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Eye-tracking in dentistry: What do children notice in the dentist?

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ABSTRACT

Objectives: To determine, using eye-tracking technology, what children notice the most when they look at the dentist.
Methods: A total of 41 children viewed 10 images of dentists of different genders and ethnicities, and wearing different attires, on a computer screen. Due to calibration issues with the eye tracking equipment, data from one child was excluded thus resulting in a final sample of 40 children (21 females; 19 males). Participants were aged 4–12 years. A Tobii X2-60 eye-tracking camera was used, which follows the location of participants' gaze as they look at images on a screen. Areas of interest (AOI's) were pre-defined on each image (e.g. eyes, mouth, shirt). Other images were displayed between dentist images with no consecutive dentist images displayed. Number of participants to fixate and mean length of fixation for each AOI were measured.
Results: Visual assessment illustrated that the dentist's face had the highest concentration of fixations, followed by attire. The circum-oral area has significantly more fixations than the eyes. The number of fixations and the mean length of fixation were both longer for the face than for the attire, and for the circum-oral area compared to the eyes. Distractors such as pens and ties exhibited more and longer fixations compared to images without distractors.
Conclusions: Children fixated most on the dentist's face particularly the circum-oral area, followed by attire. Distractors were able to draw the children's gaze. Importantly, eye-tracking was an effective tool in assessing where children look on dentists' images.
Clinical significance: This research will provide an understanding of where children focus when they look at a dentist. This has not previously been known and will allow dentists to modify how they present themselves and interact with child patients.

1. Introduction

The term 'Dental fear and anxiety' is often used to refer to strong negative feelings associated with dental treatment among children and adolescents. Dental fear and anxiety in children have an estimated prevalence of around 9%, with higher prevalence reported in younger patients [1]. Conversely, dental behaviour management problems, which is defined by the dentist's experience when treating the child, is a collective term used for uncooperative and disruptive behaviours, which result in delay of treatment or render treatment impossible, regardless of the type of behaviour or its underlying mechanism [1].

The importance of dental factors, such as pain or perceived lack of control during treatment, which includes delivery of invasive treatment, administering multiple injections, using sharp, high-speed cutting instruments has been widely reported [2,3]. It has been stated that dental fear and anxiety exist in children prior even to their first dental visit either due to a huge variation in age, competence, maturity, personality, intellectual capacity, temperament and emotions, experience, oral health, family background, parenting styles, culture, or parental modelling [4]. Therefore, one could suggest that all of these aspects may influence the child's ability to cope with the dental treatment; thus posing a great challenge to the treating dentist. Nevertheless, the most aspects of children's behaviour in the dentist's office namely, attachment, temperamental reactivity, emotional regulation, effortful control, internalizing and externalizing, psychopathology etc., which are core aspects of clinical child psychology [1,5,6] has been poorly investigated. Furthermore, these non-dental factors exhibit immense potential to unravel the critical aspects that lead to the

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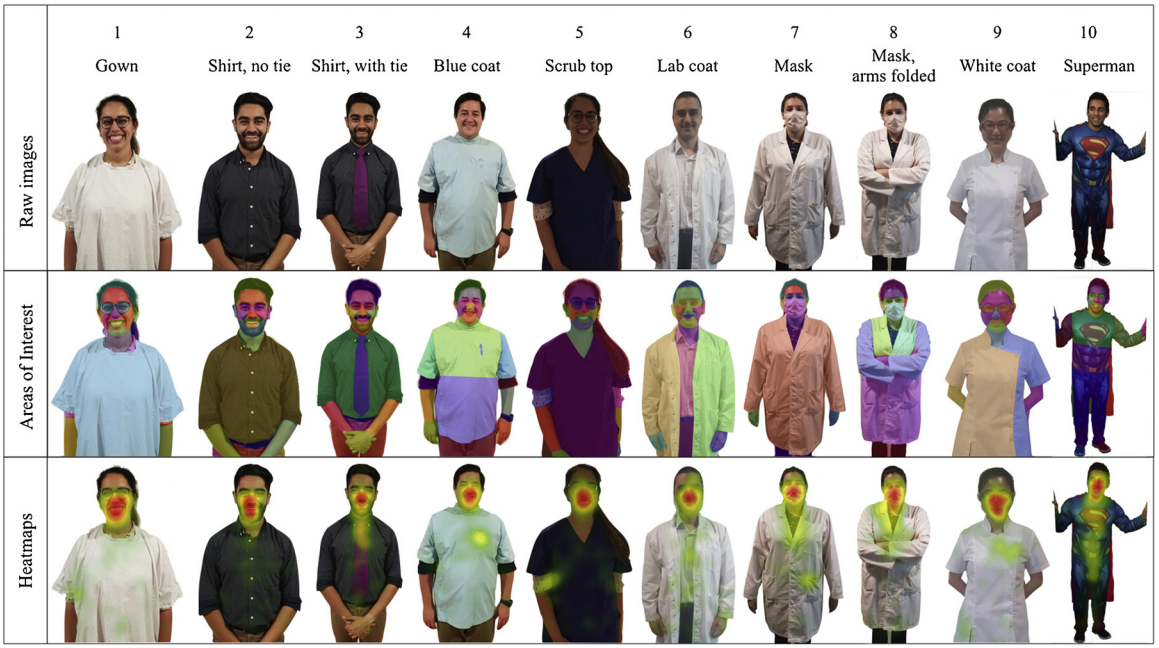

Fig. 1. The various clinician images viewed by children in this study.

development of both dental fear and anxiety and dental behaviour management problems in children and adolescents' [7].

First impressions are huge, and even before introducing yourself to someone, you probably pick up something about them, and at the same time emit something about yourself…whether you like it or not! [8]. Therefore, the first impression of the dentist is important in forming a positive child-dentist relationship, which is essential in allowing dentists to provide a high standard of dental care to their young patients. But the question remains as to what children notice when they meet a dentist. Is it their clothing, face, hair, or the shoes? There is a growing body of subjective evidence on what types of clinical attire children prefer to see on a dentist [9–11]. This research makes an assumption about the importance of attire from a child's perspective. Objectively-attained knowledge of where children fixate when they look at the dentist will allow clinicians to customise their appearance and how they interact with young patients in order to prevent or reduce dental fear and anxiety. Nevertheless, the importance of attire in this equation is not yet known.

Eye-tracking technology is an effective tool that has been used in neuroscience and psychology research, particularly in children with autism, and other conditions associated with neurological morbidities [12–14]. This technology provides an objective assessment of where an individual's gaze fixates on an image. Gaze is defined as the point on an image where the individual is looking, while fixation refers to the point where the individual's gaze stops moving for a period of time, so the individual can take in information from that point on the image. Furthermore, saccades are the movements between fixations, during which no information is taken in. A study using functional MRI to map brain activity during eye-fixation tasks demonstrated an anatomical overlap in areas of the parietal, frontal and temporal lobes to suggest that attentional and oculomotor processes are integrated at the neural level [15].

To date, there are no studies that have investigated what children notice when they meet a dentist. Therefore, this study sought to determine, using eye-tracking technology, what children notice the most when they look at the dentist. Given the assumed importance of attire in prior research, the primary hypothesis tested was that "there is no difference in the children's fixation between the dentist's attire and the other visible parts (namely face, head hair, arms, etc.) when viewing the dentist's images on a computer screen". Furthermore, the secondary aim was to identify the most fixated area on the dentist's attire (tie, pocket, shirt, apron) and face (forehead, eyes, nose, cheeks, circumoral area, chin, ears).

2. Materials and method

2.1. Ethical approval

Ethical approval was obtained from the University of Western Australia Human Research Ethics Committee (Reference: RA/4/1/9331). The parents/legal guardians read the participant information sheets prior to consenting for their child's participation in this study.

2.2. Participants

The sample consisted of 41 children, aged 4–12 years, who attended an after-school care centre in metropolitan Perth, Western Australia. The children were healthy, with no associated medical conditions and/or syndromes, typically developing and had no reported vision, hearing, or developmental issues. Data from one child was excluded due to calibration issues with the eye tracking equipment, thus resulting in a final sample of 40 participants (21 females; 19 males). Twenty-two participants were aged 4–9 years, and 18 were 10–12 years of age. All participants had visited a dentist at least once previously.

Although there was no previous research on using eye-tracking in paediatric dentistry, a recent study [16] on visual cues and recognition behaviour in children and adults included 34–35 participants per group and had power greater than 0.8. Assuming a similar or smaller effect size in the current study, we recruited 40 participants in order to achieve the same level of power.

2.3. Setting and equipment

The equipment was taken to the after-school care centre and the participants independently viewed the images in a quiet room in their childcare centre.

Tobii Studio software (Tobii, Danderyd, Sweden) was installed onto a Hewlett Packard ProBook 640 G2 laptop computer (Hewlett Packard, Boeblingen, Germany), and 10 different images of dentists wearing a range of attires were uploaded (Fig. 1). Images included both genders