Esthetic preferences of nasal base angulation and labiolingual incisor inclination in profile

Alex Rauchle, DDS

A thesis submitted in partial fulfillment for the
Degree of Master of Science in Orthodontics

Oregon Health & Science University
Portland, OR

2021

Esthetic preferences of nasal base angulation and labiolingual incisor inclination in profile

Alex Rauchle, DDS

Master of Science in Orthodontics Research Advisory Committee:

Signature:_____ Date: _____

Jeffrey Nickel, PhD, DMD, MSc
Professor-provisional, Graduate Program Director
Department of Orthodontics
Oregon Health & Science University

Signature:_____ Date: _____

Howard Freedman, DDS
Assistant Professor, Clinic Director
Department of Orthodontics
Oregon Health & Science University

Signature:_____ Date: _____

Laura Iwasaki, PhD, DDS, MSc
Professor, Chair
Department of Orthodontics
Oregon Health & Science University

ACKNOWLEDGEMENTS

I would like to extend my most sincere thank you to my thesis committee members: Dr. Laura Iwasaki, Dr. Jeff Nickel, and Dr. Howard Freedman. Your time, effort, and kindness in helping to develop, not only this thesis, but myself as an orthodontist, is greatly appreciated and will never be forgotten.

A big thank you to Dr. Dongseok Choi for performing the statistical analysis for this project. Thank you so much for your hard work; your helpful explanations and education have been greatly appreciated.

An extra special thank you to my primary thesis advisor, Dr. Laura Iwasaki, without whom this final thesis would not be what it is today. Thank you for your encouragement and guidance, your keen and thoughtful feedback, and your many hours of time spent editing and improving my drafts – I could not have done it without you.

Thank you to all the faculty, administration, and staff of the OHSU Orthodontic Department. Your smiling faces, positive attitudes, and friendship have been the best part of my last two and a half years in residency.

A final thank you to my friends and family. I'm grateful for every phone call, text message, and trip out to visit me in Portland. Thank you for supporting me every step of the way during the long road to becoming an orthodontist.

Esthetic preferences of nasal base angulation and labiolingual incisor inclination in profile

Alex Rauchle, DDS[a]
Jeffrey Nickel, DMD, MSc, PhD[b]
Howard Freedman, DDS[c]
Laura Iwasaki, DDS, MSc, PhD[d]

[a] Resident, Department of Orthodontics, Oregon Health & Science University, Portland, OR

[b] Professor-provisional, Graduate Program Director, Department of Orthodontics, Oregon Health & Science University, Portland, OR

[c] Assistant Professor, Clinic Director, Department of Orthodontics, Oregon Health & Science University, Portland, OR

[d] Professor, Chair, Department of Orthodontics, Oregon Health & Science University, Portland, OR

Keywords: orthodontics, incisor inclination, nasolabial angle, nasal morphology, profile esthetics, smile esthetics

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Background: Existing research has evaluated the optimal incisor inclination as it relates to various cephalometric values, but few have related it to soft tissue profile. The aims of this study were to establish the esthetic preferences of laypeople when viewing smiling profiles depicting a range of (1) nasal base angulations for a given labiolingual incisor inclination, and (2) labiolingual incisor inclinations for a given nasal base angulation. Secondary objectives included evaluation of the impact of raters' gender and racial/ethnic identities, as well as subjects' gender.
Methods: This study utilized a survey with altered versions of one male and one female smiling profile photograph in which first-year dental students at one dental school ranked images in order from most esthetic to least esthetic. The features that varied between images were the angle of the base of the nose and the incisor inclination. Statistical analyses included descriptive analyses, rank data analysis, and chi-square tests.
Results: The respondents consisted of 20 females and 21 males, yielding a total of 41 survey responses. Respondents were predominantly White and Asian, comprising 73% and 27% of the sample, respectively. Responses to the post-survey question ascertaining the level of difficulty inherent to distinguishing the images, showed the following: 12 (40%) "extremely challenging," 14 (47%) "very challenging," and 2 (7%) "moderately challenging" or "slightly challenging." No respondents felt that that the images were "not challenging" to distinguish. No significant effects of raters' gender ($P = 0.08 – 0.93$) and racial/ethnic identity ($P = 0.11 – 1.0$) were found for survey questions for nasal base angulation rankings grouped by incisor; therefore, ranking data from raters of both genders and racial/ethnic identities were pooled. The chi-square test for uniformity in distribution of ranks for all survey questions showed a significant difference ($P=0$) so the null hypothesis, that the distribution of ranks was uniform, was rejected. Rankings for the female and male images were not the same, so they were considered separately.
The overall image attractiveness rank orders differed between male and female images. Optimal rank estimates did not show any incisal inclination ranking differences with 95% confidence for comparisons grouped by nasal base angulation for either female or male images. Image attractiveness rankings for nasal base angulations, grouped by incisor inclination, showed with 95% confidence, that the downturned nose was rated as less attractive than the normal and upturned nasal base angulations, regardless of incisor inclination.
Discussion: The level of difficulty results indicate that the discrepancies between the images may be too subtle for use within a lay population. Future studies may analyze the effect of the AP position of the incisor on its own and in conjunction with variations in inclination, as well as nasal projection, on esthetics. Differing combinations of these morphological features appear to have a significant impact on our perception of the ideal incisor position.
Conclusion: No significant differences in raters' responses based on raters' gender or racial/ethnic identity were found. The data demonstrated that a downturned nose was perceived as un-esthetic in both the male and female subjects, and the normal and upturned nose were preferred to the downturned nose regardless of incisor inclination. The optimal rank showed no incisor ranking differences when the images were grouped by nose for both the male and female subjects. The distribution of ranks was not uniform, indicating that some combinations of nasal base angle and incisor inclination were perceived as more esthetic than others. Therefore, the null hypotheses that the esthetic preferences were unaffected by 1. the nasal base angulation for a given labiolingual incisor inclination, and 2. the labiolingual incisor inclination for a given nasal base angulation were rejected.

INTRODUCTION

It has been noted that there exists an increasing emphasis on facial esthetics as an important outcome of orthodontic treatment, and that much of the previous criteria for facial evaluation in the field of orthodontics has been arbitrary or based on art.[1] Additionally, it has become apparent that artistic depictions of the human form do not always correspond with those of current mainstream media. Furthermore, the ideals of beauty depicted in popular culture are not constant as they have changed noticeably through the decades.[1] This being the case, it stands to reason that the definition of optimal facial parameters should be regularly amended, and consideration should be taken with respect to the individual patient's goals and preferences in seeking orthodontic treatment.

Orthodontic treatment goals not only include functional, stable, and healthy results for patients, but also the achievement of the most esthetic result possible within the constraints of achieving these goals. The most ideal smile is specific to the individual's presentation and personal preferences and may differ from the orthodontists' concept of ideal. It has been established that the public perception of ideal facial characteristics is dynamic and has not remained constant through the 20th century.[2] A number of variables, pertaining to both the subject and the judge, influence what humans consider to be most attractive in regard to various facial features, such as gender, age, and ethnicity.[3] Previous studies have also demonstrated differences between the opinions of laypeople and orthodontists.[3] Given the range of physical facial characteristics, there are a number of potentially significant parameters to be studied and the optimal result may vary across time and viewer populations.

According to the Andrews' Six Elements of Orofacial Harmony the contour of the forehead in a sagittal view is an important landmark in determining ideal anteroposterior (AP) incisor position. According to Andrews' 2008 study, 93% of Caucasian female subjects in photographs from fashion magazines and product advertisements meeting the inclusion criteria of a fully visible maxillary central incisor and forehead and a generally pleasing appearance in profile had maxillary central incisors positioned between the forehead's facial axis (FFA) point and glabella in the anteroposterior plane.[4] This method of analysis can be helpful for treatment planning considerations, and uniquely relates soft tissue facial characteristics to dental ones, however, it does not relate the dentition to any

soft tissue facial features aside from the forehead.

As was stated in a 2015 study by Dasari et al., “A beautiful face has balanced harmony among all parts of the face like forehead, orbits, zygomas, nose, lips, chin and throat. In the evaluation of facial esthetics, orthodontists should consider both the frontal and lateral views, of which smiling profile view is an integral part.”[5] The authors bring to light the important point that it is necessary to see the whole face in a smile analysis, and they additionally assert that there are three major esthetic components in the facial complex that determine the overall facial profile esthetics: the forehead, nose, and chin. Furthermore, it is noted that the face in profile is divided into three equal thirds (upper, middle, and lower) with the nose occupying the vast majority of the middle third. Thus, the nose possesses a dominating effect on the facial appearance, helping to establish the character of the midface. Dasari et al. also state that, “The esthetic perception of the smiling facial profile is comprised of various subunits from the nasion to the soft tissue pogonion, which includes the nasal contour, maxillary incisor position, and the chin contour. The maxillary anterior teeth should be angulated and also positioned favorably in their antero-posterior and vertical relationships to all facial structures to ensure maximum facial harmony.”[5] This being the case, a multifaceted consideration of morphological characteristics is imperative to the esthetically-minded orthodontist. Given the existing orthodontic research on many components of the facial profile over the past century, there is surprisingly little data on the relationship between nasal morphology and incisor inclination as perceived from a lateral view.

Existing research has evaluated the optimal incisor inclination as it relates to various cephalometric values, but not many have related it to soft tissue profile. The Dasari et al. 2015 study, as introduced above, did consider soft tissue profile in conjunction with dental parameters. In this study, looking at changes in nose contour as it relates to incisor inclination, it was found that the nose can play a large role in the esthetic perception of the teeth.[5] This particular study involved varying the contours of the nose to create a nasal bridge that was concave, straight, or convex in a smiling profile view in combination with varying incisal inclinations in one male and one female subject’s smiling profile photographs. The subjects were from Indian subcontinent, Dravidian race, subgroup of Mongoloid race, and met the inclusion criteria of, “a harmonious smile in both frontal and

profile views, Angle's Class I molar and canine relationships on a skeletal Class I jaw bases, maxillary incisors well positioned according to cephalometric standards, profilometric measurements within the normal range, straight nose and orthognathic chin."[5] Incisal inclination was measured as the angle between a line tangent to the labial surface of the maxillary incisor in profile view and Frankfort Horizontal line. Each photograph was altered by changing the incisor inclination by moving the incisal edge anteriorly (+5° and +10°) and lingually (-5° and -10°), and modifying the nose contour (straight, convex, and concave) to obtain 15 photographs that were randomly distributed and presented to three groups to score the attractiveness using a visual analogue scale.[5] The three groups were: Group 1: 30 orthodontists (11 female and 19 male); Group 2: 30 dentists (17 female and 13 male); and Group 3: 30 laypeople (13 female and 17 male). To rate the photographs, a Likert-type rating scale was used as it is largely accepted in the psychology literature for performing perception/rating studies. The incisor inclination was evaluated by two methods: "(1) By drawing a Frankfort-horizontal line (FH) connecting the superior aspect of the external auditory meatus with the inferior border of the orbit and a line tangent to labial surface of maxillary central incisor (measured as 98°)" and "(2) The angle between a line tangent to labial surface of maxillary incisor and Sn-Pog' line [not defined in this study] (measured as +12°).[5] The study found: "(1) Orthodontists rated the convex nose contour with any Mx1 (maxillary central incisor) as unattractive in both male and female subjects, whereas in concave nose subjects normal Mx1 in males and mild proclination in females was esthetically acceptable. (2) The esthetic perception of altered nose contours of male subjects among dentists is similar to that of orthodontists, but in female subjects up to 10° of lingual inclination in convex nose and up to 5° of both labial and lingual inclinations in concave nose subjects were rated as attractive. (3) Among the laypeople up to 5° of labial inclination and 10° of lingual inclination in both concave and convex nose contours were scored as attractive faces in female subject, whereas in male subject 5° of both labial and lingual inclinations in concave nose and 10° of lingual inclination in convex nose contour were esthetically acceptable."[5] Thus, nose contour showed a statistically significant ($p < 0.05$) effect on the esthetic perception of maxillary incisor inclination among all three groups. If the contour of the bridge of the nose affects perception of a profile smile, it stands to reason that the inclination of the base of the nose

in profile relative to facial plane may influence what is to be considered ideal. This begs the question, how does the inclination of the base of the nose, a characteristic with greater physical proximity to the incisor, affect the perception of incisor inclination?

An additional study that considered incisor inclination in a lateral view, but not soft tissue profile, was the 2011 Ghaleb et al. study. The objectives were "(1) to evaluate the impact of maxillary incisor inclination on the esthetics of the profile view of a smile, (2) to determine the most esthetic inclination in the profile view of a smile and correlate it with facial features, and (3) to determine if dentists, orthodontists, and laypeople appreciate differently incisor inclination in smile esthetics."[6] In regard to subject positioning, it was reported that, "The profile photograph was taken with the head placed in the 'esthetic position' as recommended by Bass (2003)[7]: it is a corrected natural head position adjusted by the clinician so that the face does not appear to be tilted up or down. The horizontal line ('Hr') is an esthetic horizontal that is not modified by treatment. It is a reference line if the chin position is modified by orthopedic or orthognathic correction." The central incisor labiolingual inclination was defined as the angle between the line tangent to the labial surface of the maxillary central incisors (Tg) and the line joining the subnasal point [Sn] to the facial pogonion [Pg] (Sn-Pg). This inclination was also defined as the angle between the incisor inclination and esthetic horizontal (Tg/Hr). This study established that the upper incisor inclination as measured by a "tangent to the labial surface of the maxillary central incisor," does indeed affect smile esthetics in profile view, and that the preferred smile has a maxillary incisor inclined 93° to the horizontal line and 7° to the lower facial third.[6]

Cao et al. additionally found that maxillary incisor protrusion and lingual inclination were preferred when compared with retruded or flared incisors in the same individual as judged by orthodontists and undergraduate students.[8] Specifically, "a facial smiling profile photograph of a Chinese woman with a 'normal' profile, class I occlusion, and a class I skeletal pattern" was used and compared with retruded or flared incisors in the same individual as judged by 21 orthodontists and 66 undergraduate students. The subject met the following inclusion criteria: "(1) Class I occlusion and Class I skeletal pattern; (2) hard tissue cephalometric analysis (Win ceph 7.0) within the normal range, as described in the West China Cephalometric Analysis; (3) soft tissue cephalometric

analysis (including Ricketts' esthetic plane, Merrifield's z-angle, and measurement within the normal range); (4) facial angle and H angle within the normal range, as described by Holdaway, and nasolabial angle and maxillary lip angle within the normal range, as described by Arnett and Bergman; (5) ideal maxillary incisor–to-forehead relationship, as described by Andrews and Andrews; and maxillary central incisors' facial axis point (FA) on the Goal Anterior Limit Line (GALL)." An image was made with the subject expressing a full smile and a 100 mm ruler was fixed above the subject's head in the sagittal plane. Image alteration was then carried out using computer software (Photoshop CS2, version 9.0) to obtain four series of images. The maxillary incisor was altered to produce labially inclined variants at 5°, 10°, and 15° as well as lingually inclined variants of the same degrees to produce 7 total images, including the original, in the series. In a second series, the AP position of maxillary incisor was altered by moving it in the horizontal plane both anteriorly and posteriorly by 1 mm, 2 mm, 3 mm, and 4 mm to create 8 total images. Two additional series were created by carrying out the same modifications to incisor inclination from the first series to the +2 mm and -2 mm baseline images from the second series. In total, the study used 29 images that comprised the 4 series of images. The rater groups consisted of orthodontic professionals (14 men, 9 women) and non-orthodontists (33 men, 33 women). The images were printed and presented in randomized order, and each judge was instructed to rate the attractiveness based on whatever criteria he or she thought important. It was concluded that both maxillary incisor labiolingual inclination and anteroposterior (AP) position play an essential role in the esthetics of the smiling profile.[8] Having established that these parameters are indeed germane to the attractiveness of a profile, this study begets further research on how exactly the perception of labiolingual incisor inclination and AP position are influenced by individual soft tissue variation. Although the torque of the maxillary centrals can in theory be controlled in orthodontic treatment, patients present with a myriad of morphological varieties of facial features that the orthodontist has no influence over, assuming that the patient does not plan to undergo orthognathic or plastic surgery.

One feature of the soft tissue profile commonly considered during orthodontic treatment planning is the nasolabial angle (NLA), which is the angle formed by a tangent to the base of the nose and a tangent to the upper lip that intersect at subnasale. It is

frequently stated when considering a profile photograph in repose that a NLA that is either too obtuse or too acute is undesirable, and for that reason treatment goals may be modified. What is considered to be a desirable NLA even differs dependent on ethnicity according to a 2018 plastic surgery study that found the NLA of attractive celebrities to be significantly more acute in Asian than in Western subjects, with Asian and Western subjects averaging 97.09° and 104.59°, respectively.[9] This provides a compelling example of a pre-existing, non-modifiable feature that is related to the orthodontist's zone of work.

Interestingly, it is very common practice to take a profile photograph in repose, yet some orthodontists omit a smiling profile photograph in their initial records. As advised by Cao et al., "dentists should never underestimate the labiolingual inclination's influence on the smiling profile," and without this initial record certain aspects of the case may be disregarded during treatment planning.[8] Perhaps it behooves the clinician to do so in order to consider the central incisor inclination as it relates to a non-modifiable facial characteristic, that being the angle of the base of the nose relative to the face.

As current and evidence-based data are sought to guide decision-making, it is imperative that thorough consideration of methods of evaluation is upheld. Various studies utilize facial photographs as opposed to silhouettes or 3D renderings; however, photographs need to be devoid of confounding variables. These variables include aspects such as skin texture and complexion; hair color, style, length, and degree of coverage; eye color and size; eyelashes; eyebrows; cheek fullness and shape; ear size and shape; facial symmetry and proportion; makeup; and adornments such as jewelry. These factors influence the perception of beauty, and although they are often impossible to eliminate entirely, it is important to minimize their influence to obtain accurate results.[10] However, it is advisable to consider carefully the cropping of the image being used when attempting to eliminate extraneous factors, as a study by Tauk et al. revealed that the lower face alone does not reveal the attractiveness of the entire facial profile.[11]

Interestingly, it has also been demonstrated that rater preferences in photographs are closer to established esthetic norms than preferences in silhouettes. In a 2012 study by Hockley et al., the differences in the esthetic ratings of lip position in photographs and silhouettes of the same person were evaluated. All raters were Caucasian and included 10 orthodontic faculty and five orthodontic residents. It was found that when evaluating soft-

tissue esthetic profile preferences, rater preferences using photographs were closer to the established esthetic norm than preferences using silhouettes. Profiles flatter than the esthetic norm were more likely to be preferred in silhouettes than in photographs. The raters also more often preferred flatter profiles in male silhouettes than when viewing male photographs, female photographs, and female silhouettes. It was noted that establishing soft-tissue treatment goals or evaluating treatment results, using only silhouettes could influence raters to select profiles flatter than the established esthetic norm.[12] The results of this study support rating the attractiveness of faces with photographs over silhouettes.

A 2017 systematic review of English language studies published between January 1996 and December 2015 by Del Monte et al. aimed to identify, appraise, and synthesize existing research on smile esthetics as perceived by laypeople. This study followed the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines. After the screening of 8,851 articles, 20 studies were chosen for inclusion in a qualitative analysis of 20 different dentogingival features of smile esthetics that were divided into dental, gingival, and occlusal categories.[13] The Cao et al. 2011 study was considered and excluded from this systematic review due to lack of reliability testing and only one study that met criteria and was included in the systematic review analyzed smile esthetics from a profile view; this was the Ghaleb et al. study. This study was granted a quality assessment rating of a 'B' and was marked down for the following criteria: setting, bias, study size, statistical methods, main results, and funding. These results indicate a need for high quality research on smiling profile esthetics.

The aims of this study were to establish the esthetic preferences of laypeople when viewing smiling profiles depicting a range of (1) nasal base angulations for a given labiolingual incisor inclination, and (2) labiolingual incisor inclinations for a given nasal base angulation. These aims were a first step towards an overall objective of analyzing the influence of the inclination of the base of the nose on the perception of the optimal inclination of the maxillary incisor in a smiling profile view as well as to establish acceptable esthetic ranges for varying maxillary incisor inclinations with respect to nasal base angulations. This pilot study used a survey of 1st year dental students at one institution (Oregon Health & Science University). This particular rater population was chosen for convenience. Additionally, this particular population had a potentially balanced

distribution of gender and represented ‘laypeople’ for all intents and purposes because they were just beginning their dental education and had not begun any orthodontic courses. The null hypotheses were that the esthetic preferences were unaffected by 1. the nasal base angulation for a given labiolingual incisor inclination, and 2. the labiolingual incisor inclination for a given nasal base angulation. Secondary objectives included evaluation of the impact of raters’ gender and racial/ethnic identities, as well as subjects’ gender.

MATERIALS & METHODS

The protocol for this study was approved by the Oregon Health & Science University Institutional Review Board (Appendix A). This study utilized a survey in which the viewer ranked digitally altered versions of one male and one female right side smiling profile photograph in order of most esthetic to least esthetic. The individuals photographed volunteered and gave permission (Appendix B) to have their photographs used in this study. The features that varied between images were the angle of the base of the nose and the incisor inclination. The following inclusion criteria were used: age 18-30 years, well-balanced and harmonious facial proportions, at least 80% of the maxillary central incisor visible in the vertical dimension, and at least ½ of the maxillary canine visible in the mesio-distal dimension. The photographed volunteers were asked to have no visible clothing superior to the collarbones, accessories, facial hair, jewelry, or excessive makeup before having their photographs made. Any facial markings such as scars were digitally removed after image capture. Right side smiling profile photographs were captured using a camera (iPhone XS, Apple Inc., Cupertino, CA, USA) with the individual in the Esthetic Position (or photographic position of the head) as described by Bass.[7] This position, “is a corrected natural head position adjusted by the clinician so that the face does not appear to be tilted up or down.”[7] The volunteers were directed into the esthetic position by the same photographer (AR).

All photographic image manipulation was performed using commercially available software (Adobe Photoshop CS, version 22.1.1, Adobe Systems Inc., San Jose, California, USA). The images were cropped vertically just inferior to trichion and inferior to the cervicomental angle to include glabella to menton, and just anterior to the tragus and anterior to the nasal tip (Figure 1). The images were converted into grayscale, all facial markings were removed, and any visible hair was blurred to minimize confounding variables. The original image was further

digitally modified to demonstrate an ideally positioned maxillary central incisor with a relationship of 93° relative to horizontal (Figures 2 and 3) in accordance with the methods of Ghaleb et al.[6] The nasal base angulation was also digitally modified to obtain a nasolabial angle (NLA) of 90° relative to the upper lip (Figure 2). These aforementioned changes resulted in the baseline images for the female and male examples (Figure 3).

Once the baseline photographs were established, the maxillary incisor and nasal tip in each image were isolated using the lasso tool (Figure 4). The maxillary incisor was rotated around the center of the selection as determined by the software to obtain incisors at angles of -10, -5, 0, +5, and +10 degrees relative to the baseline image, termed I1, I2, I3, I4, and I5, respectively. The nasal base was modified in the same manner to produce nose variations of -10, 0, and +10 degrees relative to the baseline image, termed N1, N2, and N3, respectively (Figure 5). The final arrays contained 15 total images for both the female and male subjects (Appendix C). All digital modifications were performed by the same researcher for consistency (AR).

The resulting sets of 15 images for each gender example were used to create a cloud-based survey using a platform designed for this purpose (Qualtrics, 2020, Provo, UT, USA) in which the images were ranked by participants from most to least attractive in a series of questions containing different image groupings (Figures 6 and 7) using a drag-and-drop response-ordering style. Each image grouping was presented as its own page so that participants could not be influenced by other groupings at the same time. The survey (Appendix D) was designed so that all option choices had to be ranked before moving on to the next question, however, participants had the freedom to move images within a grouping within the drag-and-drop framework until the participant decided to move on to the next question. Once a question was completed the participant was not able to go back to questions answered previously. Participants were asked to self-report demographic information in the survey, including gender, birth year, and ethnicity/racial identity (Appendix D). The image-ranking component of the survey consisted of 8 questions (Figure 6) for ‘drag and drop’ style responses for the female and male examples. Within each set of 8 questions, 3 had 5 images to be ranked and 5 had 3 images to be ranked (Figure 7). The images were grouped both according to nasal base variation and incisor inclination variation so that every image was used twice in the study, for tests of internal validity. The images were randomly sorted within each question. At the end of the survey the respondents were asked about the level of difficulty in ranking the images and a write-in space

was provided for comments and questions. An invitation to participate in the web-based survey (Appendix E) was emailed to the first-year class of dental (DMD Class of 2024) students at Oregon Health & Science University (OHSU) (Table I). The email informed participants that the survey collected data for a MS thesis research project, and that survey responses were anonymous. The web-based survey was conducted using a cloud-based platform that was approved for use at OHSU (Qualtrics, Provo UT). To encourage answering of all questions, an error message was delivered if questions were left unanswered. Respondents were not compensated for responding. Consent was implied by completion of the survey. Those who had not completed the survey after 2 weeks were sent 1 reminder email. After 3 weeks the survey was closed, and all completed survey data were gathered for analyses.

All drag-and-drop ranking style survey answers and demographic data were exported directly from the cloud-based platform into a spreadsheet for statistical analyses that included rank data descriptive analyses and chi-square tests. Significance was defined as $P \leq 0.05$

Figure 1. *Unedited images for the female (a) and male (b).*

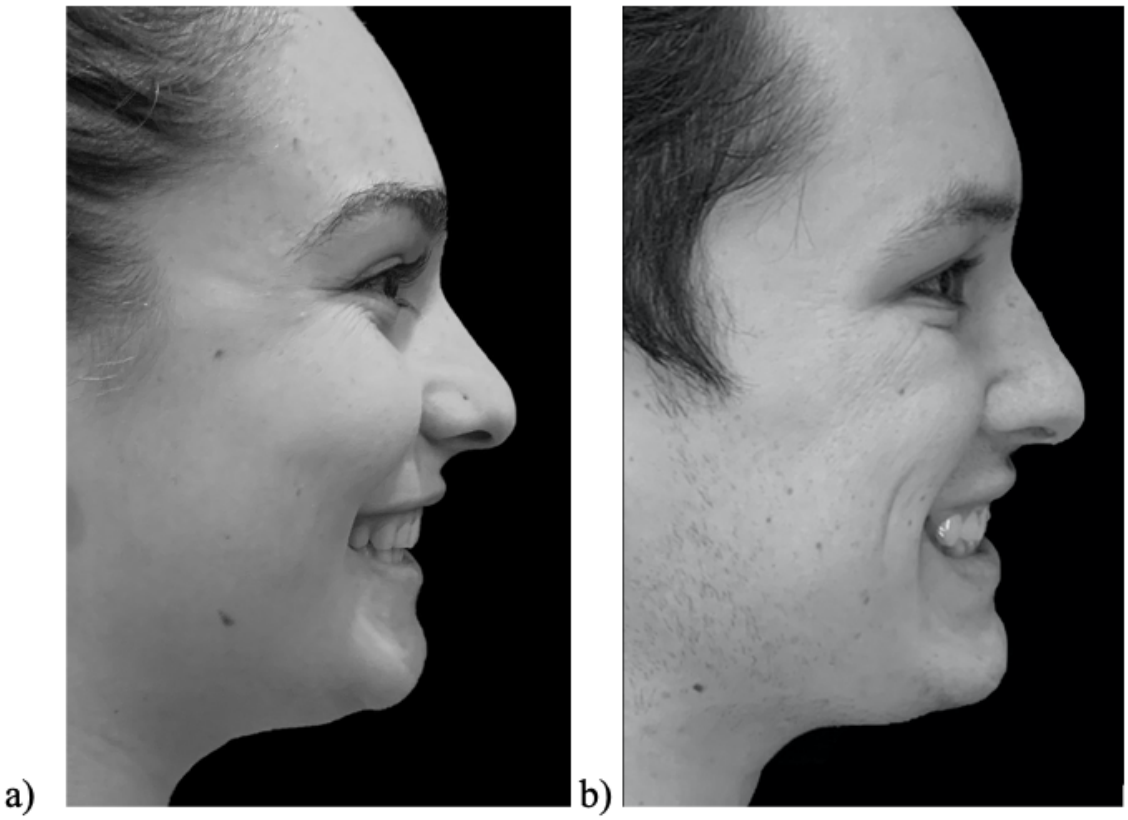


Figure 2. *Reference lines used to generate 'ideal' baseline images demonstrating a nasolabial angle of 90° (left) and a maxillary incisor with an inclination of 93° relative to horizontal (right) for the female (top row) and male (bottom row).*

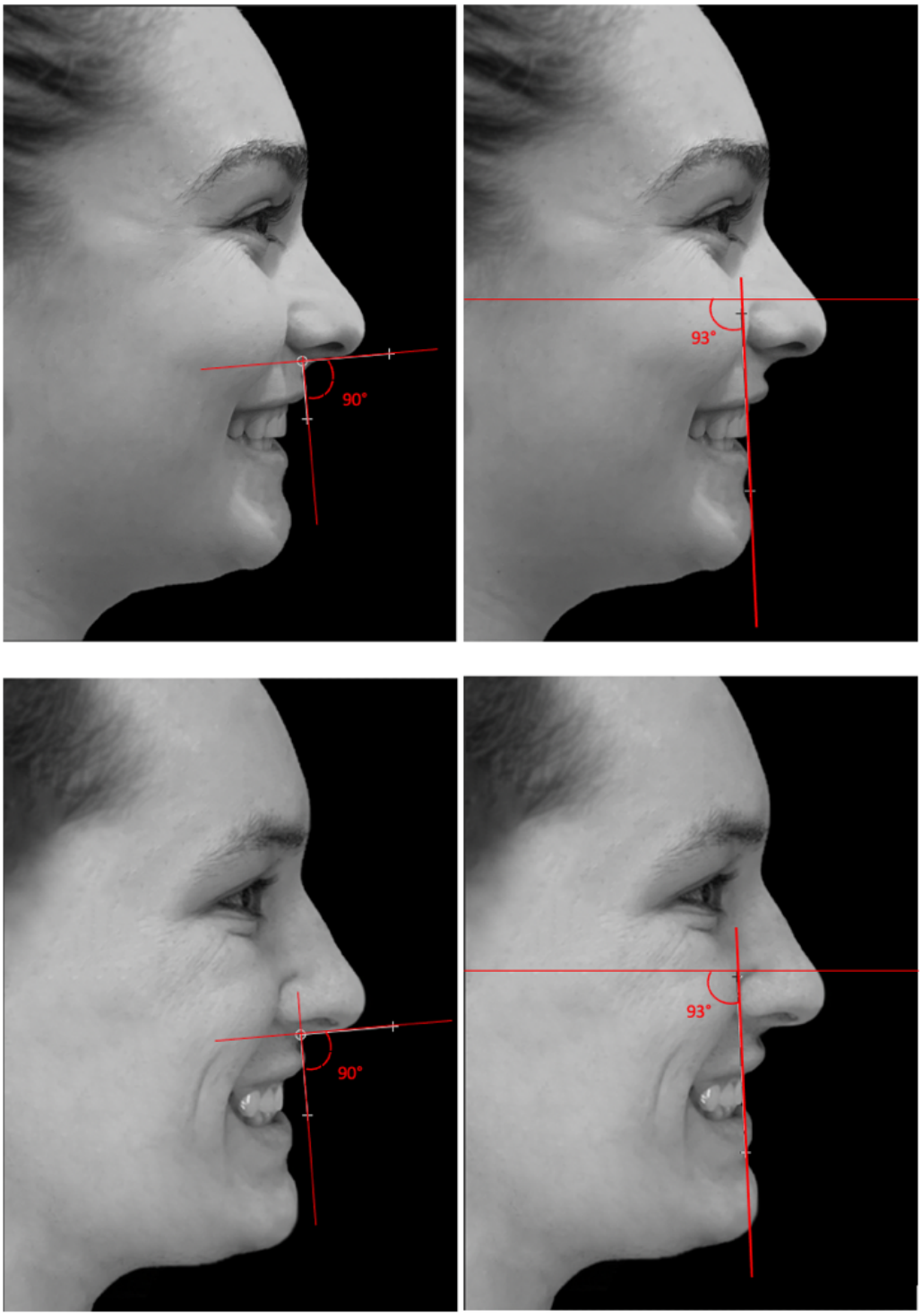


Figure 3. *Baseline 'ideal' images for the female and male after editing.*

Figure 4. *The lasso feature used on the nasal tip and maxillary incisor of the female (left) and male (right) baseline images for digital modification using image software (Adobe Photoshop).*

Figure 5. *The 3 nasal base angulation variants (top row, left to right:* N1, N2, N3*) and the 5 incisor inclination variants (bottom row, left to right:* I1, I2, I3, I4, I5 *in the female subject.*

Figure 6. *Table demonstrating survey design schematic. The baseline images were digitally modified to produce additional variations of -10 and +10 degrees. The same process was carried out with incisor inclination to produce additional variations of -10, -5, +5, and +10 degrees. N1-3 represent nasal base angulations of -10, 0, and +10° relative to the baseline image, respectively. I1-5 represent incisor inclinations of -10, -5, 0, +5, and +10° relative to the baseline image, respectively. Respondents were presented with a total of 8 questions (Q1-8), 3 of which were grouped by nasal base angulation with the 5 incisor variations (I1-5) and 5 of which were grouped by incisor angle with the 3 nasal base variations (N1-3) so that each image was ranked twice by respondents to increase internal validity.*

Survey Design Schematic

			Incisor Angulation				
Rater	Subject	Nasal Base Angulation	I1 (-10°)	I2 (-5°)	I3 (0°)	I4 (+5°)	I5 (+10°)
Female	Female	N1 (-10°)					
		N2 (0°)					
		N3 (+10°)					
	Male	N1 (-10°)					
		N2 (0°)					
		N3 (+10°)					
Male	Female	N1 (-10°)					
		N2 (0°)					
		N3 (+10°)					
	Male	N1 (-10°)					
		N2 (0°)					
		N3 (+10°)					

Q1) N1 (I1-5)
Q2) N2 (I1-5)
Q3) N3 (I1-5)
Q4) I1 (N1-3)
Q5) I2 (N1-3)
Q6) I3 (N1-3)
Q7) I4 (N1-3)
Q8) I5 (N1-3)

Figure 7. *An example of how survey question #F appeared to the respondents.*

RESULTS

The survey (Appendix C) was sent digitally via email to the 74 first year dental students at the Oregon Health & Science University from the DMD class of 2024 on May 12, 2021 (Table I). The respondents consisted of 20 females and 21 males, yielding a total of 41 survey responses collected for a response rate of 55%. The female and male respondents made up 49% and 51% of responses, respectively (Table II). The mean age in years of respondents was 24 with a standard deviation of 2. The ethnic/racial identities reported by the respondents were predominantly White and Asian, comprising 73% and 27% of the sample, respectively.

The post-survey question ascertaining the level of challenge associated with distinguishing the images in order to rank them had an overall response rate of 30 out of 41 (73%). Responses to this question (Figure 8) indicated that the survey participants found this very challenging. Responses showed the following: 12 (40%) chose “extremely challenging,” 14

(47%) chose “very challenging,” and 2 (7%) chose “moderately challenging” or “slightly challenging.” None of the 30 respondents felt that that the images were “not challenging” to distinguish (Figure 8). The quantitative results were supported by the comments provided by raters (Figure 9).

No significant effects of raters’ gender (P = 0.08 – 0.93) and racial/ethnic identity (P = 0.11 – 1.0) were found for survey questions for nasal base angulation rankings grouped by incisor inclination (3 options), which were data with the most power, given the sample sizes. Hence, ranking data from raters of both genders and racial/ethnic identities were pooled. The chi-square test for uniformity in distribution of ranks for all survey questions showed a significant difference (P=0) so the null hypothesis, that the distribution of ranks was uniform, was rejected. Rankings for the female and male images were not the same, so they were considered separately.

The images in the survey questions were labeled according to incisor inclination and nasal base angulation (Table III). When viewing the image attractiveness rankings for nasal base angulations from questions grouped by incisor inclination (Table IV), all female images showed that the normal and upturned nasal base angulations were preferable to the downturned nasal base angulation regardless of incisor inclination. The trend for nasal base angulation rank with degree of incisor inclination from very retroclined to retroclined to normal was not consistent, however the upturned nasal base angulation was ranked highest for proclined and very proclined incisor inclinations (Table IV). For male images, attractiveness rankings for nasal base angulations showed that for all incisor inclinations the rank order from most attractive to least attractive was normal > upturned > downturned (Table IV). Optimal rank estimates showed with 95% confidence, that for both female and male images, normal and upturned nasal base angulations were ranked as more attractive than downturned nasal base angulations no matter the incisal inclination (Table V).

When viewing the image attractiveness rankings for incisal inclinations from questions grouped by nasal base angulation (Table VI), the female images showed that the normal incisor inclination was ranked first with the normal and upturned nasal base angulations, but the very retroclined incisor inclination was ranked first with the downturned nasal base angulation. The retroclined incisor inclination was ranked second with both the normal and upturned nasal base angulations, whereas the proclined and very proclined incisor inclinations were ranked lowest in attractiveness with all nasal based inclinations (Table VI). For male images, the very proclined

incisor inclination was ranked first with the downturned and upturned nasal base angulations, while the proclined incisor inclination was ranked first with the normal nasal base angulation (Table VI). The normal incisor inclination was ranked second with the downturned and upturned nasal base angulations but ranked lowest with the normal nasal base angulation. In general, attractiveness rankings for different incisal inclinations did not show similar trends across the three nasal base angulations for the male images. Optimal rank estimates did not show any incisal inclination ranking differences with 95% confidence for comparisons grouped by nasal base angulation for either female or male images.

The averages and standard deviations (SD) of two attractiveness rankings per image, grouped either by incisor or nasal base angulations, showed different most and least attractive ranking for females and males (Table VII). For female images, the most and least preferred were the upturned nasal base with normal incisal inclinations and downturned nasal base with very proclined incisor inclinations, respectively, whereas for male images the most and least preferred were the normal nasal base with the proclined incisor and the downturned nasal base with the very retroclined incisor, respectively.

Table I. *OHSU DMD Class of 2024 demographics.*

OHSU DMD Class of 2024		**Overall N=74**
Gender	Female N (%)	35 (47%)
	Male N (%)	39 (53%)
Age	Mean ($years$)	23
	Age Range [minimum, maximum]	[20, 31]
Racial/Ethnic Identity	Asian (federal, actual)	18, 21
	Black or African American (federal, actual)	0, 2
	Hispanic or Latino (federal, actual)	6, 6
	White (federal, actual)	43, 53
	American Indian or Alaska Native (federal, actual)	0, 2

Table II. *Numbers (N), percent of overall number (%) and age (years) of survey respondents by gender group and overall.*

Study Respondents		**Female N=20 (49%)**	**Male N=21 (51%)**	**Overall N=41**
Age	**Mean ± SD (years)**	25 (2)	24 (2)	24 (2)
	Median [Min, Max] (years)	24 [23, 32]	24 [21, 29]	24 [21, 32]
Ethnicity	**Asian**	5 (25%)	6 (29%)	11 (27%)
	White	15 (75%)	15 (71%)	30 (73%)

Figure 8. *Number (N) and percentage of total (%) survey responses to post-survey question: "How challenging did you find it to distinguish your preferences between the images in order to rank them?" This question had an overall response rate of 30 out of 41 (73%).*

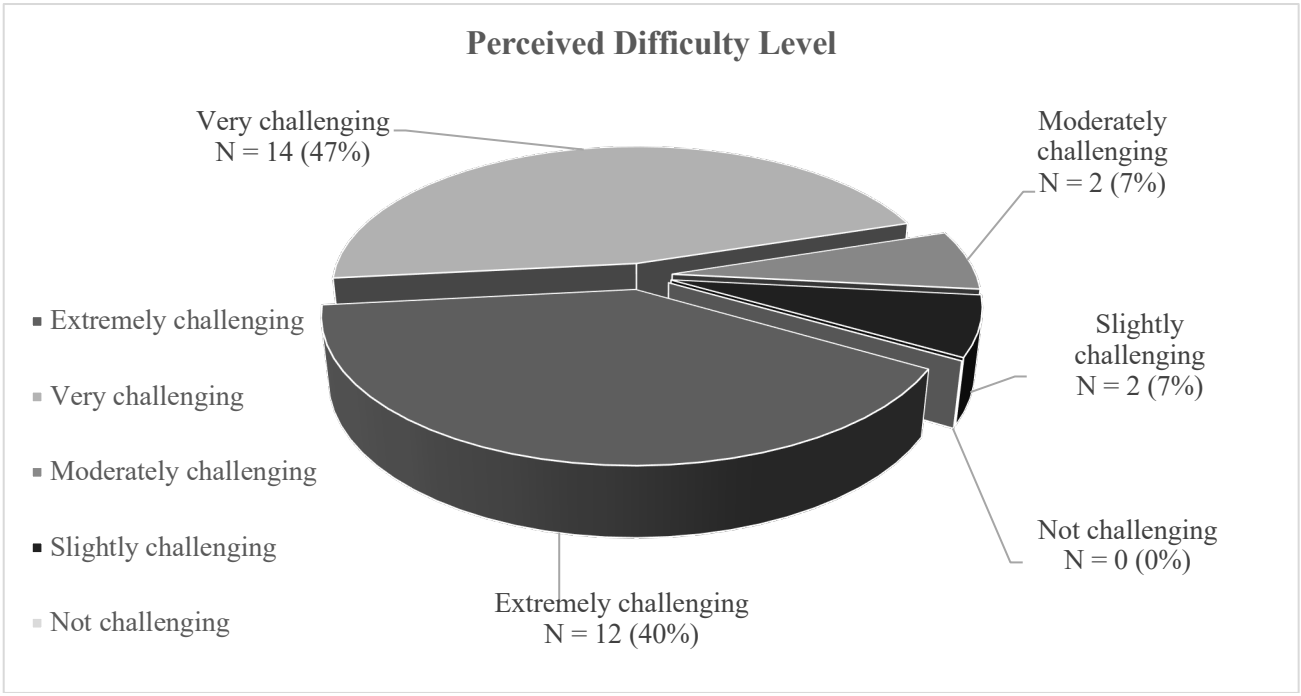
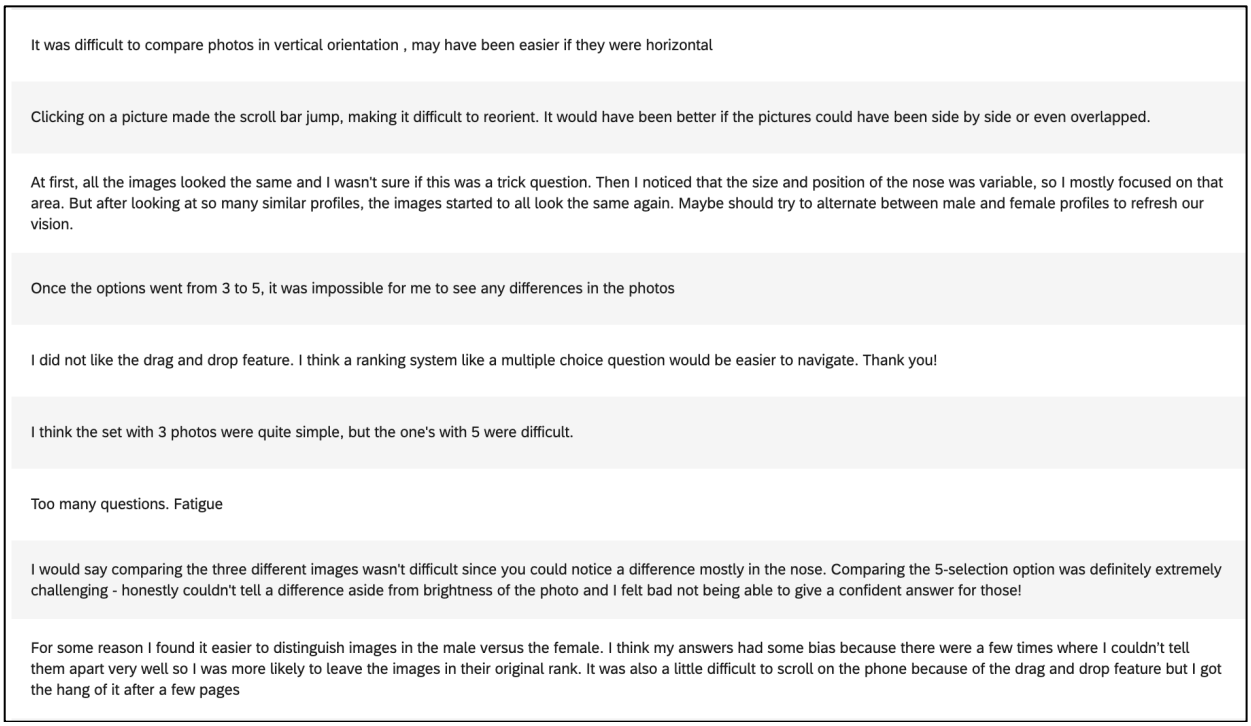


Figure 9. *Written comments and feedback provided by survey respondents upon completion of the survey.*



It was difficult to compare photos in vertical orientation , may have been easier if they were horizontal

Clicking on a picture made the scroll bar jump, making it difficult to reorient. It would have been better if the pictures could have been side by side or even overlapped.

At first, all the images looked the same and I wasn't sure if this was a trick question. Then I noticed that the size and position of the nose was variable, so I mostly focused on that area. But after looking at so many similar profiles, the images started to all look the same again. Maybe should try to alternate between male and female profiles to refresh our vision.

Once the options went from 3 to 5, it was impossible for me to see any differences in the photos

I did not like the drag and drop feature. I think a ranking system like a multiple choice question would be easier to navigate. Thank you!

I think the set with 3 photos were quite simple, but the one's with 5 were difficult.

Too many questions. Fatigue

I would say comparing the three different images wasn't difficult since you could notice a difference mostly in the nose. Comparing the 5-selection option was definitely extremely challenging - honestly couldn't tell a difference aside from brightness of the photo and I felt bad not being able to give a confident answer for those!

For some reason I found it easier to distinguish images in the male versus the female. I think my answers had some bias because there were a few times where I couldn't tell them apart very well so I was more likely to leave the images in their original rank. It was also a little difficult to scroll on the phone because of the drag and drop feature but I got the hang of it after a few pages

Table III. *Image labelling key.*

Image Labelling Key			
Incisor Inclination		**Nasal base angulation**	
I1	Very retroclined (-10°)	**N1**	Downturned (-10°)
I2	Retroclined (-5°)	**N2**	Normal (0°)
I3	Normal (0°)	**N3**	Upturned (+10°)
I4	Proclined (+5°)		
I5	Very proclined (+10°)		

Table IV. *Image attractiveness rankings for nasal base angulations, as determined by rank analysis, from questions grouped by incisor inclination, sub-categorized by female and male images. The images are listed in order of attractiveness rankings with the first being the most attractive and the last being the least attractive.*

Rank Order – Image Attractiveness Grouped by Incisor Inclination	
Female	**Male**
N2.I1 > N3.I1 > N1.I1	N2.I1 > N3.I1 > N1.I1
N3.I2 > N2.I2 > N1.I2	N2.I2 > N3.I2 > N1.I2
N2.I3 > N3.I3 > N1.I3	N2.I3 > N3.I3 > N1.I3
N3.I4 > N2.I4 > N1.I4	N2.I4 > N3.I4 > N1.I4
N3.I5 > N2.I5 > N1.I5	N2.I5 > N3.I5 > N1.I5

Table V. *Image attractiveness rankings for nasal base angulations showing 95% confidence, as determined by optimal rank estimate analyses, from questions grouped by incisor inclinations, sub-categorized by female and male images. The ' >' symbol indicates that the former was rated more attractive than the latter.*

Image Attractiveness Rankings	
Female Image	**Male Image**
N2.I1 > N1.I1	N2.I1 > N1.I1
N3.I1 > N1.I1	N3.I1 > N1.I1
N2.I2 > N1.I1	N2.I2 > N1.I2
N3.I2 > N1.I1	N3.I2 > N1.I2
N2.I3 > N1.I3	N2.I3 > N1.I3
N3.I3 > N1.I3	N3.I3 > N1.I3
N2.I4 > N1.I4	N2.I4 > N1.I4
N3.I4 > N1.I4	N3.I4 > N1.I4
N2.I5 > N1.I5	N2.I5 > N1.I5
N3.I5 > N1.I5	N3.I5 > N1.I5

Table VI. *Image attractiveness rankings for incisor inclination, as determined by rank analysis, from questions grouped by nasal base angulation, sub-categorized by female and male images. The images are listed in order of attractiveness rankings with the first being the most attractive and the last being the least attractive.*

Rank Order – Image Attractiveness Grouped by Nasal base angulation	
Female	**Male**
N1.I1 > N1.I3 > N1.I2 > N1.I4 > N1.I5	N1.I5 > N1.I3 > N1.I1 > N1.I4 > N1.I2
N2.I3 > N2.I1 > N2.I2 > N2.I4 > N2.I5	N2.I4 > N2.I1 > N2.I2 > N2.I5 > N2.I3
N3.I3 > N3.I1 > N3.I2 > N3.I5 > N3.I4	N3.I5 > N3.I3 > N3.I2 > N3.I4 > N3.I1

Table VII. *The average and standard deviation (SD) of two attractiveness rankings per image, grouped by incisor and nasal base angulations, for female and male subjects, listed in order from most attractive (top) to least attractive (bottom) average scores and smallest SD.*

Mean Rankings									
Female					**Male**				
Image	**Grouped by Incisor (3 choices)**	**Grouped by Nose (5 choices)**	**Mean**	**SD**	**Image**	**Grouped by Incisor (3 choices)**	**Grouped by Nose (5 choices)**	**Mean**	**SD**
N3.I3	1.6	2.6	2.1	0.7	***N2.I4***	1.3	2.8	2.1	1.0
N2.I1	1.6	2.9	2.2	0.9	***N3.I3***	1.8	2.6	2.2	0.6
N2.I3	1.7	2.9	2.3	0.8	***N3.I2***	1.8	2.7	2.2	0.6
N3.I1	1.7	2.9	2.3	0.9	***N3.I5***	1.8	2.9	2.3	0.8
N3.I5	1.5	3.0	2.3	1.0	***N2.I1***	1.6	2.9	2.3	0.9
N3.I2	1.6	3.1	2.3	1.1	***N2.I2***	1.6	3.0	2.3	1.0
N2.I2	1.8	2.9	2.4	0.8	***N2.I5***	1.5	3.0	2.3	1.1
N2.I5	1.8	3.1	2.4	0.9	***N2.I3***	1.5	3.3	2.4	1.3
N3.I4	1.5	3.4	2.4	1.3	***N3.I4***	1.9	3.3	2.6	1.0
N2.I4	1.9	3.2	2.6	0.9	***N1.I3***	2.7	2.7	2.7	0.0
N1.I1	2.7	2.6	2.7	0.1	***N3.I1***	1.8	3.6	2.7	1.2
N1.I3	2.6	2.9	2.8	0.2	***N1.I5***	2.7	2.9	2.8	0.1
N1.I2	2.6	3.0	2.8	0.3	***N1.I4***	2.8	3.0	2.9	0.1
N1.I4	2.6	3.1	2.8	0.3	***N1.I2***	2.6	3.1	2.9	0.4
N1.I5	2.6	3.4	3.0	0.5	***N1.I1***	2.6	3.2	2.9	0.4

DISCUSSION

This survey was designed to look at the nasal base angulation as it relates to the incisor inclination. The specified aims of this study were to establish the esthetic preferences of laypeople when viewing smiling profiles depicting a range of (1) nasal base angulations for a given labiolingual incisor inclination, and (2) labiolingual incisor inclinations for a given nasal base angulation. Secondary objectives included evaluation of the impact of raters' gender and racial/ethnic identities, as well as subjects' gender. These aims were a first step towards an overall objective of analyzing the influence of the inclination of the base of the nose on the perception of the optimal inclination of the maxillary incisor in a smiling profile view as well as to establish acceptable esthetic ranges for varying maxillary incisor inclinations with respect to nasal base angulations.

It is overwhelmingly apparent that the downturned nose was disliked, as it was ranked last in every question grouping despite incisor inclination or subjects' gender. Optimal rank estimates showed with 95% confidence, that for both female and male images, normal and upturned nasal base angulations were ranked as more attractive than downturned nasal base angulations no matter the incisal inclination (Table V). These data potentially demonstrate that the nasal base angulation variations were too large and overpowered the acknowledgement of the incisor in the eyes of the survey respondents. Results from the question aimed at assessing perceived difficulty level indicated that the differences between the images with respect to incisal inclinations may be too subtle, as compared to the changes made to the nasal base, and the survey may have been too challenging overall (Figure 8).

The retroclined incisor inclination was ranked second with both the normal and upturned nasal base angulations, whereas the proclined and very proclined incisor inclinations were ranked lowest in attractiveness with all nasal based inclinations (Table VI). The very retroclined incisor was preferred to the slightly retroclined incisor in both the normal and upturned nose – this may be indicative of the fact that the survey respondents could not distinguish between I1 I2 and I3, but preferred them to I4 and I5, which they also could not differentiate. Optimal rank estimates did not show any incisal inclination ranking differences with 95% confidence for comparisons grouped by nasal base angulation for either female or male images. This may be further evidence to support the fact that the modifications in nasal base angulation were too distracting and detracted from the participants' ability to acknowledge and discern the incisor

inclinations. Additionally, the sample size was likely insufficient for comparisons between 5 options testing incisal inclination with a given nasal base angle.

The results of the current study indicate the need for further research with re-consideration of the survey design. One limitation of the current survey design was that the overall rating of each individual image was not assessed, instead the images grouped by a given nasal base or labiolingual incisor angle were ranked. As each image was used twice, once in a grouping of 3 and once in a grouping of 5, they could not be directly compared by statistical analysis. The decision to utilize ranked choices as opposed to individual rating was made with the thought that ranking would provide an easier opportunity for survey respondents to distinguish the images. Future studies should ensure that all questions have the same number of response options to provide results conducive to more simple statistical analysis. Likert-style rating as opposed to rank choice may also be preferential for the same reason. Considerations for future iterations include limiting the degrees of change in the nasal base angulation, using a databank of non-altered images and recording existing nasal base and incisor inclinations, displaying each image individually on screen to receive a Likert-style rating, and pilot studies to assess study designs.

As this study appears to be singular in its purpose of gaining a deeper understanding into the relationship between the soft tissue of the nose and the maxillary incisor in profile, many avenues for further research remain untouched. Additional surveys modifying the AP position of the incisor on its own and in conjunction with variations in inclination would provide deeper understanding. The potentially significant and debilitating limitation inherent to analyzing both incisor AP position and inclination in conjunction with nose variants is the large number of images produced. This could lead to rater fatigue, which appeared to present as an issue in this survey consisting of 16 total questions, 8 for the male subject and 8 for the female subject as evidenced by some of the written comments provided by survey respondents (Figure 9). Future researchers interested in analyzing AP position and inclination simultaneously as it relates to the nose may choose to examine one subject gender at a time to reduce the number of image variants.

Another potentially enlightening avenue that remains is altering other aspects of the nasal morphology outside of the nasal base angulation. Namely, nasal projection, which may be defined as the AP distance from subnasale to the nasal tip. Again, inclusion of these parameters

introduces exponentially more image variants, however, differing combinations of these morphological features appear to have a significant impact on our perception of the ideal incisor position, and therefore justify continued orthodontic research on the matter.

The subject population in this pilot study was limited to the first-year dental student population at OHSU, primarily for convenience. The gender of the respondent population was well-balanced; however, balanced diversity in the mix of racial/ethnic identities in the class was lacking with there being a majority of White and Asian respondents. It has been well established that different racial/ethnic populations exhibit unique facial morphology, with the nose being a prominent example of a morphological feature correlated with race and ethnicity.[5] Thus different racial/ethnic groups may hold diverging preferences. Future studies should aim to include a wider range of racial and ethnic populations, both as subjects and raters, to compare them and elucidate any derived preferences.

The surveyed population was considered to have a 'layperson' level of orthodontic knowledge as the individuals were at the beginning of their dental education and had not experienced any orthodontic training. Future studies may consider comparing rater populations that consist of laypersons, general dentists, and orthodontic specialists to explicate the roll of dental and orthodontic training on the perception of facial esthetics. One potential complication to this aspect of research would be the need to calibrate the surveys to the sensitivity level of the population of interest. When assessing the responses to the post-survey question ascertaining the level of challenge associated with distinguishing the images, it was apparent that this survey may have too challenging for the rater population used. This indicates that the discrepancies between the images may be too subtle for use within a lay population. Future researchers may choose to perform a pilot study designed to hone in on the difficulty level required for optimum survey design for use within their specific rater population.

Areas for bias within the development of the study include derivation of the images using software (Adobe Photoshop). All digital modification was performed by the same researcher (AR) for measures of intra-rater reliability. Nevertheless, the tangent lines used to determine inclinations were formed by eye and mild artistic license was taken by the researcher to establish "natural" appearing images in developing the variants. The researcher tasked with image modification in this study did not have prior training using the applied software. Future

researchers may elect to hire a professional graphic artist for consistency and for ease of developing survey images.

As orthodontists, we cannot change nasal form, but we can adjust incisor inclination. The inspiration for this study came, in part, from a prevalence of discussion about the nasolabial angle (NLA) in treatment planning seminars, without discussion of the innate nasal anatomy and how this may affect perception of the existing nasolabial angle via inclination of the maxillary incisor. Given that a commonly expressed goal of orthodontists is to either increase or decrease the NLA, it is surprising that there exists an absence of research on the relationship between the angle of the maxillary incisor, which directly effects the lip position, and the very structure that comprises the other half of the NLA–the base of the nose. Despite the lack of linear trends resultant from the survey, the existing body of literature in combination with the current study's results indicate the importance of consideration of soft tissue elements of the facial profile when planning for the ideal incisor inclination and warrants further research.

CONCLUSIONS

No significant differences in raters' responses based on raters' gender or racial/ethnic identity were found. The data demonstrated that a downturned nose was perceived as un-esthetic in both the male and female subjects, and the normal and upturned nose were preferred to the downturned nose regardless of incisor inclination. The optimal rank showed no incisor ranking differences when the images were grouped by nose for both the male and female subjects. The distribution of ranks was not uniform, indicating that some combinations of nasal base angle and incisor inclination were perceived as more esthetic than others. Therefore, the null hypotheses that the esthetic preferences were unaffected by 1. the nasal base angulation for a given labiolingual incisor inclination, and 2. the labiolingual incisor inclination for a given nasal base angulation were rejected.

REFERENCES

1. Yehezkel S, Turley PK. Changes in the African American female profile as depicted in fashion magazines during the 20th century. Am J Orthod Dentofacial Orthop 2004;125:407-417.

2. Auger TA, Turley PK. The female soft tissue profile as presented in fashion magazines during the 1900s: a photographic analysis. Int J Adult Orthodon Orthognath Surg 1999;14:7-18.

3. Hall D, Taylor RW, Jacobson A, Sadowsky PL, Bartolucci A. The perception of optimal profile in African Americans versus white Americans as assessed by orthodontists and the lay public. Am J Orthod Dentofacial Orthop 2000;118:514-525.

4. Andrews WA. AP relationship of the maxillary central incisors to the forehead in adult white females. Angle Orthod 2008;78:662-669.

5. Dasari AK, Rachala MR, Shashidhar NR, Manjunatha CR. Influence of nose contours on aesthetic perception of maxillary incisor inclination in smiling facial profile of Indian subcontinent people. Orthodontic Waves 2015;74:83-90.

6. Ghaleb N, Bouserhal J, Bassil-Nassif N. Aesthetic evaluation of profile incisor inclination. Eur J Orthod 2011;33:228-235.

7. Bass NM. Measurement of the profile angle and the aesthetic analysis of the facial profile. J Orthod 2003;30:3-9.

8. Cao L, Zhang K, Bai D, Jing Y, Tian Y, Guo Y. Effect of maxillary incisor labiolingual inclination and anteroposterior position on smiling profile esthetics. Angle Orthod 2011;81:121-129.

9. Park CWL, Myung Ju; Jung, Yun Ik. Photogrammetric facial analysis of attractive celebrities using the glabella for planning rhinoplasty and analyzing surgical outcomes
. Archives of Aesthetic Plastic Surgery 2018;24:105-110.

10. Morar A, Stein E. A method of assessing facial profile attractiveness and its application in comparing the aesthetic preferences of two samples of South Africans. J Orthod 2011;38:99-106.

11. Tauk A, Bassil-Nassif N, Mouhanna-Fattal C, Bouserhal J. The importance of using the entire face to assess facial profile attractiveness. Int Orthod 2016;14:65-79.

12. Hockley A, Weinstein M, Borislow AJ, Braitman LE. Photos vs silhouettes for evaluation of African American profile esthetics. Am J Orthod Dentofacial Orthop 2012;141:161-168.

13. Del Monte S, Afrashtehfar KI, Emami E, Abi Nader S, Tamimi F. Lay preferences for dentogingival esthetic parameters: A systematic review. J Prosthet Dent 2017;118:717-724.

APPENDICES

Appendix A. *Approval for the study by Oregon Health & Science University Institutional Review Board.*

OREGON HEALTH & SCIENCE UNIVERSITY

IRB MEMO

Research Integrity Office
3181 SW Sam Jackson Park Road - L106RI
Portland, OR 97239-3098
(503)494-7887 irb@ohsu.edu

APPROVAL OF SUBMISSION

March 24, 2021

Dear Investigator:

On 3-24-2021, the IRB reviewed the following submission:

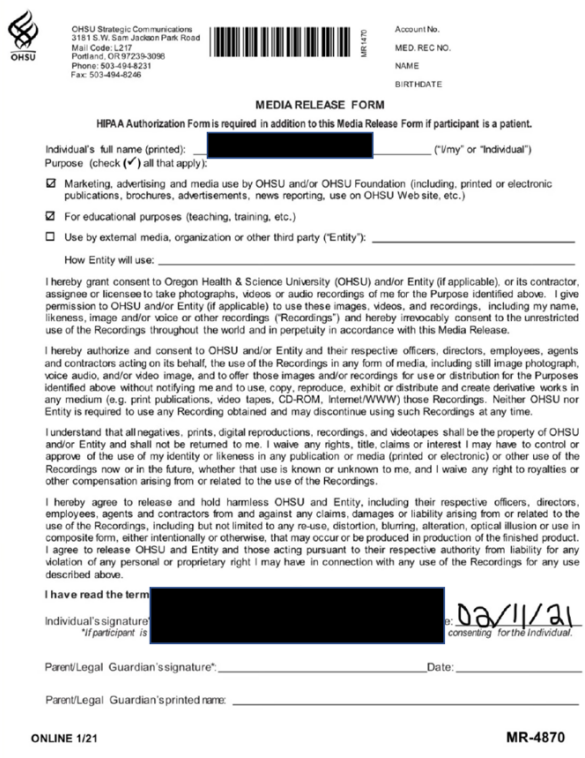
IRB ID:	STUDY00022732
Type of Review:	Initial Study
Title of Study:	The effect of nasal base angulation on the perception of labiolingual incisor inclination esthetics in profile
Principal Investigator:	Laura Iwasaki
Funding:	None
IND, IDE, or HDE:	None
Documents Reviewed:	• Media Release form MR.pdf • Informed Script_IRB_22732.docx • Media Release form IR.pdf • Survey • Protocol

The IRB granted final approval on 3/24/2021. The study requires you to submit a check-in before 3/22/2024.

Review Category: Exempt Category # 2

Copies of all approved documents are available in the study's **Final** Documents (far right column under the documents tab) list in the eIRB. Any additional documents that require an IRB signature (e.g. IIAs and IAAs) will be posted when signed. If this applies to your study, you will receive a notification when these additional signed documents are available.

Appendix B. *Signed media release forms demonstrating the photographed individuals' consent for the use of their images in the study.*



OHSU Strategic Communications
3181 S.W. Sam Jackson Park Road
Mail Code: L217
Portland, OR 97239-3098
Phone: 503-494-8231
Fax: 503-494-8246

MR-1470

Account No.
MED. REC NO.
NAME
BIRTHDATE

MEDIA RELEASE FORM

HIPAA Authorization Form is required in addition to this Media Release Form if participant is a patient.

Individual's full name (printed): [redacted] ("I/my" or "individual")

Purpose (check (✓) all that apply):

☑ Marketing, advertising and media use by OHSU and/or OHSU Foundation (including, printed or electronic publications, brochures, advertisements, news reporting, use on OHSU Web site, etc.)

☑ For educational purposes (teaching, training, etc.)

☐ Use by external media, organization or other third party ("Entity"): _____

How Entity will use: _____

I hereby grant consent to Oregon Health & Science University (OHSU) and/or Entity (if applicable), or its contractor, assignee or licensee to take photographs, videos or audio recordings of me for the Purpose identified above. I give permission to OHSU and/or Entity (if applicable) to use these images, videos, and recordings, including my name, likeness, image and/or voice or other recordings ("Recordings") and hereby irrevocably consent to the unrestricted use of the Recordings throughout the world and in perpetuity in accordance with this Media Release.

I hereby authorize and consent to OHSU and/or Entity and their respective officers, directors, employees, agents and contractors acting on its behalf, the use of the Recordings in any form of media, including still image photograph, voice audio, and/or video image, and to offer those images and/or recordings for use or distribution for the Purposes identified above without notifying me and to use, copy, reproduce, exhibit or distribute and create derivative works in any medium (e.g. print publications, video tapes, CD-ROM, Internet/WWW) those Recordings. Neither OHSU nor Entity is required to use any Recording obtained and may discontinue using such Recordings at any time.

I understand that all negatives, prints, digital reproductions, recordings, and videotapes shall be the property of OHSU and/or Entity and shall not be returned to me. I waive any rights, title, claims or interest I may have to control or approve of the use of my identity or likeness in any publication or media (printed or electronic) or other use of the Recordings now or in the future, whether that use is known or unknown to me, and I waive any right to royalties or other compensation arising from or related to the use of the Recordings.

I hereby agree to release and hold harmless OHSU and Entity, including their respective officers, directors, employees, agents and contractors from and against any claims, damages or liability arising from or related to the use of the Recordings, including but not limited to any re-use, distortion, blurring, alteration, optical illusion or use in composite form, either intentionally or otherwise, that may occur or be produced in production of the finished product. I agree to release OHSU and Entity and those acting pursuant to their respective authority from liability for any violation of any personal or proprietary right I may have in connection with any use of the Recordings for any use described above.

I have read the term

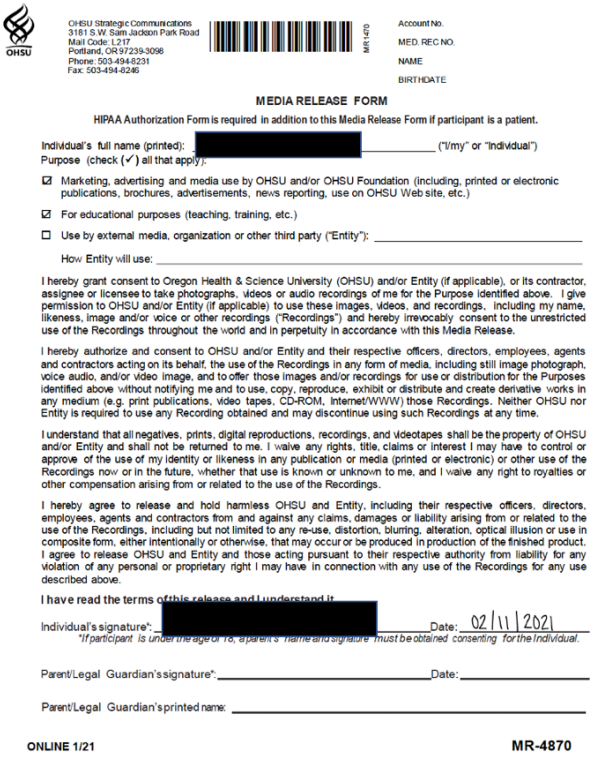
Individual's signature*: [redacted] Date: 02/11/21

**If participant is consenting for the Individual.*

Parent/Legal Guardian's signature*: _____ Date: _____

Parent/Legal Guardian's printed name: _____

ONLINE 1/21 **MR-4870**



OHSU Strategic Communications
3181 S.W. Sam Jackson Park Road
Mail Code: L217
Portland, OR 97239-3098
Phone: 503-494-8231
Fax: 503-494-8246

MR-1470

Account No.
MED. REC NO.
NAME
BIRTHDATE

MEDIA RELEASE FORM

HIPAA Authorization Form is required in addition to this Media Release Form if participant is a patient.

Individual's full name (printed): [redacted] ("I/my" or "individual")

Purpose (check (✓) all that apply):

☑ Marketing, advertising and media use by OHSU and/or OHSU Foundation (including, printed or electronic publications, brochures, advertisements, news reporting, use on OHSU Web site, etc.)

☑ For educational purposes (teaching, training, etc.)

☐ Use by external media, organization or other third party ("Entity"): _____

How Entity will use: _____

I hereby grant consent to Oregon Health & Science University (OHSU) and/or Entity (if applicable), or its contractor, assignee or licensee to take photographs, videos or audio recordings of me for the Purpose identified above. I give permission to OHSU and/or Entity (if applicable) to use these images, videos, and recordings, including my name, likeness, image and/or voice or other recordings ("Recordings") and hereby irrevocably consent to the unrestricted use of the Recordings throughout the world and in perpetuity in accordance with this Media Release.

I hereby authorize and consent to OHSU and/or Entity and their respective officers, directors, employees, agents and contractors acting on its behalf, the use of the Recordings in any form of media, including still image photograph, voice audio, and/or video image, and to offer those images and/or recordings for use or distribution for the Purposes identified above without notifying me and to use, copy, reproduce, exhibit or distribute and create derivative works in any medium (e.g. print publications, video tapes, CD-ROM, Internet/WWW) those Recordings. Neither OHSU nor Entity is required to use any Recording obtained and may discontinue using such Recordings at any time.

I understand that all negatives, prints, digital reproductions, recordings, and videotapes shall be the property of OHSU and/or Entity and shall not be returned to me. I waive any rights, title, claims or interest I may have to control or approve of the use of my identity or likeness in any publication or media (printed or electronic) or other use of the Recordings now or in the future, whether that use is known or unknown to me, and I waive any right to royalties or other compensation arising from or related to the use of the Recordings.

I hereby agree to release and hold harmless OHSU and Entity, including their respective officers, directors, employees, agents and contractors from and against any claims, damages or liability arising from or related to the use of the Recordings, including but not limited to any re-use, distortion, blurring, alteration, optical illusion or use in composite form, either intentionally or otherwise, that may occur or be produced in production of the finished product. I agree to release OHSU and Entity and those acting pursuant to their respective authority from liability for any violation of any personal or proprietary right I may have in connection with any use of the Recordings for any use described above.

I have read the terms of this release and I understand it

Individual's signature*: [redacted] Date: 02/11/2021

**If participant is under the age of 18, a parent's name and signature must be obtained consenting for the Individual.*

Parent/Legal Guardian's signature*: _____ Date: _____

Parent/Legal Guardian's printed name: _____

ONLINE 1/21 **MR-4870**

***Appendix C**. The final image array for the female (a) and male (b) subjects.*

Appendix D. *Text of the image ranking survey questions prepared for the survey platform* (Qualtrics, 2020, Provo, UT, USA).

Image Ranking Survey

Start of Block: Introduction Page

Welcome to my survey!

Thank you so much for being a part of research and helping the world of orthodontics to learn more about how to better treat patients.

This survey is designed to assess which combinations of specific facial features are perceived as the most attractive or visually pleasing. Please answer the following questions truthfully and individually.

You will be asked 8 questions about a female subject and 8 questions about a male subject.

Please note that all responses are voluntary and completely anonymous.

At the end of the survey there will be a space to leave feedback/comments that may be used to improve this survey for future versions. If you have any concerns or questions, please feel free to contact me at rauchle@ohsu.edu

Page Break

End of Block: Introduction Page

Start of Block: Demographic Questions

D1 Please select the gender with which you most closely identify
o Male
o Female
o Other

D2 Please enter your birth year
_____

D3 Please select the ethnicity with which you most closely identify
o American Indian or Alaska Native
o Asian
o Black or African American
o Hispanic or Latino
o Native Hawaiian or Other Pacific Islander

o White

Page Break

End of Block: Demographic Questions

Start of Block: Female Images

F1 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Female n1.i1*
_____ *Image:Female n2.i1*
_____ *Image:Female n3.i1*

Page Break

F2 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Female n1.i2*
_____ *Image:Female n2.i2*
_____ *Image:Female n3.i2*

Page Break

F3 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Female n1.i3*
_____ *Image:Female n2.i3*
_____ *Image:Female n3.i3*

Page Break

F4 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Female n1.i4*
_____ *Image:Female n2.i4*
_____ *Image:Female n3.i4*

Page Break

F5 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Female n1.i5*
_____ *Image:Female n2.i5*
_____ *Image:Female n3.i5*

Page Break

F6 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Female n1.i1*
_____ *Image:Female n1.i2*
_____ *Image:Female n1.i3*
_____ *Image:Female n1.i4*
_____ *Image:Female n1.i5*

Page Break

F7 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Female n2.i1*
_____ *Image:Female n2.i2*
_____ *Image:Female n2.i3*
_____ *Image:Female n2.i4*
_____ *Image:Female n2.i5*

Page Break

F8 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Female n3.i1*
_____ *Image:Female n3.i2*
_____ *Image:Female n3.i3*
_____ *Image:Female n3.i4*
_____ *Image:Female n3.i5*

Page Break

End of Block: Female Images

Start of Block: Male Images

Halfway done!

M1 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Male n1.i1*
_____ *Image:Male n2.i1*
_____ *Image:Male n3.i1*

Page Break

M2 Please drag and drop to rank the images from most attractive (1) to least attractive (3)

_____ *Image:Male n1.i2*
_____ *Image:Male n2.i2*
_____ *Image:Male n3.i2*

Page Break

M3 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Male n1.i3*
_____ *Image:Male n2.i3*
_____ *Image:Male n3.i3*

Page Break

M4 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Male n1.i4*
_____ *Image:Male n2.i4*
_____ *Image:Male n3.i4*

Page Break

M5 Please drag and drop to rank the images from most attractive (1) to least attractive (3)
_____ *Image:Male n1.i5*
_____ *Image:Male n2.i5*
_____ *Image:Male n3.i5*

Page Break

M6 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Male n1.i1*
_____ *Image:Male n1.i2*
_____ *Image:Male n1.i3*
_____ *Image:Male n1.i4*
_____ *Image:Male n1.i5*

Page Break

M7 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Male n2.i1*
_____ *Image:Male n2.i2*
_____ *Image:Male n2.i3*
_____ *Image:Male n2.i4*
_____ *Image:Male n2.i5*

Page Break

M8 Please drag and drop to rank the images from most attractive (1) to least attractive (5)
_____ *Image:Male n3.i1*
_____ *Image:Male n3.i2*
_____ *Image:Male n3.i3*
_____ *Image:Male n3.i4*
_____ *Image:Male n3.i5*

Page Break

End of Block: Male Images

Start of Block: Post-Survey Questions

E1 How challenging did you find it to distinguish your preferences between the images in order to rank them?
o Extremely challenging
o Very challenging
o Moderately challenging
o Slightly challenging
o Not challenging at all

E2 Please use this space to write any comments or feedback. This will be especially valuable for improving this survey for future versions!
_____

Page Break

End of Block: Post-Survey Questions

Appendix E. *Email invitation to participate in survey, approved by the IRB.*

Informed Script, IRB #00022732

Members of the OHSU Dental Class of 2024;

You are being asked to participate in a research study. This study is being conducted by me, Alex Rauchle a graduate student in the MS program in Orthodontics at OHSU.

The purpose of this research study is to assess which combinations of specific facial features are perceived as the most attractive or visually pleasing.

I am asking for volunteers to complete a short survey with 8 questions about a female subject and 8 questions about a male subject.

This survey will take approximately 10-15 minutes to complete. All responses will be completely unidentifiable. The surveys will not have any identifiers to link your responses back to you or any other participants. There are no foreseeable risks to you in completing the survey. We are only interested in evaluating the data for the entire group. Although there is no direct benefit to you, your participation will contribute to a better understanding of facial attractiveness.

Your participation in this research study is completely voluntary. The alternative to participating is to not participate.

If you have any questions regarding this research study, please contact me at rauchle@ohsu.edu. If you have any questions regarding your rights as a research subject, please contact the OHSU Institutional Review Board at (503) 494-7887 or irb@ohsu.edu.

Please know that your time and contribution to research is valued and appreciated.

All the best,
Dr. Alex Rauchle
Graduate Student
OHSU Orthodontics