

RESEARCH AND EDUCATION

Influence of symmetry and balance on visual perception of a white female smile

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The basic principles of natural oral esthetics must be mastered by both clinician and dental technician when restoring the anterior dentition. A checklist for esthetic restorative success was presented by Belser¹ and updated in 2002 with 14 criteria (Fig. 1).² This list covers objective esthetic principles for dental and gingival esthetics that are fundamental for establishing the common elements of the smile and defining its normality. The checklist also allows the identification of visual tensions (variations from the checklist) and the potential need for corrections.

However, integrating dental esthetics into the frame of the smile, face, and, more generally, the individual also relates to a more subjective appreciation. Objective parameters can be applied systematically and globally, yet not lead to a satisfying esthetic outcome. The esthetic result still depends on the balanced integration of fundamental esthetic criteria within the smile and, ultimately, the character of an individual. Additional criteria must be considered, including variations in tooth form, arrangement, and positioning and relative crown lengths, the fine-tuning of the negative space, and lip position.

ABSTRACT

Statement of problem. Clinicians and dental technicians may underestimate what is deemed esthetic by laypersons and dental professionals.

Purpose. The purpose of this study was to define the relative importance of symmetry, visual tension, and balance in the smile.

Material and methods. Images of a white woman were altered to reproduce symmetry, various visual tensions, distinct tooth shapes, and color changes. A 12-question survey was presented to 128 individuals, including 81 dental professionals and 47 laypersons. The survey asked individuals to choose the most desirable and beautiful image in a choice of images.

Results. Raters were most influenced by the maxillary central incisors and then the canines and were more forgiving on visual tensions of the maxillary lateral incisors. Square-shaped teeth were preferred over ovoid and triangular ones. The more upright the canines, the more the smile was perceived as masculine. Teeth whiter than the sclera of the eyes were preferred, with lay individuals choosing the lightest shade available and dental professionals choosing the shade slightly lighter than the sclera. Although participants mostly preferred a symmetrical smile, they opted for the natural face as opposed to symmetrical ones.

Conclusions. Location of visual tension plays a role in perceiving beauty. Symmetrical smiles were considered more pleasant but not symmetrical faces. Imperfections play an essential role in perceiving beauty because they express life, individuality, charisma, and charm. (J Prosthet Dent 2018;120:573-82)

Esthetics and beauty are also influenced by fashion, culture, history, and art. Rufenacht^{3,4} has been a pioneer in applying principles of art and visual perception into dental esthetics, especially introducing the notions of cohesive forces (generally matching to the esthetic checklist) and visual tensions resulting from deviations from normality. Tension or strain can be created by elements causing imbalance in a given composition. The smile can be viewed as a composition in which it is not necessary to eliminate all visual tensions but rather

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Clinical Implications

This study should help the dental team understand the goals of esthetic dentistry. Common goals include symmetry and elimination of visual tensions. Asymmetry and visual tensions create charm, and those elements have different weight depending upon where they are found. Balancing the weight versus eliminating the tensions might be preferred.

provide a balanced perception. The smile can be also perceived as a symphony, with different instruments (different teeth) playing different parts with rhythm and composition. The resulting melody (character) will be different for each patient. The definitive result also implies understanding the human brain as functioning with 2 different modes, the right side usually being more visual and perceptual, with the left side being more verbal and analytical.⁵ Right and left sides of a composition may also have different weight in the visual perception. The goal is to balance the composition.

The purpose of this survey was to investigate the relative importance of symmetry, visual tension location, and balance in the smile. Portrait and smile pictures of a white woman were altered to reproduce symmetry, various visual tensions, distinct tooth shapes, and color changes and were evaluated by dental professionals and laypersons.

MATERIAL AND METHODS

A 25-year-old white woman was selected based on her facial harmony and natural, unaltered dentition. She provided informed consent for the use of her images in the survey and publication of the manuscript. Because of the similar width of the forehead, cheekbones, and jawline, her face was classified as square/rectangular. Twelve sets of frontal views were generated by slightly modifying the original pictures to explore the effect of various visual tensions, color, symmetry, and form (Figs 2-13). Image-editing software (Photoshop CS6 v.13.0.1 x64; Adobe Systems, Inc) and the various tools within the software (mainly the Liquify Filter, but also the Clone Stamp and Spot Healing Brush tools) were used to generate the morphological alterations. The color of the teeth was altered using the selection tool (Magic Wand) and brightness adjustments. The range of questions aimed to cover some of the most common problems in esthetic dentistry. The survey started exploring the importance of gingival health and then investigated which anterior teeth were more likely to be noticed when presenting irregular features (visual tensions related to position and incisal variations). The influence of tooth

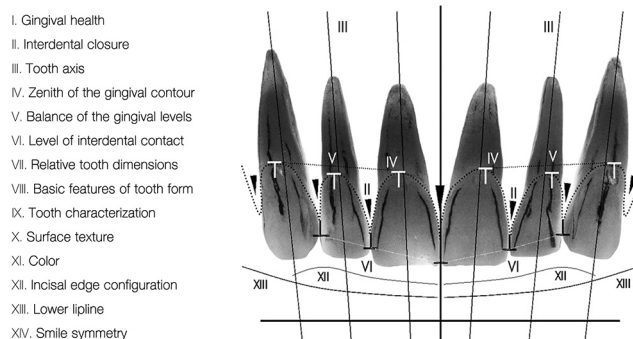


Figure 1. Modified esthetic checklist. From the study by Magne and Belser.²

color in reference to sclera, smile and face symmetry, basic form of anterior teeth, and the relation to facial shape was finally assessed. For each set of pictures, participants were asked to choose the more beautiful smile (questions 1 to 5, 9, and 11), more beautiful face (questions 6 and 8), most desirable shade (question 7), more masculine dentition (question 10), and the smile that better fits the face (question 12).

The survey was created using Free Online Surveys (www.freeonlinesurveys.com) and shared with dental students from various schools, dentists, and dental technicians, as well as lay people from various backgrounds. Participants were anonymous. A total of 128 individuals, including 81 dental professionals and 47 laypersons participated in the study. Different sample sizes were found throughout the survey because some participants failed to answer all the questions.

RESULTS

The results are presented in Figures 2-13 in the form of doughnut charts accompanying each set of images. At least 73% of participants identified as white, and 39% did not have a dental background (laypersons).

Response to question 1 (Fig. 2) demonstrated that healthy gingiva were perceived as more attractive than inflamed gingiva by 88% to 94% of participants. Question 2 (Fig. 3) revealed that dental professionals favored the visual tension on the right canine rather than the left central incisor (64%), while laypersons did not clearly prefer one over the other (51% to 49%). According to question 3 (Fig. 4), both dental professionals (72%) and laypersons (67%) preferred the visual tension on the left central incisor rather than the right central incisor. Responses to question 4 (Fig. 5) demonstrated that both dental professionals (65%) and laypersons (58%) preferred the visual tension on the right canine rather than the left canine. Question 5 (Fig. 6) revealed that both dental professionals and laypersons favored visual tensions on lateral incisors rather than canines, independent of whether present on the left or the right side.

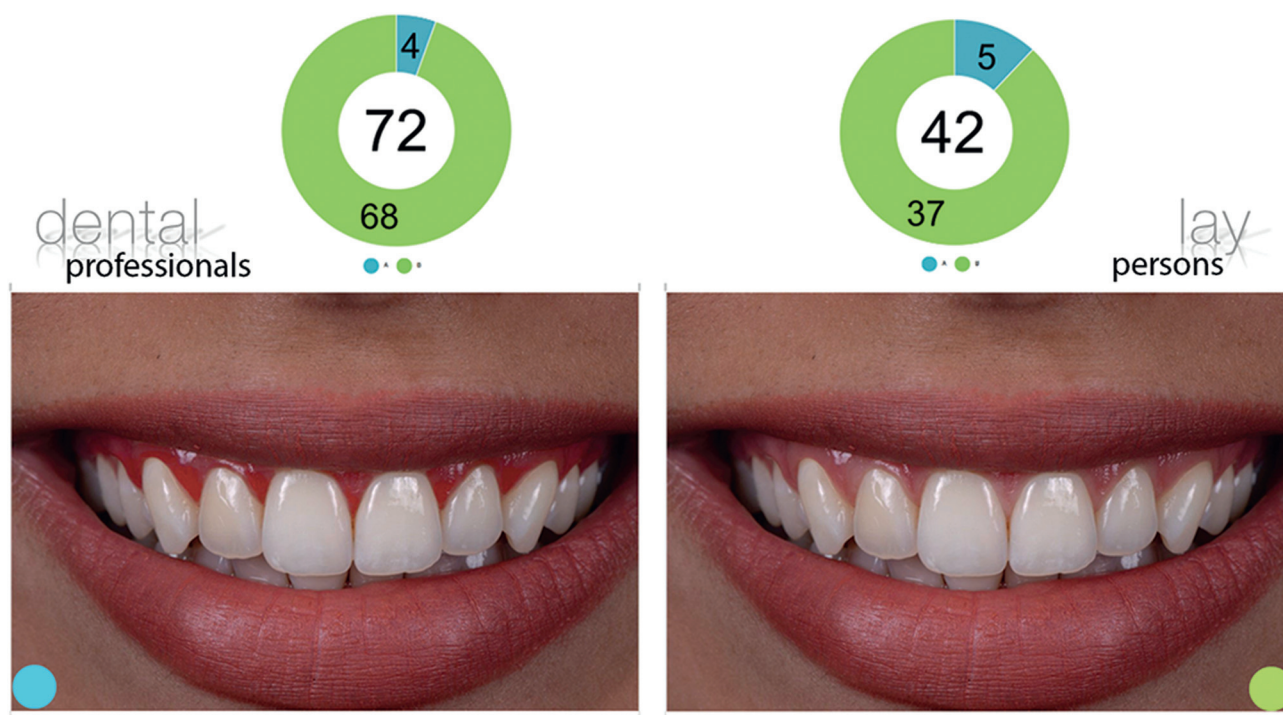


Figure 2. Question 1: Balanced smile with inflamed gingiva (turquoise) or healthy gingiva (green). Donuts show distribution of preferred smile among dental (left donut) and lay (right donut) persons.

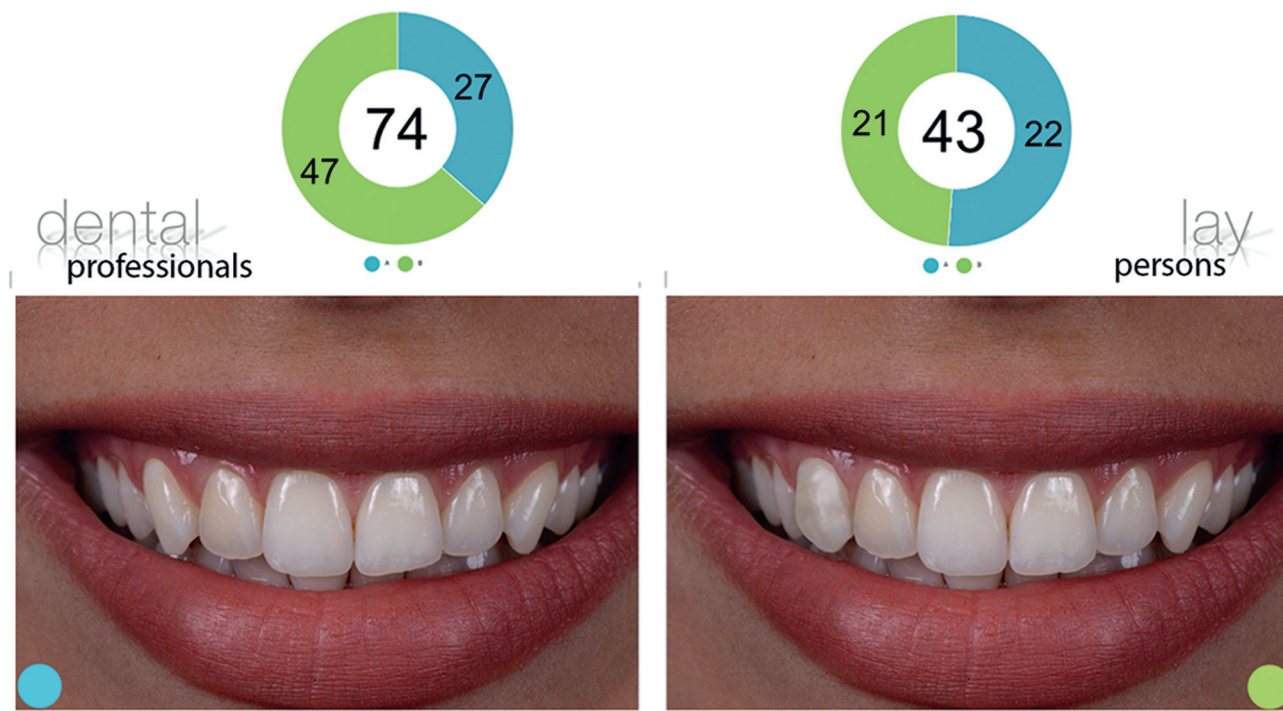


Figure 3. Question 2: Smile with shorter distoincisor edge of left central incisor (turquoise) or smile with distobuccally rotated right canine (green). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

According to question 6 (Fig. 7), the brighter color of the sclera was preferred by 63% of dental professionals, while laypersons did not have a clear preference.

Responses to question 7 (Fig. 8) demonstrated that dental professionals clearly preferred the original tooth color, while laypersons liked the original and bleached smile

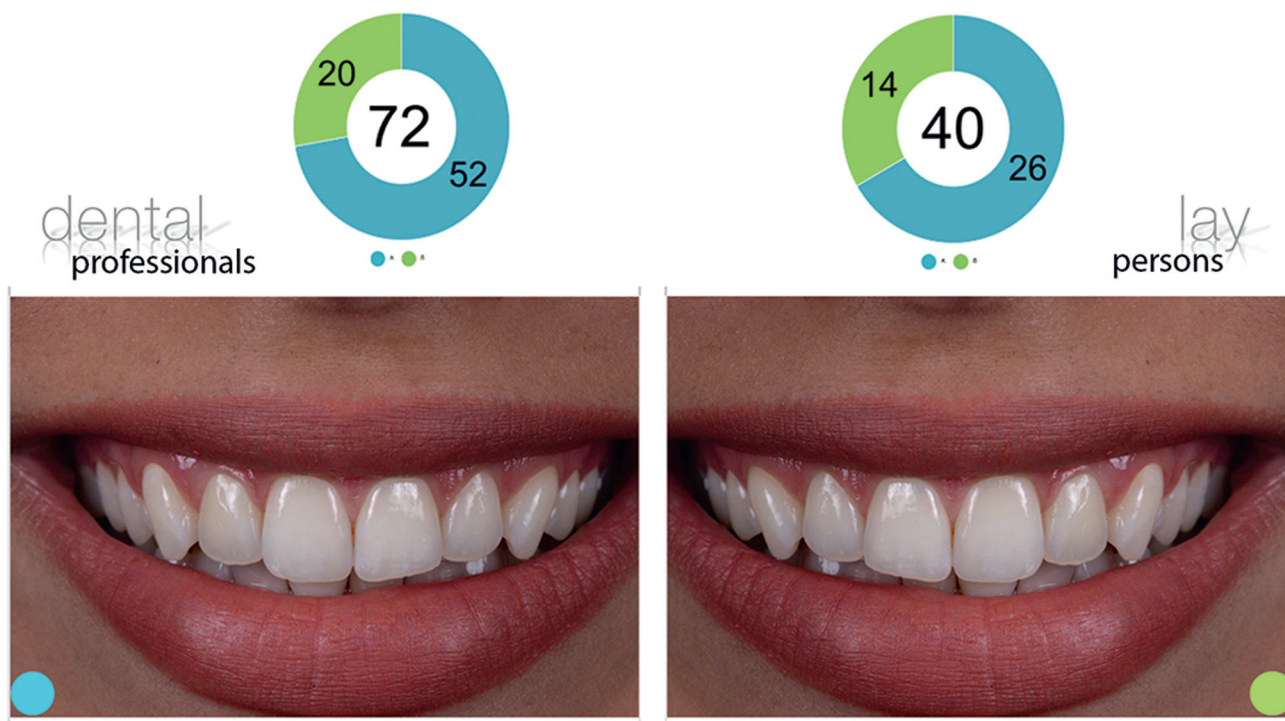


Figure 4. Question 3: Smile with shorter distoincisor edge of left central incisor (turquoise) or smile with shorter distoincisor edge of right central incisor (green). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

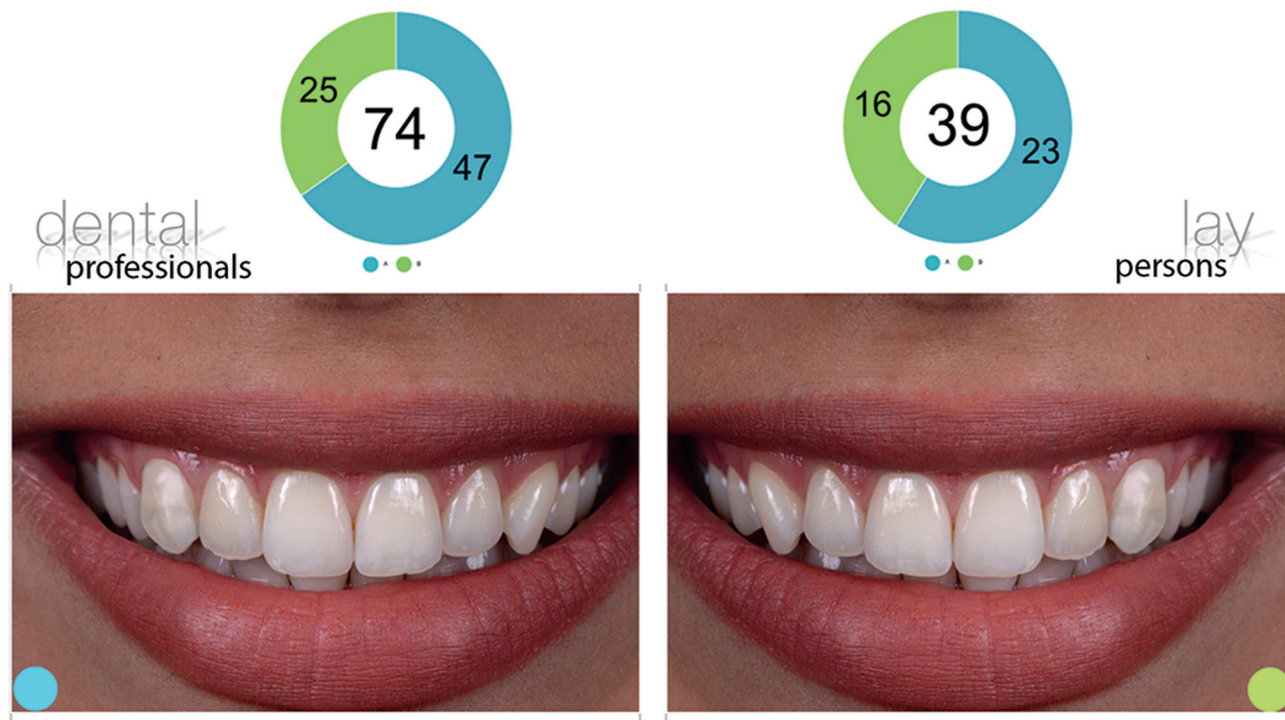


Figure 5. Question 4: Smile with distobuccally rotated right canine (turquoise) and smile with distobuccally rotated left canine (green). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

equally. Both groups had a minimal preference for the darker tooth shade. Question 8 (Fig. 9) revealed that both groups clearly favored the original face. Both symmetrical

faces were less preferred with a slight advantage for the slimmer of the 2 symmetrical portraits (left symmetrical hemifaces). According to question 9 (Fig. 10) both groups



Figure 6. Question 5: Smile with white spot lesion on right lateral incisor (turquoise), smile with white spot lesion on left lateral incisor (green), smile with white spot lesion on right canine (yellow), and smile with white spot lesion on left canine (beige). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

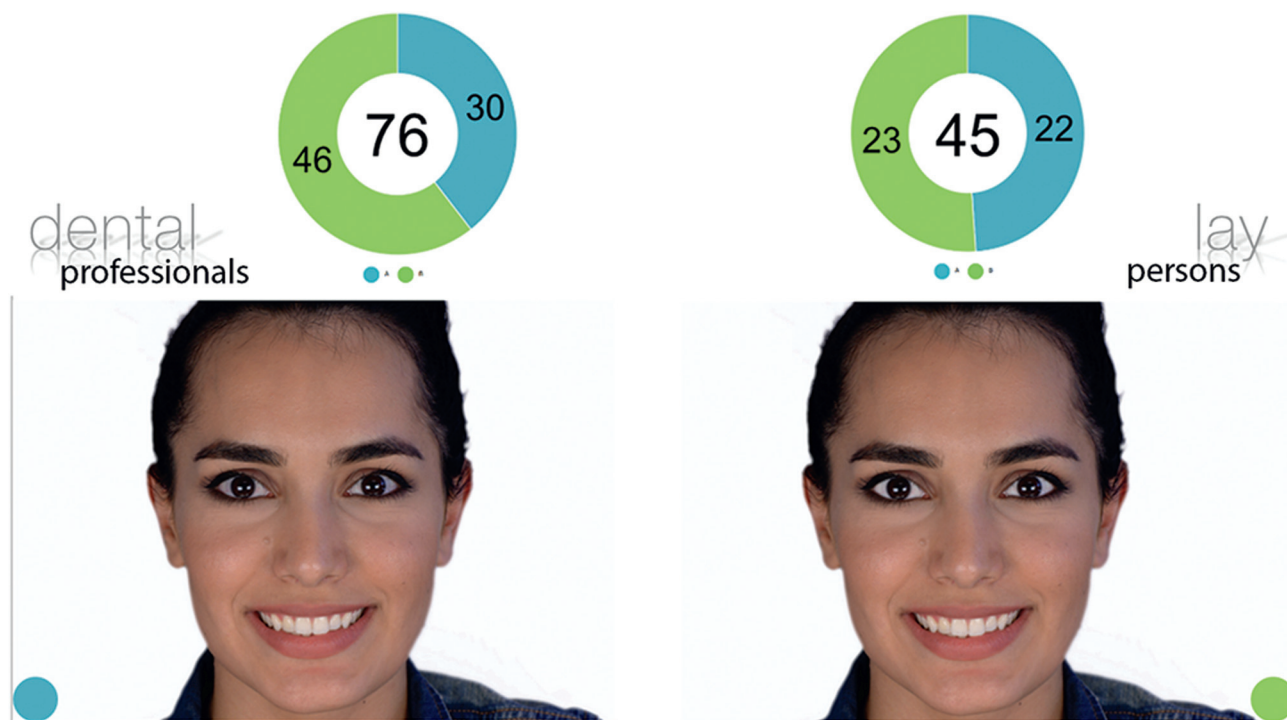


Figure 7. Question 6: Portrait with sclera of eyes darker than original (turquoise) and original portrait (green). Distribution of preferred face among dental (left donut) and lay (right donut) persons.

avored the symmetrical smiles rather than the original. The symmetrical wide smile was clearly the preferred smile for laypersons. Responses to question 10 (Fig. 11) showed that upright canines were considered more masculine in both groups. Question 11 (Fig. 12) revealed that both groups preferred squared incisors over triangular or ovoid ones; this preference was more obvious for dental professionals. According to question 12 (Fig. 13), square or

ovoid teeth were chosen over triangular teeth in both groups, while square teeth were slightly preferred over ovoid ones to match the proposed face.

DISCUSSION

The present study investigated the visual perception of face and smile among dental professionals and laypersons. A

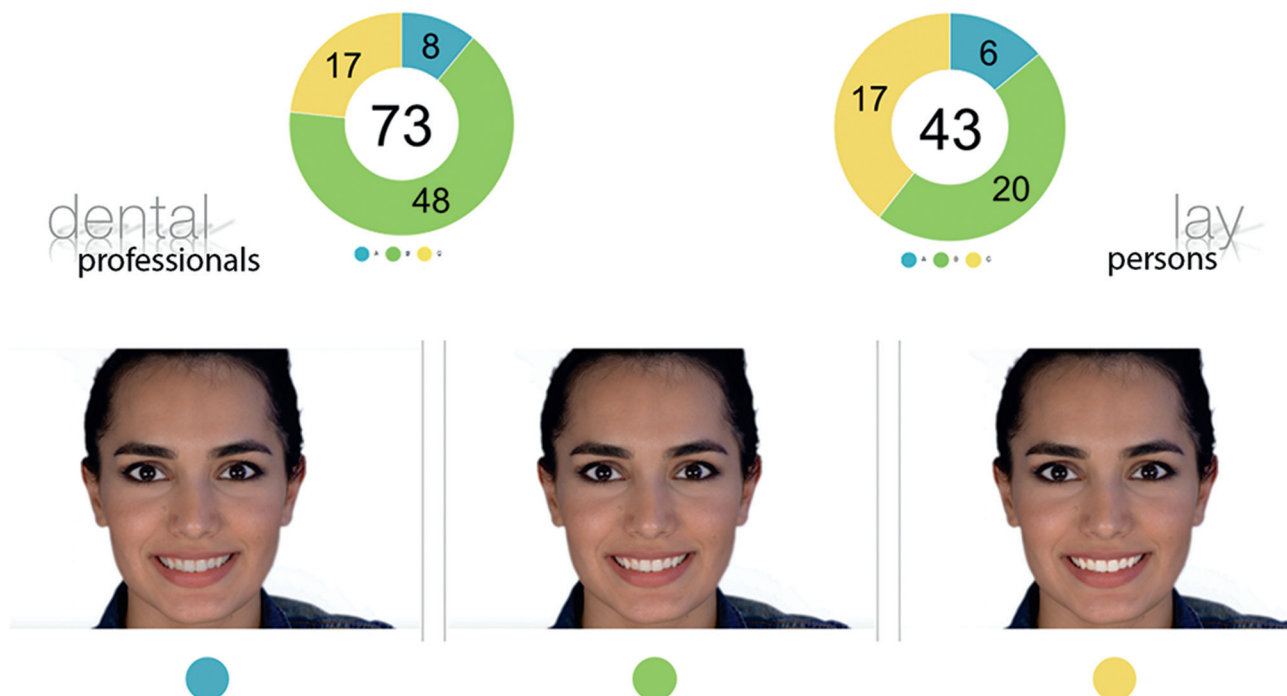


Figure 8. Question 7: Portrait with teeth slightly darker than original (turquoise), original portrait (green), and portrait with teeth slightly lighter than original (yellow). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

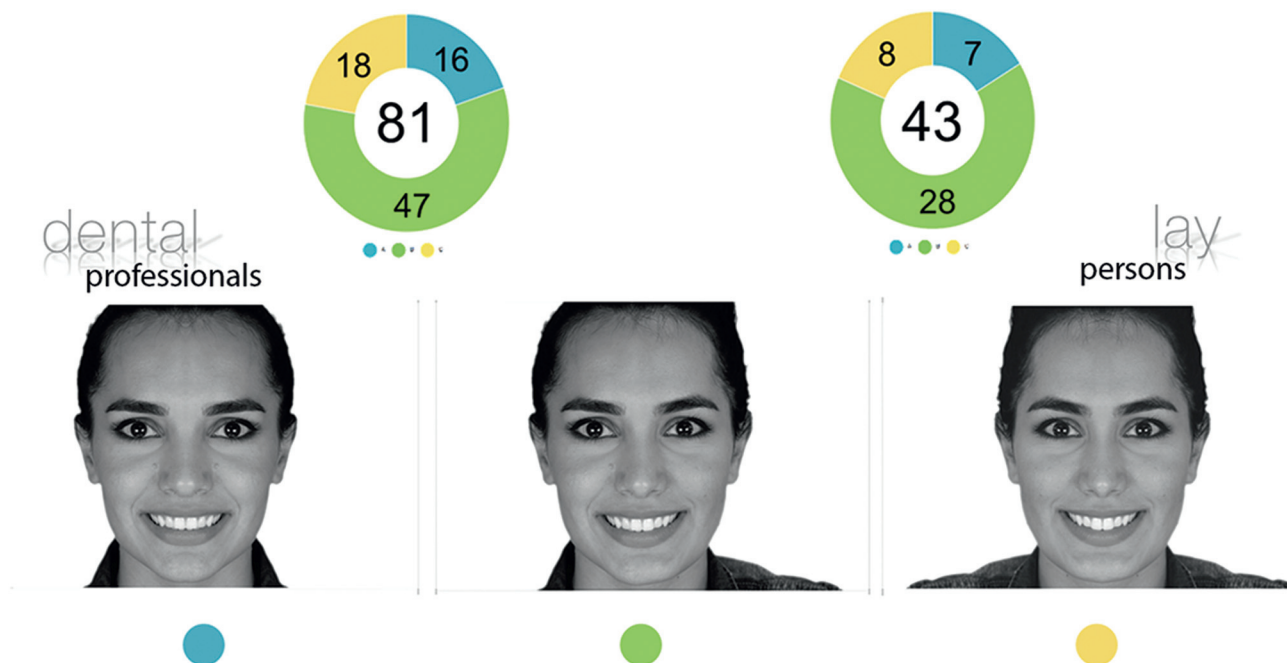


Figure 9. Question 8: Symmetrical portrait (black and white) from mirrored right hemifaces (turquoise), original portrait (green), and symmetrical portrait from mirrored left hemifaces (yellow). Distribution of preferred face among dental (left donut) and lay (right donut) persons.

unanimous answer was found for gingival health, which underlines the concern of both groups for the presence of signs of disease.

The presence of various visual tensions was the focus of questions 2-5 (Figs. 3-6). In question 2, a conflicting

element was introduced in the form of a rotated canine or worn central incisor, generating imbalance. Professionals seemed to dislike such an element when it affected a central incisor rather than a canine. However, in question 5 (Fig. 6), the white spot visual tension appeared more

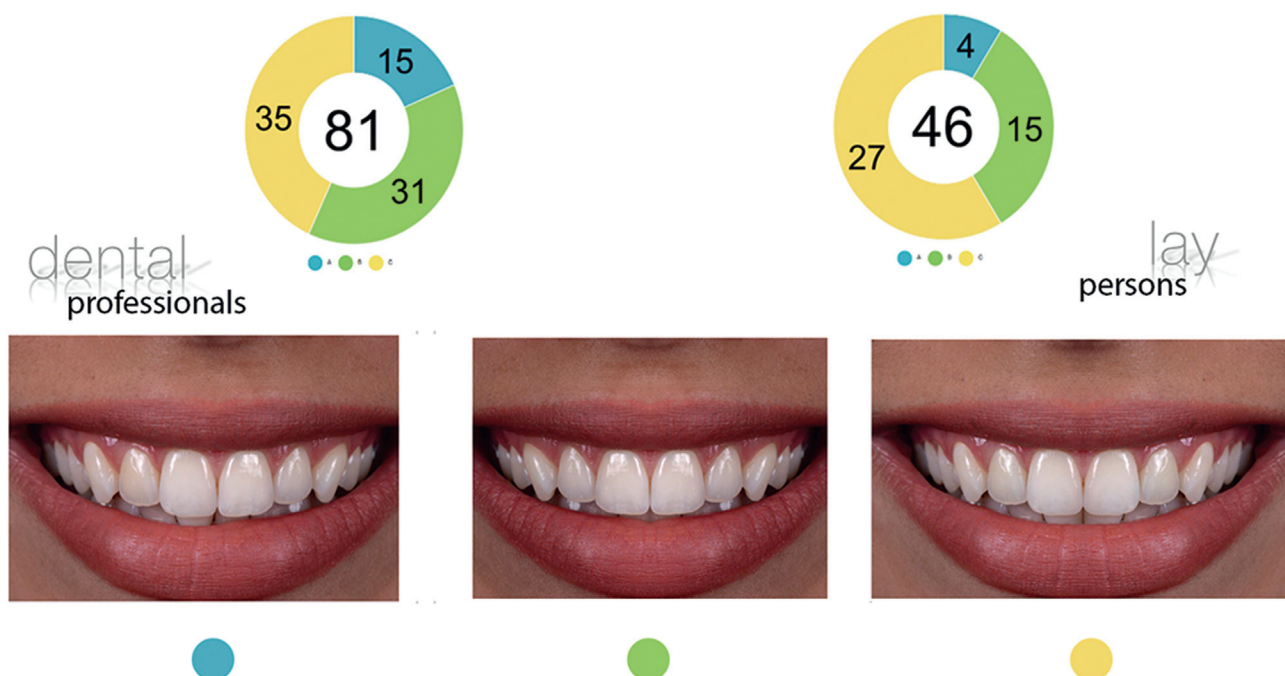


Figure 10. Question 9: Original balanced smile (turquoise), symmetrical smile from mirrored right side of smile (green), and symmetrical smile from mirrored left side of smile (yellow). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

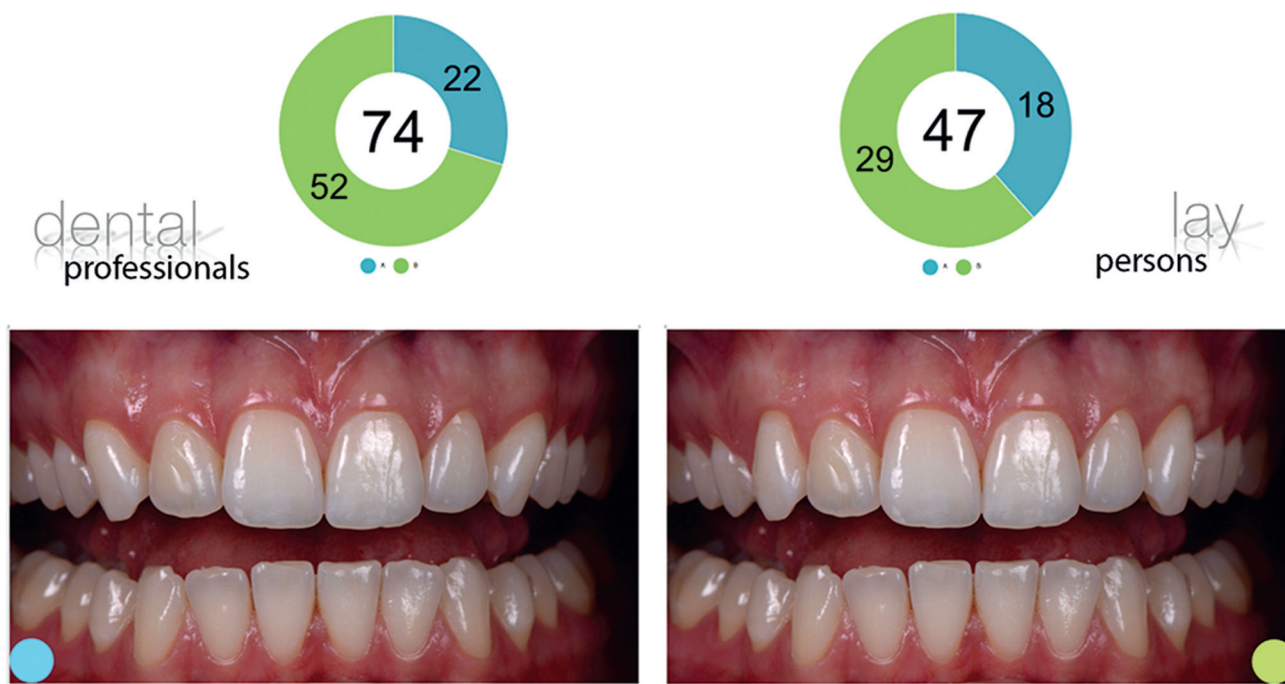


Figure 11. Question 10: Original intraoral view with canted canines (turquoise) and intraoral view with upright canines (green). Distribution of preferred dentition considered more masculine by dental (left donut) and lay (right donut) persons.

problematic when found on canines rather than laterals. From questions 2 and 5, we can speculate that the focus in the smile goes first to central incisors and then canines, while lateral incisors seem to have less visual weight in this regard. This agrees with the concept of dominance,⁶

according to which the central incisors are the dominant teeth of the smile by virtue of their location and size. These results also corroborate findings by Ribeiro et al⁷ about the negative influence of incisal asymmetries when found on central incisors compared with lateral incisors.

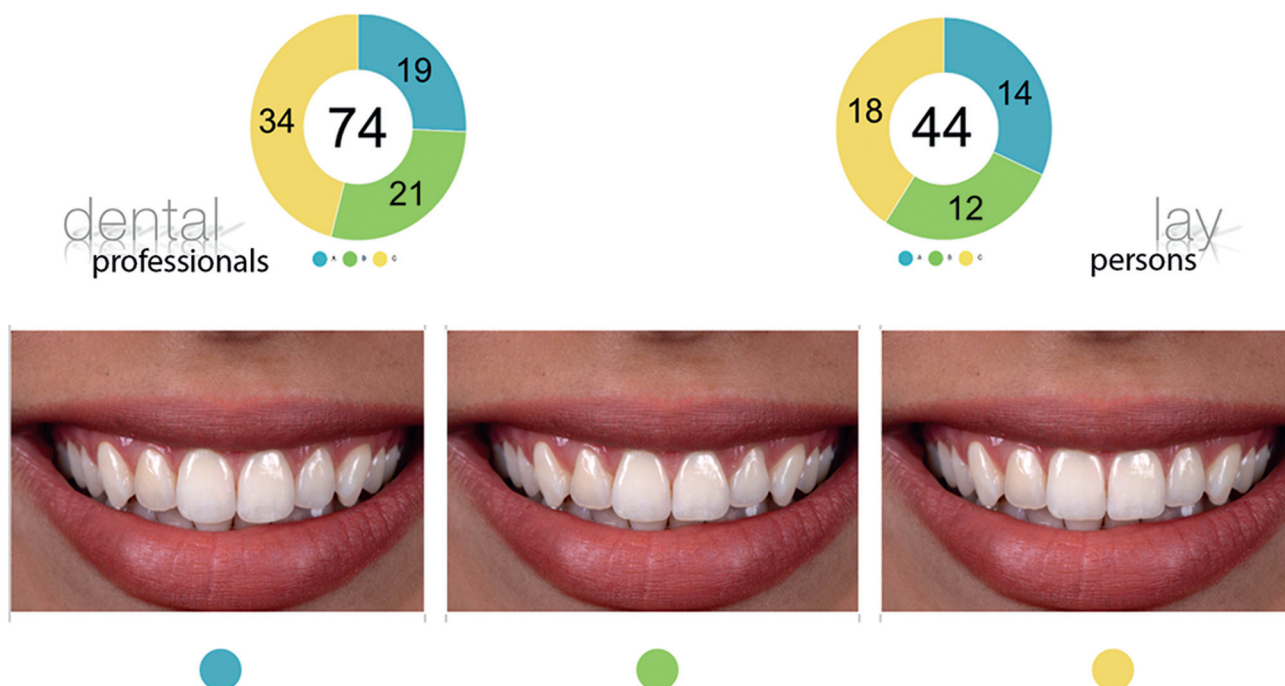


Figure 12. Question 11: Smile with ovoid maxillary incisors (turquoise), smile with triangular maxillary incisors (green), and smile with squared maxillary incisors (yellow). Distribution of preferred smile among dental (left donut) and lay (right donut) persons.

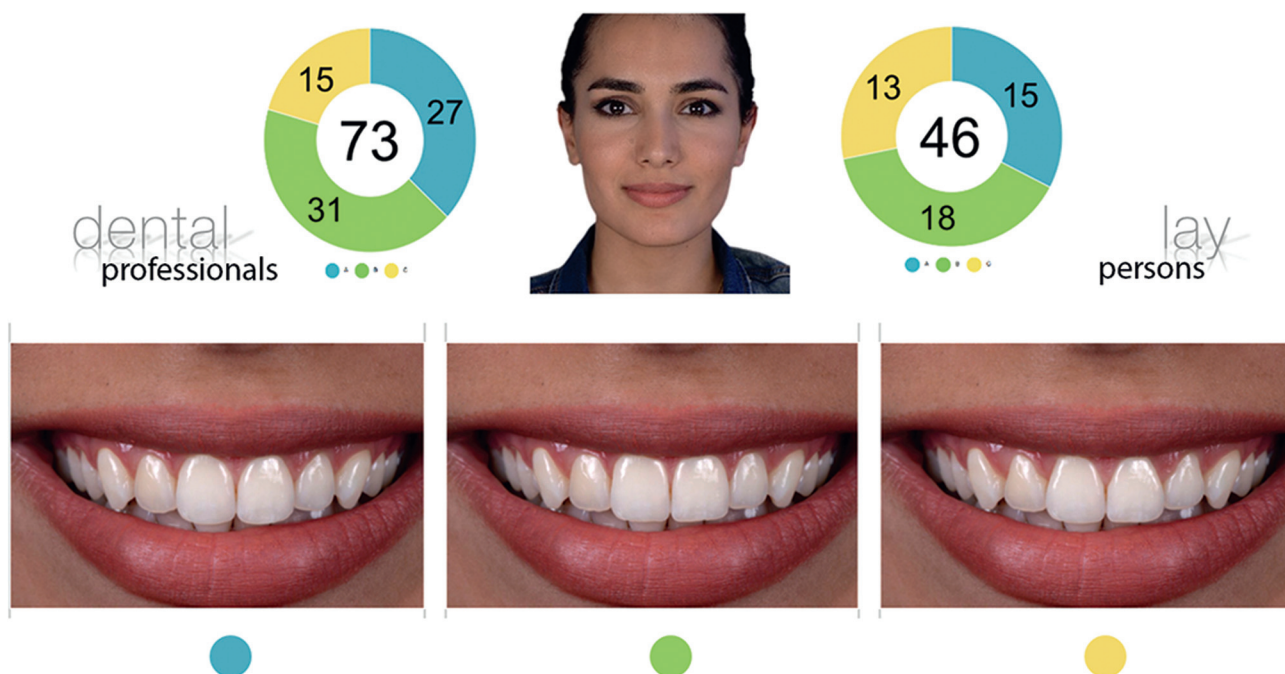


Figure 13. Question 12: Smile with ovoid maxillary incisors (turquoise), smile with triangular maxillary incisors (green), and smile with squared maxillary incisors (yellow). Distribution of preferred smile best matching proposed face by dental (left donut) and lay (right donut) persons.

Questions 3 and 4 explored the influence of the side where the visual tension was placed. However, when canines were compared (question 4), the trend was opposite, with the rotated right canine (left side of the viewer) preferred by both groups over the rotated left canine (right side of the viewer). Participants, like two

thirds of the general population, may have had a right dominant eye,⁸ which is very likely to influence visual perception.⁹ Eye dominance might not have a major influence when the defect is relatively close to the midline (centrals), whereas it becomes more significant when the defect is located away from the midline (canines).

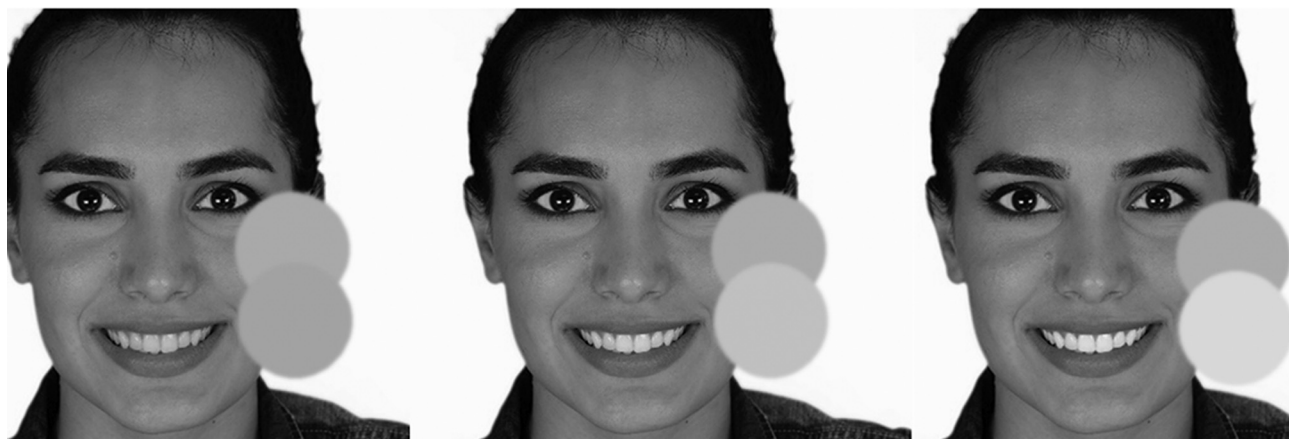


Figure 14. Additional version of [Figure 8](#) in black and white. Added disks corresponding to shade of sclera and teeth.

It is more difficult, however, to explain why for both groups the defect on the left central incisor (right side of the viewer) was less problematic than that on the right central incisor (left side of the viewer) in question 3 ([Fig. 4](#)). The opposite might have been expected because of eye sidedness. Culturally, multiple elements point to the fact that more weight is given to the right side of the viewer, such as in opera (where most important characters usually enter the stage from the right side of the viewer), wedding ring (on left hand but right side when viewed by others), or placement of a pocket square. In this study, participants may have preferred the shortened central incisor on the left side because it also featured a reduced lateral incisor offset, which changed the right unaltered central incisor into the visual tension.

For question 5 ([Fig. 6](#)), sidedness did not seem to matter for the white spot lesion, with lesions on the lateral incisors being preferred to those on the canines by both groups. This is in support of the fact that lateral incisors also appear to be the teeth with more natural variations in shape and position when compared with central incisors and canines.¹⁰

Because teeth and sclera are the brightest elements in the face, the viewer's eyes are drawn to them first.¹¹ It is therefore not surprising to expect a correlation in the brightness of those elements. The color of the sclera did not seem to matter for laypersons in question 6 ([Fig. 7](#)), but brighter sclera was more appealing to dental health professionals, maybe because it bears the connotation of health and liveliness. The same trend was found in question 7 ([Fig. 8](#)) when brightness of teeth was the variable. Laypersons showed more appreciation than professionals for the brightest smile, perhaps because fashion magazines often opt for artificially brightened teeth. An additional version of [Figure 8](#) was generated in black and white by adding disks corresponding to the shade of the sclera and the teeth ([Fig. 14](#)). The color of the disks was determined with the color-picking tool in Photoshop (Eye Dropper tool) applied to the teeth and sclera. The darker smile almost perfectly

matched the brightness of the sclera but was the least favored by both professionals and laypersons (see [Fig. 8](#)). This information should be considered in deciding the extent of tooth bleaching. The color-picking tool applied to large disks overlayed in the image (available in most graphic software) is a straightforward way to demonstrate to the patient the relationship between tooth and sclera brightness.

Questions 8 and 9 ([Figs. 9, 10](#)) explored the effect of symmetry on visual perception. While the original asymmetrical face was clearly preferred over symmetrical ones, the opposite was found when looking at the smile alone. Symmetrical smiles were largely preferred by both laypersons and dental professionals. The wide symmetrical smile was also favored compared with the narrow symmetrical version ([Fig. 10](#)), maybe due to its fuller and more voluptuous connotation. No one has a perfectly symmetrical face, which may be why the fake symmetrical versions of our model were not perceived as attractive or normal. Facial asymmetry attractiveness demonstrates our uniqueness or charm. However, symmetrical teeth were preferred, which supports the findings of Ribeiro et al¹⁷ about the negative influence of incisal asymmetries. The discrepancy in the perception of symmetry when speaking about the face or the teeth is difficult to explain. The left side of the face is known to be more expressive than the right side in adults¹² because of the dominant role of the right cerebral hemisphere in emotion processing. It is possible that the smile without face ([Fig. 10](#)) removes the emotional component and inhibits in turn the lateralization of visual perception.

Question 10 ([Fig. 11](#)) revealed an important element in the perception of gender in the smile and demonstrated that upright canines looked more masculine. This is in agreement with Lombardi⁶ who calls the straight canine "vigorous" (pointier tip) and the more slanted canine "soft" (rounder tip). While no tooth shapes can reveal the sex of an individual,¹³ there are tooth shapes that are associated with softer (feminine) or masculine (squared) traits.¹⁴ In that regard, slanted canines can be viewed as more feminine.

The general preference for squared incisors (over triangular or ovoid ones—shown in question 11) may reflect the most balanced type of shape. The sensory qualities of a square are transitional between the triangle and the circle. The circle is a transitory form (curvature), whereas the triangle is exactly opposite with 3 acute tensions (straight lines). The square is intermediate with its 4 calm tensions (4 edges), also the synonym of maturity. Preference for squared teeth reflects our brain processing towards stability. Note that less gingiva was visible in the picture of the squared teeth. The papillae look narrower and the smile appears less “gummy”, which may have influenced the results.

Answers to question 12 (Fig. 13) shows the difficulty for laypersons to associate a face with a tooth shape. Here again the square shape was preferred but only slightly over the other shapes. Because the proposed face was more a square type, professionals preferred the squared teeth. It is, however, difficult to relate tooth forms to face shape. There is a lack of scientific evidence to link those 2 elements. In one approach, the tooth shape was compared with the inverted facial shape and did not lead to any correlation. Another approach to determine the shape of the face is to use the interpupillary line and convergence with nose alae. This would lead to a triangular shape. But it seems that participants in the present study were more influenced by the angular jaws and width of the patient’s mouth.

Visual perception is a key element for the dental professional. A very good approach to develop adequate visual perception is to draw. Drawing requires 5 perceptual skills⁵ (edges, spaces, relationship, light and shadows, and gestalt), which are all significant for the dental professional during his work. Drawing allows increasing the operator’s creativity by stimulating the right brain’s creative language mode and is a very good approach to teach esthetic dentistry.¹⁵

The results of this study should help the dental team to understand the goals of esthetic dentistry. Common goals include symmetry and elimination of visual tensions, while it is also believed that a good composition is made of asymmetry and visual tensions, which in turn create charm and uniqueness. Objectivity (rational) and subjectivity (experience) have to be carefully combined when restoring a smile. This study did not explore the entire spectrum of smile analysis but generated elements to understand important aspects of interactions between common criteria. Seventy-three percent of the participants were white, which may have influenced the results. Hence, the outcomes are not generalizable. Various perceptions based on different cultural backgrounds and ethnicity call for further investigations. Another limitation of this survey is that it uses a 2-dimensional assessment based on images only. Further studies should be undertaken in a 3-dimensional approach using digital face scanning.

CONCLUSIONS

Based on the findings of this survey, the following conclusions were drawn:

1. The location of visual tension plays a role in perceiving beauty.
2. The focus in the smile goes first to the maxillary central incisors and then canines, whereas lateral incisors seem to have less visual weight in this regard.
3. Square-shaped teeth were preferred over ovoid and triangular ones.
4. Sidedness might be less significant when visual tensions are relatively close to the midline (centrals), but it becomes more significant when the defect is located away from the midline (canines). In this case, visual tension appeared more problematic when located on the right side of the viewer (left side of the patient).
5. Upright canines were considered more masculine.
6. Both professionals and laypersons preferred tooth color to be brighter than the color of the eye sclera.
7. Symmetrical smiles are considered more pleasant but not symmetrical faces.

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