof R, Fiedeldij Dop M J C. Preparing children for venepuncture. The effect of an integrated intervention on distress before and during venepuncture. *Child Care Health Dev* 2000; **26:** 251–260.
5. Liossi C, White P, Hatira P. A randomized clinical trial of a brief hypnosis intervention to control venepuncture-related pain of paediatric cancer patients. *Pain* 2009; **142:** 255–263.
6. Tak J H, van Bon W H J. Pain and distress reducing interventions for venepuncture in children. *Child Care Health Dev* 2006; **32:** 257–268.
7. Taylor C, Sellick K, Greenwood K. The influence of adult behaviour on child coping during venipuncture: a sequential analysis. *Res Nurs Health* 2011; **34:** 116–131.
8. Melamed B G, Ross S L, Courts F *et al.* Dentists' behaviour management as it affects compliance and fear in paediatric patients. *J Am Dent Assoc* 1983; **106:** 324–330.
9. Horst G, Prins P, Veerkamp J, Verhey J. Interactions between dentists and anxious child patients: a behavioural analysis. *Community Dent Oral Epidemiol* 1987; **15:** 249–252.
10. Suprabha B S, Rao A, Choudhary S, Shenoy R. Child dental fear and behaviour: the role of environmental factors in a hospital cohort. *J India Soc Paedod Prev Dent* 2011; **29:** 95–101.
11. Cline R J W, Harper F W K, Penner L A, Peterson A M, Taub J W, Albrecht T L. Parent communication and child pain and distress during painful paediatric cancer treatments. *Soc Sci Med* 2006; **63:** 883–898.
12. Jay S M, Ozolins M, Elliott C H, Caldwell S. Assessment of children's distress during painful medical procedures. *Health Psychol* 1983; **2:** 133–147.
13. Jay S M, Ozolins M, Elliott C H, Caldwell S. Assessment of children's distress during painful medical procedures. *Health Psychol* 1983; **2:** 133–147.
14. Blount R L, Zempsky W T, Jaaniste T *et al.* Management of paediatric pain and distress due to medical procedures. *In* Roberts M C, Steel R G (eds) *Handbook of paediatric psychology.* 4th ed. pp 171–188. New York: The Guilford Press, 2010.
15. Frank N C, Blount R L, Smith A J, Manimala M R, Martin J K. Parent and staff behaviour, previous child medical experience, and maternal anxiety as they relate to child procedural distress and coping. *J Paediatr Psychol* 1995; **20:** 277–289.
16. McCarthy A M, Kleiber C. A conceptual model of factors influencing children's responses to a painful procedure when parents are distraction coaches. *J Paediatr Nurs* 2006; **21:** 88–98.
17. Carlson K L, Broome M, Vessey J A. Using distraction to reduce reported pain, fear, and behavioural distress in children and adolescents: A multisite study. *J Spec Paediatr Nurs* 2000; **5:** 75–85.
18. MacLaren J E, Cohen L L. A comparison of distraction strategies for venepuncture distress in children. *J Paediatr Psychol* 2005; **30:** 387–396.
19. Agerbo E, Nordentoft M, Mortensen P B. Familial, psychiatric, and socioeconomic risk factors for suicide in young people: nested case-control study. *BMJ* 2002; **325:** 74.
20. Al-Dlaigan1 Y H, Shaw L, Smith A. Tooth surface loss: dental erosion in a group of British 14-year-old, school children. Part I: prevalence and influence of differing socioeconomic backgrounds. *Br Dent J* 2001; **190:** 145–149.
21. O'Dea J A. Gender, ethnicity, culture and social class influences on childhood obesity among Australian schoolchildren: implications for treatment, prevention and community education. *Health Soc Care Comm* 2008; **3:** 282–290.
22. Macpherson L M D, Ball G E, Brewster L *et al.* Childsmile: the national child oral health improvement programme in Scotland. Part 1: establishment and development. *Br Dent J* 2010; **209:** 73–78.
23. Turner S, Brewster L, Kidd J *et al.* Childsmile: the national child oral health improvement programme in Scotland. Part 2: monitoring and delivery. *Br Dent J* 2010; **209:** 79–83.
24. Wilson S, Alcaino E A. Survey on sedation in paediatric dentistry: a global perspective. *Int J Paediatr Dent* 2011; **21:** 321–332.
25. Crossley M L, Joshi G. An investigation of paediatric dentists' attitudes towards parental accompaniment and behavioural management techniques in the UK. *Br Dent J* 2002; **192:** 517–521.
26. Zhou Y, Cameron E, Forbes G, Humphris G. Systematic review of the effect of dental staff behaviour on child dental patient anxiety and behaviour. *Patient Educ Couns* 2011; **85:** 4–13.
27. Themessl-Huber M, Freeman R, Humphris G, MacGillivray S, Terzi N. Empirical evidence of the relationship between parental and child dental fear: a structured review and meta-analysis. *Int J Paediatr Dent* 2010; 20: 83–101.
28. Zhou Y, Forbes G, Humphris G. Camera-related behaviours of female dental nurses and nursery school children during fluoride application interactions in nursery school settings. *Int J Paediatr Dent* 2010; **20:** 374–381.
29. Penner L A, Orom H, Albrecht T L, Franks M M, Foster T S, Ruckdeschel J C. Camera-related behaviours during video recorded medical interactions. *J Nonverbal Behav* 2007; **31:** 99–117.
30. Zhou Y, Forbes G, Macpherson L M D, Ball G E, Humphris G M. The behaviour of extended duties dental nurses and the acceptance of fluoride varnish application in preschool children. *Br Dent J* 2012; **213:** 603–609.
31. Childsmile. Fluoride varnish application protocol. Online protocol available at http://www.child-smile.org.uk/professionals/fluoridevarnish1app.aspx (accessed July 2013).
32. Zhou Y, Cameron E, Forbes G, Humphris G M. Development of a novel coding scheme (SABICS) to record nurse-child interactive behaviours in a community dental preventive intervention. *Patient Educ Couns* 2012; **88:** 268–276.
33. Stevenson J, Richman N. Behaviour, language, and development in three-year-old children. *J Autism Child Schizophr* 1978; **8:** 299–313.
34. Coll C G, Kagan J, Reznick J S. Behavioural inhibition in young children. *Child Dev* 1984; **55:** 1005–1019.
35. Children's Hospital of Wisconsin. Preparing for the hospital. Online guidance available at http://www.chw.org/display/displayFile.asp?docid=37544&tfilename=/Groups/Newsbreak/Preschool_Prep_Card.pdf (accessed July 2013).
36. Gariépy N, Howe N. The therapeutic power of play: examining the play of young children with leukaemia. *Child Care Health Dev* 2003; **29:** 523–537.
37. Farhat-McHayleh N, Harfouche A, Souaid P. Techniques for managing behaviour in paediatric dentistry: comparative study of live modelling and tell-show-do based on children's heart rates during treatment. *J Can Dent Assoc* 2009; **75:** 283.
38. Horst G, Prins P, Veerkamp J, Verhey J. Interactions between dentists and anxious child patients: a behavioural analysis. *Community Dent Oral Epidemiol* 1987; **15:** 249–252.