

# **The effect of facial attractiveness on orthodontic treatment outcome**

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Master of Science in Orthodontics

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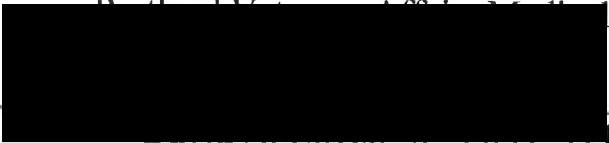
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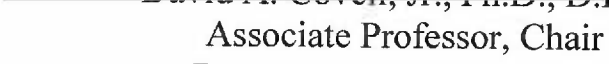
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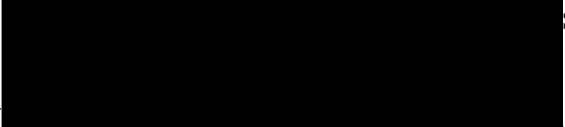
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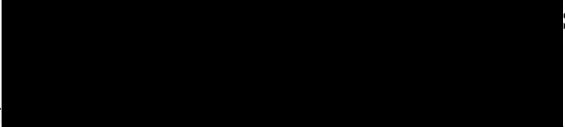
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# The effect of facial attractiveness on orthodontic treatment outcome

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## Abstract

**Introduction:** Multiple studies have documented the influence of patient appearance on medical treatment. We sought to investigate the influence of patient facial attractiveness on orthodontic treatment outcome. Additionally, we explored associations between pre-treatment facial attractiveness and post-treatment facial attractiveness, patient age, gender, case complexity (perceived and measured), compliance, oral hygiene, orthodontist satisfaction with treatment outcome, and treatment duration. **Methods:** Treatment records from 45 Angle Class I orthodontic patients between 10 and 20 years of age, treated by 45 orthodontists (one patient/orthodontist) were obtained. Treating orthodontists were surveyed regarding complexity, compliance, and oral hygiene (1=routine/poor, 7=complex/excellent). Patients' radiographs and models were assessed using the American Board of Orthodontics Discrepancy Index (DI) and Objective Grading System (OGS; lower scores signify superior outcome). Thirty raters assessed pre-treatment patient photographs for facial attractiveness using a Visual Attractiveness Scale (VAS) vis-à-vis same-gender reference photos. After calculating bivariate correlations, we used step-wise multiple regression analysis to determine if pre-treatment attractiveness predicted OGS outcome scores. Covariates included patient age, gender, compliance, and DI, which were selected a priori and entered first into the model. **Results:** VAS scores were significantly associated with OGS scores ( $r=-0.45$ ,  $p=.002$ ). In Step 1 of regression analysis, only compliance was significant in predicting OGS score ( $R^2=0.30$ ,  $F=3.76$ ,  $p=0.01$ ), however, adding pre-treatment VAS scores significantly improved prediction of OGS scores ( $R^2=0.512$ ,  $F=7.34$ ,  $p<0.001$ ; VAS  $b=-0.52$ ,  $p<0.001$  and compliance  $b=-3.64$ ,  $p<0.001$ ). Pre-treatment VAS scores were associated with post-treatment VAS scores, but were not significantly associated with treatment time, DI, perceived case complexity, compliance, hygiene, satisfaction with treatment



outcome, age, or gender. **Conclusions:** These results suggest that orthodontic treatment outcomes are significantly influenced by patient facial attractiveness.

## INTRODUCTION

Orthodontic care should be unbiased in its diagnosis, treatment planning, and execution of treatment as espoused in the American Dental Association's Principles of Ethics, describing unprejudiced equality of care.<sup>1</sup> Decades of research, however, have established that attractive people are often treated better than their lesser attractive counterparts in areas such as friendship and mating,<sup>2</sup> grades awarded and didactic encouragement,<sup>3</sup> interview outcomes and promotions,<sup>4-6</sup> evaluations of task performance,<sup>7,8</sup> and in legal decisions related to convictions and severity of punishment.<sup>9,10</sup> In medicine, perceived patient attractiveness has been shown to influence the diagnosis and care received in settings of general healthcare,<sup>11,12</sup> geriatric resident care,<sup>13</sup> neurology,<sup>14</sup> psychology,<sup>9,15-18</sup> and dentistry.<sup>19</sup> We have identified no studies on appearance-based bias in the field of orthodontic care.

The primary objective of this study was to examine the relationship between patient facial attractiveness and treatment outcomes obtained in orthodontic private practice settings. Secondary objectives included assessing the relationships between pre-treatment facial attractiveness and post-treatment facial attractiveness, patient age, gender, case complexity, compliance, oral hygiene, orthodontist satisfaction with treatment outcome, and treatment duration.

## MATERIAL AND METHODS

The design of this study was approved by the Institutional Review Board, Oregon Health & Science University (OHSU), Portland, Oregon. A waiver of patient informed consent was granted.

### Sample Selection

Orthodontists: 100 Orthodontists from the greater Portland area were invited to participate in this study by letter, followed by a phone call. Orthodontists were blinded to the purpose of the study, which was described as a study of the “effect of patient factors on treatment outcome.” The sole inclusion criterion for orthodontists was routine completion of pre- and post-treatment orthodontic records. Forty-four qualifying orthodontists agreed to participate.

Study sample: Each orthodontist provided records for their ten most recently finished cases, including: pre- and post-treatment extra-oral photographic images (profile, frontal neutral and smiling views), radiographic images (lateral cephalometric and panoramic), and dental study models (casts or digital). The cases were randomly ordered and reviewed by one investigator (DW), who selected the first case that satisfied the following inclusion criteria: pre-treatment age of 10-20 years, no missing or malformed teeth, no history of dental/facial trauma or congenital defects, skeletal Class I defined as an ANB angle of 0-4°, <sup>20,21</sup> moderate case complexity defined by an American Board of Orthodontics (ABO) Discrepancy Index (DI) <sup>22</sup> between 10-20 points, and completion of comprehensive fixed orthodontic treatment (no premature termination of treatment).

Patient and treatment factors reported to affect the assessment of treatment outcome and that were taken into consideration include treatment duration, <sup>23-26</sup> patient compliance, <sup>23-25,27</sup>

gender,<sup>26</sup> ANB angle,<sup>26</sup> and case complexity (DI).<sup>28</sup> Treatment duration, gender, and compliance were statistically controlled for, and experimental controls were implemented to control for ANB angle and DI score. Low or high ANB angles typically result in lower treatment outcome scores due to the poor fit of dental compensations from discrepant skeletal bases;<sup>26</sup> furthermore, patients with Class II and III skeletal patterns are generally perceived as less attractive at pre-treatment<sup>29</sup> and experience greater attractiveness changes during the course of treatment, therefore average, or skeletal Class I (ANB 0-4°)<sup>20,21</sup> records were selected for. Patients with low or high case complexity (DI<10 or >20) typically attain corresponding good or poor treatment outcome scores regardless of the operator; the mean orthodontic patient DI score is approximately 15,<sup>27</sup> therefore DI inclusion criteria was limited to 10-20 for moderate complexity.

Reference photograph sample: To identify photographs of one male and female to represent average facial appearance (the VAS “reference” photographs), records *OF* the 200 most recently completed orthodontic patients treated in the OHSU Graduate Orthodontic Clinic were screened. Extraoral photographs (profile, frontal neutral and smiling views) of the first 30 patients that fulfilled the patient inclusion criteria were selected.

### **Data collection and measures**

Participating orthodontists were asked to complete a 7-question survey; items included orthodontist gender, ethnicity, and satisfaction with patient treatment outcome, as well as perceptions of the selected patient’s treatment complexity, compliance, and oral hygiene. An item querying patient payment method was included as a distracter. Patient gender, age,

treatment time (number of years/months from first appliance delivery to complete appliance removal excluding retention appliances), and photographs were abstracted from the patient chart.

One evaluator (DW) measured orthodontic treatment outcomes on post-treatment records using the ABO Objective Grading System (OGS), our main outcome measure. The OGS is a quantitative assessment of parameters indicative of biologically stable dentition and functional occlusion,<sup>21</sup> with established validity and repeatability (0.96-0.993).<sup>23,24,28</sup> OGS test-retest reliability was assessed using 15 record sets, scored twice at least one week apart; test-retest reliability was excellent (ICC>.90).<sup>30</sup> Note that the OGS employs a reverse scoring system wherein lower scores signify superior outcomes.

Facial attractiveness was assessed utilizing the Kiekens Visual Analogue Scale (VAS)<sup>31</sup> which has been shown to be valid and particularly reliable ( $\geq 0.99$ ). The VAS utilizes same-gender reference photograph sets to orient raters to average facial attractiveness. To create this reference set, the 30 reference patient pre-treatment photograph sets were presented via a PowerPoint presentation, and rated by 10 orthodontic residents who ranked attractiveness by marking hard-copy 0-100 VAS scales. VAS ratings were converted to a score (0-100) by measuring the distance (to the nearest 0.1 mm) from 0 to the rater's tick mark using digital calipers (Cen-tech, Camarillo, CA). The median VAS ratings were calculated within-gender (male=45.1; female=53.2) and the male and female photograph set with the nearest within-subject median rating was selected as the reference photograph set (male=49.0; female=55.7). Thirty OHSU orthodontic faculty (n=19) and residents (n=11) rated the study sample patient photographs vis-à-vis these same-gender reference sets, which were described as representing a VAS=50 and against which the facial attractiveness of the study patients were compared.

## Data Analysis

To determine sample size, we assumed that four covariates would account for 10% of the variance in OGS scores and that pre-treatment VAS scores would account for another 20% of the variance. Sample selection was restricted to one patient per provider to maintain independence of observations.<sup>32</sup> Under these assumptions, a sample size of 30 was required to achieve 80% power and a sample size of 40 to achieve 90% power with alpha set at 0.05.<sup>33,34</sup>

We examined raw distributions visually for normality and outliers, then mean VAS scores were calculated. Bivariate relationships between pre-treatment VAS scores and OGS scores, treatment time, DI, case complexity, compliance, hygiene, satisfaction with treatment outcome, age, and post-treatment VAS scores were tested using correlation for interval and ratio level data, and t-tests for gender. Differences between VAS mean pre- and post-treatment scores were assessed using paired t-tests. Stepwise multiple regression analysis was used to determine if attractiveness significantly predicted OGS treatment outcome scores above and beyond patient age, gender, DI, and compliance. These covariates were selected a priori for their practical/theoretical interest. We used forced entry, entering control variables on step 1 and pre-treatment VAS scores on step 2. Observations with standardized residuals exceeding +/- 3.0 in initial models were censored. Differences between VAS mean pre- and post-treatment scores were assessed using paired t-tests. Analyses were run using SPSS 18.0 (IBM, Chicago, IL).

## RESULTS

The orthodontist sample was predominately male (82.2%) and white (91.0% white; 9.0% Asian). The patient sample was 53% male with a mean age of  $13.7 \pm 2.1$  years. Mean treatment time was  $2.2 \pm 0.9$  years. Mean DI was  $13.4 \pm 2.7$  and mean OGS was  $26.9 \pm 10.8$  (Table I).

Forty-two orthodontists (93%) completed surveys. Orthodontist's perceptions of patient case complexity fell at mid-range (mean= $3.43 \pm 1.3$ ), whereas perceptions of compliance, hygiene, and satisfaction with outcome had means  $\geq 5$ , with no ratings of "1" (Table I).

Although post-treatment facial attractiveness VAS mean scores were higher than for pre-treatment ( $57.7 \pm 9.2$  vs.  $49.9 \pm 9.8$ ,  $p < .001$ ), the scores were highly correlated ( $r = .67$ ,  $p < .001$ ; Table II). VAS pre-treatment scores predicted OGS scores ( $r = -.45$ ,  $p = .002$ ; Figure 1) but not treatment time, DI, perceived case complexity, compliance, or hygiene.

In multivariate analyses, no outliers were identified. On step 1, patient age, gender, DI, and compliance accounted for 29.5% of the treatment outcome score ( $F = 3.76$ ,  $p = .01$ ), but only compliance was significant ( $b = -3.55$ ,  $p = .001$ ). On Step 2, when pre-treatment VAS scores were added, the explained variance increased to 51.2% ( $F = 7.34$ ,  $p < .001$ ); compliance ( $b = -3.64$ ,  $B = -.56$ ,  $p < .001$ ) and VAS ( $b = -.52$ ,  $B = -.50$ ,  $p < .001$ ) were significantly associated with OGS scores (Table III).

## DISCUSSION

We sought to ascertain whether patient facial attractiveness plays a meaningful role in determining orthodontic treatment outcome. Indeed, the evidence here suggests that attractive patients receive a higher standard of care. In multivariate analyses, gender, age, DI, compliance, and pre-treatment facial attractiveness accounted for a approximately half of the variance in OGS scores, with compliance and facial attractiveness making the significant, and nearly equivalent, contributions to treatment outcome.

While this is the first report of the effect of facial attractiveness on orthodontic treatment outcomes, the effect of facial attractiveness on other medical treatment outcomes has been documented. When medical students or professionals rated “patient” photographs, unattractive individuals were more often assigned neurological disorders,<sup>11</sup> psychological disturbances,<sup>15</sup> poor self-concepts,<sup>16</sup> intellectual dysfunction,<sup>17</sup> or emotional maladjustment.<sup>18</sup> A particularly revealing study by Farina and colleagues<sup>9</sup> of hospitalized psychiatric patients found that unattractive patients had more severe diagnoses, were judged by staff to be less pleasant, had less information documented in their medical records, and were hospitalized for significantly longer periods of time. Diagnosis and treatment, despite a medical training steeped in “hard science,” may be impaired by appearance-based bias. Reasons for this include the inherent and pervasive quality of appearance-based bias, with onset noted as early as infancy,<sup>35</sup> and extending into nearly all areas of interactive life. In medical and dental fields, relative to less attractive patients, more attractive patients are perceived to be physically healthier,<sup>9,18</sup> to be better patients overall, with increased compliance, hygiene, and appreciation for treatment,<sup>10,11,19,36,37</sup> to value aesthetics more highly,<sup>38</sup> to require a higher standard of esthetics to maintain facial harmony,<sup>39</sup> and to have a higher potential esthetic outcome.<sup>19</sup> These assumed qualities of attractive patients can be very



motivating and inspiring to a practitioner, while the assumed qualities of unattractive patients can be equally discouraging.<sup>19</sup> Fortunately, like most discriminatory behaviors, this bias can be modulated by awareness and willingness to self-regulate.<sup>40</sup>

The secondary goal of this study was to explore relationships between treatment-related variables and facial attractiveness. Although other studies have found that attractive patients are rated as “good patients” demonstrating increased compliance and good hygiene,<sup>10,11</sup> in this study, orthodontist ratings of patient compliance and hygiene were not associated with patient facial attractiveness. Additionally, attractiveness was not associated with perceived or measured case complexity, possibly due to our restriction of the sample to Class I, moderately complex patients. Facial attractiveness also did not correlate with orthodontist’s satisfaction with treatment outcome, suggesting that orthodontists do not consider the attractiveness of the patient to be a factor when evaluating the outcome of a case. Furthermore, facial attractiveness was not associated with treatment time, age, or gender. The only measured variable associated with pre-treatment facial attractiveness, aside from treatment outcome score, was post-treatment facial attractiveness. This study aimed to assess the post-treatment outcome score in relation to the pre-treatment facial attractiveness, thus necessitating that the facial attractiveness remain largely consistent throughout treatment. A comparison of pre- and post-treatment VAS attractiveness scores showed a high correlation, thus supporting the premise.

There are a number of limitations impacting generalizability of our findings. First, the orthodontists were from one geographic area, and while it is anticipated that the providers were representative of a wider population of orthodontists, regional differences may exist. In support of the validity of our sample, the predominance of male orthodontists in the current sample (82%) is similar to that of the national distribution pattern (87%).<sup>41</sup> Another potential limitation

is volunteer bias, in that there may be treatment standard differences that influence orthodontist willingness to participate in a study that allows outsider evaluation of the orthodontic treatment. Finally, generalization beyond patients who are skeletal Class I, age 10-20, with moderate complexity, and no early debonds requires further testing.

## CONCLUSIONS

Our results suggest that for orthodontic patients, discrepancies in treatment outcomes can be attributed in large part to patient facial attractiveness, and that more attractive patients are treated to higher standards of orthodontic care. Fortunately, awareness of this bias can help providers make appropriate adjustments in their approaches.<sup>40</sup>

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## TABLES

Table I. Patient demographics, treatment-related variables, records' scores, survey results, and facial attractiveness ratings

<i>Measurement</i>	<i>Mean ± SD</i>	<i>Range</i>
Age <sup>1</sup>	13.7 ± 2.1	10.1 – 18.1
Treatment Time (years)	2.2 ± 0.9	1.1 – 4.9
Discrepancy Index (DI) <sup>2</sup>	13.4 ± 2.7	10.0 – 19.0
Objective Grading System (OGS) Score <sup>3</sup>	26.9 ± 10.8	13.0 – 59.0
Survey Results <sup>4</sup>		
- Perceived Case Complexity	3.4 ± 1.3	1.0 – 6.0
- Patient Compliance	5.3 ± 1.6	2.0 – 7.0
- Patient Hygiene	5.0 ± 1.6	2.0 – 7.0
- Orthodontist Satisfaction w/Treatment Outcome	5.6 ± 0.9	3.0 – 7.0
Visual Analogue Scale (VAS) <sup>5</sup>		
- Pre-Treatment	49.9 ± 9.8	33.6 – 74.5
- Post-Treatment	57.7 ± 9.2	35.8 – 74.9

<sup>1</sup> Inclusion criteria limited patient age at pre-treatment to 10-20

<sup>2</sup> Inclusion criteria limited DI to 10-20

<sup>3</sup> OGS utilizes a reverse scoring system; lower scores denote better treatment outcomes

<sup>4</sup> Ratings from 1-7 Likert-type scale

<sup>5</sup> Visual Analogue Scale (VAS) of 1-100

**Table II. Pair-wise associations between pre-treatment facial attractiveness and treatment-related variables**

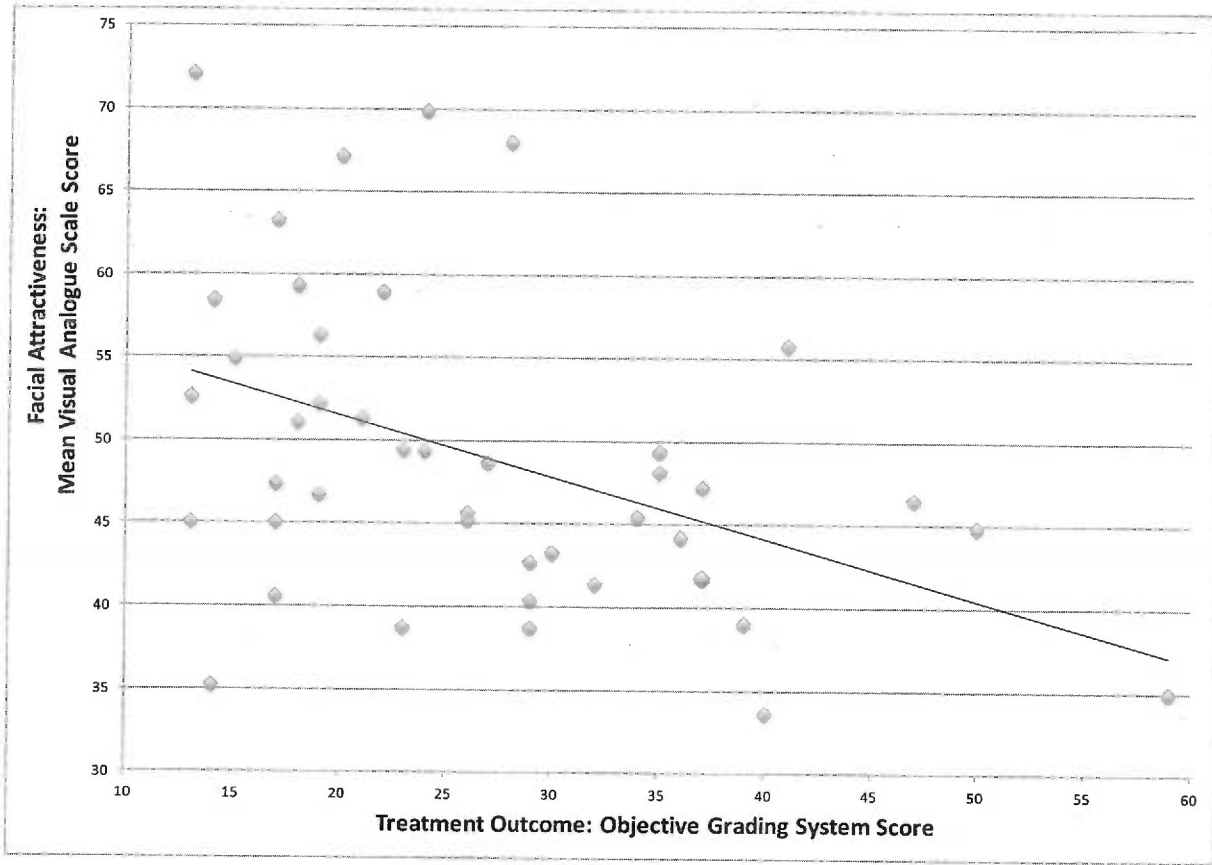
	<i>VAS Mean Pre-Treatment</i>	
	<i>r</i>	<i>p-value</i>
<b>VAS Mean Post-Treatment</b>	.674	.000
<b>Treatment Time</b>	.113	.466
<b>Discrepancy Index (DI)</b>	-.018	.910
<b>Perceived Case Complexity</b>	.088	.585
<b>Patient Compliance</b>	-.103	.522
<b>Patient Hygiene</b>	.135	.389
<b>Orthodontist Satisfaction w/ Treatment Outcome</b>	.057	.722
<b>Objective Grading System (OGS) score</b>	-.451	.002

**Table III. Results of multiple regression analysis: Predictors of treatment outcome**

	<i>Step 1: Variables Only</i>		<i>Step 2: Variables + Attractiveness</i>	
	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>
<b>Gender</b>	4.13	.167	-1.14	.663
<b>Age</b>	-0.80	.287	-0.31	.625
<b>Discrepancy Index (DI)</b>	0.18	.744	0.11	.817
<b>Compliance</b>	-3.55	.001	-3.64	<.001
<b>Facial Attractiveness</b>	-	-	-0.52	<.001

Step 1:  $R^2 = 0.295$ ; Step 2:  $R^2 = 0.512$

**FIGURE**



**Fig 1. Scatter plot of facial attractiveness (pre-treatment Visual Analogue Scale [VAS] mean) and orthodontic treatment outcome (Objective Grading System [OGS] score; n=44) showing an inverse relationship: as facial attractiveness scores improve (higher VAS scores), orthodontic treatment outcome scores improve (lower OGS scores).**

# COMPREHENSIVE LITERATURE REVIEW

## PART I: ATTRACTIVENESS

### **Definition**

The word “Attract” is a term to describe being drawn toward an object or an individual, in much the same likeness as by magnetic forces. To be “Attractive” is to possess certain positive characteristics that others can appreciate. We like to believe we are attracted to one another on the basis of such noble qualities as personality and compassion, however, the reality is that the superficial characteristics appear to us first: The Physical Attractiveness. This introductory set of features gives us our first impression, thus coloring what, if any, future interaction will be like.<sup>1,2</sup>

Physical attractiveness is comprised of two main components: the face and the body; however they are not of equal weight. The face plays the most important role in judgments of esthetics; it is the single most identifying feature of a person, the piece that will surface most frequently upon recall, and it is the perceived representation of the whole. The face also provides information about the person, such as age and gender, which are, in themselves, major influences on social interaction.<sup>3</sup> For purposes of this paper, “attractiveness” or “aesthetics” will refer to those of the face.

### **Objective and Subjective Components of Facial Attractiveness Assessment**

#### Consensus:

It is widely believed that beauty is subjective; however, in reality, there is surprising consensus among those asked to evaluate faces. “Beauty may be in the eye of the beholder, but there exists high agreement among beholders.”<sup>4</sup> A study by Strzalko et al found a significant proportion of attractiveness ratings to be shared, universal, and reproducible.<sup>5</sup> Many others have found similar results in their studies with inter-rater agreement as high as 0.93 to 0.99.<sup>4,6-8</sup> Furthermore, this rate of agreement increases for patients that are on the extreme ends of attractiveness.<sup>9</sup>

For this high rate of consensus, it is hypothesized that there are objective components for such agreement. When examined closely, specific features that often elicit increased perceived attractiveness scores include thickness of lips, the mouth index, and height-breadth facial index.<sup>5</sup> General features include average proportions, symmetry, secondary sexual characteristics, and balanced skeletal relationships (Class I).<sup>9,10,11</sup> Note that Class I individuals maintain relatively consistent scores even throughout orthodontic treatment, while Class II and III individuals typically receive lower perceived facial attractiveness scores prior to treatment, and have improved scores post-treatment.<sup>11</sup>

#### Subjective Components of Assessment:

Physical facial attractiveness may have a significant objective component; however, the remaining portion may be colored by many subjective variables, such as the rater’s background or the subject’s physical presentation. Much research has been conducted to explore these biases, however, much of it has led to conflicting results.

Gender of Rater: Cross and Cross found significant differences in the evaluations performed by males versus females, suggesting that the gender of the judge does influence the response.<sup>12</sup> In a

study by Miller et al, when female raters evaluated pictures of subjects, they were more likely to attribute to female subjects characteristics such as simpleness, submissiveness, passivity, and reservedness. Meanwhile, male judges were more likely to perceive male subjects as sad.<sup>13</sup>

Another study, based on survey response, found males to be significantly more concerned about sustaining professional objectivity when dealing with physically attractive patients.<sup>14</sup> From these studies, it may be concluded that the gender of the rater plays a role in the assessment of physical attractiveness; however, the following studies contradict these findings.

In a study evaluating the role of a student's physical attractiveness on a teacher's expectations of the child's intellectual and social behavior, no difference was found between male and female teachers.<sup>15</sup> Nordholm et al found that health professionals judge attractiveness consistently, regardless of their gender.<sup>16</sup> Finally, in three studies by Howells, Stroebe, and Patzer, and in a meta-analysis conducted by Hosada, attractiveness was shown to be as important for men as for women, and high agreement was found among same-sex and opposite-sex judges.<sup>1,4,6,17</sup>

It may be said that the gender of the rater may affect the assessment of perceived personality traits from subjects, and may affect the expected response of the rater to the subject; however, it may not affect the task of attractiveness evaluation.

**Gender of the Subject:** There is much literature that speculates that the gender of the subject influences the core of social interaction, which could translate into discrepancies in the evaluation.<sup>3,9</sup> A study by Cross and Cross agreed, reporting that the gender of the subject influenced the judging of relative beauty of the human face.<sup>12</sup> Another study found the gender of the subject to be significant; however it was only significant for one component of the evaluation. In this study, the subjects were hypothetical job applicants, and the judges had to

determine from their picture and résumé their hirability and starting salary. Attractive applicants were preferred over unattractive candidates, regardless of the candidate gender; however, when pitted against one another, male applicant vs. female, the male applicants were chosen.<sup>18</sup>

In the remaining studies, the gender of the subject had no effect on the evaluation of subject attractiveness, demonstrated by a high agreement between raters. This was shown in a teacher rating student study,<sup>15</sup> and in basic photograph assessment between strangers<sup>4</sup>

Age of Raters: In three studies conducted by Cross, Nordholm, and Peerlings, there was no difference in the response.<sup>8,12,16</sup>

Age of Subjects: The literature here is predominantly in agreement: youth plays a significant role in what is perceived to be attractive. Raters judge infants highly on aesthetic scales, while teenagers earn lower values, adults even lower values, and the elderly score the lowest values of all.<sup>3</sup> Many clinical studies show evidential support that both increased age and perceived increased age negatively affect facial attractiveness.<sup>3,9,12</sup>

Race/Culture of Raters: Evaluating the effect of race on assessments of attractiveness is a challenging task, fraught with political taboos and changing perceptions regarding race. Furthermore, it may be subject to changes with time and geographic location. It has long been speculated that the race of the rater would, in fact, change the assessments of facial attractiveness.<sup>3</sup> This was supported by a study by Cross and Cross,<sup>12</sup> but countered by a study by Bernstein et al.<sup>19</sup> In Bernstein's study, three different ethnic groups (Chinese, Black, and Caucasian) were asked to judge the attractiveness of subjects that belonged to their own ethnic group, and to subjects that belonged to the alternate ethnic group. Surprisingly, there was a high



level of agreement amongst the raters across ethnic groups. “There were essentially no differences in perceived variation for cross- vs. within-racial judgments.”<sup>19</sup>

A study by Martin et al, did find significant differences in assessment, but these were found to be based not on race, but on cultural or societal aesthetic standards. In this study, American whites and American blacks were asked to rate facial attractiveness. These groups had great similarity in their judgments. Next, the American white and black responses were compared to those of Nigerian blacks. These groups had far more discrepancy between the groups, the contrast especially wide between the American blacks and the Nigerian blacks, thus suggesting that the race of the rater was not as significant a factor as the cultural/societal factors.<sup>20</sup>

Race of Subjects: Bernstein’s study also doubles as a study that evaluates the effect of the race of the subject on the assessment of facial attractiveness. Again, there were no differences in the scores given, suggesting that subject race is not significant. However, it is interesting to note that there were differences in the criteria used to define attractiveness for each race.<sup>19</sup>

Socioeconomic Status of Rater: A study by Howells et al shows that the social class of the judge was a highly significant factor, as judges from a lower socioeconomic group had a tendency to give lower ratings in their assessment, than did those from higher socioeconomic groups.<sup>6</sup>

However, when Patzer compared the data from multiple trials, he found that the inter-judge agreement was consistently high regardless of socioeconomic class.<sup>4</sup>

Professional vs. Public Status of Rater: In a study that compared parents, art students, dental students, and orthodontists, it was found that the public opinion, as represented by the art students and parents, consistently rated faces more attractive than the trained professionals.<sup>11</sup>

This suggests that perhaps orthodontists are excessively discriminating in their assessment of attractiveness. However, a second study found just the opposite: orthodontic residents consistently rated the subjects as *more* attractive than by the dental or undergrad students.<sup>21</sup> Finally, studies by Howells, Peerlings, Knight, Patzer, and a meta-analysis by Hosada all found a strong correlation between the assessment of the panel of trained professionals and that of the laypersons involved, thus indicating that the opinion of the panel members was “representative of the esthetic values held by society at large,”<sup>6</sup> concluding that aesthetically-trained professionals agree with the public at large in their assessment of attractiveness, and that “professionals were as susceptible to the bias as were college students.”<sup>1,4,7</sup>

Aesthetics of the Rater: Rater attractiveness had no effect on their assessment or selection of the subjects.<sup>18</sup>

Context, Information Given, and Familiarity: The first form of context is contextualized images, or a photograph of the subject in a side-by-side comparison with a standardized photograph. Melamed et al demonstrated that neutral pictures, when shown adjacent to more negative pictures, appeared more attractive; and vice versa. The context of the images affected the assessment.<sup>22</sup>

The next form of context is information about the photograph subjects. A meta-analysis by Hosada found that in a hypothetical job applicant scenario, “the attractiveness bias did not differ between studies that provided low versus high amounts of job-relevant information about the targets.”<sup>1</sup>

The final form of context involves rater familiarity with the subject. This familiarity, or exposure effect, had a significant and profound effect on the physical attractiveness assessment, typically increasing the likableness and attractiveness scores.<sup>23</sup> Patzer contends that the only true measurement of physical attractiveness is by strangers, as they tend to overestimate the subjects they know.<sup>4</sup>

## **Methods of Assessing Facial Attractiveness**

### Anthropometric Proportion Indices:

The reasoning behind this methodology is simple: if subjects are assessed to be more attractive when they demonstrate average proportions, then subjects with the right numbers should be more attractive than those with deviations in numbers. Edler et al sought to verify this in a clinical study that compared the attractiveness assessment from 25 anthropometric proportion indices to that from a clinician-evaluated Visual Analogue Scale (VAS). The subjects used were 15 Caucasian patients undergoing orthodontic treatment with orthognathic surgery. Findings suggested that the improvement in facial aesthetics was reflected similarly in the anthropometric assessment and VAS assessment, indicating that the use of Anthropometric Proportion Indices may be acceptable for use in assessing physical facial attractiveness.<sup>9</sup>

### Grouping Method/Lundstrom Scale:

In this method, raters were asked to rate the facial attractiveness of the subjects along a 5-point scale. The consensus was that this method was easy to operate and consistent; however, no test

of reproducibility was performed.<sup>11</sup> Furthermore, it has been suggested that grouping patients into categories of attractiveness has the disadvantage of obscuring small but significant differences in facial attractiveness.<sup>24</sup>

#### Ranking:

One ranking method required the raters to place all subject photographs in the order of least to most attractive. From here, a number was assigned to the patients that coincided with that order. A study by Roberts-Harry found high intra-examiner agreement for this method.<sup>24</sup> A variation on this was proposed by Knight et al. First, the raters would rank 10 subjects from least attractive to most. Next, they would take the remaining 20 photographs and insert them around the others according to their perceived facial attractiveness. The final order would dictate their ranking score. The results showed a good level of intra-rater reliability, and high agreement amongst individuals within their respective groups.<sup>7</sup>

#### Reference Scale:

Peerlings et al proposed a methodology that involved assessing facial attractiveness in relation to reference images representing a same-sex average. If the judge found the subject to be more attractive by x amount, they were to lengthen the line. From here, line length was used to assess the relative attractiveness. Next, the images were sorted and the raters would evaluate the subjects again, this time by the method of magnitude estimation: assigning numerical values in lieu of line length. For example, if the subject was twice as attractive, they would give a numerical value twice as large as the standard (100). The study found this methodology to have high reproducibility and high inter-observer agreement, but lower intra-observer agreement. The

ideology of this method was that “individuals hold a common standard of attractiveness, which they use to evaluate the physical appearance of others.”<sup>8</sup> Secondly, this method allowed subsequent ratings to be performed immediately without affecting the validity.<sup>8</sup> Disadvantages of this method included the lower intra-rater reliability and the inconsistency with live scenarios: in live situations, when assessing facial attractiveness, raters are unlikely to compare subjects side-by-side, and usually evaluate on an individual basis.<sup>25</sup>

#### Visual Analogue Scale (VAS):

Today, the Visual Analogue Scale is likely the most commonly used rating system, due to its ease and convenience. Photographs are shown, and below each is a line of a consistent length for each image. One end of the line represents an assessment of “very unattractive,” and the opposite end represents an assessment of “very attractive.” The rater views each image and marks on the line where they perceive the subject to fit on the attractiveness spectrum. Numerical values are assigned based on distance along the line. Howells found this method to be highly reproducible.<sup>6</sup> A disadvantage is that “comparable positioning of marks on lines by two observers do not necessarily imply the same feeling,” and.”<sup>21</sup>

VAS-Rank: To address this disadvantage, methods have been proposed to orient the rater to the scale. The first is the VAS-Rank Method whereby the VAS ratings are placed in an order of low to high and assigned the value of their ranking. This gives a “location-free: outcome measure.” The advantage of transforming the VAS into a rank equilibrates the distribution of ratings between groups and decreases the “statistical noise” of the VAS method.<sup>21</sup>

VAS-Reference: Another orientation method is the VAS-Reference system as described by Kiekens et al.<sup>26</sup> Here, judges rate photos along the VAS in relation to same-gender reference pictures representing a midpoint in attractiveness. This method has been found to be particularly reliable ( $>0.99$ ).<sup>26</sup>

## **PART II: APPEARANCE-BASED DISCRIMINATION**

### **Overview**

*Reality is that people do judge books by their covers when dealing with a person's physical attractiveness.*<sup>27</sup>

In a time when sexism and racism have nearly become abolished with the advent of anti-discrimination laws and political correctness, it may come as a surprise that one “particularly harmful form of discrimination lingers”: Appearance-Based Discrimination.<sup>28</sup> It has been dubbed, “Lookism,” “covert discrimination,” or “interpersonal discrimination,” and it refers to “prejudice toward people because of their appearance.”<sup>29</sup>

The manifestation of this discrimination is that “beautiful people are greatly valued and well-treated while those who are unattractive receive a most regrettable reception.”<sup>30</sup> Appearance serves as an informational cue upon which individuals form impressions, make judgments, form expectations, and ultimately utilize to inform their responsive behaviors.<sup>2,27</sup>

### **Qualities**

#### **Pervasive:**

While it may not manifest itself openly with segregated water fountains and equal opportunity laws, as in racial discrimination, it may be found everywhere that people visually interact with one another: in social dynamics like friendship and dating, the job market, task evaluation,

customer service, and even in areas touted for their objectivity like education and medicine. So pervasive it is, that one may be hard-pressed to find an area of everyday life that has not been contaminated by such discrimination. It occurs around the world, permeates our social developmental process, influences our society dynamics at large, and its effects span the entire life of every sight-bound individual.<sup>27</sup>

### Powerful:

So powerful is this appearance-based discrimination that it can overpower informational cues. While it is true that increased familiarity with an individual can influence impressions, with increased positive factors compensating for disparities in physical attractiveness, the effect of this is limited at best. In many studies where facial images have been accompanied by information about a subject, it has been found that opinions about said subject's attractiveness and inferred abilities were unlikely to change dramatically.<sup>1</sup>

### Covert:

The covert nature of appearance-based discrimination makes it "even more pernicious in some respects than the simple and easily identifiable discrimination of the past."<sup>28</sup> Offenders are largely unaware of their behavior, and observers are hard-pressed to identify the subtle discrimination dubbed "positive and negative affect."<sup>27</sup> Positive affect is demonstrated in response to attractive individuals, which includes a series of welcoming nonverbal behaviors such as decreasing social distance, increasing eye contact, increasing eye blinking, and smiling.<sup>28</sup> It also elicits perceptions of the subject's increased talents and abilities, thus causing them to seem more capable than their less attractive counterparts.<sup>13</sup> Meanwhile, in response to unattractive



individuals, negative affect is often displayed, including decreased smiling, decreased eye contact, rudeness, and shorter interaction time.<sup>28</sup> Much of positive and negative affect behavior is too subtle to study or to pass legislation regarding, and thus it takes place without repercussion.

### **Theories Explaining Why Attractive People are Treated Better:**

#### Beauty is Health:

Secondary sexual characteristics, facial symmetry, and facial balance are all universally perceived to be attractive, and likewise, they all indicate health. The development of secondary sexual characteristics is costly as it diminishes the individual's immune system in the process, therefore one who can afford these attractive characteristics is assumed to be of the utmost health.<sup>10,33</sup> Meanwhile, symmetry and balance both indicate health as no developmental cog inhibited the normal progression of growth, leaving anteroposterior or asymmetrical deformities.<sup>10,33</sup> Stemming from a "Darwinian: survival of the fittest" perspective, health is a desirable characteristic in a mate, companion, or associate, therefore an individual perceived to be healthy is an attractive individual.

This has further ramifications in the health care setting as such a patient may be perceived to be healthier than they are, and this may influence the diagnostic process, thus altering the treatment provided.

#### "Beautiful is Good" Stereotype:

“Physically attractive individuals are assumed to possess more socially desirable characteristics and traits than physically unattractive individuals.”<sup>2,3,16</sup> Studies show that the more physically attractive a subject is, the more likely they are to be evaluated as curious vs. indifferent, complex vs. simple, perceptive vs. insensitive, happy vs. sad, active vs. passive, amiable vs. aloof, humorous vs. serious, pleasure-seeking vs. self-controlled, outspoken vs. reserved, flexible vs. rigid, and receiving more respect.<sup>13</sup> Another study found that the physical characteristics are what dictate the charisma or likeability of the subject.<sup>1</sup> It seems that attractiveness gives the beholder the benefit of the doubt about their character. An extension of the “Beauty is Good” stereotype is that attractive subjects are perceived to have increased compliance, better hygiene, and to value their treatment more, regardless of their actual behaviors or values.<sup>3,13,34</sup>

#### Beauty is Talent:

Attractive people are perceived to be more talented at task performance. Studies in the educational setting show that attractive students are often perceived to be more intelligent than their unattractive, but academically equal counterparts,<sup>15</sup> thus explaining the tendency for attractive individuals to earn higher grades.<sup>10</sup> A study by Landy et al attempted to show the effect of attractiveness on the perception of essay quality. Without photographs linked to the work, the well-written essays were clearly rated more favorably than the poorly written essay, suggesting that the judges were able to make an objective discrimination in the quality of the writings. However, when the essays were accompanied by pictures, the objectivity was diminished: the poorly written essay was rated more favorably when the writer was attractive, and less favorably when said writer was unattractive; meanwhile, the well-written essay was rated less favorably when the writer was attractive. It was concluded that the relative physical

attractiveness influenced the rating of the work quality, both positively and negatively, when the work itself was unchanged.<sup>2</sup>

#### Perception of Aesthetic Values:

Attractive people are perceived to value aesthetics at a higher level,<sup>35</sup> and therefore, are often treated to this higher standard of aesthetics. If a treating clinician perceives a patient to highly value aesthetics, i.e. over values such as time and expense, said clinician will likely put more into a high aesthetic outcome, even when it means more time and effort for them and the patient.

#### Aesthetic Contrast:

Perfection on an imperfect face may only draw attention to the contrast;<sup>36</sup> meanwhile, imperfection on an attractive, symmetrical, perfectly proportionate face may stand out, thus requiring a higher attention to detail for the more attractive patient. An example of this is midline tolerance: a midline discrepancy on an unattractive patient may go unnoticed by the layperson when discordant up to 3.3mm; however, on attractive patient, laypersons are less able to tolerate a discrepancy and become sensitive at 2.0mm.<sup>37</sup>

#### Aesthetic Potential:

It is common that individuals work harder at something that has a higher potential outcome, owing that the personal gratification is particularly motivating. Teachers give more encouragement to students they consider to be particularly apt in academics,<sup>15</sup> and medical providers spend more time providing care to patients perceived to respond well to treatment,

therefore it is not surprising that a provider of aesthetic treatment would strive harder for a patient who is attractive, and therefore has a higher aesthetic potential.

### **Appearance-Based Discrimination in Everyday Life**

Attractive people are treated better than unattractive people in everyday life as evidenced by many studies.

#### Interpersonal Relationships:

Attractiveness can open doors to an increased selection of friends, dates, and mates.<sup>27</sup>

#### Customer Service:

In a customer service setting, attractive subjects receive increased Positive Affect and better overall service. Attractiveness often determines who gets the most attention and who is attended to first when services are sought.<sup>27,38</sup>

#### Academic Performance:

It has been found that teachers will demonstrate more encouraging and friendly behaviors toward attractive students, and will award higher grades toward these students.<sup>15</sup>

#### Influenceability:

People in powerful positions are often more attractive than their custodial brethren; a person perceived as attractive, and therefore more charismatic and outspoken, can have undoubtable

influenceability and work their way into such positions of power. According to Campbell et al, attractiveness often determines who is most influential in groups and who gains public office.<sup>38</sup>

#### Job-Related Outcomes: Hiring, Income, Promotion:

Attractiveness plays a significant role in job-related outcomes.<sup>27,38</sup> In a study by Dipboye et al, raters were asked to view photos of theoretical job applicants with resumes, and to determine a) who they would recommend hiring and b) their starting salary. The results showed that attractive applicants were preferred over unattractive candidates with equivalent qualifications, and were offered higher starting salaries.<sup>18</sup> Watkins found similar results, and a meta-analysis by Hosada agreed, adding that even with increased job-relevant information about the subjects, the results did not vary, suggesting the significant power of attractiveness.<sup>1,39</sup>

#### **Appearance-Based Discrimination in Healthcare**

Healthcare should be based objectivity; but being that it is a social environment complete with visual informational cues, and being that healthcare providers are human with innate and powerful interpersonal discriminating instincts, it can only be assumed that physical attractiveness influences the resultant healthcare provided. In alignment with this, Stafford et al suggests that these unrecognized presuppositions drawn from patient appearance take place daily in the health care field.<sup>31</sup>

#### Examples:

General Healthcare: In a study by Nordholm et al, 289 health professionals, including occupational therapists, physical therapists, social workers, medical doctors, and speech pathologists, were given pre-scaled stimulus photographs of attractive and unattractive subjects and asked to evaluate them on 15 personality characteristics. Like the studies conducted outside of the medical field, the healthcare providers rated the attractive stimulus persons more favorably on 12 of the 15 characteristics. This confirms a “beautiful is good” stereotype amongst health professionals.<sup>16</sup> Walling et al attempted to identify principle patient characteristics that may evoke negative or positive affective reactions “sufficient to compromise the quality of patient care;” the leading two attributes were personal connection and attractiveness.<sup>14</sup>

Geriatrics: In the geriatric setting, residents in long-term care settings were evaluated for attractive characteristics, and staff members within these facilities were assessed regarding their clinical behavior toward these patients. Findings suggested that “characteristics of resident attractiveness exist within the long-term care setting and likely are related to care received.” The report went on to discuss the unconscious perceptions that lead nursing staff members toward or away from certain residents, thus influencing the decisions made about resident care.<sup>38</sup>

Psychology/Neurology: A study by Jones et al attempted to evaluate the affect of attractiveness on the assessment of psychological disturbance. College students were shown pictures of attractive and unattractive subjects and asked to identify who was undergoing hospital-based psychiatric care. The results were that the college students identified the lesser attractive subjects as the ones more likely to be hospitalized. Furthermore, even when a second group of raters were warned that attractiveness was unimportant, the results were the same with attractiveness influencing the decisions.<sup>40</sup> In a similar study, Hansson asked college students to identify which

subjects had an epileptic disorder from a lineup of attractive and unattractive subjects. Again, the unattractive individuals were most frequently selected as having the condition.<sup>41</sup> Hobfoll et al investigated the effect of physical attractiveness on a therapist's initial judgment of their self-concept. Again, students acted as judges, but this time, it was a composite of undergraduate and graduate students in clinical psychology. Stimulus persons were 2 attractive males, 2 attractive females, 2 unattractive males, and 2 attractive females. Judges based their judgment of self-concept on either a videotape or audiotape of the subject. For attractive females, the ratings of their self-concept increased significantly from the audiotape (no visual) to the videotape conditions. This suggested that the attractiveness of the subject played a sizeable role in the judges' interpretation of their self-concept.<sup>42</sup> Sandler et al used 123 trained and certified therapists to judge intellectual functioning from subject photographs and a problem oriented record. Once again, the judgment of intellectual functioning was affected by the attractiveness of the patient, with attractive patients receiving higher judgments of their intellectual function. The conclusion was that "therapists as a group hold a stereotypical perception of a patient's level of intellectual functioning based on the attractiveness of the patient."<sup>43</sup> A study by Martin et al concluded that trained health professionals found, from their pool of hospitalized schizophrenic subjects, that attractive patients were perceived to be better adjusted and less disturbed than their unattractive counterpoints.<sup>44</sup> Finally, a particularly revealing study by Farina et al investigated the relationship between physical attractiveness and mental disorders. The findings were that unattractive subjects had more severe diagnoses, were hospitalized for longer periods, were judged by the staff to be less pleasant, and had less written in their records at the time of admission and preliminary evaluation. "Physical attractiveness accounted for a large significant amount of length of hospitalization variation when degree of psychopathology and other possible

moderator variables were controlled statistically.” The conclusion was that the attractiveness of psychiatric patients does, in fact, influence their treatment in terms of daily conduct, diagnosis, and treatment prescribed.<sup>30</sup>

**Dentistry:** Dentistry is an area where the social implications of attractiveness are only beginning to be explored. A study by Rouse et al investigated the dentists’ perceptions of patients that could be directly associated to the quality of care received. A literature search was performed, as well as a survey of general dentists. The three dimensions that affected the dentist’s perception of a patient substantially enough to affect quality of care were tractability, patient compliance, and most of all, interpersonal responsiveness which included such patient traits as a Positive Affect, appreciativeness, and attractiveness.<sup>45</sup>

#### Conclusion:

Patient attractiveness may considerably affect the diagnostic process and treatment proffered in the healthcare scenario.

#### Implications of Appearance-Based Discrimination in Healthcare:

Patients are to be treated on the basis of the presentation of their disease conditions. If healthcare providers are unable to maintain objectivity in the face of attractive or unattractive stimuli, the implications could be detrimental to the patients involved, as well as to the provider.

**Ethical violation:** The code of ethics discusses justice as equality of care; every patient should be treated to the best of one’s ability without discrimination. If this is compromised, the provider may be subject to disciplinary measures.



Negative Affect: An unattractive patient who receives signals such as increased social distance, early termination of the interaction, and lack of eye contact might construe this as disinterest by the clinician. This could be further interpreted as a clinician's inability to provide proper care to the patient, even when the diagnosis and treatment are appropriate. As a result, the patient's trust and confidence in the provider's judgment or treatment could wane. For the patient, this lack of trust or confidence could manifest itself in non-compliance and/or hopelessness for resolution of his/her ailment. In summation, negative affect may lead to a loss of confidence crucial to attaining a positive treatment outcome.

Clinical Judgment: A final repercussion of appearance-based discrimination in the healthcare setting is that of affected clinical judgment, including improper diagnosis and inappropriate treatment.<sup>46</sup> This could mean the difference between acceptable treatment and substandard or inappropriate treatment, leaving the patient in a worsened condition than they presented with.

#### Solution:

Fostering appropriate attitudes toward patients begins with recognition of the physician's personal biases and preferences about patients.<sup>14</sup> Once these disparities have been made evident, one can increase the awareness regarding appearance-based health-care discrimination.<sup>31</sup> Finally, like most discriminatory behaviors, this bias can be modulated by awareness and willingness to self-regulate.<sup>47</sup>

### **PART III: ASSESSING ORTHODONTIC TREATMENT OUTCOME**

#### **Overview**

The assessment of orthodontic treatment outcome must fulfill many important criteria: it must be a valid assessment of relevant criteria, it must have appropriate assignment of points for each criterium, it must be objective and reliable, and it must be practical in its use. Despite the challenge, those in the orthodontic community have found the pursuit of this to be an important one. The assessment of treatment outcome is necessary for researchers to evaluate treatment methodologies, for clinicians to evaluate personal work, and for the American Board of Orthodontics to use in their standardization and board certification process. Over the years, many indices have been designed to aid in the objective quantitative evaluation of orthodontic treatment outcome, and with the changing attitudes about factors of importance, new assessments have been designed while others have fallen out of fashion.

#### **Methods**

##### **Occlusal Index (OI):**

The OI was designed to evaluate nine characteristics of occlusion, including dental age, molar relation, overbite, overjet, posterior cross-bite, posterior open-bite, tooth displacement, midline relations, and missing permanent maxillary incisors.<sup>48</sup> Disadvantages of this system are that it is tedious in its application, and that it is more applicable to pretreatment scoring, rather than post-treatment record analysis.<sup>49</sup>

### Peer Assessment Rating Index (PAR):

The PAR is another such method that has fallen out of favor in the United States. It was primarily designed for epidemiologic purposes,<sup>50</sup> it was used to examine a group of patients (rather than a single patient's outcome), and it was used to assess the severity of the malocclusion with subsequent change in discrepancy with treatment.<sup>51,52</sup> The PAR system has the advantage of having good reliability and validity; however, it has its limitations in areas of precision. The American Board of Orthodontics (ABO) does not find it "precise enough to discriminate between minor inadequacies of tooth position that are found in ABO case reports."

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### Ideal Tooth Relationship Index (ITRI):

The ITRI was designed based on interarch relationships, interincisal contacts, and interproximal contacts.<sup>53,54</sup>

### Objective Grading System (OGS):

The OGS is the official method used by the ABO on the casts and radiographs of post-treatment records for the purpose of measuring treatment outcomes. With calibration and the inclusion of an instrument for measurement accuracy, the ABO believes this system to be strong in its validity, objectivity, and reliability.<sup>49</sup>

Objectivity: Lieber et al tested the reliability and subtraction frequency of the OGS with 36 post-treatment models which were evaluated by 4 calibrated judges on 2 separate scoring sessions. Results were surprisingly low for intra-judge ( $r=0.77$ ) and inter-judge ( $r=0.85$ ) reliability, thus

calling into question the extent of the objectivity of the system. Lieber et al did suggest, however, that it increased the objectivity from previous evaluation methods.<sup>55</sup> More recent studies, however, have reported inter-judge repeatability of 0.98,<sup>50</sup> 0.96,<sup>51</sup> and 0.993.<sup>56</sup> It is possible that the OGS scoring calibration process has become improved over the years.

**Validity:** The parameters assessed by the OGS are alignment, marginal ridges, buccolingual inclination, occlusal relationship, occlusal contacts, overjet, interproximal contacts, and root angulations.<sup>49</sup> A study by Deguchi et al found that, compared to PAR-treated cases, OGS-treated cases finished more precisely in all 3 planes.<sup>51</sup> Tahir et al examined 90 ABO-treated cases in comparison with 147 naturally occurring good-to-excellent occlusions using the ITRI. The ABO cases scored higher for all ITRI segments (except for the anterior interarch segments), had ideal overjet and overbite, had improved skeletal convexity, and had improved dental characteristics including incisor position and inclination. The conclusion was that cases treated to the ABO standards had improved occlusion and cephalometric changes.<sup>54</sup>

**Mean Scores:** Average reported post-treatment OGS scores range from 19.3-45.54, however the patient samples in these studies range in their malocclusion inclusion criteria.<sup>57,58</sup> The means reported for Class I patient samples are from studies by Knierim: Mean 25.29, SD 9.68 ;<sup>59</sup> and Fleming: Mean 24.9, SD: 8.0.<sup>60</sup>

**Factors found to affect OGS score:**

- **Case Complexity:** Cases considered to be complex as determined by the Discrepancy Index were found to be correlated with inferior treatment outcome scores as assessed by

both OGS and CCA.<sup>56</sup> Note that average complexity is 15,<sup>61</sup> and a moderate complexity range is 10-20.

- Treatment Duration: Increased treatment duration was cited as a significant treatment factor of inferior treatment outcome scores.<sup>50,51,59,60</sup> Fleming et al found that for every 3 additional months of treatment, the OGS score would increase by 1 point (indicating an inferior outcome).<sup>60</sup>
- Compliance: Compliance was cited as another frequent significant factor of the overall OGS score.<sup>50,51,59,61</sup> Decreased patient compliance indicates that the patient did not perform their assigned tasks such as headgear or elastic wear, thus disabling the practitioner from being able to correct certain malocclusions with compliance-based mechanics.
- Treatment timing: Patients that underwent phase 1 or early treatment received worse clinical outcomes than those who were treated later in a comprehensive single phase treatment.<sup>59</sup>
- ANB value: The average ANB value is 2° with a Class I range of approximately 0-4°. <sup>62-</sup>  
<sup>65</sup> A high or low ANB value indicates a Class II or Class III skeletal relationship. When a skeletal discordance is camouflaged, the dentition does not typically attain the ideal occlusion that a skeletal Class I individual might attain.<sup>60</sup>
- Gender<sup>60</sup>
- Post-treatment anterior Bolton ratio<sup>60</sup>
- Pretreatment mandibular plane angle: The OGS increased 1 point for every 4 degree increase in mandibular plane angle.<sup>60</sup>

- Orthodontist variability: 15% of the variation in buccolingual inclination, 16% of the variation in alignment, and 2.3% of the overall OGS score was attributed to orthodontist variability.<sup>60</sup>
- Early debonds, missing or malformed teeth, dental/facial defects

Advantages and Limitations: Advantages of the OGS are that it has appropriate measurement criteria, digestible sections, offers a method for clinicians to evaluate their own cases, and objectivity.<sup>55</sup> A limitation of the OGS is that some teeth are evaluated repeatedly. For example, a malalignment in the 2<sup>nd</sup> molars could lose points 8 different times, whereas a central incisor can only lose points twice.<sup>55</sup> A second limitation of the OGS is that it does not rate the aesthetics of how the dentition relates to the facial soft tissue or smile aesthetics.<sup>58</sup> A study by Schabel et al found that when OGS scores were compared with esthetic evaluations of perceived smile attractiveness, they found extremely weak relationships. Occlusion-focused treatment did not necessarily dictate improved smile esthetics, as evaluated by the Q-sort method. It was then suggested that additional criteria be incorporated for the purpose of assessing the resultant smile esthetics.<sup>58</sup> In opposition to this, Tahir et al examined the correlation between OGS values and smile aesthetics and found that in studies that the patients treated to the OGS standards had the corresponding benefit of improved lip balance and harmony, closure at rest, and closure without strain. The conclusion was that improved esthetics was a natural sequelae of treatment to the OGS occlusal standards.<sup>54</sup> Two more studies agreed; occlusions that were detailed according to OGS standards tended to be more aesthetic.<sup>50,51</sup>

#### Comprehensive Clinical Assessment (CCA):

The CCA was designed to complement the OGS with additional criteria to fill in for deficiencies of the OGS. Among its assessment parameters are facial form, dental esthetics, vertical dimension, arch form, periodontium preservation, root resorption, and treatment efficiency.<sup>50</sup>

The average post-treatment score for the CCA, as reported by two post-graduate orthodontic residencies, is approximately 4.<sup>51</sup>

#### Clinical Outcome:

Clinical outcome is a compilation of OGS and CCA evaluations. Deguchi et al evaluated the use of multiple indices: PAR, DI, OGS, and CCA, and found that while all examined indexes could be successfully used to evaluate orthodontic treatment outcomes, the most specific information regarding clinical quality came from the combined OGS and CCA system.<sup>51</sup>

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# Orthodontic Research

## OHSU ORTHODONTIC MASTERS PROJECT

I am currently a second-year orthodontic resident at Oregon Health & Science University, and I am working on my Masters Project. To complete this research, I am asking for assistance from 50 orthodontists in the community. If you are interested in supporting my project, your involvement would be minimal, but crucial. What I need from you, simply put, is access to patient records and the completion of a short survey.

### *Who can participate?*

- *Orthodontists who routinely take full pre-treatment and post-treatment records and who treat toward ABO standards.*

### Will the treatment provider be anonymous?

- I will encode names and maintain complete anonymity.

### Who will review the records?

- I will review the records in their entirety at your office.
- OHSU orthodontic residents and faculty will review facial photographs only.

### Will patient records be taken from the office?

- Patient facial photographs will be duplicated on site, and evaluated at OHSU.

### Will the anonymity of the patients be preserved?

- Photographs will be shared with the OHSU orthodontic residents and faculty. No outside party will have access to any patient information.
- IRB has approved our protocol, and a waiver of informed consent has been granted.
- All records/data will be stored securely

### *How many records do I need?*

- One case that fulfills my criteria for the study. I will begin by asking for your 10 most recently completed cases.



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# Survey for Treating Orthodontists

Please take a few minutes to fill out this survey about yourself and the patient selected for study. If you have any questions whatsoever, please contact me at the email address, phone number, or mailing address above

## TREATING ORTHODONTIST INFORMATION

**1. Treating Orthodontist ID #:**

**2. Gender:**

- Male       Female

**3. Ethnicity:**

- American Indian or Alaska Native       Asian       Black or African American       Native Hawaiian or Other Pacific Islander       White       Other

## SELECTED PATIENT INFORMATION

**1. Rate the Relative Complexity of the Selected Case:**

- Routine:      Complex
- 1       2       3       4       5       6       7

**2. Rate your satisfaction with the treatment outcome on this selected case:**

- Very Dissatisfied      Very Satisfied
- 1       2       3       4       5       6       7

**3. Rate Patient's Compliance (i.e. wearing elastics, headgear, etc.)**

Very <b>Non-</b> Compliant							Very Compliant
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	2	3	4	5	6	7	

**4. Rate Patient's Home-Care/Oral Hygiene:**

Poor Home-Care							Excellent Home-Care
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	2	3	4	5	6	7	

**5. Method of Payment for Orthodontic Treatment:**

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dental Insurance	Self-Pay	Insurance & Co-Pay	Pro Bono	Other

**6. Please share any additional comments about your practice methods, this patient, or this patient's treatment in particular you feel may be helpful:**

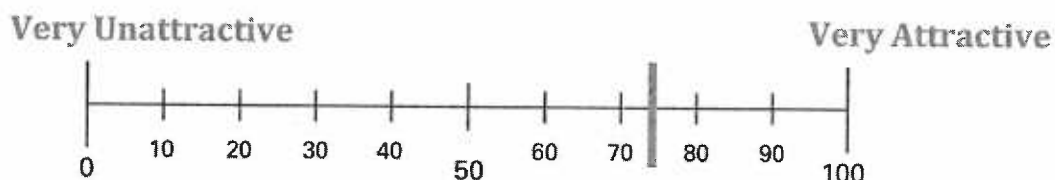
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## Instructions for VAS Rating

1. **Write your name on the first page of each packet.** This is for record-keeping.
2. **Briefly look at each photo set and evaluate the subject's facial attractiveness.** Note that according to the research, viewing the photo for 1 second vs. 15 seconds vs. unlimited time will not vary the assessment. Treat this like the SATs – your first answer is probably the correct answer.
3. **A male and female reference photo set representing an average score (50) is available for you.** If the powerpoint photo is more attractive than the reference photo, you know you can use the upper region of the scale (50-100), and vice-versa.
4. **Mark your assessment clearly with a hatch mark on the VAS scale provided.**

PATIENT 1: ID# \_\_\_\_\_



5. **Ensure that you utilize the full scale** (i.e. do not mark just 10, 20, 30, etc.).
6. **Do not score the patient you treated.** Star the patient number and move on.
7. **Check the patient number.** The slide number corresponds to the patient number. Routinely check that you are marking the appropriate scale.
8. **Please keep your assessments to yourself.**
9. **Disregard last 10 pages.**
10. **Note that you are evaluating the entire face as a whole,** not just the teeth or profile, etc.
11. **Do not go back and rescore.** Your initial scoring is final.



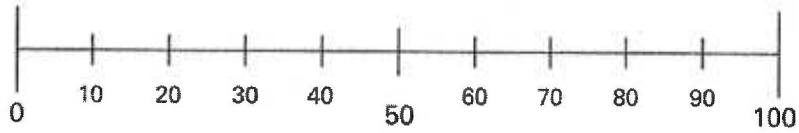
# Rate Patient Facial Attractiveness

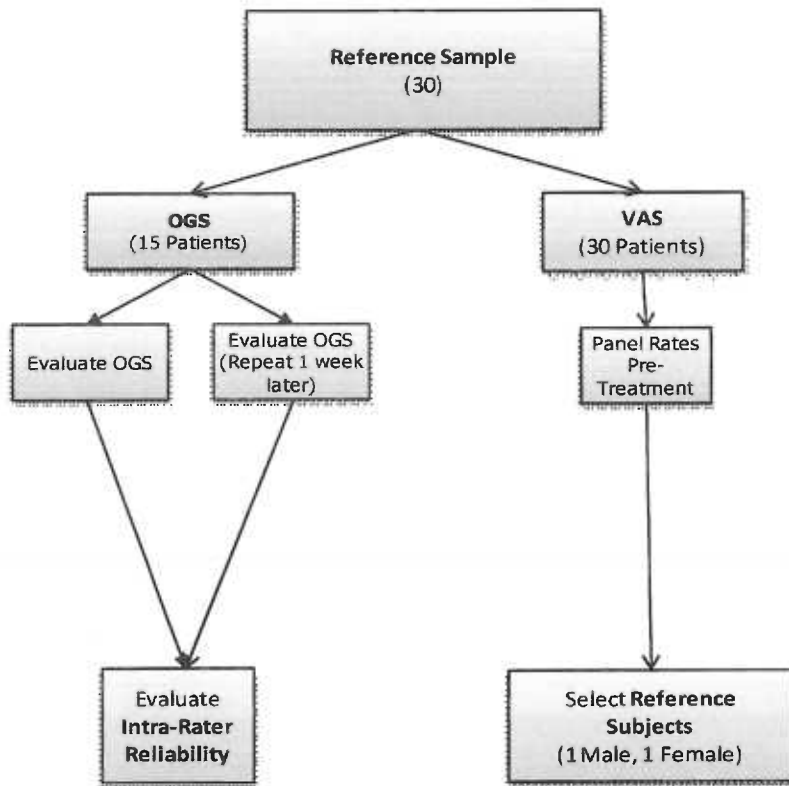
## *VISUAL ANALOGUE SCALE*

PATIENT 1: ID# \_\_\_\_\_

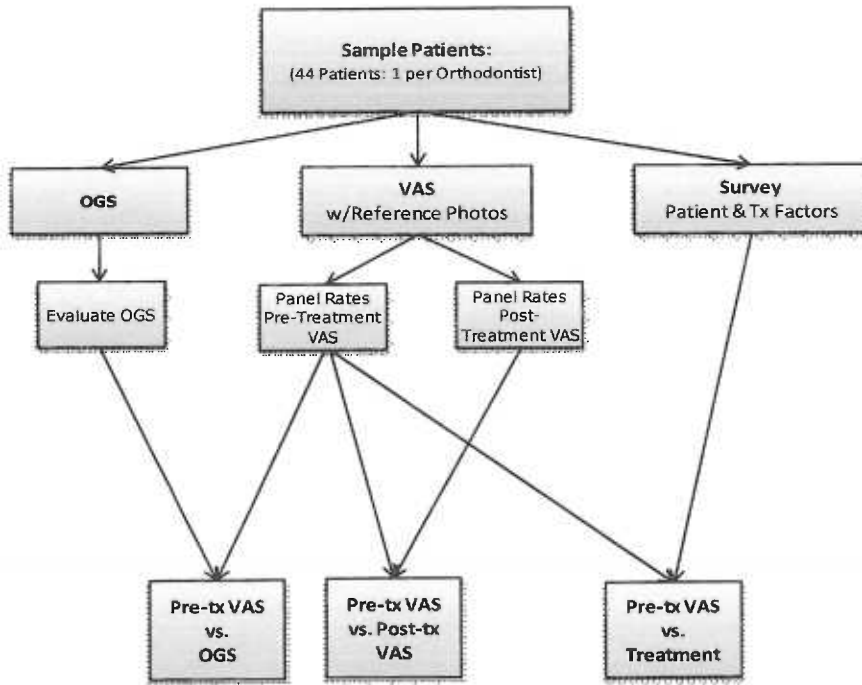
**Very Unattractive**

**Very Attractive**





Flowchart for reference sample.



Flowchart for study sample