Effect of Protruding Ears on Visual Fixation Time and Perception of Personality

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Protruding ears continue to be perceived as a negative physical attribute in many cultural settings, with affected children frequently being ridiculed and adolescents experiencing reduced self-esteem.1 Protruding ears have been associated with inferior cognitive performance at school, immaturity, less favorable personality traits, diminished self-confidence, and social avoidance.2,3 Media often select a person with large, prominent, or oddly shaped ears when wishing to depict an odd character or a less-intelligent individual.4 Few, if any, features are believed to elicit such negative responses as prominent or overly large ears. Protruding ears have been found to be significantly larger than normal ears.4 From this perspective, protruding ears may be perceived as a stigma, defined as “an attribute or characteristic that conveys a social identity that is devalued in a particular social context,” which includes “being the target of negative stereotypes, being rejected socially, being discriminated against, and being economically disadvantaged.”5 Protruding auricles, defined as protruding ears, may therefore be considered a stigma.

**OBJECTIVE** To quantify attention directed toward protruding ears and its effect on the perception of selected personality traits.

**DESIGN, SETTING, AND PARTICIPANTS** In this observational study conducted from August 1, 2013, to October 31, 2013, visual scan paths were recorded of 20 lay observers looking at photographs of faces of 20 children (age range, 5-19 years) with either protruding ears or ears morphed via computer software to appear nonprotruding. Subsequently, the observers rated 10 perceived personality traits based on the same photographs.

**MAIN OUTCOMES MEASURES** Visual fixation time on protruding vs nonprotruding ears was compared and correlated with observers’ scores for personality traits.

**RESULTS** Fixation time on protruding ears was significantly longer compared with that for morphed nonprotruding ears (mean [SD], 9.6% [5.6%] vs 5.8% [3.2%] of total fixation time, \( P = .04 \)). The difference between the overall personality questionnaire scores and between individual scores for assiduousness, intelligence, and likeability was not significant for protruding and nonprotruding ears. Faces in which the protruding auricles received the highest percentage of visual attention scored higher than average for the overall personality scores (mean [SD], 66.09 [4.50] vs. 55.81 [13.36]) and for assiduousness (6.64 [0.74] vs. 5.59 [1.41]), intelligence (6.78 [0.74] vs. 5.83 [1.31]), and likeability (7.29 [0.47] vs. 6.28 [1.40]).

**CONCLUSIONS AND RELEVANCE** Protruding ears had the potential to draw viewers’ attention but did not cause a negative perception of personality traits. This study therefore does not provide confirmatory evidence for the stigmatizing nature of protruding ears.

**LEVEL OF EVIDENCE** 3.

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Protruding ears continue to be perceived as a negative physical attribute in many cultural settings, with affected children frequently being ridiculed and adolescents experiencing reduced self-esteem.1 Protruding ears have been associated with inferior cognitive performance at school, immaturity, less favorable personality traits, diminished self-confidence, and social avoidance.2-3 Media often select a person with large, prominent, or oddly shaped ears when wishing to depict an odd character or a less-intelligent individual. Few, if any, features are believed to elicit such negative responses as prominent or overly large ears. Protruding ears have been found to be significantly larger than normal ears.4 From this perspective, protruding ears may be perceived as a stigma, defined as “an attribute or characteristic that conveys a social identity that is devalued in a particular social context,” which includes “being the target of negative stereotypes, being rejected socially, being discriminated against, and being economically disadvantaged.”5,6 Protruding auricles, defined as protruding ears, may therefore be considered a stigma.
analyzed the psychological effect of microtia in children.\textsuperscript{8,9} Patients with larger deformities were found to cope better with the negative feelings of others (mostly pity and aversion) probably owing to adaptation, unlike those with less-pronounced cosmetic deformities, who may be continuously uncertain about their ears potentially becoming subject to ridicule.\textsuperscript{10} Children pay more attention than do adults to small differences in appearance between themselves and others.\textsuperscript{1} Measuring the effect of corrective otoplasty using tests, such as the Child Behavior Checklist, the State-Trait Anxiety Inventory for Children, and the Children’s Depression Inventory, revealed improvements in almost all the assessed items after the procedure.\textsuperscript{10,11} Happiness and self-confidence increased, social experience improved, and bullying was reduced. Otoplasty was also found to potentially significantly increase patients’ health-related quality of life and lead to a high rate of patient satisfaction.\textsuperscript{12,13} It is estimated that roughly 10\% of the population bears some type of facial deformity, with protruding ears having an incidence of 5\%.\textsuperscript{14} Surprisingly, given the high prevalence and psychological effect of facial deformities, data on the visual perception of faces with deformities are sparse.\textsuperscript{15,16}

To our knowledge, no attempt at quantifying the attention-drawing potential of protruding ears has been published. Also, the effect of auricular deformities on the perception of personality traits has not been reported. The aim of this study was therefore to quantify the visual attention of naive observers directed to protruding ears and to measure the effect of protruding ears on the perception of personality traits. Our first hypothesis was that protruding ears unknowingly cause the observer to give them more visual attention compared with nonprotruding ears; our second hypothesis was that personality traits of faces with protruding ears are judged less favorably.

Methods

This observational study was conducted at the Department of Otorhinolaryngology–Head and Neck Surgery of Cantonal Hospital, St Gallen, Switzerland. Written informed consent for the use of patients’ photographs was obtained from patients or their legal guardians and ethical approval was granted by the local Ethics Committee of the Canton St Gallen. The study consisted of 2 parts, reflecting both hypotheses.

Visual Attention for Protruding and Nonprotruding Ears

In the first part, visual attention to the auricles was quantified with an eye-tracking device. A sample of 20 preoperative photographs of patients (14 male and 6 female; age range, 5-19 years) who had requested an otoplasty and 20 photographs of the simulated desired outcome of the procedure was selected from the database of the Department of Otorhinolaryngology–Head and Neck Surgery of Cantonal Hospital. All en face patient photographs were taken under standardized conditions (distance, lighting, background, and resolution). The degree of overall ear protrusion and symmetry of protrusion was heterogeneous among the patients, reflecting the variability found in the consecutive sample. Outcome simulations were created as part of the routine initial consultation using Adobe Photoshop Elements (Adobe Systems) as described elsewhere.\textsuperscript{17} Simulations of the intended outcome of otoplasty were used instead of the actual postoperative outcome to eliminate inevitable confounders in postoperative photographs, such as facial expression or changed hair color, hairstyle, or clothing (Figure 1). The 20 preoperative photographs and the 20 simulated outcome photographs were divided into 2 series of 20 photographs each, containing either the preoperative or the simulated outcome photograph. These sets were processed for eye tracking by cropping, centering, and correcting scales (resolution of 1024 × 1024 pixels) of the patient images and by adding calibration images and relaxing photographs of pleasant landscapes between the patient photographs in a file (PowerPoint, Microsoft Office Professional 2010) for presentation. Presentation times of the faces and landscapes were 10 and 3 seconds, respectively.

Twenty participants were recruited from the outpatient clinic at the Department of Otorhinolaryngology–Head and Neck Surgery of Cantonal Hospital. Participants were patients in good health presenting for a routine follow-up, as well as persons who were accompanying patients. All participants (18 male and 2 female; mean age, 44.7 years [range, 21-75 years]) had normal, symmetric eye movements as a prerequisite for eye tracking. The participants were informed that they would be asked questions about the personality of the persons whose faces they were about to see on a screen after the having seen the photographs. Participants provided written informed consent that their eye movements would be recorded but they were not informed of the purpose of the study.

An eye tracker is a device used, especially in psychological research, to record eye movements (visual scan path) of a study participant and measures the duration of the fixation in specific regions of interest. This technique enables investigation of the spontaneous, initial visual assessment of a face. A visual scan path is composed of a sequence of fixations and saccades.\textsuperscript{12,18} Fixations contain a continuous series of gaze points on a segment of the visual field with a predefined duration that is set at 200 milliseconds.\textsuperscript{19}

The visual scan paths (Figure 2) were recorded using a Tobii X120 eye tracker (Tobii Technology AB) linked to a host computer and a second monitor with a 19-inch diagonal display facing the seated participant. For the calibration of the eye tracker and presentation of the photographs, Tobii Studio Software, version 2.0.6 (Tobii Technology AB), was used, in which participants had to follow a red dot on the screen.

In each group, there were 200 eye-tracker measurements and a total of 400 measurements. The power analysis was based on the data published by Ishii et al\textsuperscript{18} (mean [SD] fixation time of the defect region of 1630 [1177] milliseconds). A total of 137 viewed photographs per group or 247 photographs in total were required to detect a difference of 400 milliseconds with 80\% power and a significance level of P < .05. These calculated numbers of photographs were increased from 137 and 247 to 200 and 400, respectively, to improve power of the study and because of anticipated withdrawals.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Visual scan paths for protruding and nonprotruding ears.}
\end{figure}
Personality Ratings for Faces With Protruding and Nonprotruding Ears

For the assessment of perceived personality traits, a questionnaire was delivered that included pairs of antipodes on 10 personality traits (sociable–withdrawn, content–discontent, assiduous–lazy, intelligent–unintelligent, creative–uninspired, friendly–unfriendly, successful–unsuccessful, exciting–boring, accessible–inaccessible, and honest–dishonest). These items were extracted from the Neuroticism-Extraversion-Openness Personality Inventory and are said to represent the 5 broad dimensions of traits that are used to describe human personality: neuroticism, extraversion, openness, agreeableness, and conscientiousness.\(^\text{19}\) We added 4 more traits in accordance with previously published research: successfulness, boredom, accessibility, and honesty.\(^\text{20}\) Each trait was displayed on a visual analog scale from 0 to 10, with 0 indicating the lowest and 10 the highest positive score. These personality traits were rated by all participants immediately after they had completed the eye-tracking part of the study with the image they had seen on the screen printed on the questionnaire for recognition. Eye tracking and rating of personality traits required between 25 and 35 minutes and was monitored by one of us (J.M.).

Statistical Analysis

The auricles were selected as the area of interest in Tobii Studio and the fixation time of both pinnae was calculated as the percentage of total fixation time (Figure 3). The difference between relative fixation times for protruding and nonprotruding ears was analyzed by the average fixation time for each patient with protruding and nonprotruding ears with a nonparametric paired sample test (Wilcoxon signed rank test). The fixation time of both pinnae was also correlated with the sum score of the questionnaire, as well as with the scores for individual questions regarding likeability, intelligence, and assiduousness.

Results

Visual Attention for Protruding and Nonprotruding Ears

Data of all 20 observers on 20 patient photographs were amenable for analysis of 400 eye-tracking data sets. Four questionnaires had to be excluded owing to missing data.

Mean (SD) fixation time of both auricles was 9.6% (5.6%) of total fixation time for protruding ears and 5.8% (3.2%) for nonprotruding ears (Figure 4). This difference was significant ($P = .04$).

Personality Ratings for Faces With Protruding and Nonprotruding Ears

Sixteen of the 20 observers returned the questionnaire fully completed, including 10 visual analog score personality trait ratings for each patient image, totaling 200 individual ratings by each of the 16 observers, for a sum of 3200 individual ratings.

A significant correlation between the sum of the personality questionnaire scores for faces with protruding and nonprotruding ears was found (Pearson correlation; $R$, 0.73, $P < .001$). The difference between the sum of the personality questionnaire scores for faces with protruding and nonprotruding ears was not significant (mean [SD], 55.8 [1.37] vs 53.6 [1.25], $P = .31$).
As for the sum of all personality traits, the difference between the mean (SD) scores for assiduousness, intelligence, and likeability did not differ significantly depending on protrusion or deformity of the ears (5.59 [14.5] vs 5.24 [1.43], \( P = .22 \); 5.83 [1.34] vs 5.53 [1.42], \( P = .41 \); and 6.28 [1.44] vs 6.20 [1.26], \( P = .83 \), respectively). A significant positive correlation between the scores for faces with protruding and nonprotruding ears was found for likeability (\( R, 0.75, P < .001 \)).

Both the quartile of the 5 faces for which the protruding auricles received most visual attention (patients 2, 3, 4, 5, and 6, respectively; orange and green squares in Figure 5) and the quartile of the 5 faces with the largest difference in fixation time between protruding and nonprotruding auricles (patients 1, 3, 4, 5, and 6, respectively; orange and blue squares in Figure 5) scored higher than the average for overall personality scores (mean [SD], 66.09 [4.50] vs 55.81 [13.36]) and for individual scores on assiduousness (6.64 [0.74] vs 5.59 [1.41]), likeability (7.29 [0.47] vs 6.28 [1.40]), and intelligence (6.78 [0.74] vs 5.83 [1.31]). In the quartile of faces for which the protruding auricles received most visual attention, the sum of personality scores and the likeability score was lower for the modified photograph without protrusion of the auricle in 4 of 5 patients (patients 3, 4, 5, and 6). The scores for assiduousness and intelligence were lower for the modified images in 3 of 5 patients (patients 3, 4, and 5).

Discussion

Facial stigmata catch the eye because a negative stimulus receives more visual attention than does a positive stimulus. Spiders or unhappy faces, for example, are fixated on longer than butterflies or happy faces.\(^2\)\(^1\)\(^-\)\(^2\)\(^3\) One contributing factor to this phenomenon may be that an abnormality in the face is perceived as new and represents a novel stimulus. According to the novel stimulus theory, to become familiar with it, people stare at a stigma.\(^2\)\(^4\) Also, unexpected facial features, such as a crooked nose or floppy ears, may be helpful in the face recognition process and therefore receive more attention.\(^7\)\(^-\)\(^2\)\(^5\)

Research has shown a negative correlation between attractiveness and the lesion size of a facial disfigurement but not between attractiveness and the location of a facial disfigurement.\(^2\)\(^6\) A person’s attractiveness is known to strongly influence the perception of personality by the viewer. This phenomenon is often referred to as the attractiveness halo. Individuals who are considered attractive will more likely be seen as nice, friendly, and intelligent. As a consequence of a negative first impression, people with facial deformities will more likely be treated harshly.\(^2\)\(^7\) Such a first impression can have a distressing effect and dramatic psychosocial influence on people with facial disfigurements. Dating agents ranked pro-
truding ears as having a large negative effect more in men than in women.28 Of all visible disfigurements, those of the face seem to be least tolerated and most likely to provoke anxiety and aversion. Children with protruding ears had more problems regarding self-esteem compared with children with normal ears or even facial port-wine stains.29

Experience shows that the eyes of the viewer typically follow a particular scan path in a face with no obvious facial deformities, focusing on a central triangle, which includes the mouth, nose, and eyes.14,30–32 Attention had been found to be redirected to obvious facial defects at the expense of time spent analyzing the central triangle.

Therefore, it was expected that the average visual fixation time on protruding ears would be longer than the attention directed to nonprotruding ears. Still, the difference that was quantified in this study appeared smaller than the perception of the clinical problem from the patient’s and physician’s perspective might suggest. The experimental setup and the cutoff setting for registration of visual fixation of 200 milliseconds may have reduced an effect that could be more pronounced in personal encounters. The spectrum of auricular deformities included in this study was representative of the patients requesting an otoplasty at a Swiss tertiary care center. Obviously, the degree of deformity varied considerably, explaining part of the variation in attention directed toward the ears. Only ears that protruded markedly or were conspicuously deformed caught the eye, as documented for patients 2, 3, 4, 5, and 6.

If noticeable protruding ears were to be perceived by the population at large as heralding less-favorable personality traits, the experimental setup in this study should be expected to have reflected this phenomenon, at least in part, through lower scores given by the observers. Surprisingly, the opposite was found, with the quartile of faces with the ears attracting the most attention scoring higher than the 3 quartiles with less noticeable ears. These faces also yielded higher scores than their counterpart with corrected auricles in 4 of 5 cases for the total personality sum score and likeability score and in 3 of 5 cases for assiduousness and intelligence scores. In light of these findings, the relevance of protruding ears as a negative stigma regarding perceived personality traits may be considered less pronounced than purported in the literature.

This study has several strengths. Use of preoperative original and morphed postoperative images in which the degree of protrusion and deformity was the only variable in otherwise identical images excluded potentially attention-drawing differences between preoperative and real postoperative photographs. In addition, lay individuals acting as observers in this study were naive to the objective of the study and were shown either the original or the morphed image, excluding a potential recognition of faces or noticing of a difference between 2 versions of the same face as a confounder. Finally, the degree...
of protrusion was variable, further reducing the clues the observers may have noticed regarding the end point of the study while scanning the faces.

Several limitations of this study require discussion. First, the observers who were initially naive regarding the end point of the study may have noticed the high prevalence of protruding ears (50%) while viewing the faces, which may explain relative fixation times that may exceed those reported in the literature. Reducing the likelihood of this confounder would have required a substantially larger sample of faces with inconspicuous ears. A preliminary study had revealed that a substantially larger sample would have strained the visual attention span of observers to the point of acquiring invalid data. It also remains unclear to what extent looking at photographs of faces on a monitor relates to visual analysis of a face during encounters in person. The faces included displayed a variable degree of protrusion or deformation of the auricle, reflecting the deformities found in a consecutive sample of patients who requested an otoplasty in a Swiss tertiary care center. The simulated degree of correction was variable, mirroring the preoperatively agreed-upon objective of a planned otoplasty. The shape of the modified auricle was realistic as to the desired projection but less so for the anticipated relative position of the antihelical fold and helix in some patients. This shortcoming being inherent to the imaging method used in this study may have had an effect on the fixation times of virtually corrected pinnae. Also, the eye-tracking segment of the study was designed for optimum feasibility, respecting the expected attention span of participants. The definition of 10 seconds’ projection time for each face was arbitrary and an effect of this projection time cannot be ruled out. Finally, answering 20 sets of 10 questions each on personality was thought to be tedious by some participants and fatigue cannot be ruled out as a potential confounder. Still, with the sequence of the original or modified patient image being identical in both sets, the effect of fatigue should be expected to have been minor and evenly distributed. Finally, the group of lay observers may be considered to be representative of the Swiss adult population. Still, the effect of a cultural bias on the perception of protruding ears cannot be ruled out.

Conclusions

To our knowledge, this is the first study quantifying the attention-drawing potential of protruding ears using an eye-tracking device and the first report correlating this effect with perceived personality. The confirmation of the hypothesis that protruding ears catch the attention of observers was expected. Not finding support for the second hypothesis, that protruding ears negatively affect the perception of personality traits, was surprising. It remains unclear to what extent local cultural factors may have influenced this outcome. These data may be helpful for future reference and for comparison with studies addressing other facial regions of interest.

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Moving Toward Objective Measurement of Facial Deformities
Exploring a Third Domain of Social Perception

Lisa E. Ishii, MD, MHS

In this issue, Litschel et al1 present novel data on the visual distraction caused by protruding ears. They used an eye-tracking device for objective evaluation and correlated the eye-tracking test findings with personality survey assessments. These data represent an important addition to a burgeoning body of evidence on the effect of facial deformities.

Until now, in facial plastic and reconstructive surgery, we have had a relatively limited understanding of the effect of facial deformities and abnormalities on visual distraction and facial perception. Previously, we had accepted the general tenet that faces with abnormalities are less attractive and less “normal” and that our surgical procedures restore attractiveness and normality; however, these ideas have been based on limited objective evidence. Furthermore, we have relied primarily on the subjective perceptions of experts and the patients themselves to inform our ideas on these paradigms of attractiveness and normalcy, inadequately assessing the perceptions of casual observers.

Only recently have we begun to formally attempt to measure the effect of facial deformities from the perspective of casual observers. The importance of measuring this effect lies in part in the fact that, for many people, one of their greatest concerns is how they think others, particularly strangers, are viewing them. In a survey of patients with head and neck cancer, patients noted how distracting facial deformities are by measuring how casual observers gaze on faces of children with protruding ears,10 and then measure gaze patterns after a surgical simulation, using software to morph protruding ears into normal appearing ears. They correlate the changes in eye gaze by an observer with changes in perception of the faces before and after surgery.

Significant progress has been made in recent years in subjectively and/or objectively measuring the perception of the casual observer of facial deformities or abnormalities, including the “abnormality” of the aging face. In a 2013 survey study by Zimm et al,13 patients who had undergone surgical procedures for aging faces were perceived to be younger than their actual age. An objective line of investigation using eye tracking has developed based on the foundation of normal face viewing, first described by Walker-Smith et al16 in the 1970s. Eye movements are a surrogate for attention, so, by measuring eye movements, one has insight into where an observer is directing attention. In their seminal work, Walker-Smith et al demonstrated that casual observers gazing on novel faces do so in a highly conserved manner, directing the majority of attention to the central triangle region in a manner measurable using objective eye tracking. Recent research has taken advantage of this foundation, using eye tracking to objectively measure how distracting facial deformities are by measuring how facial gaze patterns deviate from the normal, highly conserved pattern in the presence of deformities. This method has been used to quantify the visual distraction caused by crooked noses,2 skin lesions, and facial paralysis.6 After objectively showing the extent to which the gaze of naive observers is drawn to facial deformities, survey studies have demonstrated how observers then perceive attractiveness,7 affect display,8 and willingness to engage in conversation, based on the distraction of the deformity. Furthermore, these findings have been extended to show the effect of surgical reconstruction on these visual distractions and changes in perception.6

In their novel application, Litschel et al1 initially measure how casual observers gaze on faces of children with protruding ears, and then measure gaze patterns after a surgical simulation, using software to morph protruding ears into normal-appearing ears. They correlate the changes in eye gaze by an observer with changes in perception of the faces before and after surgery.

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