

Objective assessment of the contribution of dental esthetics and facial attractiveness in men via eye tracking

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Introduction: Recently, greater emphasis has been placed on smile esthetics in dentistry. Eye tracking has been used to objectively evaluate attention to the dentition (mouth) in female models with different levels of dental esthetics quantified by the aesthetic component of the Index of Orthodontic Treatment Need (IOTN). This has not been accomplished in men. Our objective was to determine the visual attention to the mouth in men with different levels of dental esthetics (IOTN levels) and background facial attractiveness, for both male and female raters, using eye tracking. **Methods:** Facial images of men rated as unattractive, average, and attractive were digitally manipulated and paired with validated oral images, IOTN levels 1 (no treatment need), 7 (borderline treatment need), and 10 (definite treatment need). Sixty-four raters meeting the inclusion criteria were included in the data analysis. Each rater was calibrated in the eye tracker and randomly viewed the composite images for 3 seconds, twice for reliability. **Results:** Reliability was good or excellent (intraclass correlation coefficients, 0.6-0.9). Significant interactions were observed with factorial repeated-measures analysis of variance and the Tukey-Kramer method for density and duration of fixations in the interactions of model facial attractiveness by area of the face ($P < 0.0001$, $P < 0.0001$, respectively), dental esthetics (IOTN) by area of the face ($P < 0.0001$, $P < 0.0001$, respectively), and rater sex by area of the face ($P = 0.0166$, $P = 0.0290$, respectively). For area by facial attractiveness, the hierarchy of visual attention in unattractive and attractive models was eye, mouth, and nose, but for men of average attractiveness, it was mouth, eye, and nose. For dental esthetics by area, at IOTN 7, the mouth had significantly more visual attention than it did at IOTN 1 and significantly more than the nose. At IOTN 10, the mouth received significantly more attention than at IOTN 7 and surpassed the nose and eye. These findings were irrespective of facial attractiveness levels. For rater sex by area in visual density, women showed significantly more attention to the eyes than did men, and only men showed significantly more attention to the mouth over the nose. **Conclusions:** Visual attention to the mouth was the greatest in men of average facial attractiveness, irrespective of dental esthetics. In borderline dental esthetics (IOTN 7), the eye and mouth were statistically indistinguishable, but in the most unesthetic dental attractiveness level (IOTN 10), the mouth exceeded the eye. The most unesthetic malocclusion significantly attracted visual attention in men. Male and female raters showed differences in their visual attention to male faces. Laypersons gave significant visual attention to poor dental esthetics in men, irrespective of background attractiveness; this was counter to what was seen in women. (*Am J Orthod Dentofacial Orthop* 2018;153:523-33)

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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Submitted, March 2017; revised and accepted, August 2017.

0889-5406/\$36.00

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<https://doi.org/10.1016/j.ajodo.2017.08.016>

In recent years, increased emphasis has been placed on esthetics in dentistry. It has been suggested that dentists should plan treatment that considers not only functional, but also esthetic, objectives because most patients said that they were interested in improving the appearance of their teeth.¹

Shaw² and Shaw et al³ were some of the first to begin to understand the effect of dental esthetic alterations and the way that they affect how people are judged. They showed that 11-year-old children with normal incisors were judged to be more desirable as friends, better looking, more intelligent, and less aggressive. With

young adults, they showed that although background facial attractiveness was more important than dental condition, a normal dental appearance (normal incisor relationship) was judged to be more socially attractive over a range of personal characteristics.

In 2015, using an online survey conducted by the Harris Poll, 14,962 responses from a randomly selected study group of people, ages 18 and older, were analyzed.⁴ Twenty-nine percent of low-income adults and 28% of young adults (18–34 years) believed that the appearance of their mouth and teeth affects their ability to interview for a job. Twenty-five percent of all adults avoid smiling, 23% feel embarrassed, and 20% experience anxiety due to the condition of their mouth and teeth. Finally, 82% of all responders agreed that “it is easier to get ahead in life if I have straight, bright teeth.” Overall, it is clear that the general population feels that dental esthetics are important,^{4–7} and they also have an influence on psychosocial judgments.^{2,3,8,9}

Other studies have been conducted to explain what is an esthetic and visually pleasing smile. The aims in these studies have been to determine what the raters found most esthetic and what deviations from ideal were acceptable. For example, ideal upper to lower midlines have no deviation, but it is acceptable to vary 2 to 3 mm from the ideal and still be considered esthetic.¹⁰ These authors used a specific perspective (circumoral only, lower face only, or full-face views) with different rating groups (laypersons, dental professionals, different sexes).^{10–13} These studies may have been biased because they directed the raters’ attention to the dentition.

Through these studies, many important confounding factors have been uncovered. A model sex effect has been shown that affects different preferences in dental esthetic characteristics.^{12,14} Also, in general, female models have been shown to be judged more critically.¹³ Furthermore, the sex of the rater may also be influential on the dental esthetic ratings made.^{13,15,16}

A number of studies have demonstrated that dental professionals tend to be more critical of dental esthetic aberrations than the lay population,^{17–19} although this is not always the case.^{20,21} Additionally, the perspective that the raters are viewing the model in may be important.^{16,22} When a full-face perspective is used, the background facial attractiveness of the model and its possible effect on dental esthetic perceptions must also be considered. Chang et al¹⁴ demonstrated different preferences for models of different facial attractivenesses for dental variables that had a facial context.

To achieve an objective measure of a person’s visual attention to the face, eye tracking can be used to record where persons are looking when they view a face. Eye

trackers can provide a quantitative measure of real-time visual attention.²³ The majority of viewing time is spent in fixations (90%), whereas the remaining portion involves saccades, which are the fast eye movements to reposition the fovea, and occur when visual attention is directed to a new area.²⁴

Eye-tracking cameras use video-processing software to track the pupil with infrared or near infrared light, and corneal reflection is used to record visual attention. Viewers are calibrated to several predetermined positions before viewing the images.²⁵ Typically, it is the fixation that is used to determine visual attention. This method maintains the most essential information for understanding cognitive and visual processing behavior.²⁶

Eye tracking has been used in dentistry. Hickman et al²⁷ showed that in well-balanced faces of orthodontically treated patients, no single area had a significantly greater amount of visual attention, and that the mouth was only a small part of the visual attention at 10%. Subsequently, the eye-tracking characteristics of female models with different levels of dental esthetics and background facial attractiveness were reported by Richards et al.²⁸ As a follow-up to this study, Johnson et al²⁹ looked at some esthetic borderline IOTN treatment need levels in women.

Wang et al³⁰ showed a significant deviation in the scan path of pretreatment patients compared with normal and posttreatment patients, and that orthodontic treatment normalizes the scan path.

In this study, we examined male models in the same manner as did Richards et al²⁸ and Johnson et al.²⁹ Our specific aim was to ascertain whether there is a point on the aesthetic component of the Index of Orthodontic Treatment Need (IOTN-AC) when the severity of dental esthetics would be enough to attract the most visual attention in male faces. A secondary aim was to determine whether background facial attractiveness level (attractive, average, unattractive), or the sex of the rater, had any effect on the visual attention to dental esthetics.

MATERIAL AND METHODS

The first preliminary step for the development of this project was to obtain models for background facial images to be used in the study. Potential models were recruited at Ohio State University, Columbus. Two frontal full-face digital images were obtained for each consenting subject (EOS Digital Rebel XT camera, Canon, Melville, NY)– 1 social smile where the participants showed the teeth and 1 photo with no teeth visible. Facial attractiveness was rated from the image with no teeth visible to avoid the potential that the facial attractiveness of the models would be affected by their natural dentition.

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