Laypeople’s preferences regarding frontal dentofacial esthetics

Tooth-related factors

Matthew Witt, DMD; Carlos Flores-Mir, DDS, DSc

Dental care professionals can change tooth-related esthetic factors such as position, shape, size and proportion. Researchers have shown that the lay public is able to identify a few factors that have an effect on an esthetic smile, however, they are less critical than are dental care professionals regarding the influence of some of these factors. Furthermore, factors such as sex and the facial frame surrounding the teeth appear to affect the lay public’s perceptions.

Dentoalveolar esthetics are a popular focus of contemporary dentistry. Inquiry into and understanding of the general public’s preferences with regard to dentofacial esthetics are essential to appreciate fully patients’ chief concerns, their perceptions of treatment need and their expectations, as well as the way in which their peers will judge their appearances.

Therefore, the objective of this systematic review is to summarize and critique the literature regarding the lay public’s esthetic evaluations of tooth-related factors that influence the anterior region of the mouth.

METHODS

With the assistance of a health sciences reference librarian, we conducted a systematic search of electronic databases (MEDLINE, PubMed, Embase, Cochrane Library and Web of Science) until May 31, 2010. We applied no limits to the search.

Background. Researchers have conducted extensive studies regarding dentoalveolar factors that affect anterior dental esthetics; however, there is no consensus regarding laypeople’s perspectives on these factors.

Methods. The authors conducted a systematic search of electronic databases (MEDLINE, PubMed, Embase, Cochrane Library and Web of Science) until May 2010. They identified and selected articles in which investigators explored anterior dental esthetics from a layperson’s perspective, and they assigned methodological scores to the studies.

Results. Seventeen articles met the inclusion criteria. The authors determined laypeople’s preferences for tooth shape, tooth size and proportion, and incisor position.

Conclusions. The results of this literature review show that laypeople did not discriminate between square, square-round (basically square with rounded mesioincisal and distoincisal angles) and round incisors or between canine shapes when displayed in photographs of female models. They preferred square-round incisors to square incisors and flat canines (when paired with round incisors) in photographs of male models. Most laypeople appeared to prefer unworn dentitions, small teeth in photographs of female models and large teeth in photographs of male models, width-to-length ratios in central incisors between 75 and 85 percent, and tooth-to-tooth proportions between the lateral and central incisors between 50 and 74 percent. Laypeople discerned a 10° angulation of one or both central incisors as being less attractive. Significant discrepancies in perceptions existed for incisal edges. Most laypeople preferred an overbite of 2.0 millimeters, with some leeway (around 2 mm). The authors noted that laypeople had a preference for no diastemas.

Clinical Implications. Laypeople have varying degrees of sensitivity to certain esthetic issues. Thus, clinicians can expect their patients to be more attentive to some dental esthetic factors than to others.

Key Words. Tooth; dentofacial esthetics; smile; laypeople.

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electronic searches. Appendixes 1 through 5 (available as supplemental data to the online version of this article [found at “http://jada.ada.org”]) document the search strategies.

We scrutinized the abstracts of the retrieved reports and identified those that seemed to meet our initial selection criteria of studies in which researchers investigated variables that affect dental esthetics from a layperson's perspective. For articles that did not contain an abstract (except the title, which appeared to be related to the inclusion criteria), we retrieved and reviewed the entire article before deciding whether to include it. In cases involving differences of opinion, we discussed the article until we reached consensus.

We then obtained the complete articles that met our initial selection criteria and performed the second stage of article selection. We excluded articles at this stage if they were descriptive, an editorial or a letter; were investigations of facial esthetics only, without any dentoalveolar link; were investigations of dental esthetics from a lateral aspect rather than from a frontal aspect; pertained to denture teeth only or involved drawings or diagrams of teeth; required patients to analyze their own dental esthetics; did not include identification of the relative contribution of specific variables (such as smile arc, buccal corridor, tooth shape) but combined all variables together in the esthetic evaluation; compared a layperson's esthetic perspectives with those of another group according to level of agreement only without reporting the layperson's specific opinions.

We selected these criteria with the expectation that they would result in a homogeneous sample of opinions solely from a layperson's perspective regarding another person's dentoalveolar and facial appearance.

We then discussed the articles and resolved any differences of opinion to arrive at a consensus regarding the final selected articles. We then performed a secondary (manual) search by reviewing the reference lists of the selected articles to identify any article that met the initial inclusion criteria but had been missed by the electronic searches.

We then evaluated all selected articles according to criteria shown in Table 1 and assigned a methodological score to each report. We need to point out that we did not use scoring to exclude articles from the review. Rather, the purpose of scoring was to enable us to assign relative weights to the studies because of the myriad ways in which they were conducted. We did not validate the selected criteria.

RESULTS

Although we geared the systematic search to identify all factors that affect perceptions of anterior dental esthetics, this systematic review focuses on four tooth-related factors only: tooth shape, tooth size, tooth proportion and incisor position. We will evaluate other factors that influence a layperson's perception of anterior dental esthetics in future systematic reviews. Examples of these are periodontal factors (midline deviation, smile arc, buccal corridors, occlusal plane orientation and gingival display) and optical factors (tooth shade and translucency).

The appendices (available as supplemental data to the online version of this article [found at “http://jada.ada.org”]) document the number of results yielded by the searches, the articles selected from the searches on the basis of the abstracts and the articles that met the final inclusion criteria. Of the articles that met our initial selection criteria, only three were rejected after undergoing a comprehensive review. Researchers in one of these studies investigated only the agreement between different groups of laypeople with respect to their esthetic perspectives; investigators in one study used dentures as the survey stimulus; and one article was written in Russian and could not be included because of difficulty in finding a translator.

Seventeen articles met our inclusion criteria for the systematic review. Table 2 (page 638) provides a summary of each article that met the inclusion criteria, as well as the methodological scores assigned to them. The highest score assigned to an article was 20 points and the lowest score assigned was 13 points (out of a total of 22 possible points).

DISCUSSION

Methodological scoring. Apart from a few studies conducted by the same authors, the studies described in the selected articles used unique methodologies. As a result, direct comparison of the studies’ results and conclusions was cumbersome. Consequently, we assigned methodological scores on the basis of specific criteria to facilitate our comparison of the studies’ conclusions.

We penalized some studies for not including pertinent information, which may have been the

ABBREVIATION KEY: VAS: Visual analog scale.
result of space limitations imposed by the
journal. Therefore, we attempted to contact the
authors of these articles to clarify some points.

We believe that the opinions of fewer than 10
laypeople are unlikely to represent those of the
general public. However, it is difficult to deter-
mine the point at which the sample size
becomes representative of the general public.
None of the investigators in our selected studies
stated how they calculated the sample size to
have adequate statistical power. Thus, the
range of scores is arbitrary, and we assigned
higher scores to studies that included a greater
number of judges.

Few articles mentioned the population from
which the researchers recruited the sample of
laypeople and whether they did this in a
random fashion. When assigning scores to the
articles, we took into consideration the type of
laypeople participating in the studies. We
decided that laypeople should be selected ran-
domly from a public setting (such as a shopping
mall, airport, neighborhood) because their opin-
ions more likely would represent those of the
general public. We awarded higher scores to
articles in which the authors attempted to
take the general public in this manner. Par-
ticipants in samples drawn from dental patient
pools might have an enhanced awareness of, or
education about, dentofacial esthetic issues;
therefore, they may not be representative of the
general public. If this is true, the downside of
valuing the opinions of the general public over
those of dental patients is that dentally edu-
cated patients may express dissatisfaction with
treatment objectives that reflect the views of
laypeople drawn randomly from a public
setting.

Studies varied widely in terms of the presen-
tation of photographs to laypeople (that is, judges), but we found six general types. We
weighted intraoral views higher than perioral
views, which, in turn, we weighted more highly
than full-face views. We decided to keep to a min-
imum the influence of extraoral variability in
photographs, because specific features, such as
facial form, face and hair color, and sex, may
influence the layperson’s perception of the dental
esthetics.

With the advent of software programs to
manipulate digital photographs, it is possible to
alter specific dental features such as the mid-
line, buccal corridors and gingival display while
keeping other facial features constant, thereby
eliminating the variability in photographs. The
majority of studies involved some degree of dig-
ital manipulation of photographs. How-
ever, the degree of realism that can be achieved
depends on the skill of the operator performing
the manipulation, and it is possible that some of
the generated images were not realistic.

Several investigators justified the use of digi-
tally altered perioral photographs rather than
full-face photographs because they believed that
perioral photographs focus the judges’ attention
on the dental esthetics and remove confounding

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<th>CRITERION</th>
<th>SCORE/ POSSIBLE SCORE</th>
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<td>No. of Participants (Judges) Involved in Evaluation</td>
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<tr>
<td>&lt; 10</td>
<td>1/4</td>
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<tr>
<td>10-29</td>
<td>2/4</td>
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<td>30-99</td>
<td>3/4</td>
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<td>≥ 100</td>
<td>4/4</td>
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<tr>
<td>Participant Source</td>
<td></td>
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<tr>
<td>Not mentioned</td>
<td>1/3</td>
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<tr>
<td>Patients or patients’ parents from a dental office</td>
<td>2/3</td>
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<tr>
<td>People recruited from a public space (such as a mall or a neighborhood)</td>
<td>3/3</td>
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<tr>
<td>Presentation Type</td>
<td></td>
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<tr>
<td>Patient’s full-face photograph</td>
<td>1/6</td>
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<tr>
<td>Patient’s perioral photograph</td>
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<tr>
<td>Patient’s intraoral photograph</td>
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<tr>
<td>Intraoral photograph unchanged except for altered teeth</td>
<td>4/6</td>
</tr>
<tr>
<td>Perioral photograph unchanged except for altered teeth</td>
<td>5/6</td>
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<tr>
<td>Full-face photograph unchanged except for altered teeth</td>
<td>6/6</td>
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<tr>
<td>Viewing Protocol</td>
<td></td>
</tr>
<tr>
<td>Viewing procedure not described</td>
<td>1/4</td>
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<tr>
<td>Participant viewed more than one photograph at a time; participant manipulated a digital photograph to find an acceptable value</td>
<td>2/4</td>
</tr>
<tr>
<td>Participant viewed one photograph at a time; multiple viewings of each photograph allowed</td>
<td>3/4</td>
</tr>
<tr>
<td>Participant viewed one photograph at a time; no rereviewing allowed</td>
<td>4/4</td>
</tr>
<tr>
<td>Intraexaminer Reliability</td>
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<tr>
<td>No test of reliability mentioned</td>
<td>1/2</td>
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<tr>
<td>Reliability tested (evaluation repeated or photograph viewings repeated in series)</td>
<td>2/2</td>
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<tr>
<td>Scoring Technique</td>
<td></td>
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<tr>
<td>Rank ordering of available photographs</td>
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<tr>
<td>“Acceptable” versus “unacceptable”</td>
<td>2/3</td>
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<tr>
<td>VAS,* Likert scale or other numerical scoring method</td>
<td>3/3</td>
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</table>

* VAS: Visual analog scale.
### TABLE 2

<table>
<thead>
<tr>
<th>Study</th>
<th>Layperson Sample</th>
<th>Study Methods</th>
<th>Results</th>
<th>Methodological Score*</th>
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<tbody>
<tr>
<td>Anderson and Colleagues, 2005</td>
<td>102 patients selected randomly from dental college waiting room</td>
<td>Judges evaluated 18 color photographs of a man’s or a woman’s smiles displayed in a booklet; the booklet of the woman’s smiles was created by taking photographs of 18 unique veneer restorations of the six maxillary anterior teeth; the booklet of the man’s smiles was created by digitally transferring the photographs of the woman's teeth onto a single male smile; photographs distributed randomly; no mention of judges’ rereviewing photographs or of reliability testing; scoring by visual analog scale (VAS) for esthetics</td>
<td>Judges did not discriminate between incisor shapes in photographs of the woman; they preferred square-round incisors to square incisors in photographs of the man; judges did not indicate a preference for canine shape in photographs of the woman; they rated flat canines as more attractive than round or pointed canines when paired with round incisors in photographs of the man</td>
<td>18</td>
</tr>
<tr>
<td>Brisman, 1980</td>
<td>160 patients from the greater New York City area</td>
<td>Judges evaluated photographs that differed in terms of tooth shape; photographs presented simultaneously; no mention of reliability testing; scoring based on ranking images with regard to preference in general and preference with regard to one’s own dentition</td>
<td>Sixty percent of men preferred so-called masculine square-ovoid central incisors and 40% preferred so-called feminine tapered-ovoid central incisors; 69% of women preferred square-ovoid central incisors and 31% preferred tapered-ovoid central incisors; 58% of men preferred square-ovoid central incisors and 42% preferred tapered-ovoid central incisors for their own dentition; 65% of women preferred square-ovoid central incisors and 35% preferred tapered-ovoid central incisors for their own dentition</td>
<td>13</td>
</tr>
<tr>
<td>Carlsson and Colleagues, 1998</td>
<td>254 laypeople (mostly patients) from seven cities across the world</td>
<td>Judges evaluated five sets of frontal full-face photographs of a man and woman that had been altered digitally with respect to tooth size, tooth form, tooth color, smile line or presence of a diastema; all photographs in each set were presented simultaneously; no mention of reliability testing; judges were asked to select the variation they liked best in each set of photographs</td>
<td>Forty-six percent of judges preferred small teeth in photographs of the woman and 44% preferred medium teeth; 57% of judges preferred large teeth in photographs of the man and 38% preferred medium teeth; 56% of judges preferred oval incisors in photographs of the woman and 30% preferred rectangular incisors; 71% of judges preferred rectangular incisors in photographs of the man and 23% preferred oval incisors; 96% of judges preferred no maxillary midline diastema in photographs of the woman; 94% of judges preferred no diastema in photographs of the man</td>
<td>16</td>
</tr>
<tr>
<td>Geron and Atalia, 2005</td>
<td>100 dental patients</td>
<td>Judges evaluated 75 frontal perioral photographs of people smiling and speaking in which the gingival display or tilt of the incisal plane was altered digitally; photographs were distributed randomly; no mention of rereviewing photographs or of reliability testing; scoring on a 10-level Likert esthetic scale</td>
<td>Judges graded incisal plane tilting as unesthetic if more than 2° of deviation from the horizontal plane in both clockwise and counterclockwise directions</td>
<td>18</td>
</tr>
<tr>
<td>Gule-e-Erum and Fida, 2008</td>
<td>12 laypeople (orthodontic patients, attendants, others)</td>
<td>Judges evaluated 46 frontal full-face photographs of a male and female model that were altered digitally with respect to buccal corridors, incisal show/line, smile arc, midline or axial incisal angulation; no mention of rereviewing photographs; scores invalid if inconsistent with those for contralateral side; scoring on a five-level Likert esthetic scale</td>
<td>Judges rated a 5° axial incisal angulation as unesthetic in photographs of a male and female model</td>
<td>19</td>
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* The total possible score was 22.
### TABLE 2 (CONTINUED)

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<tr>
<td>Ker and Colleagues, 17 2008</td>
<td>243 laypeople from four U.S. cities</td>
<td>Judges evaluated frontal perioral photographs of a sex-neutral face in which numerous esthetic parameters were modifiable continuously by a computer program; judges manipulated photographs by use of a slider bar; reliability testing done by use of weighted κ values; judges scored photographs by selecting the arrangement that was most acceptable and by selecting the first arrangement that was unacceptable</td>
<td>Maximum tolerable overbite was 5.7 millimeters, ideal overbite was 2.0 mm and minimum tolerable overbite was 0.4 mm; maximum tolerable maxillary central-to-lateral step was 2.9 mm, ideal step was 1.4 mm; many judges preferred even incisal edges; maximum tolerable incisal cant was 4°, ideal occlusal cant was 0°</td>
<td>18</td>
</tr>
<tr>
<td>King and Colleagues, 18 2008</td>
<td>40 clerical and research staff members at a dental college</td>
<td>Judges evaluated an animated frontal perioral photograph of a smiling person in which the vertical position of the maxillary lateral incisors was morphed continuously from a position 2.2 mm above the incisal edge of the central incisors to 1.4 mm past the incisal edge of the central incisors; the photograph was modified continuously; each judge took the test six times to determine ideal position and another six times to determine range of acceptability; scoring based on selection of most pleasing lateral incisor position and on selection of range of acceptable lateral incisor positions</td>
<td>Mean upper limit of acceptability for incisal edge of lateral incisor: 1.10 mm apical to incisal edge of central incisor; mean most pleasing position for incisal edge of lateral incisor: 0.61 mm apical to incisal edge of central incisor; mean lower limit of acceptability for incisal edge of lateral incisor: 0.26 mm apical to incisal edge of central incisor</td>
<td>17</td>
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<tr>
<td>Kokich and Colleagues, 5 1999</td>
<td>74 laypeople from the community</td>
<td>Judges evaluated 40 frontal perioral photographs of smiling people that had been altered digitally in terms of maxillary central incisor crown length, maxillary lateral incisor crown width, maxillary incisor crown angulation, maxillary midline, open gingival embrasure, gingival margin, incisal plane and gingiva-to-lip distance; more than one photograph viewed at one time; no mention of reliability testing; scoring by VAS for attractiveness</td>
<td>Threshold for crown length was 2 mm shorter than ideal maxillary central incisor length; threshold for crown width was 4 mm narrower than ideal maxillary lateral incisor width; threshold for crown angulation was 2 mm from ideal maxillary incisor angulation; threshold for incisal plane cant was 3 mm</td>
<td>15</td>
</tr>
<tr>
<td>Kokich and Colleagues, 6 2006</td>
<td>66 laypeople from the community</td>
<td>Judges evaluated 35 frontal perioral photographs of smiling female models that had been altered digitally in terms of crown length (asymmetrically), crown width (asymmetrically without altered crown length and asymmetrically with proportionally altered crown length), midline diastema, papillary height (with unilateral discrepancy and bilateral discrepancy) and gingiva-to-lip distance; more than one photograph viewed at a time, no reliability testing performed; scoring by VAS for attractiveness</td>
<td>Crown length threshold was a 1.5- to 2.0-mm discrepancy in length of one maxillary central incisor; crown width threshold was a 2.0-mm discrepancy in width of one maxillary lateral incisor; tooth proportion threshold was a 4.0-mm discrepancy in width (with proportionate decrease in height) of one maxillary lateral incisor; maxillary midline diastema threshold was 2.0 mm</td>
<td>15</td>
</tr>
<tr>
<td>Ong and Colleagues, 19 2006</td>
<td>12 nondentists</td>
<td>Judges evaluated 60 frontal intraoral photographs for various features of teeth and gingivae (tooth alignment, color, shape, size, tooth crown proportions, dentition proportions, gingivae color and contour); all photographs presented simultaneously; interrater reliability testing performed; scoring by five-level Likert esthetic scale for each component</td>
<td>Golden proportion and golden percentage were not decisive factors in determining dental attractiveness</td>
<td>15</td>
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<th>METHODOLOGICAL RESULTS</th>
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<td>Pinho and Colleagues,20 2007</td>
<td>50 university students</td>
<td>Judges evaluated three frontal perioral photographs of smiling female models that had been altered digitally to simulate several degrees of asymmetry of the gingival margin of a maxillary central incisor, wear of a maxillary canine cusp and a dental midline shift; photographs presented randomly; judges not allowed to rereview photographs; no reliability testing performed; scoring by VAS for attractiveness</td>
<td>Judges did not perceive the asymmetric change in the maxillary canine cusp (maximum wear, 2.0 mm)</td>
<td>16</td>
</tr>
<tr>
<td>Rodrigues and Colleagues,21 2009</td>
<td>20 patients and companions of patients</td>
<td>Judges evaluated perioral and full-face photographs of a smiling person altered digitally to create four variations (3-mm maxillary midline deviation, 10° distal axial inclination of maxillary lateral incisors, 1-mm maxillary midline diastema and reverse smile arc); photograph sets (perioral or full face) presented in random order; all photographs in each set presented simultaneously; no mention of reliability testing; scoring by rank ordering followed by 10-level Likert esthetic scale</td>
<td>Judges rated full-face and perioral photographs with maxillary midline diastemas as significantly less attractive; judges found no significant difference between full-face photographs with and without 10° distal axial inclination of maxillary lateral incisors or between perioral photographs with and without 10° inclination of maxillary lateral incisors</td>
<td>16</td>
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<tr>
<td>Rosenstiel and Rashid,2 2002</td>
<td>1,934 laypeople (contacted by mass unsolicited e-mail)</td>
<td>Judges evaluated frontal perioral and full-face photographs of smiling people altered digitally to create five variations (absence of incisal embrasures, midline diastema, increased tooth whiteness, altered anterior tooth proportion and midline discrepancy); photographs presented in pairs; no mention of reliability testing; scoring by comparison of paired images and selecting the preferred image</td>
<td>Ninety percent of judges preferred no diastema in comparison with a 0.5-mm diastema; younger judges, women and whites had stronger opinions against a diastema; 30% of judges (the largest group) had no preference for the golden proportion over teeth with normal proportions; 61.5% of judges preferred natural (unworn) incisal embrasures over straight (worn) incisal embrasures</td>
<td>17</td>
</tr>
<tr>
<td>Thomas and Colleagues,22 2003</td>
<td>50 laypeople (patients, parents and nondental staff of the Harvard Dental Center, Boston)</td>
<td>Judges evaluated frontal full-face photographs of a smiling man and woman in which the maxillary dental midline had been altered digitally to the left and right at 5°, 10°, 15° and 20° angles from the facial midline; photographs presented separately in predetermined order; judges not allowed to rereview photographs; photographs repeated during test for reliability; scoring on a five-level Likert scale and judges asked whether or not the smile was acceptable</td>
<td>Mean acceptable threshold for photograph of the male model was 10.7° ± 6.28°; mean acceptable threshold for photograph of the female model was 10.0° ± 6.18°; discrepancies of 10° were unacceptable to 41% of laypeople; neither the direction of the deviation nor dominant hand of the judge had a statistically significant effect on perceived attractiveness of person in the photograph</td>
<td>20</td>
</tr>
<tr>
<td>Wagner and Colleagues,23 1996</td>
<td>63 laypeople (mostly dental patients)</td>
<td>Judges evaluated five sets of full-face frontal photographs of a man and woman that had been altered digitally with respect to tooth size, tooth form, tooth color, smile line or presence of a diastema; all photographs in each set presented simultaneously; no mention of reliability testing; judges asked to select the variation they liked best in each set of photographs</td>
<td>Sixty-five percent of judges preferred small teeth in photograph of the man and 17% preferred medium teeth; 46% of judges preferred large teeth in photograph of the man and 44% preferred medium teeth; 45% of judges preferred oval teeth, 95% of judges preferred no maxillary midline diastema in photograph of the woman; 91% of judges preferred no diastema in photograph of the man</td>
<td>15</td>
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</table>
variables. However, this approach is not entirely realistic; a person’s smile almost certainly will be judged within a frame that includes his or her face. Because investigators are able to alter the dentition while keeping the lips, nose, chin, eyes and hair constant, we believe that it is advantageous to make use of this ability to create the most realistic scenario possible. For this reason, we assigned higher scores to studies in which the investigators digitally altered dentitions in full-face photographs while keeping other facial features constant.

The viewing procedures used in each study also varied substantially. Investigators in some studies allowed judges (that is, laypeople) to examine more than one photograph at a time with multiple viewings, while a few investigators allowed judges to view only one photograph at a time and allowed only one viewing of each photograph. The latter is a more accurate representation of real-life situations, as one typically is unable to view a person’s smile while comparing it directly with someone else’s smile. In addition, typically one does not have the opportunity to view a smile repeatedly within a short time span.

In the studies in which more than one photograph was presented at a time, the judges may have been able to deduce what was being tested and, thus, were biased in their decision making. In one study, the investigators presented more than one photograph at a time with the intention that judges would be able to identify the small esthetic differences in the photographs. In another study, the researchers posed questions that pointed specifically to the differences between photographs. In studies in which judges were able to modify a variable continuously (for example, maxillary central to lateral step) by using a slider bar, they definitely were able to identify the variable being tested. In these situations, participants were not masked and we assigned a lower score to these studies to reflect this weakness. Likewise, we assigned lower scores to studies that did not mention whether judges were permitted to rereview photographs and revise their scores.

In many of the studies, investigators did not report having conducted intraexaminer reliability testing by repeating the entire test at a later date or by presenting photographs more than once during a single test. Therefore, the results of these studies may not consistently reflect the opinions of the general public, and we assigned lower scores to them.

Judges scored esthetic appearance in one or more of three ways: rank ordered the photographs; stated whether the photograph was acceptable or unacceptable; assigned a score via a Likert scale or a visual analog scale (VAS). Each of these methods has its advantages and disadvantages.

**Rank ordering.** From a statistical point of view, ranking never is independent because each rank can be used only once. Rank ordering forces judges to decide which esthetic arrange-
ment they prefer, thereby preventing them from assigning the same grade to more than one photograph. As a result, two images that are essentially of equal value in the judge’s opinion must receive different scores. Furthermore, rank-ordered scoring does not reflect real-life scenarios because people do not judge one person’s dentofacial esthetics in direct comparison with those of another person.

**Acceptable or unacceptable.** We preferred studies that required judges to state whether a photograph was acceptable or unacceptable over those that used rank-ordered scoring, because they allowed the judges to express tolerance regarding esthetic deviation. However, this approach is limited by the possibility that marginally acceptable dentofacial appearances received the same “acceptable” score as did ideal dentofacial appearances.

**Likert scale and VAS.** In this systematic review, the study authors’ preferred method of scoring was via a Likert scale or VAS. These methods allowed judges to give the same score to more than one photograph, which is important in determining a layperson’s sensitivity to unesthetic dentofacial arrangements. Unfortunately, judges might not have used either extreme of the scale, resulting in a tendency to score toward the middle of the scale. This method of scoring might have been problematic in studies in which judges were not allowed to rereview photographs and revise their scores. To illustrate, if a judge awarded the highest possible score to one of the first images presented, he or she could not award a higher score to any subsequent images, even if he or she deemed them worthy of a higher score. In two studies, judges received several warm-up photographs before the scoring procedure to familiarize them with the range of dentofacial appearances; this may have helped the researchers control for the limitation inherent in scoring scales.

**Tooth shape.** For laypeople, tooth shape may be one of the most important variables determining dental attractiveness. In four of the articles in our systematic review, researchers investigated tooth shape preferences among laypeople. Anderson and colleagues found that laypeople did not discriminate between square, square-round and round incisors when displayed in photographs of a female model, but they preferred square-round incisors to square incisors in photographs of a male model. With regard to canine shape, laypeople did not express a preference in photographs of a female model, but they found flat canines more attractive than round or pointed canines when paired with round incisors in photographs of a male model. The lack of strong opinions regarding canine shape is supported by the finding in the study by Pinho and colleagues that laypeople failed to notice 2.0 mm of unilateral wear on one maxillary canine.

The findings of Brisman were similar to those of Anderson and colleagues in that male judges preferred square-ovoid central incisors to tapered-ovoid incisors. Brisman also found that female judges favored square-ovoid central incisors. This study was flawed, however, because the photograph of the tapered-ovoid incisors showed more irregularities in tooth position and less gingival display than did other tooth shapes in other photographs.

These findings are in contrast to those of Carlsson and colleagues and Wagner and colleagues, who found that laypeople preferred oval incisors in photographs of a female model and rectangular incisors in photographs of a male model. However, these findings might be attributed to the fact that the investigators in the two studies did not present photographs displaying a square-round or square-ovoid tooth as an intermediate shape. Also, the investigators used the same photographs and questionnaires with different populations of judges, so it is somewhat understandable that their conclusions were the same.

Investigators in only one study assessed laypeople’s preference for tooth shape with regard to tooth wear and incisal embrasures. They found that laypeople preferred “natural” (unworn) incisal embrasures to “straight” (worn) incisal embrasures.

Among the studies investigating tooth shape, the study by Anderson and colleagues received the highest methodological score, and the authors presented photographs displaying a range of square, square-round and round incisors. Thus, it is likely that the results of this study represent the best data regarding tooth shape preferences. It appears that laypeople do not discriminate between square, square-round and round incisors or between canine shapes when displayed in photographs of female models, but they prefer square-round incisors to square incisors and flat canines (when paired with round incisors) in photographs of male models. Furthermore, laypeople appear to prefer unworn dentitions, but only one study investigated this variable.

**Tooth size and proportion.** Carlsson and colleagues and Wagner and colleagues conducted nearly identical studies of tooth size. In
both studies, the majority of laypeople preferred small teeth to medium teeth in photographs of a female model, with only a small percentage of respondents preferring large teeth. In photographs of a male model, the majority of judges preferred large teeth to medium teeth, with only a small percentage preferring small teeth. It is important to note that tooth sizes were relative, as the researchers did not provide any actual measurements of small, medium and large teeth.

Researchers in five studies investigated tooth proportion. Golden proportion does not appear to have been a decisive factor in determining dental attractiveness from a layperson’s perspective. Wolfart and colleagues reported that laypeople preferred width-to-length ratios of between 75 and 85 percent for the central incisors and tooth-to-tooth proportions of between 50 and 74 percent between the lateral and central incisors.

Kokich and colleagues reported that laypeople detected variations in crown width and height among individual teeth, and they identified as unesthetic maxillary central incisors that were 2.0 mm shorter than the ideal height and lateral incisors that were 4.0 mm narrower than the ideal width. This sensitivity increased when the crown lengths or widths were altered asymmetrically; laypeople identified a unilateral central incisor shortening of 1.5 to 2.0 mm and a unilateral lateral incisor narrowing of 2.0 mm as unesthetic.

However, if the unilateral decrease in width of a lateral incisor was accompanied by a proportionate decrease in height, laypeople did not identify the change as unesthetic until the crown was 4.0 mm narrower than the ideal width. These results reinforce the importance of symmetry and proportion to achieve harmonious smiles.

These data indicate that judges preferred small teeth in photographs of female models and large teeth in photographs of male models. Thus, proportion appears to be important to laypeople. They detected variations in crown width or height among individual teeth, especially when the variation was unilateral. However, this sensitivity decreased when ideal crown proportions were maintained.

**Incisor position.** Incisor position consists of the vertical, horizontal and angular positions of the incisors. More broadly, incisor position also can describe the relationship between incisors such as the incisal plane cant, the relationship of the lateral and central incisal edges, overbite and the presence or absence of a diastema. Researchers in seven studies investigated laypeople’s perceptions of anterior incisal angulation, either as a group (that is, a canted occlusal plane) or with regard to individual teeth.

Ker and colleagues investigated laypeople’s perspectives regarding an ideal occlusal plane cant and found it to be 0°. Other researchers investigated the ability of laypeople to identify changes in the incisal plane; the results of these studies show a range of acceptability that varied from 2° to 5° of canting. Other researchers investigated laypeople’s ability to discern incisal plane cants. They reported that laypeople in their study discerned a 5° incisal plane cant. However, Ker and colleagues and Geron and colleagues used smaller increments, and their findings suggest that laypeople can identify smaller degrees of canting (4° and 2°, respectively). Thus, it is likely that laypeople are able to discern incisal plane cants between 2° and 5° as unesthetic.

Kokich and colleagues investigated laypeople’s ability to discern incisal plane canting; however, they measured the alteration in terms of 1-millimeter-increment rotations around a point located at the incisal embrasures between the central incisors. It is unclear why they used a linear value to measure an alteration generally regarded as an angular variable. In their study, laypeople rated a 3-mm rotation as unesthetic; however, because of the way in which incisal canting was measured, this finding is difficult to compare with those of other studies.

Researchers in three studies investigated the effect of angulation of the maxillary central incisors on esthetics. Kokich and colleagues reported that laypeople rated a 2-mm angulation of the maxillary incisors as unesthetic. Again, we face the same difficulty comparing these data with those of other studies because the authors used millimeter measurements rather than angular measurements.

Wolfart and colleagues altered symmetrically and asymmetrically the angulation of central and lateral crowns by 10°. They observed that laypeople preferred images of symmetrical teeth with ideal axes (with canine, lateral and central incisors diverging by a maximum of ± 2°) and images in which the lateral incisor angulations were changed (unilaterally or bilaterally) by 10°. They rated as less attractive images in which the angulation of one or both central incisors had been altered, indicating that a smile must be more symmetrical nearer the midline to appear harmonious. The findings of this study were supported by those of Thomas and colleagues, who observed that midline...
angulations of 10° were unacceptable to 41 percent of laypeople. In another study, laypeople did not notice a 10° distal angulation of the lateral incisors, which supports the supposition that they are less aware of esthetic deviations that are farther from the midline.21

Researchers in two studies17,18 investigated laypeople’s preferences regarding the relationship between the central and lateral incisal edges (that is, the maxillary central to lateral step). Both studies used continuously modifiable variables but with different methods. Judges in the study conducted by Ker and colleagues12 used a slider bar to modify the images, whereas King and colleagues18 used an animated photograph in which the length of the lateral incisors increased until the judges stopped it at the desired relationship.

Ker and colleagues17 found that the maximum tolerable step was 2.9 mm, with the ideal step being 1.4 mm. They noted, however, that many laypeople preferred even incisal edge relationships, so it may be prudent for practitioners to ask patients what they prefer. These findings differed from those of King and colleagues,18 who found a maximum tolerable step of 1.10 mm, an ideal step of 0.61 mm and a minimum tolerable step of 0.26 mm. The methodology used by Ker and colleagues17 might have generated more accurate results because it did not rely on judges’ reaction time and judges were able to fine-tune their responses. Furthermore, in the study by King and colleagues,18 the length of the lateral incisors increased without proportionate changes in crown width, which may have influenced the judges’ perception of esthetics. Therefore, the findings of the study by Ker and colleagues17 likely represent the best current data regarding laypeople’s perceptions of the relationships between the incisal edges of the maxillary central and lateral incisors.

Only one study17 investigated laypeople’s preferences regarding overbite. The results show that the ideal overbite was 2.0 mm, while the maximum and minimum tolerable values were 5.7 mm and 0.4 mm, respectively. Clearly, further studies are required to elucidate laypeople’s preferences regarding overbite.

Investigators in five studies examined laypeople’s attitudes toward maxillary midline diastemas.2,6,14,21,22 Rosenstiel and Rashid,2 Carlsson and colleagues14 and Wagner and colleagues23 reported that more than 90 percent of respondents found images of diastemas unesthetic. Younger judges, women and whites had stronger opinions against diastemas.2,21 Rodrigues and colleagues21 reported that a diastema of 1 mm was noticeable when presented in a full-face or perioral photograph; however, Kokich and colleagues6 found that laypeople did not notice diastemas in a perioral photograph unless they were 2.0 mm or larger. Although the overwhelming majority of laypeople found a diastema unesthetic, they found them somewhat more acceptable in photographs of men than in photographs of women.14,21

It appears that laypeople are able to discern an incisal plane cant of between 2° and 5° as unesthetic, and they are able to discern a 10° angulation of one or both central incisors as being less attractive than a 2° angulation. The majority of laypeople preferred a 1.4-mm step between the incisal edges of maxillary central and lateral incisors but tolerated a maximum step of 2.9 mm; however, many laypeople preferred even incisal-edge relationships. Judges in one study preferred an overbite of 2.0 mm, but they tolerated a maximum overbite of 5.7 mm and a minimum overbite of 0.4 mm. Most laypeople preferred dentitions without diastemas; however, diastemas tended to go unnoticed if they were smaller than 2.0 mm.

**CONCLUSIONS**

The results of this systematic review show that most laypeople did not discriminate between square, square-round and round incisors or canine shapes when displayed in photographs of female models, but they preferred square-round incisors to square incisors and flat canines (when paired with round incisors) when displayed in photographs of male models. In addition, laypeople preferred unworn dentitions and small teeth in images of female models and large teeth in images of male models. Most laypeople appeared to prefer width-to-length ratios of between 75 and 85 percent in the central incisors and tooth-to-tooth proportions of between 50 and 74 percent between the lateral and central incisors. They also detected variations in crown width or height among individual teeth, especially when the variation was unilateral. Laypeople’s sensitivity to variations in crown width or height appears to be diminished when the variation maintains ideal crown proportions and when the variation is not in the midline.

The study results also show that laypeople discerned a 10° angulation of one or both central incisors as being less attractive than a 2° angulation. The majority of laypeople preferred a 1.4-mm step between the incisal edges of maxillary central and lateral incisors, but they tolerated a maximum step of 2.9 mm. However, many laypeople preferred even incisal-edge rela-
tionships. In addition, according to the results of one study, they preferred an overbite of 2.0 mm and tolerated maximum and minimum overbites of 5.7 mm and 0.4 mm, respectively. They also preferred no diastemas and tended to notice a diastema larger than 1 mm.

Laypeople have varying degrees of sensitivity to certain dental esthetic issues. Consequently, clinicians can expect their patients to be more attentive to some esthetic factors than to others. ■

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