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What Do We See When We Look at Faces?

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Recent scientific findings on the perception of facial attractiveness coupled with technological advances in computer imaging make it possible to measure the facial characteristics that may be associated with specific judgments of facial appearance. These new methods can be used to produce psychometric norms of facial attractiveness which potentially could supplement the conventional population norms or averages used currently in orthodontic treatment planning. It is hypothesized that consideration of psychometric norms will enhance doctor-patient communication and lead to greater patient satisfaction at the completion of orthodontic treatment.

Ⅰ. Introduction

Since a pleasing facial appearance provides advantages to the person seeking opportunities in education, employment, or mate selection, the improvements in appearance obtained via orthodontic treatment and other esthetic dental interventions are generally thought to benefit mental health and social behavior[1)]. Prospective patients or parents of young patients recognize these psychosocial benefits of orthodontic treatment and seek esthetic change as well as functional corrections. However, what the patient sees as a problem requiring treatment may not be similarly judged by clinicians using specific anatomic measurements for their assessment [2)]. Because the clinician's assessment of facial harmony is usually based on comparison of a patient's actual morphological characteristics to population norms, the clinician may overlook the role of perception when analyzing patient complaints and formulating treatment plans[3)].

It is useful to consider the scientific basis of perception. For example, when a person looks at a single optical illusion, multiple pictures may be seen, clearly demonstrating that the brain can interpret the single image present on the retina by giving multiple results[4)]. Recordings of brain activity show that what a person actually sees is the result of neural activity at various levels and diverse locations in the brain and consists of more than the pure image or signal that is present on the retina. The specific areas of the brain activated in the perception of an image depend on the task. The area of the brain active in an up-down or where task, such as looking for a red book on a bookshelf, differs for that when the focus involves a "bottom-up" or what task such as examining an involuntary illusion that gives conflicting images. The entire visual pathway is involved in looking and seeing.

Perception of facial appearance is very complex and it is not known how the brain judges attractiveness[3, 5)]. To avoid subjective assessments, orthodontists currently base their treatment objectives on population norms or averages[6)]. Anthropometrics and radiogra

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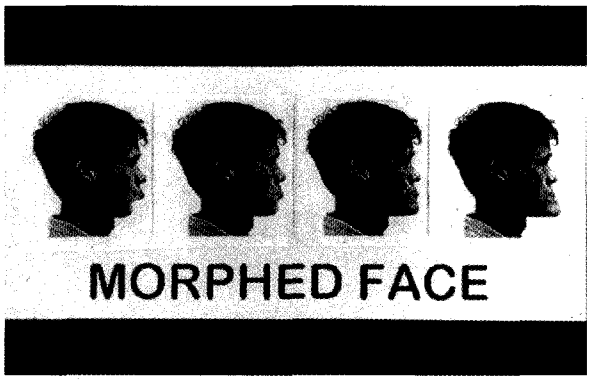

Fig. 1. A typical morphed face after Arpino, et al.[18]

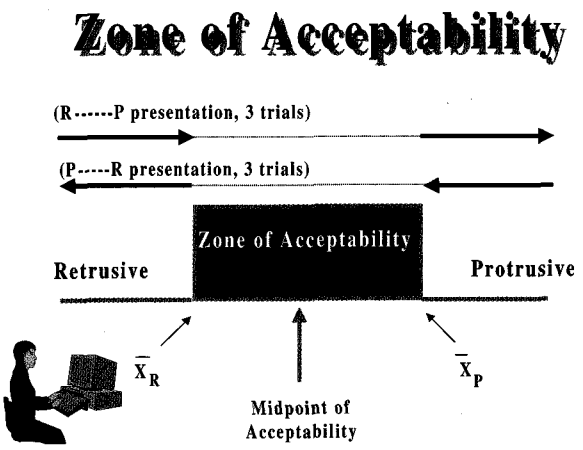

Fig. 2. A diagram showing how the zone of acceptability is determined. (R = retrusive direction; P = protrusive direction).

phic cephalometry provide the norms and ranges of anatomic variance used as the basis for orthodontic treatment planning. By doing so, however, the success of treatment in esthetic terms may be limited. As explained in a pair of articles, Attractive faces are only average;" "but very attractive faces are not average"[7,8]. Langlois and Roggman[7] proposed that the average female face of a population is perceived as being the most attractive, but this idea was contradicted in a later commentary by Alley and Cunningham[8] and in subsequent work by other investigators; they countered that the shape of highly attractive faces differs from average. Perrett et al.[9], for example, compared a composite of average female faces to a composite of a subset of the study's most attractive faces. The differences were measured and additional changes in the same direction were added to the attractive composite to produce an enhanced composite. Judges found that these exaggerated enhancements differences produced an image with even greater beauty. In a similar study, Moss et al.[10] compared three-dimensional synthesized images of professional models to those of average people. They found not only that models and average people differ in facial shape, but that the models studied did not fit the golden proportion or divine rule ratio of 1:1.618 so often quoted in media presentations and art books. Jones and Hill[11] used the terms neoteny or juvenility to describe the facial forms preferred by judges in their studies; a high eye width to face height ratio consistent with youth was found to be attractive in Brazilians, U.S. Americans, Russians, and Indians in Paraguay and Venezuela.

Usually orthodontic treatment objectives are determined on the basis of anatomic norms[6]. Dysmorphic patient are compared to average measurements, i.e. anatomic norms of specific population groups. Patients seek esthetic improvement as well as functional change. So why should clinicians be satisfied with achieving average or normal faces based on anatomic norms, when more attractive outcomes or beauty may be possible? Psychometric research will give us improved norms based on perception of attractiveness and potentially lead to increased satisfaction for patients. Current studies are underway to test the hypothesis that if psychometric norms are considered in addition to anatomic or population norms, orthodontists can produce a more pleasing appearance and increase patient satisfaction with the treatment. In addition, having objective measures of the patient's preferences based on perception may help detect and manage patients who have unrealistic expectations.

While anthropometrics clearly describes the extent of variation in facial morphology, the border between acceptability and unacceptability is unclear as are the socio-cultural, age, gender and morphologic determinants of perception and judgments of acceptability. Moreover, currently used orthodontic standards may not adequately assess general facial appearance or

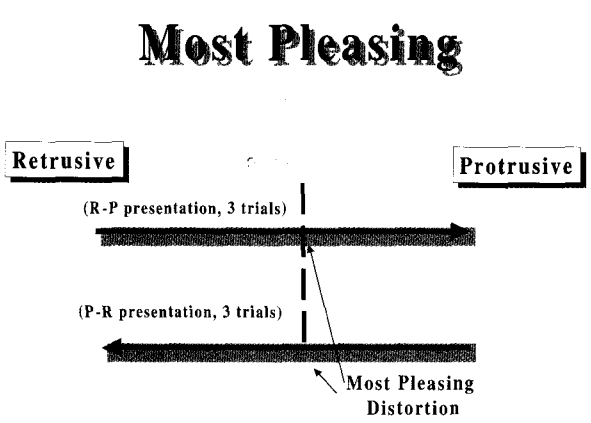

Fig. 3. A diagram showing how the most pleasing point is determined. (R = retrusive direction; P = protrusive direction).

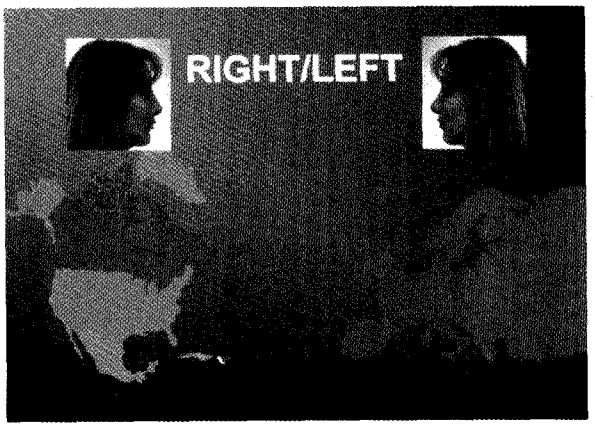

Fig. 4. Evaluation of right and left profiles after Anderson, et al.[20]

recognize gender differences[5]. They may rely too heavily on skeletal landmarks and not reflect current social environment because they were developed many years ago. Thus, clinicians lack adequate information about the physical basis for esthetic judgments. Psychometric assessment of facial variation is needed to complement the anthropometric presentation of anatomic variability in the human population.

Custom computer software packages have been developed to facilitate psychometric research on facial form[2,3]. For example, Perceptometer (Health Programs International, Inc., Wellesley, Massachusetts, U.S.A.) adapts standard psychophysical techniques[12,13] to measure judges' responses to variations of features in facial pictures. In a number of research papers[14-20], judges were asked to view a computerized movie of continuously modified facial features and complete two tasks by clicking the computer mouse button. The first task was to choose the most pleasing image. Also, the judges were asked to indicate the range of acceptability by pressing down on the computer mouse button when the changing image is acceptable and releasing the button when the image is no longer acceptable. The software recorded the coordinates of choices so that esthetic judgments could be related directly to anthropometric measurements. Issues such as optimal program parameters[14-17] give interesting insights into human thought processes and psychomotor responses.

Some interesting clinical conclusions have been reached. Arpino et al.[18] studied profile preferences of surgical patients, their significant others, orthodontists and oral surgeons. For patients who either Class II and Class III malocclusions, the patients themselves have the narrowest zone of acceptability for variations in positions of the lips, mandible and chin, followed by oral surgeons, then significant others, and finally orthodontists. Orthodontists are far more accepting of variations in lower face height than are the other groups. In a study of lip fullness, Hier et al.[19] found that female college-age judges prefer fuller lips than male judges. Non-orthodontically treated judges prefer fuller lips than orthodontically-treated judges. Also, the study showed that males and females prefer lips fuller than the Ricketts Standard, supporting previous investigators' findings that profile preferences have changed during the past half-century.

Anderson et al.[20] tested whether similar judgments are made for distortions of the same facial photographs as taken and then reversed (Fig. 4). That data were analyzed for differences in judges' lateral eye preference, lateral hand preference, ethnicity, bilingual reading ability, and familiarity with faces, but no differences in the zone of acceptability or the most pleasing position were found for any of the variables. This study is reassuring because it is important to know that the same conclusions are reached regardless of the direction facial profile photographs or lateral cephalo-

metric radiographs are examined. Typically in Europe lateral films and their tracings have the profile pointed left while on the United States side of the Atlantic Ocean, the radiographs are examined and traced with the profile on the right. Other studies have found differences in preferences between Koreans, Korean-Americans, and Caucasians (Giddon and Lim, personal communication); how people classify Asian female faces by ethnic characteristics (Giddon and Anderson, personal communication), changing preferences as a function of acculturation in Mexican-Americans (Evans and Mejia-Maidl, personal communication), and preferences of Korean-American orthodontic patients (Evans and Park, personal communication).

II. Summary

In summary, various clinical applications of psychometric concepts can be found, including implementation of psychometric norms to complement existing anatomically-based computer programs for orthodontic and surgical treatment planning, improving doctor-patient communication, as an objective way to determine patient preferences, detect unrealistic expectations, and ultimately to enhance the psychosocial well-being of the patient. In addition to having applications in orthodontics, the psychometric approaches may be used in orthognathic and plastic surgery, psychiatric/psychological practice, forensic activities such as witness identification, fashion design, and basic psychophysical research.

III. Conclusion

The psychometric approach to determining patient preferences has potential to improve treatment outcomes and patient satisfaction. Custom morphing software of the type described in the paper should be considered a computerized interview or preference test, not a prediction of treatment results. The computer is used to facilitate communication from the patient to the doctor; the choices are not intended to be shown to the patient.

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IV. References

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