Layperson Perception of Esthetic Benefit of Orthodontics in Patients of Different Racial Backgrounds

2025 Research Aid Awards (RAA)

Dr Jenna Berry

jburt23@uic.edu
O: 734-788-5067

FollowUp Form

Award Information

In an attempt to make things a little easier for the reviewer who will read this report, please consider these two questions before this is sent for review:

- *Is this an example of your very best work, in that it provides sufficient explanation and justification, and is something otherwise worthy of publication? (We do publish the Final Report on our website, so this does need to be complete and polished.)*
- *Does this Final Report provide the level of detail, etc. that you would expect, if you were the reviewer?*

Title of Project:*

Layperson Perception of Esthetic Benefit of Orthodontics in Patients of Different Racial Backgrounds

Award Type

Research Aid Award (RAA)

Comment: *Appropriate category of research for this type of study*

Period of AAOF Support

July 1, 2025 through June 30, 2026

Institution

The Board of Trustees of the University of Illinois - Chicago

Names of principal advisor(s) / mentor(s), co-investigator(s) and consultant(s)

Mohammed Elnagar

Comment: *Dr. Elnagar is a strong researcher with a track record of relevant investigations.*

Amount of Funding
$6,000.00

Abstract
(add specific directions for each type here)

Factors including gender, age, race and ethnicity all play strong roles in determining an individual's facial features. A robust body of research demonstrates that modification of certain features through orthodontic treatment, such as profile concavity, buccal corridor width, and facial symmetry, are generally regarded as more aesthetic or attractive. A growing body of literature suggests that how lay people view the attractiveness of different facial features may be influenced by their own race or ethnicity. However, little research has been done on how the race of individuals influences their perceived attractiveness after different types of orthodontic treatment. We plan to use VTO to simulate different treatment outcomes, and then question lay people on their preferred outcomes for different individuals.

This study aims to evaluate the laypersons' perception of the esthetic impacts of different orthodontic treatments in patients of different races presenting with Class I malocclusions. This project will test the hypothesis that race impacts the perception of attractiveness and esthetics through the observer's lens, and based on the race of the person being observed. In turn, this will address these gaps in the literature by investigating these two distinct but related correlations between race and esthetics as they relate to orthodontic treatment. This study is applicable clinically when treating patients with borderline extraction malocclusions. More than this, results of this research are applicable to all cases that profile changes may accompany. Insights from this project could underscore the importance of patient preference in treatment planning, assist orthodontists in remaining sensitive to racial factors concerning esthetics, and encourage orthodontists to actively involve patients in clinical decision-making.

Comment: *Studies such as this, must have a close control of biases. Many factors can be found to include bias. We hope they were managed well.*

Respond to the following questions:

Detailed results and inferences:*
If the work has been published, please attach a pdf of manuscript below by clicking "Upload a file".
OR
Use the text box below to describe in detail the results of your study. The intent is to share the knowledge you have generated with the AAOF and orthodontic community specifically and other who may benefit from your study. Table, Figures, Statistical Analysis, and interpretation of results should also be attached by clicking "Upload a file".

BERRY-PRIMARY-2026 (1).pdf
A portion of work has been reported on for completion of a masters thesis and the other portion is currently being submitted to the AJODO for publication.

Comment: *Congrats on Presenting this work at the AAO 2026 and in Chicago.*

Were the original, specific aims of the proposal realized?*

This study aimed to evaluate the layperson perception of the esthetic impacts of different orthodontic treatments in patients of different races. Specifically, the project tested the hypothesis that race impacts the perception of attractiveness and esthetics both through the lens of the observer and based on the race of the person being observed. These research aims were fully realized in that this study demonstrated that both race of the viewer and person being viewed play a significant role in esthetic perception.

Statistically significant associations were found between a viewer's race and their preferred profile when viewing four of the sixteen case scenarios. Variations in preferences were also observed based on the race of the patient being viewed; pre-treatment profiles were generally preferred for Asian individuals and extraction profiles were favored in Black, White, and Hispanic cases. Despite these differences, substantial agreement was observed across racial groups, with the majority of viewers preferred extraction profiles regardless of their own racial background or the race of the patient being viewed.
In demonstrating the complex relationship between race and esthetic perception, this project underscores the need for orthodontists to remain sensitive to racial factors, prioritize patient preference, and actively involve patients in the treatment planning process.

Were the results published?*

No

Have the results of this proposal been presented?*

Yes

Comment: *the response for this question is not correct. This was has not being presented outside the university. And a copy of the manuscript submitted to AJODO was NOT submitted yet.*

To what extent have you used, or how do you intend to use, AAOF funding to further your career?*

This funding has been essential for the study. Without this support of the AAOF, project development and participant recruitment would have been significantly less robust leading to lower quality results and less clinically relevant insights. As this project aimed to understand race and esthetic perception in a practically applicable manner, it has shaped my practice as a well-rounded clinician. By grounding my clinical approach in objective data, these insights allow me to continue practicing evidence based orthodontics and deliver the highest quality care that respects the diverse backgrounds of all my patients.

In addition to the immediate benefits, this support has provided assistance for my long-term career goals of being in academia. In completing this research, I have laid a foundation that I hope will allow me to transition into a faculty role in the future. In this way, I hope to give back to the profession by contributing meaningfully to orthodontic education as my professors have done for me.

Comment: *This answer has not been objectively responded by the award recipient. AAOF just wants to know how the funds were used. And the answer does not really address the question. It is a sort of general, not focused answer.*

Accounting: Were there any leftover funds?*

If "yes", enter your best estimate and work with your grants manager to finalize financial reports and send refund payable to: AAOF
Attn: George
401 N. Lindbergh Blvd.
St. Louis, MO. 63141-7839

If "no", enter zero.

$875.00

Not Published

Are there plans to publish? If not, why not?*

There are plans to publish this work. As a part of the research team, I am preparing a manuscript to submit to the AJODO.

Comment: *Please submit a copy of the manuscript being submitted to the AJODO.*

Presented

Please list titles, author or co-authors of these presentation/s, year and locations:*

Title: Esthetic Benefit of Orthodontic Treatments in Patients of Different Racial Backgrounds
Authors: Jenna Berry, DDS; Mohammed Elnagar, DDS, MS, PhD; Michael Han, DDS, FACS; Maria Therese Galang-Boquiren, DDS, MS, MBA; Phimon Atsawasuwan, DDS, MSc, MSc, MS; Grace Viana, MS
Year and Location: AAO Annual Session. Orlando, Florida (2026)

Title: Esthetic Benefit of Orthodontic Treatments in Patients of Different Racial Backgrounds
Authors: Jenna Berry, DDS; Mohammed Elnagar, DDS, MS, PhD; Michael Han, DDS, FACS; Maria Therese Galang-Boquiren, DDS, MS, MBA; Phimon Atsawasuwan, DDS, MSc, MSc, MS; Grace Viana, MS
Year and Location: UIC College of Dentistry Clinical Research Day. Chicago, Illinois (2026)

Comment: *Well done in presenting the results of this investigation at the AAO an UI*

Was AAOF support acknowledged?

If so, please describe:

Yes! The support of the AAOF through funding was acknowledged including the award number was included on slide 5 of the AAO presentation and the bottom left corner of the Clinical Research Day poster.

Comment: *Thanks for acknowledging AAOF.*

Internal Review

Reviewer comments

This investigation was interesting, and it attempted to answer a cultural questions of bias. The master thesis was completed, but the award recipient has not send a copy of the manuscript being submitted for publication. A copy of the manuscript must e submitted to the AAOF to be considered as a complete process.

Reviewer Status*

Incomplete (needs more information)

File Attachment Summary

Applicant File Uploads

- BERRY-PRIMARY-2026 (1).pdf

Esthetic Benefit of Orthodontic Treatments in Patients of Different Racial Backgrounds

by

Jenna Berry

Bachelor of Science, Grand Valley State University, 2019

Doctor of Dental Surgery, Columbia University, 2023

THESIS

Submitted as partial fulfillment of the requirements for the degree of Master of Science in Oral Sciences in the Graduate College of the University of Illinois at Chicago, 2026

Chicago, IL

Defense Committee:

Dr. Mohammed H. Elnagar, Chair and Advisor
Dr. Phimon Atsawasuwan, Orthodontics
Dr. Maria Therese Galang Boquiren, Orthodontics
Grace Viana, Orthodontics
Dr. Michael Han, Oral Surgery

CONTRIBUTION OF AUTHORS

This study was a collaborative effort amongst many individuals. Project development assistance and constructive feedback was provided by Dr. Mohammed Elnagar, Grace Viana, Dr. Michael Han, Dr. Maria Therese Galang-Boquiren, and Dr. Phimon Atsawasuwan. Research assistants, Deemah Tarabichi and Jasmine Jabr assisted in participant recruitment. Additional support was provided by the University of Illinois Chicago College of Dentistry, particularly Dr. Veerasathparush Allareddy, Dr. Budi Kusnoto, Dr. Maysaa Oubaidin, Dr Steven Miller, and Marta Kucharska. This thesis was written in its entirety by this author, Jenna Elise Burton Berry.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE PAGE

LIST OF ABBREVIATIONS

ABO	American Board of Orthodontics
IRB	Institutional Review Board
UIC COD	University of Illinois Chicago College of Dentistry
VTO	Dolphin Imaging Software Virtual Treatment Objective

SUMMARY

It is well established that there is significant diversity in facial features among individuals. Certain features are of particular interest to the orthodontic community as they can both guide and be influenced by treatment. This study focused on patients with Class I bimaxillary protrusion, which could reasonably be treated with the extraction of four bicuspids or non-extraction methods, impacting facial profile esthetics in different ways. A growing body of literature suggests that how laypeople view the attractiveness of different facial features may be influenced by their own race or ethnicity. Little research has examined how the race of individuals influences the perceived attractiveness of their profiles by others.

A 37-item questionnaire was distributed to participants in the UIC COD waiting areas via Qualtrics Survey Software. Eight cases (two each from White, Black, Hispanic, and Asian women) were presented with pre-treatment, simulated extraction, and simulated non-extraction profiles. Participants ranked each set from most to least attractive. 303 respondents completed the survey. Pearson chi-square tests were used to examine associations between viewer race, case race, and esthetic preference. All statistical tests were two-sided, and statistical significance was set at $p < .05$.

Statistically significant associations were found between viewer race and esthetic preference in four scenarios. Esthetic preferences also varied depending on the race of the case being viewed, with pre-treatment profiles preferred for Asian cases while extraction profiles were preferred for Black, Hispanic, and White cases. However, substantial agreement was observed across viewer racial groups with most preferring extraction profiles regardless of their own race. Both null hypotheses were rejected as an association was found between race of the observer and

race of the observed as they relate to perception of facial profile attractiveness. The results of this study demonstrate a complex relationship between race and esthetics and lay the groundwork for future studies investigating this relationship. More directly, insights from this project highlight the importance of considering racial factors in esthetics and encourage orthodontists to engage patients actively in the treatment planning process.

1.0 BACKGROUND

1.1 Objectives

The primary aim of this study was to examine the layperson's perception of the esthetic impacts of four premolar extractions as compared to non-extraction orthodontic treatment in patients of different races presenting with Class I bimaxillary protrusion. Our objectives are to 1) understand how an individual's own race may influence their perception of other women's profiles following orthodontic treatment; and 2) understand how the race of the person being viewed may influence how they are perceived by others following orthodontic treatment.

1.2 Hypotheses

Null Hypothesis (H_0) 1: There is no association between the race of the observer and the perception of facial profile attractiveness following extraction or non-extraction orthodontic treatments

Null Hypothesis (H_0) 2: There is no association between the race of the observed and the perception of facial profile attractiveness following extraction or non-extraction orthodontic treatments

1.3 Rationale for Ongoing Research

1.3.1 Diversity in Facial Features

It has been well established that there is great diversity in facial features between individuals. Factors, including gender, age, race, and ethnicity, all play strong roles in determining such facial features (Wen et al., 2015; Liu et al., 2014). Facial differences associated with race and ethnicity are relevant to the orthodontic community as they relate to traditional cephalometric and morphologic standards. When examining the major racial groups in the United States, African American individuals are more likely to have greater facial convexity, lower lip protrusion, soft tissue thickness, and facial width when compared to other groups (Y. Liu et al., 2014). Asian individuals more often have greater lower facial third height, lesser upper lip length, and greater mandibular width (Kurian et al., 2023). White individuals exhibit more maxillary and mandibular retrusion, as well as less soft tissue thickness. Hispanic individuals are more likely to have smaller nasolabial angles, greater lip protrusion, and lower facial fullness (Celebi et al., 2017; Vela et al., 2011). These are some of the many differences observed between individuals of different races and ethnicities.

1.3.2 Cephalometric Radiographic Analysis

Orthodontic interest in the esthetics of facial profiles and their relationship to underlying skeletal structures has prompted decades of research aimed at defining ideal facial features. For both esthetic and functional purposes, cephalometric analysis has become a standard of practice in orthodontic diagnosis and treatment planning (J. N. Sharma, 2011).

Since the 1930s, numerous cephalometric analyses have been developed to quantify craniofacial relationships. Each analysis defines ideal values and acceptable ranges for skeletal landmarks, typically based on small samples of individuals considered “normal” or “esthetic,” and is typically named after its developer (Saadeh et al., 2025). Traditional analyses, namely Tweed, Broadbent, Ricketts, McNamara, and Steiner, were derived from small cohorts of White North American participants, while other foundational analyses, including Nanda and Schwarz, were based on White populations in Western Europe (Broadbent, 1931;Krogman, 1948; Steiner, 1953; Jacobson, 1975; Ricketts, 1960;McNamara, 1984; Nanda & Ghosh, 1995).These analyses primarily reflect craniofacial averages specific to these populations. In the 2000’s the American Board of Orthodontics established its own set of cephalometric values. These norms synthesize multiple classic analyses, primarily drawing upon the measurements of Steiner, Downs, and Ricketts, all of which were derived from White populations (Cangialosi et al., 2004).

Although early cephalometric studies focused almost exclusively on White populations, subsequent research has demonstrated significant variation across different populations, particularly racial and ethnic groups (Uysal et al., 2011;Ahsan et al., 2013; Daer & Abuaffan, 2016; Mummareddy et al., 2025). Applying traditional cephalometric norms to non-White patients can make individuals appear “out of the norm”, even when their features are typical for their population. Many studies have demonstrated variation of non-White groups from these typically accepted cephalometric standards, but widely accepted, racially specific cephalometric norms have yet to be established (Saadeh et al., 2025;Mummareddy et al., 2025). These findings emphasize the limitations of current cephalometric analyses as they relate to morphological differences associated with race and importance of developing and applying normative standards tailored to specific populations.

1.3.3 Influence of Orthodontic Treatment on Profile

While there are a myriad of characteristics that determine the morphology of one's face, certain features are of particular interest to the orthodontic community as they can both guide and be influenced by treatment. Various modalities of orthodontic treatment of adult patients may influence the appearance of their profile. Changes in profile can be achieved through surgical orthodontic treatment, extraction of teeth, or non-surgical, non-extraction orthodontic treatment. (Proffit, 2012). Both extraction and non-extraction treatments have associated soft tissue profile changes. Extraction of bicuspids generally results in increased upper lip length, increased nasolabial angle, and decreased lip protrusion (N. Alqahtani et al., 2020). Non-extraction treatment generally results in an increased lip protrusion, increased lower facial fullness, and more pronounced mento-labial sulcus (Bakhshaei et al., 2020; Khan & Fida, 2010)

This study focuses on patients with bimaxillary Class I protrusion. Depending on the severity of the protrusion, Class I bimaxillary protrusive cases in adults are often treated non-surgically with bilateral upper and lower bicuspid extractions or non-surgically without extractions using traditional orthodontic mechanics. Determination of which cases should be treated with or without bicuspid extractions has been long debated (N. D. Alqahtani et al., 2019; Kouli et al., 2019 Khan & Fida, 2010). Definitive clinical guidelines for determining if extractions are indicated are not clear in the literature (Bakhshaei et al., 2020;Dinçer et al., 2013) In general, orthodontic treatment without extraction of bicuspids is utilized in patients with mild to moderate crowding or incisor proclination. Extraction of the bicuspids is utilized in patients with severe crowding or incisor proclination. Definitions of severe crowding and proclination vary depending on the source (Burstone & Choy, 2015;Dinçer et al., 2013). There exist many Class I bimaxillary protrusive

cases which could reasonably be treated with or without extractions. Such cases are referred to as borderline Class I extraction cases.

1.3.4 Profile Esthetics in Orthodontics

There is a robust body of research that demonstrates that modification of certain features through orthodontic treatment, such as profile concavity, buccal corridor width, and facial symmetry, are generally regarded as more aesthetic or attractive (Moore et al., 2005;Janson et al., 2011; Shyagali et al., 2008; Eslami et al., 2016). Many other features, including lip protrusion, lower facial fullness, and facial convexity, are more variable in how they are perceived as it relates to facial attractiveness.

Among these more variable facial profile features, anterior-posterior lip position has received the most attention in the literature, followed by facial convexity and fullness of the lower facial third. While lip position is the most frequently researched, the preferred amount of lip protrusion is highly variable both within and between studies. Zarif Najafi et al. (2016), for example, found that the most esthetic profiles had protrusive upper and lower lips, whereas a similarly structured study 2022 study by Sharma et al. reported a preference for retrusive upper and lower lips. Other studies, including Ghorbanyjavadpour et al.(2019) found that the most esthetic profiles had moderately protrusive upper lips and mildly retrusive lower lips (Rebaque Pistoni et al., 2023).

Increasingly, studies have begun to investigate how lip position, facial convexity, and facial fullness interact with each other to influence overall facial attractiveness. Several studies demonstrate that the preferred esthetic lip position differs based on the vertical lower anterior facial height and morphology (Seo et al., 2021;Murakami et al., 2016). Similarly, the amount of overall

facial convexity and divergence have been found to impact the preferred lip position and most attractive profile even in patients all presenting with a Class I skeletal pattern (Alshammari et al., 2023). These findings suggest that analysis of facial features with more complex impacts on esthetics should be analyzed in concert for the most clinically relevant insights.

1.3.5 Race and Ethnicity in Esthetic Evaluation

A growing body of literature suggests that how lay people view the attractiveness of different facial features may be influenced by their own traits and background. For example, a 2023 study by Taee et al. asked respondents from seven different countries to rate profiles with digitally modified nose and lip positions. Researchers found significant differences in the preferred profiles, with some populations favoring more retrusive lower facial thirds with smaller, upturned noses, while others preferred noses and lips with greater projection. Further, other studies have demonstrated similar patterns, showing that preferred profiles differ according to viewers' own characteristics, including race, age, sex, level of acculturation, education, and socioeconomic status, though specific findings vary across studies (Sy et al., 2016; Tugran & Baka, 2021; Heppt & Vent, 2015).

Many studies demonstrate that an individual's race strongly influences their perceptions of others attractiveness. Several hypotheses have been proposed to explain this, including the idea that people prefer faces that most closely resemble their own racial features or the features of those in their communities or social groups. However, the exact reasons behind these differences remain uncertain. While existing research offers support for both hypotheses, neither fully account for the observed pattern.

The most robust body of research conducted on esthetic preferences of people of different races in the United States compares White and Black Americans. Studies assessing Black and White American evaluators largely demonstrate that thicker, more full, protrusive lips are more preferred by Black participants, whereas White participants preferred thinner and more retrusive lower facial thirds, and straight overall profiles (Sadek & Alali, 2025; Kempa et al., 2024;Souza et al., 2022).

Relatively few studies conducted in the United States have examined racial groups outside of Black and White participants. This is particularly notable as Hispanic and Asian populations account for almost 25% of the American population, and this percentage continues to grow (Hispanic Latino Health, 2025). Hispanic individuals are among the least studied in the orthodontic literature as it relates to esthetic preferences. The available findings, although limited, show conflicting patterns. In one study comparing Mexican and White Americans, Mexican participants preferred more retrusive lower lips than White participants. This contrasts with typical Hispanic facial features, which include greater facial fullness and protrusive lips (Mejia-Maidl et al., 2005). A separate study comparing Americans of Mexican and European dissent found that, when assessing profiles, Mexican Americans rated greater convexity and dentoalveolar protrusion as most attractive (Vela et al., 2011). This preference is consistent with Hispanic facial norms. These findings in the literature highlight the underrepresentation of research on Hispanic Americans and potential variability within this racial group.

Within Asia, numerous studies have compared esthetic preferences between different Asian ethnic groups. Multiple investigations have found that Korean and Chinese evaluators demonstrate a preference for a more retrusive maxilla-mandibular complex, and accept a slightly

convex profile, whereas Japanese judges tend to favor a straight profile with greater lip protrusion (Chan et al., 2008; Park et al., 2006;Chong et al., 2014; Bronfman et al., 2015).

Interestingly, Sy et al. in 2016 investigated how the level of acculturation, the process in which members of one cultural group adopt the beliefs and behaviors of another group, influenced Asian American opinions of profile esthetics. Factors including time spent in the United States, ethnicity of close friends, origin of commonly consumed foods, and preferred language were considered. It was found that individuals more assimilated into American culture tended to prefer profiles more consistent with historically White esthetic norms as opposed to Asian norms (Sy et al., 2016). This supports the hypothesis that esthetic preferences are influenced by culture and the surrounding community. While studies examining specific racial groups provide valuable insight, they may not fully represent the perception of individuals in multicultural contexts. Still, the cumulative body of literature suggests that the race of individuals may influence how they perceive the attractiveness of others' profiles.

Though race of the viewer has been more thoroughly explored, significantly less research has been done on how the race of individuals influences their perceived attractiveness by others. The methodology employed in most studies involves viewers evaluating a single participant, or participants of one racial group (Chan et al., 2008; Park et al., 2006;Seo et al., 2021;Chong et al., 2014;Sharma et al., 2022). To our knowledge, no study has simultaneously examined how the race of the viewer and individual being viewed influences esthetic perception across the major racial groups in the United States.

2.0 MATERIALS AND METHODS

2.1 Institutional Review Board Approval

This is a questionnaire-based study of laypeople and their esthetic preferences. This study has been granted Institutional Review Board approval by the Office of Human Subjects Research at University of Illinois Chicago (IRB Protocol #STUDY2024-0060).

2.2 Development of Survey Instrument

A 37-item questionnaire was developed. The questionnaire was organized into three sections: (1) demographic information, (2) comparison of silhouette images, (3) comparison of color profile images. The first section selected for inclusion criteria and captured demographic information. Demographic information including racial background, age group, and gender identity were collected. The survey instrument was designed to capture ordinal, categorical data.

The second and third sections were composed of cases. To select cases to be viewed, patient profile images from the UIC COD Department of Orthodontics and a private practice (AllCare Orthodontic Center) in Chicago, Illinois were gathered from Dolphin imaging software. All case participants signed written consent (Appendix A). Patients were eligible for inclusion as cases if they were identified in the software as between the ages of 18 and 40 years, female, and White, Black, Hispanic, or Asian. Case participants were limited to those identifying as women due to the scope of the study considering the difference in preferred esthetics for males and females (Fiala et

al., 2021; Ghorbanyjavadpour & Rakhshan, 2019). In pre-treatment images, cases classified as skeletal Class I bimaxillary protrusive were selected. These cases were deemed to have lower facial third fullness that could be reasonably treated with or without four bicuspid extractions. Skeletal Class I was determined based on a Wits Appraisal of -1-3° and ANB of 1-4°. Borderline extraction/non-extraction protrusion was determined based on interincisal angle of <110°, nasolabial angle 79-90°, upper lip to E-plane 2-8mm, and lower lip to E plane 4-9mm (Siangloy & Charoemratrote, 2024). See Figure 1.

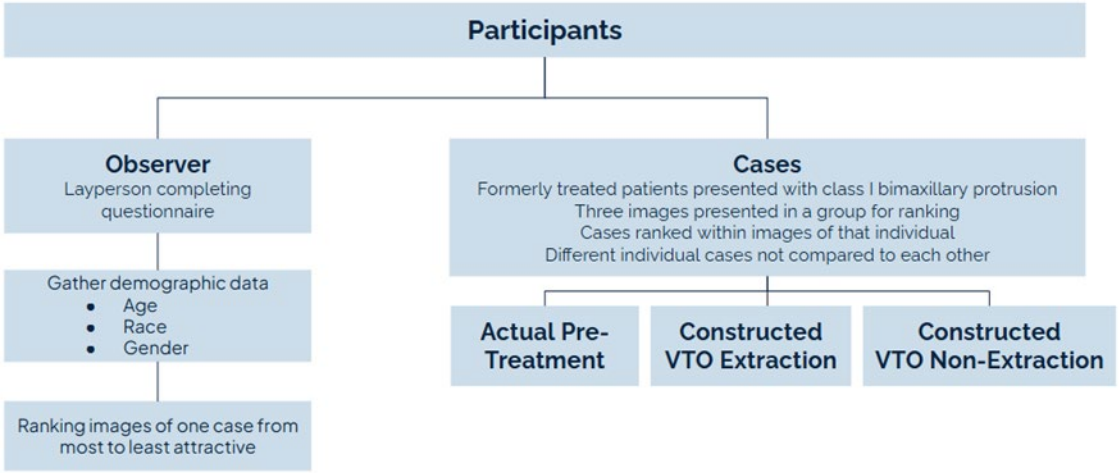


Figure 1: Case and Observer Participant Organization

Cases were clincially treated either non-surgically with bilateral upper and lower bicuspid extractions or non-surgically using traditional orthodontic mechanics without bicuspid extractions. To maintain balance in the sample, two participants from each racial group (White, Black, Hispanic, and Asian) were selected, with one actually treated with four bicuspid extractions and one treated without extractions.

These pre-treatment profile images were then converted into simulated extraction and non-extraction profile images using the Dolphin Imaging Software Virtual Treatment Objective (VTO) program. This software estimates the resulting soft tissue changes following different orthodontic and surgical interventions using traced ceohalometric radiographs (Soheilifar et al., 2022). To simulate the extraction of four bicuspids, maxillary incisors were retroclined 8° and retracted 5mm. Lower incisors were retroclined 7° and retracted 4mm. To simulate non-extraction treatment, maxillary incisors were proclined 4° and protruded 5mm. Lower incisors were proclined 5° amd protruded 5mm (Leonardi et al., 2010) This resulted in a set of three profile images for each case, actual pre-treatment, simulated extraction, and simulated non-extraction. Each case set was coverted to black and white silhouette profile images and color profile images.

The second section was composed of each case presented in a set of three black and white silhouette images: actual pre-treatment, simulated extraction, and simulated non-extraction. Participants were asked to rank these three images from most to least attractive for each case. Images marked as A, B, and C represent actual pre-treatment, simulated extraction, and simulated non-extraction respectively. See Figure 2.

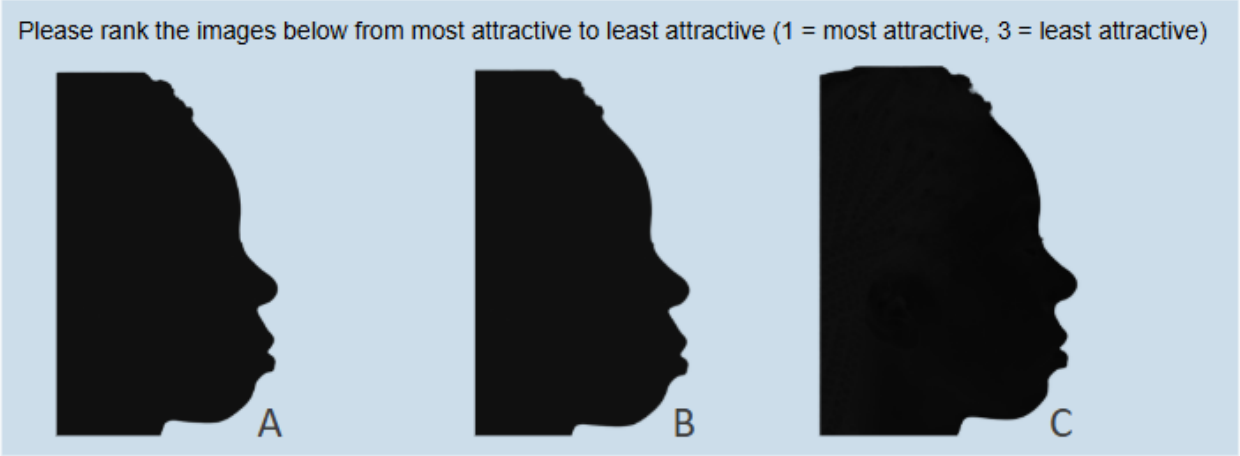


Figure 2: Presentation of Silhouette Images.

The third section was composed of each case presented in a set of three color profile images: actual pre-treatment, simulated extraction, and simulated non-extraction. Participants were asked to rank these three images from most to least attractive for each case. Images marked as A, B, and C represent actual pre-treatment, simulated extraction, and simulated non-extraction respectively. An excerpt from the survery instrument is present in Appendix B. See Figure 3.

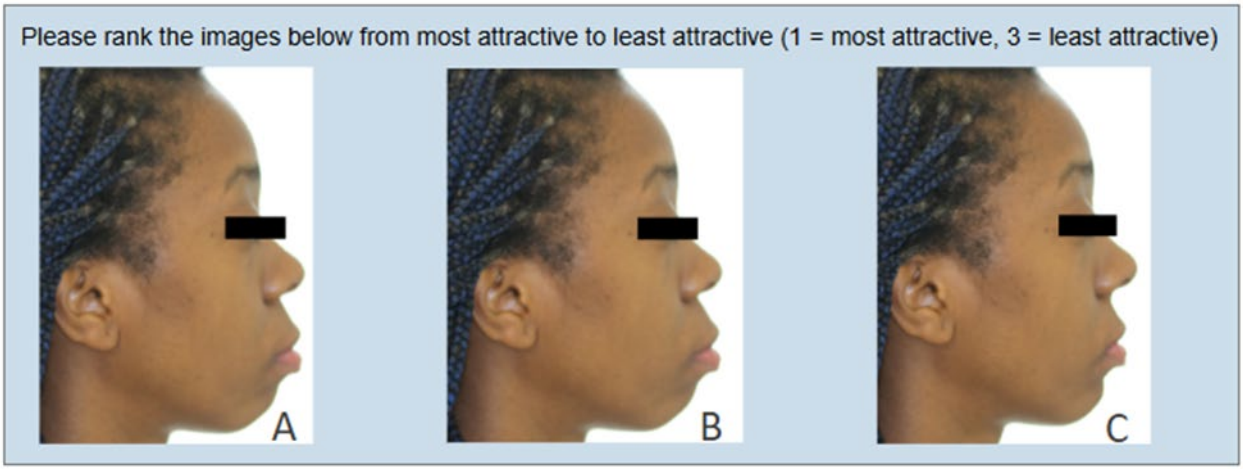


Figure 3: Presentation of Color Images

2.3 Survey Administration

The questionnaire was administered via Qualtrics Survery Software (Qualtrics LLC). Informed consent was embedded into questionnaire and required to begin participation. Participants were invited to complete the questionnaire on printed recruitment materials posted in the UIC COD waiting areas. During data collection, an IRB approved modification was made to include an additional verbal recruitment script.

2.4 Inclusion Criteria

Participants must be present in the UIC COD waiting areas, between 18 and 65 years of age, able to read and understand English, and agree to self-identify as White, Black, Hispanic, or Other on the questionnaire.

2.5 Exclusion Criteria

Participants cannot be present outside the UIC COD waiting areas, under 18 years of age or over 65 years of age, or any dental or orthodontic professional (dental assistant, orthodontic resident, dental student, etc).

2.6 Statistical Analysis

This research utilized a survey involving 303 participants of diverse racial backgrounds, ages, and sexes to evaluate their preferences for images of completed orthodontic treatments. Participants ranked the images based on aesthetic preference of the profile, with a rank of 1 indicating "liked most" (best) and 3 indicating "liked least" (worst).

The images presented were faces of orthodontic patients treated for Class I and Class II anomalies. The images varied based on specific treatment details, the patients' race, and their presentation as either black and white or color photographs. The rankings for the three images (A,

B, and C) were coded as nominal data using the six possible permutations (e.g., ABC, ACB, etc.), representing the "like to dislike" scale of 1, 2, and 3, respectively.

The primary goal of the data analysis was to investigate the association between a participant's derived (using the Plurality Rule) first-choice image (A, B, or C) and their own racial background.

The analysis proceeded as follows: Exploratory and descriptive statistics were performed using frequencies (%) for the overall rankings and the derived first-choice image. Cross-tabulation of the first-choice variable was used to test for associations with race using Chi-square tests (Pearson Chi-square (χ^2) statistics). The level of statistical significance was set at $p < 0.05$ (5%).

A Python script was used for data processing (generating the rankings), and IBM-SPSS Statistics (Version 30.0) was used for the subsequent statistical analysis.

2.7 Sample Size Justification Considerations

For a multinomial test based on frequency counts using 3 categories (such as A,B,C), with a significance level of alpha=0.05, and an overall sample of 303 respondents, the powers to detect frequency distributions similar to those aggregate preferences observed in Table II are all greater than 0.80, with the exception of the Asian Case 2 group in which the power was only 0.42.

3.0 RESULTS

3.1 Survey Participant Demographics

A total of 303 participants completed the questionnaire. The largest proportion identified as Hispanic, representing 46.9% of the sample (n = 142). Black participants comprised 22.8% (n = 69), while White participants accounted for 19.1% (n = 58). Asian participants represented 8.3% of the sample (n = 25). An additional 3.0% (n = 9) identified as “Other.”

Participants ranged in age from 18 to 64 years. The largest age group was 35–44 years (30.7%, n = 93), followed by 25–34 years (27.1%, n = 82) and 45–54 years (17.2%, n = 52). Those aged 18–24 made up 13.5% (n = 41), and participants aged 55–64 comprised 11.6% (n = 35). All 303 participants provided responses to race and age questions as required by the inclusion criteria.

Among those who reported their gender, 72.2% identified as female (n = 218), and 27.8% identified as male (n = 84). One participant did not provide gender information.

3.2 Aggregate Participant Preferences by Case Race

Table I: AGGREGATE ESTHETIC PREFERENCES BY CASE RACE

Case Silhouette	Winner	Count (n)	Percent (%)	Case Color	Winner	Count (n)	Percent (%)
Asian Case 1	**A**	134	56.1%	**Asian Case 1**	**A**	105	41.5%
Asian Case 2	**A**	101	48.1%	**Asian Case 2**	**A**	89	39.7%
Black Case 1	**C**	175	68.1%	**Black Case 1**	**C**	182	70.3%
Black Case 2	**C**	153	57.5%	**Black Case 2**	**C**	157	63.3%
Hispanic Case 1	**C**	92	38.5%	**Hispanic Case 1**	**C**	106	47.1%
Hispanic Case 2	**C**	172	68.5%	**Hispanic Case 2**	**C**	103	43.3%
White Case 1	**C**	136	51.9%	**White Case 1**	**C**	133	54.4%
White Case 2	**B**	109	45.0%	**White Case 2**	**C**	106	43.4%

Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. For the cases of each race, Case 1 represents participants clinically treated with the extraction of four bicuspids. Case 2 represents participants clinically treated without the extraction of four bicuspids.

Frequency analysis was conducted to identify which case variation (pre-treatment, simulated non-extraction, simulated non-extraction) was most often selected as the most esthetic option by all survey participants. Analysis of the most frequently selected response across the 16 scenarios showed an overall preference for Option C. Option C was the most selected choice in 11 scenarios (68.8%). Option A was the most selected in 4 scenarios (25.0%). Option B was most selected in 1 scenario (6.25%). These results indicate an overall preference for Option C in the majority of scenarios. See Table I.

3.2.1 Esthetic Preference by Color Case Image

Table II: AGGREGATE ESTHETIC PREFERENCES BY COLOR CASE IMAGE

Black Case 1		**Frequency (n)**	**Percent**
Valid	A	37	12.2
	B	40	13.2
	C	182	60.1
	Total	259	85.5
Missing		44	14.5
Total		303	100.0
Black Case 2		Frequency (n)	Percent
Valid	A	63	20.8
	B	28	9.2
	C	157	51.8
	Total	248	81.8
Missing		55	18.2
Total		303	100.0

Asian Case 1		**Frequency (n)**	**Percent**
Valid	A	105	34.7
	B	46	15.2
	C	102	33.7
	Total	253	83.5
Missing		50	16.5
Total		303	100.0
Asian Case 2		Frequency (n)	Percent
Valid	A	89	29.4
	B	67	22.1
	C	68	22.4
	Total	224	73.9
Missing		79	26.1
Total		303	100.0

Hispanic Case 1		**Frequency (n)**	**Percent**
Valid	A	63	20.8
	B	56	18.5
	C	106	35.0
	Total	225	74.3
Missing		78	25.7
Total		303	100.0
Hispanic Case 2		Frequency (n)	Percent
Valid	A	72	23.8
	B	63	20.8
	C	103	34.0
	Total	238	78.5
Missing		65	21.5
Total		303	100.0

White Case 1		**Frequency (n)**	**Percent**
Valid	A	46	15.2
	B	65	21.5
	C	133	43.9
	Total	244	80.5
Missing		59	19.5
Total		303	100.0
White Case 2		Frequency (n)	Percent
Valid	A	66	21.8
	B	72	23.8
	C	106	35.0
	Total	244	80.5
Missing		59	19.5
Total		303	100.0

Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. For the cases of each race, Case 1 represents participants clinically treated with extraction of four bicuspids. Case 2 represents participants clinically treated without extraction of four bicuspids.

Frequency analysis was conducted to identify which color image case variation (pre-treatment, simulated non-extraction, simulated non-extraction) was most often selected as the most esthetic option by all survey participants. See Table II.

Black Cases

For Black Case 1, a total of 259 participants provided valid responses. The largest proportion selected Option C, representing 60.1% of the sample (n = 182). Option B was selected by 13.2% (n = 40), while Option A accounted for 12.2% (n = 37). An additional 14.5% (n = 44) did not provide a response.

For Black Case 2, a total of 248 participants provided valid responses. Option C remained the most frequently selected choice, representing 51.8% of the sample (n = 157). Option A was selected by 20.8% (n = 63), while Option B accounted for 9.2% (n = 28). An additional 18.2% (n = 55) did not provide a response.

Asian Cases

For Asian Case 1, a total of 253 participants provided valid responses. Option A was the most frequently selected choice, representing 34.7% of the sample (n = 105). Option C was selected by 33.7% (n = 102), while Option B accounted for 15.2% (n = 46). An additional 16.5% (n = 50) did not provide a response.

For Asian Case 2, a total of 224 participants provided valid responses. Option A was selected most frequently, representing 29.4% of the sample (n = 89). Option C was selected by 22.4% (n = 68), while Option B accounted for 22.1% (n = 67). An additional 26.1% (n = 79) did not provide a response.

Hispanic Cases

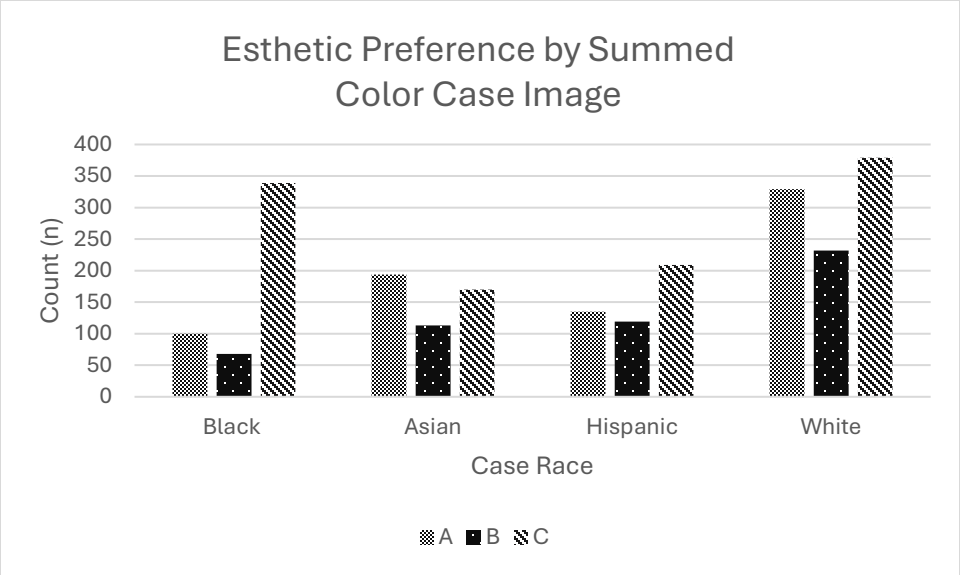
For Hispanic Case 1, a total of 225 participants provided valid responses. Option C was the most frequently selected choice, representing 35.0% of the sample (n = 106). Option A was selected by 20.8% (n = 63), while Option B accounted for 18.5% (n = 56). An additional 25.7% (n = 78) did not provide a response.

For Hispanic Case 2, a total of 238 participants provided valid responses. Option C remained the most frequently selected choice, representing 34.0% of the sample (n = 103). Option A was selected by 23.8% (n = 72), while Option B accounted for 20.8% (n = 63). An additional 21.5% (n = 65) did not provide a response.

White Cases

For White Case 1, a total of 244 participants provided valid responses. Option C was the most frequently selected choice, representing 43.9% of the sample (n = 133). Option B was selected by 21.5% (n = 65), while Option A accounted for 15.2% (n = 46). An additional 19.5% (n = 59) did not provide a response.

For White Case 2, a total of 244 participants provided valid responses. Option C was selected most frequently, representing 35.0% of the sample (n = 106). Option B was selected by 23.8% (n = 72), while Option A accounted for 21.8% (n = 66). An additional 19.5% (n = 59) did not provide a response. See Table II.



Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. Labels Black, Asian, Hispanic, and White represent the summed data from Case 1 and Case 2 within that racial group.

Figure 4: Esthetic Preference by Summed Color Case Image

Frequency analysis was conducted to identify which color image case variation (pre-treatment, simulated non-extraction, simulated non-extraction) was most often selected as the most esthetic option by all survey participants. Data within each case racial group (for example Black Case 1 + Black Case 2) was summed. See Figure 4.

Black Cases Combined

Across both Black cases, a total of 507 valid responses were recorded. Option C was the most frequently selected choice, representing 66.9% of responses (n = 339). Option A was selected

by 19.7% (n = 100), while Option B accounted for 13.4% (n = 68). An additional 99 responses (16.3% of the full sample) were missing across both cases.

Asian Cases Combined

Across both Asian cases, a total of 477 valid responses were recorded. Option A was the most frequently selected choice, representing 40.7% of responses (n = 194). Option C was selected by 35.6% (n = 170), while Option B accounted for 23.7% (n = 113). An additional 129 responses (21.3% of the full sample) were missing across both cases.

Hispanic Cases Combined

Across both Hispanic cases, a total of 463 valid responses were recorded. Option C was the most frequently selected choice, representing 45.1% of responses (n = 209). Option A was selected by 29.2% (n = 135), while Option B accounted for 25.7% (n = 119). An additional 143 responses (23.6% of the full sample) were missing across both cases.

White Cases Combined

Across both White cases, a total of 488 valid responses were recorded. Option C was the most frequently selected choice, representing 49.0% of responses (n = 239). Option B was selected by 28.1% (n = 137), while Option A accounted for 22.9% (n = 112). An additional 118 responses (19.5% of the full sample) were missing across both cases. See Figure 4.

3.2.2 Esthetic Preference by Silhouette Case Image

Table III: AGGREGATE ESTHETIC PREFERENCE BY SILHOUETTE CASE IMAGE

Black Case 1		Frequency (n)	Percent
Valid	A	52	17.2
	B	30	9.9
	C	175	57.8
	Total	257	84.8
Missing	.	46	15.2
Total		303	100
Black Case 2		Frequency (n)	Percent
Valid	A	68	22.4
	B	45	14.9
	C	153	50.5
	Total	266	87.8
Missing	.	37	12.2
Total		303	100.0

Asian Case 1		Frequency (n)	Percent
Valid	A	134	44.2
	B	39	12.9
	C	66	21.8
	Total	239	78.9
Missing	.	64	21.1
Total		303	100.0
Asian Case 2		Frequency (n)	Percent
Valid	A	101	33.3
	B	51	16.8
	C	58	19.1
	Total	210	69.3
Missing	.	93	30.7
Total		303	100.0

Hispanic Case 1		Frequency (n)	Percent
Valid	A	64	21.1
	B	83	27.4
	C	92	30.4
	Total	239	78.9
Missing	.	64	21.1
Total		303	100.0
Hispanic Case 2		Frequency (n)	Percent
Valid	A	32	10.6
	B	47	15.5
	C	172	56.8
	Total	251	82.8
Missing	.	52	17.2
Total		303	100.0

White Case 1		Frequency (n)	Percent
Valid	A	54	17.8
	B	72	23.8
	C	136	44.9
	Total	262	86.5
Missing	.	41	13.5
Total		303	100.0
White Case 2		Frequency (n)	Percent
Valid	A	52	17.2
	B	109	36.0
	C	81	26.7
	Total	242	79.9
Missing	.	61	20.1
Total		303	100.0

Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. For the cases of each race, Case 1 represents participants clinically treated with extraction of four bicuspids. Case 2 represents participants clinically treated without extraction of four bicuspids.

Frequency analysis was conducted to identify which silhouette image case variation (pre-treatment, simulated non-extraction, simulated non-extraction) was most often selected as the most esthetic option by all survey participants. See Table III.

Black Cases

For Black Case 1, a total of 257 participants provided valid responses. The largest proportion selected Option C, representing 57.8% of the sample (n = 175). Option A was selected by 17.2% (n = 52), while Option B accounted for 9.9% (n = 30). An additional 15.2% (n = 46) did not provide a response.

For Black Case 2, a total of 266 participants provided valid responses. Option C remained the most frequently selected choice, representing 50.5% of the sample (n = 153). Option A was selected by 22.4% (n = 68), while Option B accounted for 14.9% (n = 45). An additional 12.2% (n = 37) did not provide a response.

Asian Cases

For Asian Case 1, a total of 239 participants provided valid responses. Option A was the most frequently selected choice, representing 44.2% of the sample (n = 134). Option C was selected by 21.8% (n = 66), while Option B accounted for 12.9% (n = 39). An additional 21.1% (n = 64) did not provide a response.

For Asian Case 2, a total of 210 participants provided valid responses. Option A was selected most frequently, representing 33.3% of the sample (n = 101). Option C was selected by 19.1% (n = 58), while Option B accounted for 16.8% (n = 51). An additional 30.7% (n = 93) did not provide a response.

Hispanic Cases

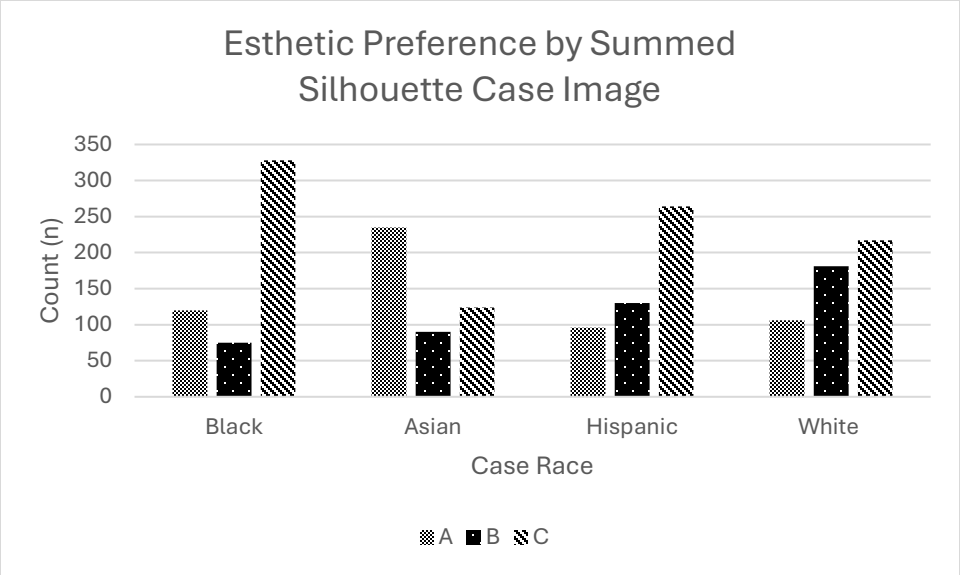
For Hispanic Case 1, a total of 239 participants provided valid responses. Option C was the most frequently selected choice, representing 30.4% of the sample (n = 92). Option B was selected by 27.4% (n = 83), while Option A accounted for 21.1% (n = 64). An additional 21.1% (n = 64) did not provide a response.

For Hispanic Case 2, a total of 251 participants provided valid responses. Option C was the most frequently selected choice, representing 56.8% of the sample (n = 172). Option B was selected by 15.5% (n = 47), while Option A accounted for 10.6% (n = 32). An additional 17.2% (n = 52) did not provide a response.

White Cases

For White Case 1, a total of 262 participants provided valid responses. Option C was the most frequently selected choice, representing 44.9% of the sample (n = 136). Option B was selected by 23.8% (n = 72), while Option A accounted for 17.8% (n = 54). An additional 13.5% (n = 41) did not provide a response.

For White Case 2, a total of 242 participants provided valid responses. Option B was the most frequently selected choice, representing 36.0% of the sample (n = 109). Option C was selected by 26.7% (n = 81), while Option A accounted for 17.2% (n = 52). An additional 20.1% (n = 61) did not provide a response. See Table III.



Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. Labels Black, Asian, Hispanic, and White represent the summed data from Case 1 and Case 2 within that racial group.

Figure 5: Esthetic Preference by Summed Silhouette Case Image

Frequency analysis was conducted to identify which silhouette image case variation (pre-treatment, simulated non-extraction, simulated non-extraction) was most often selected as the most esthetic option by all survey participants. Data within each case racial group (for example Black Case 1 + Black Case 2) was summed. See Figure 5.

Black Cases Combined

Across both Black cases, a total of 523 valid responses were recorded. Option C was the most frequently selected choice, representing 62.7% of responses (n = 328). Option A was selected

by 22.9% (n = 120), while Option B accounted for 14.3% (n = 75). An additional 83 responses (13.7% of the full sample) were missing across both cases.

Asian Cases Combined

Across both Asian cases, a total of 449 valid responses were recorded. Option A was the most frequently selected choice, representing 52.3% of responses (n = 235). Option C was selected by 27.6% (n = 124), while Option B accounted for 20.0% (n = 90). An additional 157 responses (25.9% of the full sample) were missing across both cases.

Hispanic Cases Combined

Across both Hispanic cases, a total of 490 valid responses were recorded. Option C was the most frequently selected choice, representing 53.9% of responses (n = 264). Option B was selected by 26.5% (n = 130), while Option A accounted for 19.6% (n = 96). An additional 116 responses (19.1% of the full sample) were missing across both cases.

White Cases Combined

Across both White cases, a total of 504 valid responses were recorded. Option C was the most frequently selected choice, representing 43.1% of responses (n = 217). Option B was selected by 35.9% (n = 181), while Option A accounted for 21.0% (n = 106). An additional 102 responses (16.8% of the full sample) were missing across both cases. See Figure 5.

3.2.3 Comparison of Silhouette and Color Images

Table IV: CROSSTABULATION OF SILHOUETTE AND COLOR IMAGE BY CASE

Black Case 1		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	12	10	24	46
		% of Total	5.3%	4.4%	10.7%	20.4%
	B	Count	3	7	13	23
		% of Total	1.3%	3.1%	5.8%	10.2%
	C	Count	19	19	118	156
		% of Total	8.4%	8.4%	52.4%	69.3%
Total		Count	34	36	155	225
		% of Total	15.1%	16.0%	68.9%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	13.394[a]	4	.010	
		Likelihood Ratio	12.373	4	.015	
		N of Valid Cases	225			

Black Case 2		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	24	5	29	58
		% of Total	10.5%	2.2%	12.7%	25.4%
	B	Count	11	7	16	34
		% of Total	4.8%	3.1%	7.0%	14.9%
	C	Count	22	12	102	136
		% of Total	9.6%	5.3%	44.7%	59.6%
Total		Count	57	24	147	228
		% of Total	25.0%	10.5%	64.5%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	20.861[a]	4	<.001	
		Likelihood Ratio	19.895	4	<.001	
		N of Valid Cases	228			

Asian Case 1		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	59	15	40	114
		% of Total	27.8%	7.1%	18.9%	53.8%
	B	Count	16	7	14	37
		% of Total	7.5%	3.3%	6.6%	17.5%
	C	Count	18	7	36	61
		% of Total	8.5%	3.3%	17.0%	28.8%
Total		Count	93	29	90	212
		% of Total	43.9%	13.7%	42.5%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	11.053[a]	4	.026	
		Likelihood Ratio	10.942	4	.027	
		N of Valid Cases	212			

Asian Case 2		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	39	24	19	82
		% of Total	23.9%	14.7%	11.7%	50.3%
	B	Count	15	12	10	37
		% of Total	9.2%	7.4%	6.1%	22.7%
	C	Count	15	9	20	44
		% of Total	9.2%	5.5%	12.3%	27.0%
Total		Count	69	45	49	163
		% of Total	42.3%	27.6%	30.1%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	7.350[a]	4	.119	
		Likelihood Ratio	7.084	4	.132	
		N of Valid Cases	163			

Hispanic Case 1		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	17	14	18	49
		% of Total	8.9%	7.3%	9.4%	25.7%
	B	Count	17	17	31	65
		% of Total	8.9%	8.9%	16.2%	34.0%
	C	Count	20	19	38	77
		% of Total	10.5%	9.9%	19.9%	40.3%
Total		Count	54	50	87	191
		% of Total	28.3%	26.2%	45.5%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	2.281[a]	4	.684	
		Likelihood Ratio	2.290	4	.683	
		N of Valid Cases	191			

Hispanic Case 2		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	9	8	10	27
		% of Total	4.3%	3.8%	4.8%	12.9%
	B	Count	15	11	13	39
		% of Total	7.2%	5.3%	6.2%	18.7%
	C	Count	34	37	72	143
		% of Total	16.3%	17.7%	34.4%	68.4%
Total		Count	58	56	95	209
		% of Total	27.8%	26.8%	45.5%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	5.320[a]	4	.256	
		Likelihood Ratio	5.299	4	.258	
		N of Valid Cases	209			

White Case 1		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	11	12	20	43
		% of Total	5.0%	5.5%	9.2%	19.7%
	B	Count	6	17	34	57
		% of Total	2.8%	7.8%	15.6%	26.1%
	C	Count	20	27	71	118
		% of Total	9.2%	12.4%	32.6%	54.1%
Total		Count	37	56	125	218
		% of Total	17.0%	25.7%	57.3%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	5.194[a]	4	.268	
		Likelihood Ratio	5.210	4	.266	
		N of Valid Cases	218			

White Case 2		**Color Image**	**A**	**B**	**C**	Total
Silhouette Image	A	Count	13	14	16	43
		% of Total	6.2%	6.6%	7.6%	20.4%
	B	Count	25	28	46	99
		% of Total	11.8%	13.3%	21.8%	46.9%
	C	Count	20	18	31	69
		% of Total	9.5%	8.5%	14.7%	32.7%
Total		Count	58	60	93	211
		% of Total	27.5%	28.4%	44.1%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)	
		Pearson Chi-Square	1.345[a]	4	.854	
		Likelihood Ratio	1.362	4	.851	
		N of Valid Cases	211			

Pearson chi-square tests of independence were conducted to examine the consistency of participants preferences between paired silhouette and color images for each case. These tests assessed whether selecting a particular option (A, B, or C) in one image format predicted selections in the other format for each case. See Table IV.

Statistically significant associations were observed in 3 out of the 8 paired scenarios. In these cases, participants demonstrated that their esthetic preference in the silhouette/color image type was predictive of their preference in the other image type in corresponding cases (p-value < .05). This predictive relationship between silhouette and color images supports the conclusion that seeing the race of a case did not influence the most preferred option.

Black Case 1 silhouette vs. Black Case 1 color: $\chi 2$ (4, N = 225) = 13.39, p = .010

Black Case 2 silhouette vs. Black Case 2 color: $\chi 2$(4, N = 228) = 20.86, p < .001

Asian Case 1 silhouette vs Asian Case 1 color: $\chi 2$(4, N = 212) = 11.05, p = .026

No statistically significant associations were found in 5 of the 8 paired scenarios analyzed indicating that participants demonstrated that their esthetic preference in the silhouette/color image was independent of their preference in the paired condition for these variables (p-value > .05). This relationship between silhouette and color images supports the conclusion that seeing the race of a case did influence what participants chose as the most preferred option.

Asian Case 2 silhouette vs Asian Case 2 color: p = .119

Hispanic Case 1 silhouette vs Hispanic Case 1 color: p = .684

Hispanic Case 2 silhouette vs Hispanic Case 2 color: p = .256

White Case 1 silhouette vs White Case 1 color: p = .268

White Case 2 silhouette vs White Case 2 color: p = .854

3.3 Esthetic Preferences Stratified by Participant Race

3.3.1 Preferences by Case Race

Table V: ESTHETIC PREFERENCE BY VIEWER RACIAL GROUP

	Scenario	White	Asian	Hispanic	Black	Other
Case Silhouette	Asian Case 1	A	A	A	A	A
	Asian Case 2	A	A	A	A / C (Tie)	A
	Black Case 1	C	C	C	C	C
	Black Case 2	C	C	C	C	C
	Hispanic Case 1	C	C	C	B	C
	Hispanic Case 2	C	C	C	C	C
	White Case 1	C	C	C	C	C
	White Case 2	C	B	B	B	B / C (Tie)
Case Color	Asian Case 1	A	C	A	A	A
	Asian Case 2	A	B	A	C	A
	Black Case 1	C	C	C	C	C
	Black Case 2	C	C	C	A	C
	Hispanic Case 1	C	C	C	C	C
	Hispanic Case 2	C	C	C	B	C
	White Case 1	C	C	C	B	C
	White Case 2	C	A	C	C	C

Response options A, B, C represent pre-treatment, simulated non-extraction, and simulated extraction profiles respectively. For the cases of each race, Case 1 represents participants clinically treated with extraction of four bicuspids. Case 2 represents participants clinically treated without extraction of four bicuspids. “Tie" indicates two options received the exact same highest percentage of votes.

Frequency analysis was conducted to identify which case variation (pre-treatment, simulated non-extraction, or simulated non-extraction) was most often selected as the most esthetic option by survey participants of different racial backgrounds. See Table V.

For Black Case 1 and Black Case 2, the first choice across viewer racial groups (White, Asian, Hispanic, Black, and Other) was Option C for silhouette and color images.

For Asian Case 1 and 2 silhouettes, Option A was preferred across all viewer groups except Black viewers who showed an A/C tie for Asian Case 2. In the color images, Asian Case 1, Option A was preferred by White, Hispanic, Black, and Other viewers while Option C was the top choice by Asian viewers. For the color images of Asian Case 2, White, Hispanic, and Other viewers selected Option A, Asian viewers selected Option B, and Black viewers selected Option C.

For Hispanic Case 1 color images and Hispanic Case 2 silhouette images, all groups selected Option C as most preferred. In the silhouette image of Hispanic Case 1 White, Asian, Hispanic, and Other viewers selected Option C, while Black viewers selected Option B. In the color image of Hispanic Case 2, White, Asian, Hispanic, and Other viewers selected Option C, while Black viewers selected Option B.

For White Case 1 silhouette and color image, Option C was preferred across all groups in both conditions, except Black viewers who selected Option B in the color condition. For White Case 2 silhouette, White viewers selected Option C, Asian, Hispanic, and Black viewers selected Option B, and Other viewers showed a B/C tie. When viewing White Case 2 color image, White, Hispanic, Black, and Other viewers most selected Option C, while Asian viewers selected Option A. See Table V.

3.3.2 Preferences by Viewer Race

White viewers most selected Option A for both Asian Cases in color and silhouette and selected Option C for all Black, Hispanic, and White cases in color and silhouette. See Table V.

Asian viewers selected Option A for both Asian Cases in the silhouette condition; in the color condition, selected Option C for Asian Case 1 and Option B for Asian Case 2. Asian viewers selected Option C for both Black Cases in color and silhouette, Option C for both Hispanic Cases in color and silhouette, Option C for White Case 1 in color and silhouette; for White Case 2, selected Option B in silhouette and Option A in color.

Hispanic viewers selected Option A for both Asian Cases in color and silhouette, Option C for both Black and Hispanic Cases in color and silhouette. Hispanic viewers selected Option C for White Case 1 in color and silhouette. In White Case 2, Hispanic viewers selected Option B in silhouette and Option C in color.

Black viewers selected Option A for Asian Case 1 in color and silhouette. For Asian Case 2, Black viewers showed an A/C tie in silhouette and selected Option C in color. This group selected Option C for Black Case 1 in color and silhouette, Option C for Black Case 2 silhouette, and Option A for Black Case 2 color. For Hispanic Case 1, Black viewers selected Option B in silhouette and Option C in color; for Hispanic Case 2, selected Option C in silhouette and Option B in color. This group selected Option C for White Case 1 silhouette and Option B in color; selected Option B for White Case 2 silhouette and Option C in color.

Other viewers selected Option A for both Asian Cases in color and silhouette and option C for both Black and Hispanic Cases in color and silhouette. Other viewers selected Option C for White Case 1 in color and silhouette. For White Case 2, this group showed a B/C tie in silhouette and selected Option C in color. See Table V.

Table VI: ESTHETIC PREFERENCE BY VIEWER RACIAL GROUP

Black Case 1 Silhouette		Viewer Race	White	Asian	Hispanic	Black	Other	Total
1st choice	A	Count	8	5	17	21	1	52
		% of Total	3.1%	1.9%	6.6%	8.2%	0.4%	20.2%
	B	Count	2	2	15	11	0	30
		% of Total	0.8%	0.8%	5.8%	4.3%	0.0%	11.7%
	C	Count	36	14	87	32	6	175
		% of Total	14.0%	5.4%	33.9%	12.5%	2.3%	68.1%
Total		Count	46	21	119	64	7	257
		% of Total	17.9%	8.2%	46.3%	24.9%	2.7%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)			
		Pearson Chi-Square	16.835[a]	8	.032			
		Likelihood Ratio	17.821	8	.023			
		N of Valid Cases	257					

Hispanic Case 2 Silhouette		Viewer Race	White	Asian	Hispanic	Black	Other	Total
1st choice	A	Count	5	5	17	5	0	32
		% of Total	2.0%	2.0%	6.8%	2.0%	0.0%	12.7%
	B	Count	5	0	26	16	0	47
		% of Total	2.0%	0.0%	10.4%	6.4%	0.0%	18.7%
	C	Count	41	13	78	33	7	172
		% of Total	16.3%	5.2%	31.1%	13.1%	2.8%	68.5%
Total		Count	51	18	121	54	7	251
		% of Total	20.3%	7.2%	48.2%	21.5%	2.8%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)			
		Pearson Chi-Square	18.696[a]	8	.017			
		Likelihood Ratio	23.295	8	.003			
		N of Valid Cases	251					

Black Case 2 Color		Viewer Race	White	Asian	Hispanic	Black	Other	Total
1st choice	A	Count	8	4	26	25	0	63
		% of Total	3.2%	1.6%	10.5%	10.1%	0.0%	25.4%
	B	Count	8	3	9	8	0	28
		% of Total	3.2%	1.2%	3.6%	3.2%	0.0%	11.3%
	C	Count	33	13	81	22	8	157
		% of Total	13.3%	5.2%	32.7%	8.9%	3.2%	63.3%
Total		Count	49	20	116	55	8	248
		% of Total	19.8%	8.1%	46.8%	22.2%	3.2%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)			
		Pearson Chi-Square	24.345[a]	8	.002			
		Likelihood Ratio	26.269	8	<.001			
		N of Valid Cases	248					

White Case 1 Color		Viewer Race	White	Asian	Hispanic	Black	Other	Total
1st choice	A	Count	4	3	29	10	0	46
		% of Total	1.6%	1.2%	11.9%	4.1%	0.0%	18.9%
	B	Count	10	2	26	26	1	65
		% of Total	4.1%	0.8%	10.7%	10.7%	0.4%	26.6%
	C	Count	33	14	59	22	5	133
		% of Total	13.5%	5.7%	24.2%	9.0%	2.0%	54.5%
Total		Count	47	19	114	58	6	244
		% of Total	19.3%	7.8%	46.7%	23.8%	2.5%	100.0%
Chi-Square Test			Value	Df	Asymptotic Significance (2-sided)			
		Pearson Chi-Square	24.415[a]	8	.002			
		Likelihood Ratio	25.328	8	.001			
		N of Valid Cases	244					

Pearson chi-square tests of independence were performed to examine the relationship between participant race (White, Asian, Hispanic, Black, Other) and esthetic preference selection. Statistically significant associations were found between Race and the top preference in the following five scenarios. This indicates that for these specific variables, the distribution of preferences varied significantly across racial groups (p-values <0.05). See Table VI.

Black Case 1 silhouette: χ^2 (8, N = 257) = 16.84, p = .032

Hispanic Case 2 silhouette: χ^2 (8, N = 251) = 18.70, p = .017

Black Case 2 color image: χ^2 (8, N = 248) = 24.35, p = .002

White Case 1 color image: χ^2 (8, N = 244) = 24.42, p = .002

No statistically significant associations were found between race and the remaining first-choice variables (Black Case 2 silhouette, Hispanic Case 1 silhouette, Asian Case 1 silhouette, Asian Case 2 silhouette, White Case 1 silhouette, White Case 2 silhouette, Black Case 1 color image, White Case 2 color image, Asian Case 1 color image, Asian Case 2 color image, Hispanic Case 1 color image, Hispanic Case 2 color image). In these scenarios, the distribution of preferences did not differ significantly by race, (p > .05).

4.0 DISCUSSION

The primary aim of this study is to examine laypersons' perceptions of the esthetic impacts of four premolar extractions compared to non-extraction orthodontic treatment in patients of different races presenting with Class I bimaxillary protrusion. The study had two objectives: 1) to understand how an individual's own race may influence their perception of other women's profiles following orthodontic treatment, and 2) to understand how the race of the person being viewed may influence how they are perceived by others following orthodontic treatment.

Questionnaire respondents were predominantly female (72.2%) and the majority identified as Hispanic (46.9%). The greater proportion of female participants may be due to sampling bias as survey participants were recruited from a dental school setting. In general, women seek oral health treatment more often than men, thus would presumably be present in greater numbers in this recruitment setting (Lipsky et al., 2021; Cha & Cohen, 2022.) Similarly, the greater number of Hispanic participants as compared to other races may be due to a greater proportion of people identifying as Hispanic being present at the UIC COD. The representation of Hispanic participants provides valuable data for an underrepresented group in orthodontic esthetic research (Vela et al., 2011; Mejia-Maidl et al., 2005.) However, the small proportion of Asian participants (8.3%) limits statistical power and generalizability of findings for this viewer group.

Case participants consisted of two women, each identifying as Black, White, Hispanic, and Asian. Participants not identifying as women were excluded due to the scope and timeframe of this project. A robust body of research has established that esthetic preferences differ when evaluating male and female faces. Attractive features for women include narrow facial width, fuller lower facial thirds, and less pronounced chins. Conversely, men are perceived as more attractive

with well-defined chins, prominent eyebrow ridges, and flatter cheeks (Alshammari et al., 2023; Einy et al., 2021; Feng et al., 2025; Kanavakis et al., 2021.) Given these differences, including both male and female cases could confound interpretation of racial differences in esthetic perception. Women were selected for inclusion in this study as females have historically been underrepresented in medical and dental research (K. A. Liu & Mager, 2016; Merone et al., 2022.)

Irrespective of race or gender, the majority of viewers preferred Option C, the extraction profile with the most retrusive outcome. This option was chosen in 68.8% (11/16) of scenarios, indicating that lay observers generally preferred extraction treatment outcomes in Class I bimaxillary protrusion cases. This finding is consistent with the broader literature on bimaxillary protrusion, which generally demonstrates that extraction treatment yields more aesthetically pleasing profiles than pre-treatment profiles (Almutairi et al., 2015; Huang & Li, 2015.)These findings differ from studies on Class I participants without specified skeletal protrusion levels. In most such studies, extraction and non-extraction treatments produced measurable profile changes; however, esthetic perception scores did not differ significantly between groups (Cheng & Wang, 2018; Elias et al., 2024.)

4.1 Race of the Observed and Perception of Profile Attractiveness

Two null hypotheses were tested: that there is no association between race of the observer and the perception of facial profile attractiveness following extraction or non-extraction orthodontic treatments, and that there is no association between race of the observed and the perception of facial profile attractiveness following extraction or non-

extraction orthodontic treatments. Based on the findings of this study, both null hypotheses were rejected.

The data in this project supports rejecting the null hypothesis that there is no association between race of the observed and perception of facial profile attractiveness.

The consistency of preferences within racial groups suggests that race-related facial features may influence esthetic perception. For Black, Asian, and Hispanic cases, participants preferred the same treatment outcome for both Case 1 and Case 2 (Table I). This supports that evaluators may have been responding to shared facial characteristics within racial groups rather than to features unique to each individual. White cases were the exception, with the extraction profile being preferred for Case 1 in color and silhouette and Case 2 in color while the non-extraction profile was preferred in the Case 2 silhouette. This could be attributable to race related features, or a function of the small sample sizes, two per racial group, in this study.

The differences in preferences across racial groups provide stronger evidence that race influences esthetics. In the color images, extraction treatment was most esthetic for Hispanic, Black, and White cases. Black cases showed a clear preference for extraction, with over two-thirds (66.9%) of responses favoring the most retrusive profile (Table II, Figure 4). Hispanic and White cases showed a more moderate preference for extraction, with pre-treatment images as the second most preferred profile, suggesting that a greater degree of protrusion was esthetically acceptable in these groups. Asian cases showed the opposite pattern. Observers preferred the pre-treatment profile over both treatment simulations (Table II, Figure 4). The difference in preferred profile for Asian cases contrasts with existing literature supporting extraction as the most esthetic treatment for

bimaxillary protrusion, suggesting that this preference may not apply uniformly across all racial groups.

The comparison between color and silhouette images yields mixed results regarding the role of race. As shown in Table I, all cases except White Case 2 had the same preferred profile in silhouette and color. Chi-square tests comparing paired silhouette and color images showed that for Asian Case 1 and both Black cases, preferences were consistent across both formats, suggesting that race did not influence the preferred profile in these cases (Table IV). However, for Asian Case 2, and both Hispanic and White cases, preferences differed between silhouette and color images. While this pattern could suggest that the influence of race is case-dependent, another explanation is that race-associated structural features visible in both image formats drove these differences.

When comparing the results of this study to the literature on the race of the person being observed, direct comparisons are limited. Prior studies typically assess a single racial group and manipulate lip position relative to the E-line rather than simulating extraction and non-extraction outcomes, and they do not systematically vary the race of those viewed. Despite these limitations, general trends can be identified.

Studies of Class I bimaxillary treatment generally report that both extraction and non-extraction approaches yield acceptable esthetic results. In 2017, a systematic review by Iared et al. found no significant difference in esthetic perception between Class I patients treated with or without four premolar extractions, though participant racial composition was not reported. The vast majority of studies on bimaxillary protrusion do not specify race of participants (Almutairi et al., 2015; Leonardi et al., 2010.) The authors in the 2017 review did suggest adjusting lip-to–E-line targets by race in borderline cases, but did not

elaborate on how or the potential influence of race. These literature findings contrast with our present study, which showed a general preference for extraction outcomes (Table I).

Studies examining specific racial groups show mixed agreement with the present findings. For White individuals, Taee et al. (2023) presented silhouettes based on White facial features to evaluators from seven countries and found that lips positioned posterior to the E-line were rated as more attractive. This is consistent with the present findings, in which extraction treatment was generally preferred for White cases (Table I), as extraction produces greater lip retrusion. Similarly, for Hispanic individuals, Mejia-Maidl et al. (2005) fabricated facial images of Mexican men and women to Mexican American and White judges, finding that both groups preferred lips located posterior to the E-line. This is also consistent with the present study's preference for extraction treatment in Hispanic cases (Table I).

In contrast, findings in this study for Asian and Black cases were inconsistent with prior literature. Huang et al. (2015) compared pre-treatment and post-treatment profile photographs of Asian-Chinese Class I bimaxillary protrusion patients and found that post-treatment extraction images were preferred over pre-treatment profiles. This contrasts with the present study, in which pre-treatment profiles were preferred for Asian cases (Table I). For Black individuals, Souza et al. (2022) presented facial profile photographs of Black participants to Black orthodontists and laypeople, finding that both groups selected fuller profiles as most attractive. This contrasts with the present study, which found a general preference for extraction treatment in Black cases (Table I). Although non-extraction treatment results in greater lip protrusion and would therefore predict a preference for non-extraction profiles, this was not observed.

The study design included silhouette images with the intent of removing the influence of race from esthetic judgments. Surface features like skin color and hair texture are visible on color images, but not black and white silhouettes. However, this approach did not fully account for structural facial features associated with race, like soft tissue thickness, lip morphology, and nasolabial angle that remain visible in silhouettes. These morphological differences may confound the relationship between silhouette and color image preferences, making it difficult to isolate the effect of visible racial identification. If surface features, like skin color alone determined the effect of race, we would expect consistent differences between silhouette and color images across all cases. This pattern was not observed.

Due to the differences in structural facial features, individuals of different races often respond differently to extraction and non-extraction treatment when examining post-treatment profiles. A significant determinant of the amount of profile change following orthodontic treatment is soft tissue thickness. Particularly when treated with bicuspid extractions, the thinner the overlying soft tissue is on cephalometric evaluation, the greater the profile change. This includes increased lip retraction and nasolabial angle, and decreased mentolabial sulcus (Leonardi et al., 2010.) Of the racial groups included in this study, on average, Black individuals have the greatest soft tissue thickness followed by Hispanic, Asian, and White individuals respectively (Celebi et al., 2017; Kurian et al., 2023; Y. Liu et al., 2014; Vela et al., 2011; Wen et al., 2015.) In our study, it stands to reason that race of the case participant may have influenced the observable changes in their profile to viewers.

These findings support that race of the person being viewed influences their most esthetic profile, though it is likely one of several contributing factors. The differential preferences across racial groups, particularly the difference in Asian cases as compared to Black, Hispanic, and White cases, provide evidence that race plays a role in esthetic perception. However, the mixed silhouette-color results and variability within racial groups suggest that race may be one of many factors in shaping esthetic judgments.

4.2 Race of the Observer and Perception of Profile Attractiveness

The data also supports rejecting the null hypothesis that there is no association between race of the observer and perception of profile attractiveness. However, this relationship is complex.

Observers across all racial groups showed substantial agreement in their preferences. When examining color images, White, Asian, and Hispanic viewers selected the extraction profile as their top choice for 75% (6/8) of cases, while Black viewers selected it for 50% (4/8) of cases (Table V). This agreement suggests that despite being a part of different racial groups, observers in this study frequently share common esthetic standards when viewing facial profiles. This is contrary to the greater body of literature on this topic which demonstrates a strong influence of viewers race on their perception of others (Kempa et al., 2024; Taee et al., 2023; Vela et al., 2011).

Despite this general agreement, esthetic preference differed by viewer race in specific case scenarios. Statistically significant associations (p-value <0.05) between viewer race and esthetic preference were present for Black Case 1 silhouette, Hispanic Case 2 silhouette, Black Case 2 color image, and White Case 1 color image (Table VI). Interestingly, these specific scenarios do not show consistent patterns of a shared racial group, actual treatment type, or image format. This

implies that other factors present in the case images that are not accounted for in this study may be responsible. It is also possible that differences based on viewer race are highly case dependent. For example, in Black Case 2 color image, White, Asian, and Hispanic viewers most frequently selected the extraction profile, while Black viewers preferred the pre-treatment image. Similarly, in White Case 1 color image, Black viewers preferred the non-extraction outcome while all other groups preferred extraction.

The finding that Black viewers preferred more protrusive profiles in certain cases partially aligns with existing literature. Prior research comparing Black and White evaluators demonstrated that Black participants often prefer thicker, fuller, more protrusive lips (Kempa et al., 2024; Sadek & Alali, 2025; Souza et al., 2022.) This study's finding that Black viewers selected a more protrusive option than the other racial groups (pre-treatment as opposed to extraction treatment) for Black Case 2 is consistent with this pattern (Table V). However, Black viewers selected extraction profiles for the majority of other cases, which cuts against the idea of a general preference for protrusion (Figure 4, Figure 5). More detailed analysis of Black viewers suggests that the observed preference for protrusion may be more nuanced and context dependent as opposed to universal.

Hispanic and White viewers were most similar in preference in this study, frequently selecting retrusive, extraction profiles across cases. The most selected profile differed in only one scenario, White Case 2, wherein White participants preferred the extraction profile and Hispanic participants preferred the non-extraction profile. Interestingly, though both groups generally preferred the extraction profile, this is more consistent with typically White facial features than Hispanic facial features. Individuals identifying as White generally exhibit lower facial retrusion as opposed to the greater facial fullness and protrusive lips often exhibited by Hispanic individuals

(Celebi et al., 2017; Vela et al., 2011).This observation is inconsistent with the hypothesis that individuals prefer faces that resemble their own and suggests that although race influences perception, the underlying reasoning is more complex than a simple preference for one's own features reflected in others.

Asian viewers in this study largely agreed with viewers of other races, selecting extraction profiles for most cases. Notably, this preference diverged from the greater group when viewing both Asian cases in color. While the vast majority of participants selected the pre-treatment images as the most attractive, Asian viewers chose extraction and non-extraction treatment for Asian Case 1 and Asian Case 2, respectively. This discrepancy suggests that Asian viewers may apply different esthetic standards when evaluating profiles of their own racial group, but this pattern is not mirrored in other viewer racial groups.

Similarities and differences from the literature are present in each viewer racial group. One potential explanation for the inconsistency between this study and other studies investigating the relationship between viewer race and esthetics is acculturation. Rather than recruiting participants from geographically distant communities, all participants in this study were recruited from a single site in Chicago and presumably live in the surrounding area. Shared exposure to media and the diverse, multicultural setting may reduce race based preferences. This aligns with research demonstrating that cultural assimilation influences esthetic choices (Sy et al., 2016).

Another important factor to address is the influence of time. It is firmly established that cultural beauty standards change throughout the years (Dimitrov & Kroumpouzos, 2023.) Trends, media, and even popular celebrities are known to modulate esthetic preferences. In the current landscape of social media, research is emerging in the orthodontic literature that time spent

consuming this type of content may itself impact beauty standards (Rebaque Pistoni et al., 2023) Temporal factors, like social media, may have also influenced our questionnaire results.

These findings support that viewer race is a factor in esthetic judgment, though it is likely a contributing factor rather than a primary determinant. The evidence of association between viewer race and preferred profile supports its influence on esthetic perception. However, the inconsistency of significant findings across all cases suggests that the influence of observer race is nuanced and is case-dependent.

4.3 Limitations

Recruitment of participants was a primary challenge of this study. Particularly, achieving sufficient representation from different genders and racial groups was difficult. Most questionnaire participants (72.2%) identified as female and relatively few participants identified as Asian (8.3%). This is likely due to population present in the recruitment area. Recruiting participants from a non-healthcare setting with greater racial diversity could have resulted in a more balanced questionnaire sample.

Further, studying broad racial groups is inherently difficult as race is a social construct rather than a clear biological difference. Racial identification is not always representative of ethnicity, there can be many ethnic groups within a racial group, and many people identify with numerous racial groups. Individual features often, but do not always, correspond to those found in the identified racial group. Obtaining more detailed information on race and ethnicity could best inform future studies. Gathering related information including level of acculturation and media use could also be beneficial.

As for the cases, increasing the number (n) from each racial group and including multiple genders could broaden the utility of the findings. This was not possible due to the scope and time limitations of this study.

Finally, participants largely completed this on their phones while waiting for dental appointments. The combination of the phone screen being small and the time it took to take the survey could have led to participant fatigue. Providing larger screens to view the images could have minimized the risk of fatigue.

4.4 Future Directions

This study could act as a foundation for future research. To further elucidate the factors influencing esthetic perception and the influence of race, more detailed information on race and ethnicity could be gathered, as well as related information like acculturation and media use. Additionally, participants could be recruited from multiple locations and regions to better understand the influence of different communities. In this study, cases were also limited to Class I females. Future studies including multiple genders and a wide variety of malocclusions could extend the applicability of these findings.

5.0 CONCLUSION

In this study, Pearson chi-square tests revealed statistically significant associations between viewer race and esthetic preference in four scenarios ($p < .05$). Esthetic preference also varied depending on the race of each case being viewed, with pre-treatment profiles preferred for Asian individuals and extraction profiles being preferred in Black, White, and Hispanic cases. Despite these differences, substantial agreement was observed across racial groups, with most preferring extraction profiles regardless of their own race or the race of the case. Therefore, we rejected both null hypotheses. An association between race of the observer and the perception of facial profile attractiveness following extraction or non-extraction orthodontic treatments was found. An association between the race of the observed and the perception of facial profile attractiveness following extraction or non-extraction orthodontic treatments was also demonstrated. These findings suggest that both race of the viewer and person being viewed are factors in esthetic perception, though further research is needed to clarify this complex relationship.

CITED LITERATURE

Ahsan, A., Yamaki, M., Hossain, Z., & Saito, I. (2013). Craniofacial cephalometric analysis of Bangladeshi and Japanese adults with normal occlusion and balanced faces: A comparative study. Journal of Orthodontic Science, 2(1), 7–15. https://doi.org/10.4103/2278-0203.110327

Almutairi, T. K., Albarakati, S. F., & Aldrees, A. M. (2015a). Influence of bimaxillary protrusion on the perception of smile esthetics. Saudi Medical Journal, 36(1), 87–93. https://doi.org/10.15537/smj.2015.1.9480

Almutairi, T. K., Albarakati, S. F., & Aldrees, A. M. (2015b). Influence of bimaxillary protrusion on the perception of smile esthetics. Saudi Medical Journal, 36(1), 87–93. https://doi.org/10.15537/smj.2015.1.9480

Alqahtani, N., Alqasir, A., Al-Jewair, T., Almoammar, K., & Albarakati, S. (2020). Dental and Soft Tissue Changes Following Extraction of Second Premolars in Females with Bimaxillary Protrusion: A Retrospective Study. Nigerian Journal of Clinical Practice, 23(8), 1110–1119. https://doi.org/10.4103/njcp.njcp_636_19

Alqahtani, N. D., Alshammari, R., Almoammar, K., Almosa, N., Almahdy, A., & Albarakati, S. F. (2019). Post-orthodontic cephalometric variations in bimaxillary protrusion cases managed by premolar extraction - A retrospective study. Nigerian Journal of Clinical Practice, 22(11), 1530–1538. https://doi.org/10.4103/njcp.njcp_125_19

Alshammari, A. K., Algharbi, M. A., Alshammari, S. K., Alenzi, A. A., Malik, Y. R., Abideen, M. Z., Siddiqui, A. A., & Madfa, A. A. (2023a). Influence of lip position on esthetics perception with respect to profile divergence using silhouette images. BMC Oral Health, 23(1), 791. https://doi.org/10.1186/s12903-023-03537-3

Alshammari, A. K., Algharbi, M. A., Alshammari, S. K., Alenzi, A. A., Malik, Y. R., Abideen, M. Z., Siddiqui, A. A., & Madfa, A. A. (2023b). Influence of lip position on esthetics perception with respect to profile divergence using silhouette images. BMC Oral Health, 23(1), 791. https://doi.org/10.1186/s12903-023-03537-3

Bakhshaei, A., Soheilifar, S., Soheilifar, S., Mollabashi, V., Amini, P., Naghdi, N., & Ataei, H. (2020). Extraction versus non-extraction orthodontic treatment: Soft tissue profile changes in borderline class I patients. Dental and Medical Problems, 57(3), 275–283. https://doi.org/10.17219/dmp/119102

Broadbent, B. H. (1931). A new X-ray technique and its application to orthodontia. The Angle Orthodontist, 45–66.

Bronfman, C. N., Janson, G., Pinzan, A., & Rocha, T. L. (2015). Cephalometric norms and esthetic profile preference for the Japanese: a systematic review. Dental Press Journal of Orthodontics, 20(6), 43–51. https://doi.org/10.1590/2177-6709.20.6.043-051.oar

Burstone, C. J. ., & Choy, Kwangchul. (2015). The biomechanical foundation of clinical orthodontics. Quintessence Publishing Co, Inc.

Cangialosi, T. J., Riolo, M. L., Owens, S. E., Dykhouse, V. J., Moffitt, A. H., Grubb, J. E., Greco, P. M., English, J. D., & James, R. D. (2004). The ABO discrepancy index: a measure of case complexity. American Journal of Orthodontics and Dentofacial Orthopedics, 125(3), 270–278. https://doi.org/10.1016/j.ajodo.2004.01.005

Celebi, A. A., Kau, C. H., & Ozaydin, B. (2017). Three-Dimensional Anthropometric Evaluation of Facial Morphology. The Journal of Craniofacial Surgery, 28(5), e470–e474. https://doi.org/10.1097/SCS.0000000000003773

Cha, A., & Cohen, R. (2022). Dental Care Utilization Among Adults Aged 18−64: United States, 2019 and 2020.

Chan, E. K. M., Soh, J., Petocz, P., & Darendeliler, M. A. (2008). Esthetic evaluation of Asian-Chinese profiles from a white perspective. American Journal of Orthodontics and Dentofacial Orthopedics, 133(4), 532–538. https://doi.org/10.1016/j.ajodo.2006.03.038

Chen, C., Chen, Y., Li, Q., & Kau, C. H. (2019). The Esthetic Difference of Chinese Beauty Evaluated by Two Different Human Races Based on Three-Dimensional Average Face Analysis. The Journal of Craniofacial Surgery, 30(5), 1435–1440. https://doi.org/10.1097/SCS.0000000000005316

Cheng, H.-C., & Wang, Y.-C. (2018). Effect of nonextraction and extraction orthodontic treatments on smile esthetics for different malocclusions. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 153(1), 81–86. https://doi.org/10.1016/j.ajodo.2017.05.033

Chong, H. T., Thea, K. W., Descallar, J., Chen, Y., Dalci, O., Wong, R., & Darendeliler, M. A. (2014). Comparison of White and Chinese perception of esthetic Chinese lip position. The Angle Orthodontist, 84(2), 246–253. https://doi.org/10.2319/031213-212.1

Daer, A. A., & Abuaffan, A. H. (2016). Skeletal and Dentoalveolar Cephalometric Features of Anterior Open Bite among Yemeni Adults. Scientifica, 2016, 3147972. https://doi.org/10.1155/2016/3147972

Dinçer, B., Yetkiner, E., Aras, I., Attin, T., & Attin, R. (2013). Influence of lateral cephalometric radiographs on extraction decision in skeletal class I patients. Head & Face Medicine, 9, 36. https://doi.org/10.1186/1746-160X-9-36

Einy, S., Miri, T., Katzhendler, E., Aizenbud, D., Emanuela, K., & Zaslansky, P. (2021). Orthodontists and lay people rate masculine soft tissue profiles similarly but feminine soft tissue profiles differently. Quintessence International (Berlin, Germany : 1985), 52(1), 72–79. https://doi.org/10.3290/j.qi.a45269

Elias, K. G., Sivamurthy, G., & Bearn, D. R. (2024). Extraction vs nonextraction orthodontic treatment: a systematic review and meta-analysis. The Angle Orthodontist, 94(1), 83–106. https://doi.org/10.2319/021123-98.1

Eslami, N., Omidkhoda, M., Shafaee, H., & Mozhdehifard, M. (2016). Comparison of esthetics perception and satisfaction of facial profile among male adolescents and adults with different profiles. Journal of Orthodontic Science, 5(2), 47. https://doi.org/10.4103/2278-0203.179406

Feng, X., Chen, X., & Ren, H. (2025). A Study on Gender Differences in the Maximum Attractiveness Values for Cephalometric Measures. The Journal of Craniofacial Surgery. https://doi.org/10.1097/SCS.0000000000011763

Fiala, V., Třebický, V., Pazhoohi, F., Leongómez, J. D., Tureček, P., Saribay, S. A., Akoko, R. M., & Kleisner, K. (2021). Facial attractiveness and preference of sexual dimorphism: A comparison across five populations. Evolutionary Human Sciences, 3, e38. https://doi.org/10.1017/ehs.2021.33

Ghorbanyjavadpour, F., & Rakhshan, V. (2019a). Factors associated with the beauty of soft-tissue profile. American Journal of Orthodontics and Dentofacial Orthopedics : Official

Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 155(6), 832–843. https://doi.org/10.1016/j.ajodo.2018.07.020

Ghorbanyjavadpour, F., & Rakhshan, V. (2019b). Factors associated with the beauty of soft-tissue profile. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 155(6), 832–843. https://doi.org/10.1016/j.ajodo.2018.07.020

Heppt, W. J., & Vent, J. (2015). The Facial Profile in the Context of Facial Aesthetics. Facial Plastic Surgery : FPS, 31(5), 421–430. https://doi.org/10.1055/s-0035-1567815

Hispanic Latino Health . (2025).

Huang, Y.-P., & Li, W. (2015a). Correlation between objective and subjective evaluation of profile in bimaxillary protrusion patients after orthodontic treatment. The Angle Orthodontist, 85(4), 690–698. https://doi.org/10.2319/070714-476.1

Huang, Y.-P., & Li, W. (2015b). Correlation between objective and subjective evaluation of profile in bimaxillary protrusion patients after orthodontic treatment. The Angle Orthodontist, 85(4), 690–698. https://doi.org/10.2319/070714-476.1

Iared, W., Koga da Silva, E. M., Iared, W., & Rufino Macedo, C. (2017). Esthetic perception of changes in facial profile resulting from orthodontic treatment with extraction of premolars: A systematic review. Journal of the American Dental Association (1939), 148(1), 9–16. https://doi.org/10.1016/j.adaj.2016.09.004

Jacobson, A. (1975). The “Wits” appraisal of jaw disharmony. American Journal of Orthodontics, 67(2), 125–138. https://doi.org/10.1016/0002-9416(75)90065-2

Janson, G., Branco, N. C., Fernandes, T. M. F., Sathler, R., Garib, D., & Lauris, J. R. P. (2011). Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness. The Angle Orthodontist, 81(1), 153–161. https://doi.org/10.2319/040710-195.1

Kanavakis, G., Halazonetis, D., Katsaros, C., & Gkantidis, N. (2021). Facial shape affects self-perceived facial attractiveness. PloS One, 16(2), e0245557. https://doi.org/10.1371/journal.pone.0245557

Kempa, J., Alfertshofer, M., Chua, D., Domehri, M., Akinsooto, O., Antoszewski, B., Timler, W., Cotofana, S., & Kasielska-Trojan, A. (2024). Influence of ethnicity on aesthetic preferences for lip characteristics in Caucasian male and female faces. Journal of Plastic, Reconstructive & Aesthetic Surgery : JPRAS, 95, 181–189. https://doi.org/10.1016/j.bjps.2024.06.013

Khan, A. R., Fida, M., & Sukhia, R. H. (2019). Factors affecting changes in soft tissue profile after various treatment modalities for skeletal Class II malocclusion: A cross-sectional study. International Orthodontics, 17(3), 497–505. https://doi.org/10.1016/j.ortho.2019.06.009

Khan, M., & Fida, M. (2010). Soft tissue profile response in extraction versus non-extraction orthodontic treatment. Journal of the College of Physicians and Surgeons--Pakistan : JCPSP, 20(7), 454–459.

Kouli, A., Papagiannis, A., Konstantoni, N., Halazonetis, D. J., & Konstantonis, D. (2019). A geometric morphometric evaluation of hard and soft tissue profile changes in borderline extraction versus non-extraction patients. European Journal of Orthodontics, 41(3), 264–272. https://doi.org/10.1093/ejo/cjy056

Krogman, W. M. (1948). The face in profile. An Anthropological X-ray Investigation on Swedish Children and Conscripts. By Arne Björk. Svensk Tandläkare-Tidskrift, Lund, vol. 40, no. 5B, 180 pp., 34 tables, 65 figures. 1947. American Journal of Physical Anthropology, 6(1), 121–125. https://doi.org/10.1002/ajpa.1330060117

Kurian, K., Hao, Y., Boczar, D., Brydges, H. T., Parker, A., Chaya, B. F., Trilles, J., Rodriguez Colon, R., & Rodriguez, E. D. (2023). Systematic Review and Meta-analysis of Facial Anthropometric Variations Among Cisgender Females of Different Ethnicities: Implications for Feminizing Facial Gender Affirming Surgery. The Journal of Craniofacial Surgery, 34(3), 949–954. https://doi.org/10.1097/SCS.0000000000009157

Leonardi, R., Annunziata, A., Licciardello, V., & Barbato, E. (2010). Soft tissue changes following the extraction of premolars in nongrowing patients with bimaxillary protrusion. A systematic review. The Angle Orthodontist, 80(1), 211–216. https://doi.org/10.2319/010709-16.1

Lipsky, M. S., Su, S., Crespo, C. J., & Hung, M. (2021). Men and Oral Health: A Review of Sex and Gender Differences. American Journal of Men's Health, 15(3), 15579883211016360. https://doi.org/10.1177/15579883211016361

Liu, K. A., & Mager, N. A. D. (2016). Women's involvement in clinical trials: historical perspective and future implications. Pharmacy Practice, 14(1), 708. https://doi.org/10.18549/PharmPract.2016.01.708

Liu, Y., Kau, C. H., Pan, F., Zhou, H., Zhang, Q., & Zacharopoulos, G. V. (2013). A 3-dimensional anthropometric evaluation of facial morphology among Chinese and Greek population. The Journal of Craniofacial Surgery, 24(4), e353-8. https://doi.org/10.1097/SCS.0b013e3182902e5d

Liu, Y., Kau, C. H., Talbert, L., & Pan, F. (2014). Three-dimensional analysis of facial morphology. The Journal of Craniofacial Surgery, 25(5), 1890–1894. https://doi.org/10.1097/01.SCS.0000436677.51573.a6

McNamara, J. A. (1984). A method of cephalometric evaluation. American Journal of Orthodontics, 86(6), 449–469. https://doi.org/10.1016/S0002-9416(84)90352-X

Mejia-Maidl, M., Evans, C. A., Viana, G., Anderson, N. K., & Giddon, D. B. (2005). Preferences for facial profiles between Mexican Americans and Caucasians. The Angle Orthodontist, 75(6), 953–958. https://doi.org/10.1043/0003-3219(2005)75[953:PFFPBM]2.0.CO;2

Merone, L., Tsey, K., Russell, D., & Nagle, C. (2022). Sex Inequalities in Medical Research: A Systematic Scoping Review of the Literature. Women's Health Reports (New Rochelle, N.Y.), 3(1), 49–59. https://doi.org/10.1089/whr.2021.0083

Möhlhenrich, S. C., Kötter, F., Peters, F., Kniha, K., Chhatwani, S., Danesh, G., Hölzle, F., & Modabber, A. (2021). Effects of different surgical techniques and displacement distances on the soft tissue profile via orthodontic-orthognathic treatment of class II and class III malocclusions. Head & Face Medicine, 17(1), 13. https://doi.org/10.1186/s13005-021-00264-4

Moore, T., Southard, K. A., Casko, J. S., Qian, F., & Southard, T. E. (2005). Buccal corridors and smile esthetics. American Journal of Orthodontics and Dentofacial Orthopedics, 127(2), 208–213. https://doi.org/10.1016/j.ajodo.2003.11.027

Mummareddy, S., Kuchimanchi, P. K., Inturi, N. R., Nandakumar, A., Nagisetty, J., & Vuyyuru, L. (2025). Ethnic Deviation of Northeastern Andhra Population from Standard Cephalometrics for Orthognathic Surgery - A Comparative Study. Annals of Maxillofacial Surgery, 15(1), 9–13. https://doi.org/10.4103/ams.ams_157_24

Murakami, T., Kataoka, T., Tagawa, J., Yamashiro, T., & Kamioka, H. (2016). Antero-posterior and vertical facial type variations influence the aesthetic preference of the antero-posterior lip positions. European Journal of Orthodontics, 38(4), 414–421. https://doi.org/10.1093/ejo/cjv073

Nanda, R. S., & Ghosh, J. (1995). Facial soft tissue harmony and growth in orthodontic treatment. Seminars in Orthodontics, 1(2), 67–81. https://doi.org/10.1016/s1073-8746(95)80094-8

NIH-Designated Populations with Health Disparities. (2025).

Nomura, M., Motegi, E., Hatch, J. P., Gakunga, P. T., Ng'ang'a, P. M., Rugh, J. D., & Yamaguchi, H. (2009). Esthetic preferences of European American, Hispanic American, Japanese, and African judges for soft-tissue profiles. American Journal of Orthodontics and Dentofacial Orthopedics, 135(4), S87–S95. https://doi.org/10.1016/j.ajodo.2008.02.019

Omar, Z., Short, L., Banting, D. W., & Saltaji, H. (2018). Profile changes following extraction orthodontic treatment: A comparison of first versus second premolar extraction. International Orthodontics, 16(1), 91–104. https://doi.org/10.1016/j.ortho.2018.01.017

Park, Y. S., Evans, C. A., Viana, G., Anderson, N. K., & Giddon, D. B. (2006). Profile preferences of Korean American orthodontic patients and orthodontists. World Journal of Orthodontics, 7(3), 286–292.

Pinho, T., & Raposo, R. (2017). Orthodontic Camouflage vs. Surgical-Orthodontic Treatment of Skeletal Class II Malocclusions. Journal of Clinical Orthodontics : JCO, 51(4), 209–222.

Pithon, M. M., Silva, I. S. N., Almeida, I. O., Nery, M. S., de Souza, M. L., Barbosa, G., dos Santos, A. F., & da Silva Coqueiro, R. (2014). Photos vs silhouettes for evaluation of profile esthetics between white and black evaluators. The Angle Orthodontist, 84(2), 231–238. https://doi.org/10.2319/051513-373.1

Proffit, W. R. . (2012). Contemporary Orthodontics.

Raposo, R., Peleteiro, B., Paço, M., & Pinho, T. (2018). Orthodontic camouflage versus orthodontic-orthognathic surgical treatment in class II malocclusion: a systematic review and meta-analysis. International Journal of Oral and Maxillofacial Surgery, 47(4), 445–455. https://doi.org/10.1016/j.ijom.2017.09.003

Rebaque Pistoni, T., de la Cruz Pérez, J., & Nieto Sánchez, I. (2023). Influence of social media on the esthetic perception of the lip profile of orthodontic patients. Heliyon, 9(5), e15870. https://doi.org/10.1016/j.heliyon.2023.e15870

Ricketts, R. M. (1960). The influence of orthodontic treatment on facial growth and development. The Angle Orthodontist, 30(3), 103–133.

Saadeh, M., Haddad, R., Haydar, M., & Ayoub, F. (2025). Cephalometric Hard and Soft Tissue Norms in Lebanese Adults. Cureus, 17(6), e85437. https://doi.org/10.7759/cureus.85437

Sadek, M. M., & Alali, M. B. (2025). Influence of lip protrusion and thickness on the perception of facial profile attractiveness among subjects with different ethnic backgrounds. The Angle Orthodontist, 95(6), 656–662. https://doi.org/10.2319/092724-796.1

Sadry, S., Eusmanaga, E., & Kayalar, E. (2024). Nasal profile changes after orthodontic tooth extraction in Class II, Division 1 malocclusion patients: A retrospective study. Journal of Stomatology, Oral and Maxillofacial Surgery, 125(5), 101748. https://doi.org/10.1016/j.jormas.2023.101748

Seo, K.-H., So, D.-H., Song, K.-T., Choi, S.-K., & Kang, K.-H. (2021). Effect of lower facial height and anteroposterior lip position on esthetic preference for Korean silhouette profiles. Korean Journal of Orthodontics, 51(6), 419–427. https://doi.org/10.4041/kjod.2021.51.6.419

Sharma, J. N. (2011). Steiner's cephalometric norms for the Nepalese population. Journal of Orthodontics, 38(1), 21–31. https://doi.org/10.1179/14653121141209

Sharma, K., Trehan, M., Singh, S., Mahlawat, H., Kenkare, P., & Jayavarma S, A. (2022). Comparison of Antero-Posterior Lip Position in Most Favored Facial Profile of Jaipur Population. Cureus, 14(8), e27774. https://doi.org/10.7759/cureus.27774

Shyagali, T. R., Chandralekha, B., Bhayya, D. P., Kumar, S., & Balasubramanyam, G. (2008). Are ratings of dentofacial attractiveness influenced by dentofacial midline discrepancies? Australian Orthodontic Journal, 24(2), 91–95.

Smedley, A., & Smedley, B. D. (2005). Race as biology is fiction, racism as a social problem is real: Anthropological and historical perspectives on the social construction of race. The American Psychologist, 60(1), 16–26. https://doi.org/10.1037/0003-066X.60.1.16

Soheilifar, S., Soheilifar, S., Afrasiabi, Z., Soheilifar, S., Tapak, L., & Naghdi, N. (2022). Prediction accuracy of Dolphin software for soft-tissue profile in Class I patients undergoing fixed orthodontic treatment. Journal of the World Federation of Orthodontists, 11(1), 29–35. https://doi.org/10.1016/j.ejwf.2021.10.001

Soheilifar, S., Soheilifar, S., Ataei, H., Mollabashi, V., Amini, P., Bakhshaei, A., & Naghdi, N. (2020). Extraction versus non-extraction orthodontic treatment: Soft tissue profile changes in borderline class I patients. Dental and Medical Problems, 57(3), 275–283. https://doi.org/10.17219/dmp/119102

Souza, D. B. de, Oliveira, A. I., Gouvêa, G. R., & Santamaria-Jr, M. (2022). What do black patients expect from orthodontic treatment? The aesthetic perception of facial profile between orthodontists and black laypersons. Dental Press Journal of Orthodontics, 27(4), e2220519. https://doi.org/10.1590/2177-6709.27.4.e2220519.oar

Steiner, C. C. (1953). Cephalometrics for you and me. American Journal of Orthodontics, 39(10), 729–755. https://doi.org/10.1016/0002-9416(53)90082-7

Sy, A. A., Kim, W. S., Chen, J., Shen, Y., Tao, C., & Lee, J. S. (2016). Acculturation levels and personalizing orthognathic surgery for the Asian American patient. International Journal of Oral and Maxillofacial Surgery, 45(10), 1201–1208. https://doi.org/10.1016/j.ijom.2016.04.013

Taee, A., Alsulaiman, A., Hersberger-Zurfluh, M., Bouserhal, J., Bassil-Nassif, N., Sathekge, R., Arai, K., Ikoma, M., Al-Turki, G., Idrees, A., Tagrikulu, B., Will, L., & Motro, M. (2023). Multinational study on profile preference of laypersons. Journal of the World Federation of Orthodontists, 12(5), 220–228. https://doi.org/10.1016/j.ejwf.2023.05.006

Tahir, E., Sadowsky, C., & Schneider, B. J. (1997). An assessment of treatment outcome in American Board of Orthodontics cases. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 111(3), 335–342. https://doi.org/10.1016/s0889-5406(97)70193-8

Tugran, M., & Baka, Z. M. (2021). Esthetic evaluation of profile photographs showing various sagittal and vertical patterns. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 159(3), 281–291. https://doi.org/10.1016/j.ajodo.2019.12.027

Uysal, T., Yagci, A., Aldrees, A. M., & Ekizer, E. (2011). Ethnic differences in dentofacial relationships of Turkish and Saudi young adults with normal occlusions and well-balanced

faces. The Saudi Dental Journal, 23(4), 183–190. https://doi.org/10.1016/j.sdentj.2011.08.002

Vela, E., Taylor, R. W., Campbell, P. M., & Buschang, P. H. (2011). Differences in craniofacial and dental characteristics of adolescent Mexican Americans and European Americans. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 140(6), 839–847. https://doi.org/10.1016/j.ajodo.2011.04.026

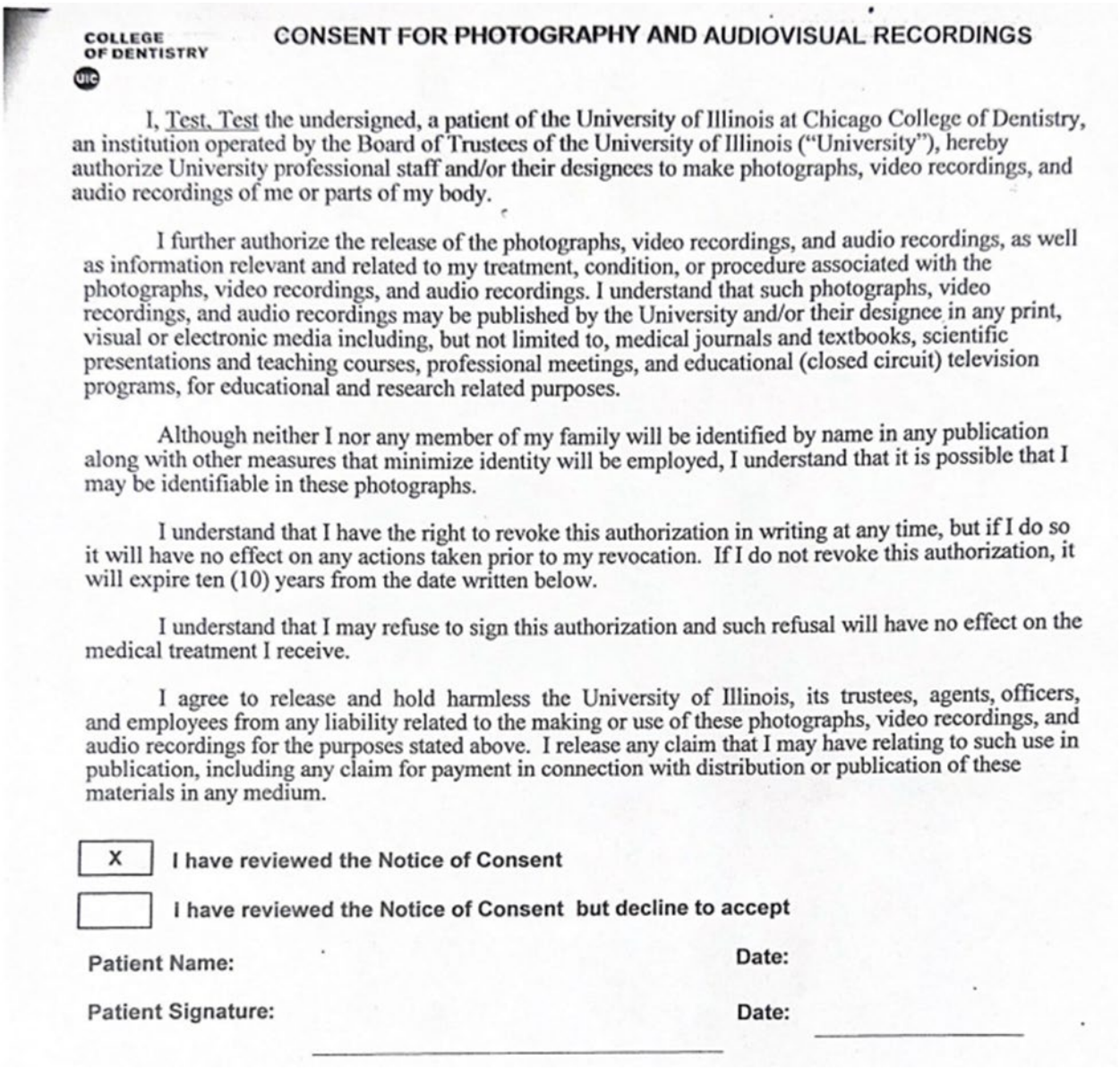
Wen, Y. F., Wong, H. M., Lin, R., Yin, G., & McGrath, C. (2015). Inter-Ethnic/Racial Facial Variations: A Systematic Review and Bayesian Meta-Analysis of Photogrammetric Studies. PloS One, 10(8), e0134525. https://doi.org/10.1371/journal.pone.0134525

Wolf, S. T., Jablonski, N. G., & Kenney, W. L. (2020). Examining "race" in physiology. American Journal of Physiology. Heart and Circulatory Physiology, 319(6), H1409–H1413. https://doi.org/10.1152/ajpheart.00698.2020

Zarif Najafi, H., Sabouri, S. A. A., Ebrahimi, E., & Torkan, S. (2016). Esthetic evaluation of lip position in silhouette with respect to profile divergence. American Journal of Orthodontics and Dentofacial Orthopedics : Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 149(6), 863–870. https://doi.org/10.1016/j.ajodo.2015.11.028

APPENDICES

Appendix A



COLLEGE OF DENTISTRY

UIC

CONSENT FOR PHOTOGRAPHY AND AUDIOVISUAL RECORDINGS

I, Test, Test the undersigned, a patient of the University of Illinois at Chicago College of Dentistry, an institution operated by the Board of Trustees of the University of Illinois ("University"), hereby authorize University professional staff and/or their designees to make photographs, video recordings, and audio recordings of me or parts of my body.

I further authorize the release of the photographs, video recordings, and audio recordings, as well as information relevant and related to my treatment, condition, or procedure associated with the photographs, video recordings, and audio recordings. I understand that such photographs, video recordings, and audio recordings may be published by the University and/or their designee in any print, visual or electronic media including, but not limited to, medical journals and textbooks, scientific presentations and teaching courses, professional meetings, and educational (closed circuit) television programs, for educational and research related purposes.

Although neither I nor any member of my family will be identified by name in any publication along with other measures that minimize identity will be employed, I understand that it is possible that I may be identifiable in these photographs.

I understand that I have the right to revoke this authorization in writing at any time, but if I do so it will have no effect on any actions taken prior to my revocation. If I do not revoke this authorization, it will expire ten (10) years from the date written below.

I understand that I may refuse to sign this authorization and such refusal will have no effect on the medical treatment I receive.

I agree to release and hold harmless the University of Illinois, its trustees, agents, officers, and employees from any liability related to the making or use of these photographs, video recordings, and audio recordings for the purposes stated above. I release any claim that I may have relating to such use in publication, including any claim for payment in connection with distribution or publication of these materials in any medium.

[X] I have reviewed the Notice of Consent

[ ] I have reviewed the Notice of Consent but decline to accept

Patient Name: Date:

Patient Signature: Date:

Appendix Figure 1: Case Participant Consent

Appendix B

Institution: University of Illinois at Chicago (UIC)
STUDY ID: STUDY2024-0060
Study Title: Layperson Perception of the Esthetic Benefit of Orthodontic Treatments in Patients of Different Racial Background
Principal Investigator: Mohammed Elnagar DDS, MS, PhD
Co-Principal Investigator: Jenna Berry DDS You are being asked to participate in a research study.

Research studies answer important questions that might help change or improve the way we do things in the future. This consent form will give you information about this research study to help you decide whether you want to participate. Please read this form and ask any questions you have before agreeing to be in this study. **Taking part in this study is voluntary.** It's up to you if you want to participate in this research. You do not have to take part in this study. You may change your mind and stop your participation at any time.
What is this research study about? This is a study on how people of different races and ethnicities perceive attractiveness of different facial features following orthodontic treatments. **Why am I being asked to be in this study?** To participate in this survey, you must be an English-speaking adult who self-identifies as either White, Black, Hispanic, and/or Asian, and who is NOT a dental or orthodontic professional (e.g., dental assistant, orthodontic resident, dental student, etc) AND you must be between 18 and 40 years old. About 200 people will be enrolled in this research study
What will I be asked to do during the study? You will be asked to complete a brief, anonymous, online questionnaire. The questionnaire will include demographic questions about race, ethnicity, and gender. You will also be presented with facial silhouettes and profile photographs and be asked to rank the images based on attractiveness of different facial features for these individuals.
How much time will I spend on the study? This survey will take 10-15 minutes to complete.
What are the benefits to being in this study? There are no direct benefits to you for participating in this research study. We hope that your participation in the study may benefit other people in the future by helping us learn more about individuals' esthetic preferences when viewing orthodontic patients.
What are the main risks to being in this study? We do not anticipate that you will experience any risks beyond everyday use of the internet. Online privacy can never be fully guaranteed. Privacy and confidentiality will be protected to the extent that it is technologically possible. Personal information will not be collected and it will not be possible to identify any individual respondent from this survey. Your participation in this study is voluntary. You will not be offered or receive any special consideration if you participate in this research.
What are my other options if I choose not to be in this study? If you do not wish to participate at any time during the survey, you can simply stop responding and close out the browser
Who can answer my questions about the study? For questions, concerns, or complaints about the study, please contact Principal Investigator Dr. Elnagar at melnagar@uic.edu or Co-Investigator Dr. Jenna Berry at jburt23@uic.edu

If you have questions about your rights as a study subject; including questions, concerns, complaints, or if you feel you have not been treated according to the description in this form; or to offer input you may call the UIC Office for the Protection of Research Subjects (OPRS) at 312-996-1711 or e-mail OPRS at uicirb@uic.edu Now that you know the main information about this study, please read about the details

Appendix Figure 2: Survey Excerpt 1

APPENDIX B (continued)

and other things you should know. Feel free to ask questions at any time.This research will be performed at The University of Illinois Chicago College of Dentistry. If you agree to be in the study, you will be asked to do the following procedures: complete a brief, anonymous, online questionnaire including demographic questions about race, ethnicity, and gender. You will also be presented with facial silhouettes and profile photographs and be asked to rank the images based on attractiveness of different facial features for these individuals.

What are the potential risks and discomforts of the study? Side effects, risks, and/or discomforts from participation in this study do not exceed any risks beyond everyday use of the internet. Online privacy can never be fully guaranteed. Privacy and confidentiality will be protected to the extent that it is technologically possible. Personal information will not be collected and it will not be possible to identify any individual respondent from this survey.

How will my information be kept private and safe? We will try to keep your information confidential by not sharing your information with others outside this research team. There can never be a guarantee of complete confidentiality. Your name and other personal information will not be collected as a part of this questionnaire. When data from this research is shared, no one will know it was you.

What are the costs for participating in this research study? There is no cost to you for participating in this research study.

Will I be compensated for my time? Yes. Participants who finish the survey will receive $15 in cash for their participation.

Can I withdraw, stop, or be removed from the study? If you choose to be in this study, you have the right to withdraw your consent and leave the study at any time without penalty. The researchers may stop your participation in this study without your consent. The researchers may use your information that was collected before you left the study.

Remember Your participation in this research study is voluntary. Your choice whether or not to participate will not affect your ability to receive care or services from the University. If you choose to participate, you are free to stop and withdraw at any time.

Consent of Subject: I have read the above information. I have been given an opportunity to contact the researchers and ask questions, and my questions have been answered to my satisfaction. I understand that by responding to the questions in this survey, I agree to participate and have the data aggregated and used for research.

PLEASE PRINT OUT A COPY OF THIS DOCUMENT FOR YOUR RECORDS. There are no right or wrong answers to the following questions. Please only submit one response to the survey. By clicking the "ACCEPT to continue to survey" button. If you do not wish to participate at any time during the survey, you can simply stop responding and close out the browser. Thank you for your interest in our survey! **Click "Accept" to continue to questionnaire**

Close the browser or click "Decline" to exit the questionnaire

○ Accept (1)

○ Decline (2)

End of Block: Consent

Start of Block: Demographics

Appendix Figure 3: Survey Excerpt 2

APPENDIX B (continued)

English Are you able to read and understand English?

- ○ Yes (1)
- ○ No (2)

Dental Professional Are you a dental professional (dental student, dental assistant, dentist, etc)

- ○ Yes (1)
- ○ No (2)

Race What is your race?

- ○ White (7)
- ○ Black (8)
- ○ Hispanic (9)
- ○ Asian (10)
- ○ Other (11)
- ○ Prefer not to disclose (12)

Appendix Figure 4: Survey Excerpt 3

APPENDIX B (continued)

Age How old are you?

- ○ Under 18 (1)
- ○ 18-24 years old (2)
- ○ 25-34 years old (3)
- ○ 35-44 years old (4)
- ○ 45-54 years old (5)
- ○ 55-64 years old (6)
- ○ 65+ years old (7)

Gender With which gender do you most identify?

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)
- ○ Prefer not to disclose (4)

End of Block: Demographics

Start of Block: CI Silhouettes

Please rank the following images in order of most attractive to least attractive. 1 = Most attractive 3 = Least attractive

_____ A
_____ B
_____ C

Appendix Figure 5: Survey Excerpt 4

APPENDIX B (continued)

End of Block: CI Silhouettes

Start of Block: CI Images

A  B  C 

Please rank the following images in order of most attractive to least attractive. 1 = Most attractive 3 = Least attractive

_____ A
_____ B
_____ C

End of Block: CI Images

Thank you for your participation!

You have completed this study.

Please proceed to the **UIC Department of Orthodontics, Room 131 to collect your $15 cash** reimbursement as a thank you for your time!

Reimbursement can be collected Monday-Thursday between 9:30 and 4:30

Appendix Figure 6: Survey Excerpt 5

Appendix C

UIC RESEARCH

IRB APPROVAL

April 7, 2025

Mohammed Elnagar
3129967138
melnagar@uic.edu

Dear Mohammed Elnagar:
On 4/7/2025, the IRB reviewed the following submission:

Submission ID:	STUDY2024-0060-MOD001
Type of Review:	Modification / Update
Study Title:	Layperson Perception of the Esthetic Benefit of Orthodontic Treatments in Patients of Different Racial Background
Principal Investigator:	Mohammed Elnagar
Co-Principal Investigator:	Jenna Berry
Expedited Review Category(ies):	5, 7
Scope of Modification:	• Study team member information • Other parts of the study
Additional Determinations:	• Waiver of Documentation of Informed Consent • Consent Exception for screening, recruitment, or determining eligibility • HIPAA Review Preparatory to Research
Funding:	Name: American Association of Orthodontists Foundation
Documents Reviewed:	• AAOF Funding Award.pdf, Category: Sponsor Attachment; • Consent Form 5.pdf, Category: Consent Form; • Final Approved IRB (3).docx, Category: IRB Protocol; • Grant Application, Category: Sponsor Attachment; • Letter of Support - AllCare Orthodontic Center to Dr Jenna Berry.docx, Category: Letter of Support/Approval (non-UIC)

The IRB approved the Modification on 4/7/2025.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the UIC Research IRB Library within the IRB system.

Sincerely,
Office for the Protection of Research Subjects

Office for the Protection of Research Subjects
201 AOB, M/C 682
1737 W. Polk St | Chicago, IL 60612
Phone: (312) 996-1711
Email: uicirb@uic.edu
UIC Research: research.uic.edu/uicresearch

Appendix Figure 7: Institutional Review Board

Appendix D

Figure 2 Long Description:

This figure presents the facial profile superior to the clavicular region of a female. The image is a black silhouette on a light colored background. There are three separate profile images presented left to right that appear identical except for the lower facial third. On each image, the lower facial third is different, displaying modified upper lip position and shape, lower lip position and shape, muscle tension, protrusion, and chip shape.

Above each profile image is the letter A, B and C respectively. Below each profile image text reads, “Please rank the following images in order of most to least attractive. 1= most attractive. 3= least attractive.” Below this text are two columns. The leftmost column has three underlined black spaces, present to indication positions 1, 2, and 3. The rightmost column contains one letter per cell, with A, B, and C written respectively. Participants are to sort the letters A, B, and C into the blank spaces in position 1, 2 and 3 to indicate their most and least preferred images.

Appendix D (continued)

Figure 3 Long Description:

This figure presents the facial profile superior to the clavicular region of a female. The image is a Black woman with dark hair and a black rectangle obscuring her eyes presented in color with a light background. There are three separate profile images presented left to right that appear identical except for the lower facial third. On each image, the lower facial third is different, displaying modified upper lip position and shape, lower lip position and shape, muscle tension, protrusion, and chip shape.

Above each profile image is the letter A, B and C respectively. Below each profile image text reads, “Please rank the following images in order of most to least attractive. 1= most attractive. 3= least attractive.” Below this text are two columns. The leftmost column has three underlined black spaces, present to indication positions 1, 2, and 3. The rightmost column contains one letter per cell, with A, B, and C written respectively. Participants are to sort the letters A, B, and C into the blank spaces in position 1, 2 and 3 to indicate their most and least preferred images.

VITA

NAME:	Jenna Berry
EDUCATION:	BS, Grand Valley State University, Allendale, MI, 2019 DDS, Columbia University, College of Dental Medicine, New York, NY , 2023
PROFESSIONAL MEMBERSHIPS:	American Association of Orthodontists American Dental Association Michigan Association of Orthodontists
PUBLICATIONS:	Burton, J. E., & McManus, J. M., Jr (2022). Factors that influenced students to matriculate at a northeastern dental school: A comparative study. Journal of dental education, 86(12), 1634–1642. https://doi.org/10.1002/jdd.13077