



# Reconstruction of residual cleft nasal deformities in adolescents: Effects on social perceptions

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## ABSTRACT

**Purpose:** The investigators hypothesized that a layperson's social perceptions of a primarily repaired adolescent cleft lip and palate (CL/P) patient is more favorable after definitive nasal reconstruction with regard to perceived social traits.

**Methods:** The investigators implemented a survey comparing layperson's social perceptions of 6 personality traits, 6 emotional expression traits, and 7 perceptions of interpersonal experiences before and >6 months after definitive nasal reconstruction in CL/P adolescent subjects by viewing standardized facial photographs. The sample was composed of consecutive CL/P subjects treated by one surgeon using a consistent technique involving a rib cartilage caudal strut graft through an open approach. Five non-cleft adolescent subjects who underwent cosmetic rhinoplasty involving a septal cartilage caudal strut graft through an open approach were used as a comparison group. The outcome variable was change in 6 perceived personality, 6 emotional expression traits studied, and 7 perceptions of interpersonal experiences. Descriptive and bivariate statistics were computed ( $p$ -value <0.05).

**Results:** The sample was composed of 10 consecutive CL/P subjects and 5 non-cleft adolescent comparison subjects. 500 respondents (raters) completed the survey. The respondents were 54% male with 56% age 25 to 34. After definitive cleft nasal reconstruction, study subjects were perceived to be significantly more attractive ( $p = 0.04$ ) and less threatening ( $p = 0.04$ ). They were also perceived as less angry ( $p < 0.01$ ), sad ( $p < 0.01$ ), or disgusted ( $p < 0.01$ ) than prior to surgery. The subjects were also perceived to be less likely to have negative interpersonal experiences ( $p < 0.01$ ).

**Conclusion:** We confirmed that laypeople consistently report positive changes in adolescent CL/P subject's perceived social traits after definitive cleft nasal reconstruction. Overall, the positive changes were largely comparable between the cleft and non-cleft groups.

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## 1. Introduction

Residual nasal deformities in the adolescent with a repaired unilateral cleft lip and palate (UCLP) or bilateral cleft lip and palate (BCLP) are common. The nasal deformities are characterized by the under corrected aspects of the malformation not addressed at the time of primary repair, the effects of revision procedures that may

have been carried out in childhood, and any restrictive nasomaxillary deformities that occur during growth. The required cleft rhinoplasty is considered one of the most challenging facial plastic surgery procedures.

Adolescents with repaired cleft lip and palate, as a group, report ongoing social stigmata from their residual nasal deformities (Semb et al., 2005; Rosenboom et al., 2014; Albers et al., 2016). A study by Semb and colleagues report that teenaged cleft patients remained dissatisfied about their nasal appearance and their parents shared this concern (Semb et al., 2005). Rosenblum et al. used a visual analogue scale for nasal morphology to study the impact of

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rhinoplasty on the cleft subject's life (Rosenboom et al., 2014). They found a high patient satisfaction in adolescents at 1 year after secondary cleft rhinoplasty resulting in significant improvement in the subject's self-esteem. Albers and colleagues used the Derriford appearance scale to assess cleft rhinoplasty outcomes (Albers et al., 2016). The study group showed an improvement in self-conceived appearance after cleft rhinoplasty in adults.

We report on a consecutive series of cleft lip/palate subjects who underwent primary repair in infancy and then presented in adolescents with varied secondary nasal deformities. For all study subjects, definitive nasal reconstruction included use of a consistent rib cartilage caudal strut graft placed through an open approach.

This study tests the hypothesis that a definitive rhinoplasty in adolescents improves a layperson's perception of social traits in cleft subjects who present with residual nasal deformities. The specific aims of this study were to 1) gather unbiased, large sample layperson data about social perceptions of adolescent cleft subjects with residual nasal deformity prior to and after definitive rhinoplasty by viewing standardized facial photographs and 2) compare layperson social perceptions of adolescent cleft subjects to non-cleft adolescent subjects prior to and after rhinoplasty.

## 2. Material and methods

### 2.1. Study sample

To address the research objectives, a cohort study group was identified. The sample was derived from patients treated by one surgeon (JCP) in a private practice setting (Posnick Center) with surgery carried out at a single hospital (MedStar Georgetown University Hospital, Washington, DC). A group of subjects born with UCLP or BCLP and then followed through reconstruction were identified. If maxillary hypoplasia was present at the completion of growth, orthognathic correction was carried out at least 6 months prior to definitive nasal reconstruction. Study subjects underwent staged cleft lip and palate reconstruction that included definitive rhinoplasty using a rib cartilage caudal strut graft (open approach) by the primary investigator (JCP). A comparison group of non-cleft adolescent rhinoplasty subjects, also treated by the primary investigator (JCP) were identified. Subjects with associated syndromes and less than one year of follow-up were excluded. The adolescent cosmetic rhinoplasty subjects were confirmed to have well-proportioned jaws and did not require orthognathic surgery. The Georgetown University Institution Review Board approved this study protocol (#2018-1260).

### 2.2. Cleft study subject data

Demographic variables and staging of cleft reconstruction were recorded. Demographic variables consisted of sex and type of cleft. Type of cleft was recorded as either UCLP or BCLP (complete or incomplete).

Age at each stage of cleft reconstruction and any additional procedures were recorded for each subject. Prior to cleft nasal reconstruction, consistent stages of reconstruction for each subject included primary lip/nasal repair, primary palate repair and mixed dentition bone grafting. Additional procedures often included insertion of a pharyngeal flap, cleft lip scar revision, and orthognathic surgery.

The methods of definitive nasal reconstruction were previously reported and are consistent for all study subjects (Posnick, 2014a, b, c; Posnick and Kinard, 2018). An open rhinoplasty was performed for each subject. We harvested autogenous rib cartilage from the anterior chest wall in each subject. From the rib cartilage, a dorsal strut graft was crafted and secured to the anterior maxilla with a

Kirschner (K) wire. Depending on the other associated cleft nasal deformities, the subjects underwent: nasal osteotomies (straightening and in-fracturing), dorsal reduction (bone and cartilage), lower lateral cartilage (LLC) modification (excision of cephalic excess) and grafting (LLC augmentation grafts), and use of spreader grafts (to straighten and/or augment the cartilaginous vault).

### 2.3. Crowdsourcing raters

Mechanical Turk (Amazon.com, Inc., Seattle, WA) was used to gather unbiased layperson impressions of facial photographic images taken before and then after rhinoplasty in cleft and non-cleft study subjects to determine perception of 6 specific personality traits, 6 specific emotional facial expressions, and 7 perceptions of interpersonal experiences. A 7-point Likert response scale format was used to assess perception of each of the 19 variables. The survey was limited to Mechanical Turk respondents (raters) who had a minimum 95 percent approval rating and were living in the United States. A series of demographic questions (about each rater) preceded each survey, which included age, sex, race, education level, and the annual income. Dispersed within this set of questions were 2 control questions to ensure a thoughtful effort was made on the survey; we asked for the current year and simple addition (7 + 4). Survey respondents (raters) were excluded if they did not answer the 2 control questions correctly. The preoperative and postoperative facial photograph images for review by raters were delivered in a random order. Each respondent (rater) viewed each image once, and was blinded to the purpose of the study, to knowledge that subjects may have been born with facial clefting, and to having undergone any face-altering procedures. Each respondent (rater) was prevented from completing the survey more than one time and was compensated with \$3 to complete the survey. The number of Mechanical Turk respondents was limited to 500. Study subject facial photographs were included at the beginning and end of each page to allow for immediate reference by the rater while they answered each question.

### 2.4. Survey design

A series of 19 questions were asked with Likert scale responses regarding the respondent's (rater's) perception of 6 specific personality traits, 6 specific emotional expressions, and 7 perceptions of interpersonal experiences for each subject. The raters' perception of each social trait for each subject was based on viewing a standardized facial photograph image set (Figs. 1–4). The methodology used to rate each subject for each personality trait and emotional facial expression in this study was drawn from prior research of the effects of facial appearance on character impressions (Mazzafarro et al., 2017; Lin et al., 2018; Crerand et al., 2017; Hunt et al., 2006). A single standardized facial image set was created for each subject prior to rhinoplasty. This included a three-quarter (oblique facial) view, a lateral (profile facial) view, and a frontal view in repose (Figs. 1 and 3). The region of the face included in the image set was also standardized and limited to focus on the nasal esthetic unit. A similar facial image set was replicated from each subject's post-rhinoplasty set of photographs (Figs. 2 and 4). For subjects with UCLP, the cleft side was presented in the three-quarter and lateral views. During the course of treatment, each subject (cleft and non-cleft) underwent 6 standardized facial view photographs prior to rhinoplasty ( $T_1$ ), and at a minimum of 6 months after rhinoplasty ( $T_2$ ). The facial photographic series taken at each interval included frontal in repose, frontal with smile, left and right oblique views, and left and right profile views. Identical photo sets (timing and method) were used for both the cleft and the comparison non-cleft rhinoplasty subjects. The  $T_1$  and  $T_2$  photographs were used to create the standardized image sets described for each subject.



**Fig. 1.** Example of a cleft lip and palate study subject prior to definitive nasal reconstruction. The standardized facial photographic image set formatted for review by each layperson rater is shown.



**Fig. 2.** The cleft lip and palate study subject in Fig. 1 is shown after definitive nasal reconstruction. The standardized facial photographic image set formatted for review by each layperson rater is shown.



**Fig. 3.** Example of a non-cleft study subject prior to cosmetic rhinoplasty. The standardized facial photographic image set formatted for review by each layperson rater is shown.

### 2.5. Collection, management, and analysis of data

The data were abstracted and recorded on a standardized data collection form from the hospital and outpatient medical records. This also included review of facial photographs prior to nasal reconstruction ( $T_1$ ) and then after surgery ( $T_2$ ). The data was entered into a database created using Microsoft Excel (Microsoft Inc., Redmond, WA). The data were then transferred to a commercially available statistical software package (SPSS, v.25.0 (c) IBM Corp., Armonk, NY), for analysis. Descriptive statistics were computed to provide an overview of the sample population. Non-parametric paired samples analyses (Wilcoxon signed ranks tests) were used to compare pre- and post-operative assessments within each clinical group. Non-parametric independent samples tests (Mann–Whitney U) were used to compare the cleft group to the cosmetic group and UCLP to BCLP. P-values less than 0.05 were considered significant.

During the time frame of the study, no cleft lip and palate adolescent patient undergoing definitive nasal reconstruction by the primary investigator (JCP) and meeting protocol was excluded or lost to follow-up and no data points were missing for any of the study parameters for any of the subjects.

### 3. Results

Ten consecutively treated cleft lip and palate subjects (5 UCLP and 5 BCLP) undergoing staged reconstruction that included definitive rhinoplasty using a rib cartilage caudal strut graft placed through an open approach were identified for this study. Five adolescent non-cleft (cosmetic) rhinoplasty subjects, in which a septal caudal strut graft was placed through an open approach were also identified for this study. Demographics and the subject age at staged cleft reconstruction are reported in [Table 1](#).



**Fig. 4.** The non-cleft study subject in Fig. 3 is shown after cosmetic rhinoplasty. The standardized facial photographic image set formatted for review by each layperson rater is shown.

**Table 1**  
Cleft Nasal Reconstruction Study Subjects: Staging of reconstruction and age at operation.

Subject	Sex	Type of Cleft	Primary Lip Repair	Primary Palate Repair	Mixed Dentition Bone Grafting	Orthognathic Surgery	Cleft Nasal Reconstruction
1 <sup>b</sup>	F	Complete UCLP	11 weeks	10 months	9 years	15 years	16 years + pharyngeal flap + lip scar revision
2	M	Complete UCLP	5 weeks lip adhesion 5 months lip repair	10 months	8 years	15 years	16 years + pharyngeal flap + lip scar revision
3 <sup>b</sup>	F	Complete UCLP	13 weeks	10 months	8 years	15 years	15 years + pharyngeal flap + lip scar revision
4 <sup>b</sup>	M	Complete UCLP	11 weeks	9 months	8 years + pharyngeal flap	17 years	17 years + lip scar revision
5 <sup>b</sup>	F	Complete UCLP	9 weeks	10 months	6 years	N/A	15 years + lip scar revision
6 <sup>b</sup>	F	Complete BCLP	11 weeks	10 months	8 years + pharyngeal flap	14 years	15 years + bilateral otoplasty
7	F	Complete BCLP	9 weeks	9 months	8 years + pharyngeal flap	14 years	15 years
8	F	Complete BCLP	33 weeks <sup>a</sup>	33 weeks <sup>a</sup>	11 years	18 years	19 years
9	F	Complete BCLP	10 weeks	9 months	N/A	N/A	13 years
10 <sup>b</sup>	M	Complete BCLP	11 weeks	11 months	9 years	N/A	17 years + septoplasty + inferior turbinate reduction

Pharyngeal flap: Superiorly based pharyngeal flap.

Cleft orthognathic surgery: Le Fort I, bilateral sagittal split osteotomies, bilateral inferior turbinate reductions, and septoplasty.

Cleft nasal reconstruction: Open approach with use of rib cartilage caudal “strut” graft.

Abbreviations: UCLP: unilateral cleft lip/palate, BCLP: bilateral cleft lip/palate, LF: Le Fort.

<sup>a</sup> Repaired at age of adoption.

<sup>b</sup> Followed since birth.

### 3.1. Demographic analysis of mechanical Turk raters

Five hundred respondents (raters) completed the survey in less than 12 h. Twenty-one respondents were excluded due to incorrect answers of the control questions, with a final sample size of 479 respondents. Each respondent spent an average of 37 min to complete the survey. The majority of respondents within each demographic group were male (54%), 25–34 year of age (56%), Caucasian (63%), college graduates (59%) with an annual income between \$20,000 and \$50,000 (44%). The detailed demographics of the Mechanical Turk raters are summarized in [Supplemental Data eTable 1](#).

### 3.2. Perceived personality traits and emotional facial expressions of cleft lip and palate adolescent subjects prior to and after definitive nasal reconstruction

After completion of nasal reconstruction, cleft lip and palate adolescent study subjects as a group were perceived to be significantly less threatening and more attractive ( $p < 0.05$ ). They were also perceived to be significantly less angry, sad or disgusted ( $p < 0.05$ ). [Table 2](#) summarizes the differences in each perceived personality trait from before to after nasal reconstruction.

**Table 2**  
Comparison of social perceptions in cleft adolescent subjects prior to and after nasal reconstruction.

	Preoperative	Postoperative	Difference	P-value	Interpretation
<b>Personality Traits</b>					
Submissive to dominant	3.64 + 1.69	3.67 + 1.68	0.026	0.097	No change
Untrustworthy to trustworthy	4.40 + 1.53	4.46 + 1.52	0.060	0.322	No change
Nonthreatening to threatening	3.44 + 1.87	3.43 + 1.88	-0.010	<b>0.039</b>	<b>Less Threatening</b>
Unfriendly to friendly	4.46 + 1.56	4.48 + 1.55	0.025	0.417	No change
Unintelligent to intelligent	4.45 + 1.42	4.45 + 1.44	0.010	0.704	No change
Unattractive to attractive	3.57 + 1.77	3.75 + 1.73	0.176	<b>0.038</b>	<b>More attractive</b>
<b>Expressed Emotional Trait</b>					
Angry	3.07 + 1.92	3.00 + 1.91	-0.084	<b>&lt; 0.001</b>	<b>Less Angry</b>
Surprised	2.95 + 1.89	2.94 + 1.88	-0.016	0.098	No change
Happy	3.63 + 1.88	3.70 + 1.87	0.071	0.083	No change
Sad	3.24 + 1.91	3.14 + 1.91	-0.096	<b>&lt; 0.001</b>	<b>Less Sad</b>
Afraid	3.00 + 1.92	2.92 + 1.92	-0.063	0.110	No change
Disgusted	2.96 + 1.97	2.90 + 1.98	-0.063	<b>0.001</b>	<b>Less Disgusted</b>
<b>Likelihood to Experience Interpersonal Events</b>					
Feel Lonely	4.20 + 1.69	4.05 + 1.70	-0.151	<b>&lt; 0.001</b>	<b>Less likely to feel lonely</b>
Teased by others	4.43 + 1.66	4.13 + 1.70	-0.303	<b>&lt; 0.001</b>	<b>Less likely to be teased by others</b>
Romantic relationships	3.71 + 1.73	3.87 + 1.72	0.158	<b>0.014</b>	<b>More likely to have romantic relationships</b>
Praised by others	3.85 + 1.67	3.92 + 1.66	0.075	0.178	No change
Friendships	4.40 + 1.53	4.48 + 1.50	0.082	0.207	No change
Bullied by others	4.32 + 1.70	4.05 + 1.72	-0.273	<b>&lt; 0.001</b>	<b>Less likely to be bullied by others</b>
Feel anxious around others	4.29 + 1.68	4.11 + 1.72	-0.181	<b>&lt; 0.001</b>	<b>Less likely to feel anxious around others</b>

Each personality trait ranked on a Likert scale (1 – not at all; 7 – very). Items in bold are statistically significant.

### 3.3. Perceived likelihood of positive interpersonal experiences of cleft lip and palate adolescent subjects prior to and after definitive nasal reconstruction

After completion of nasal reconstruction, cleft lip and palate adolescent study subjects were perceived to feel less lonely, less likely to be teased or bullied by others and less likely to feel anxious around others. They were also perceived to more likely to have romantic relationships than they were prior to surgery ( $p < 0.05$ ). [Table 2](#) summarizes the results in the differences in perceived likelihood of interpersonal experiences.

### 3.4. Perceived personality traits and emotional facial expressions of non-cleft adolescent subjects prior to and after cosmetic rhinoplasty

The non-cleft adolescent subjects who underwent open rhinoplasty were perceived as significantly more attractive, less threatening, less angry, less sad, and less disgusted as compared to prior to surgery. They were also perceived less likely to be teased or bullied by others, less likely to feel lonely or to feel anxious around others and more likely to have romantic relationships post-operatively ([Supplemental Data eTable II](#)).

### 3.5. Comparison of social perception changes in UCLP versus BCLP adolescent subjects prior to and after definitive nasal reconstruction

BCLP, as compared to UCLP study subjects, experienced a greater magnitude of change in 14 of the 19 social traits. BCLP subjects experienced a greater improvement than UCLP subjects in being perceived as more trustworthy, friendlier, more intelligent, more attractive and less dominant or threatening ( $p < 0.05$ ). BCLP subjects also experienced a greater improvement than UCLP subjects in the perception of being happier and less angry, sad, afraid or disgusted after definitive nasal reconstruction ( $p < 0.05$ ). BCLP subjects also experienced a greater extent of improvement than their UCLP counterparts in the perception of being less likely to be teased or bullied and less likely to feel anxious around others ( $p < 0.05$ ) ([Table 3](#)).

### 3.6. Comparison of social perception changes in cleft versus non-cleft adolescent subjects prior to and after rhinoplasty

Cleft lip and palate adolescent subjects, as a group, experienced a greater degree of positive change than non-cleft subjects after

rhinoplasty in being perceived as more dominant, more attractive and less likely to be teased by others. The non-cleft rhinoplasty subjects experienced a larger magnitude of change than the CL/P subjects in being perceived as less sad ( $p < 0.05$ ) ([Supplemental Data eTable III](#)).

## 4. Discussion

The purpose of this study was to assess a layperson's social perceptions of cleft lip and palate adolescent subjects prior to and after definitive nasal reconstruction. Our null hypothesis stated that definitive nasal reconstruction would make no improvement in perceived social traits in cleft lip and palate adolescent subjects. The study results reject the null hypothesis. We confirmed that after nasal reconstruction, cleft lip and palate adolescent subjects experienced positive changes in perceptions of multiple social traits. After definitive cleft rhinoplasty, cleft lip and palate subjects were perceived to have significant improvement in 10 of the 19 measured social trait. The BCLP subjects benefited to a greater extent than the UCLP subjects in 14 of the 19 measured social traits. Both the cleft and non-cleft subjects experienced similar significant positive change in social perceptions by laypersons.

The evaluation of facial esthetics prior to and after either cosmetic rhinoplasty or cleft nasal reconstruction has proven difficult to quantify and is typically reported from the perspective of either the surgeon or the patient ([Rosenboom et al., 2014](#); [Albers et al., 2016](#); [Gassling et al., 2015](#); [Sawyer et al., 2017](#); [Bryne et al., 2014](#)). Layperson's opinions may be more representative of whom the subject may interact with on a daily basis, therefore providing valuable input from individuals not personally involved. We found statistically significant positive change in social perceptions as reported by laypersons after nasal surgery for both the cleft and for the non-cleft adolescent subjects. This was true for the 6 specific perceived personality traits, the 6 specific perceived emotional facial expressions, and the 7 perceptions of interpersonal experiences studied.

Crowdsourcing via MTurk has proved to be a valuable tool to rapidly gather unbiased opinions of large numbers of laypersons. It has been used in healthcare related research to assess surgical technical skills, outcomes of treatment for cosmetic procedures and patient preferences when seeking surgery ([Posnick and Kinard, 2018](#); [Mazzafarro et al., 2017](#); [Lin et al., 2018](#); [Ranard et al., 2014](#); [Mason and Suri, 2012](#); [Aghdasi et al., 2015](#); [Holst et al., 2015](#); [Hu et al., 2018](#); [Tse et al., 2016](#); [Wu et al., 2017](#); [Nellis et al., 2017](#); [Reilly et al., 2015](#); [Lu et al., 2018](#)) The quality

**Table 3**  
Comparison of significant social perception changes in UCLP versus BCLP adolescent subjects prior to and after nasal reconstruction.

	UCLP $\Delta$	BCLP $\Delta$	P-value	Interpretation
<b>Personality Traits</b>				
Submissive to dominant	0.144	-0.093	<0.001	Bigger change in UCLP
Untrustworthy to trustworthy	0.007	0.113	0.005	Bigger change in BCLP
Nonthreatening to threatening	0.123	-0.143	<0.001	Bigger change in BCLP
Unfriendly to friendly	-0.089	0.139	<0.001	Bigger change in BCLP
Unintelligent to intelligent	-0.044	0.063	0.002	Bigger change in BCLP
Unattractive to attractive	0.117	0.235	<0.001	Bigger change in BCLP
<b>Expressed Emotional Trait</b>				
Angry	0.023	-0.191	<0.001	Bigger change in BCLP
Happy	-0.037	0.179	<0.001	Bigger change in BCLP
Sad	0.015	-0.207	<0.001	Bigger change in BCLP
Afraid	-0.022	-0.104	0.038	Bigger change in BCLP
Disgusted	0.013	-0.139	<0.001	Bigger change in BCLP
<b>Likelihood to Experience Interpersonal Events</b>				
Teased by others	-0.185	-0.421	<0.001	Bigger change in BCLP
Bullied by others	-0.209	-0.337	0.002	Bigger change in BCLP
Feel anxious around others	-0.134	-0.227	0.009	Bigger change in BCLP

Each personality trait ranked on a Likert scale (1 – not at all; 7 – very).

of participant (rater) responses collected through mTurk have been found similar to responses collected in person and are capable of producing a more diverse group of respondents (Bryne et al., 2014). Mechanical Turk respondents have also been shown to produce results that rival the work of highly paid, domain-specific experts and due to the greater number of available respondents less inter-rater variability is reported (Mason and Suri, 2012; Aghdasi et al., 2015; Holst et al., 2015).

Strengths of this study include a focus on the subgroup of cleft lip and palate adolescent subjects with acceptable jaw proportions but with significant residual nasal deformities and the consistency in the type of nasal reconstruction (use of a rib cartilage caudal strut graft through open approach and secured with K-wire) carried out. In an effort to decrease bias, we only used standardized facial photographs limited to the nasal esthetic unit just prior to reconstruction and at a minimum of 6 months after definitive nasal reconstruction. Subjects were taken from our database without patient dropout or surgeon bias. For the cleft subjects with maxillary deficiency (7 of 10 subjects), cleft orthognathic surgery was performed prior to nasal reconstruction. Therefore all 10 cleft subjects were evaluated by laypersons in the presence of harmonious jaws. An additional strength of this study is that the raters were blinded to the knowledge that any subjects were born with facial clefting, had undergone any facial surgery, and that the subject's before and after photographs were presented in a random, non-synchronous, order.

There are some limitations to our study that merit consideration as to allow appropriate interpretation of the results. Study weaknesses include our inability to control the effort of raters in completing the survey, possibility of rater fatigue, and the inherent limitations of our study design. While our survey length was limited to decrease rater fatigue and attention check questions were used, these issues may still exist. However the rater limitations are consistent with other published results (Mazzaferro et al., 2017; Lin et al., 2018; Tse et al., 2016). Second, while photos were taken with neutral facial expressions, they are from isolated time points and may be influenced by the patient's mood at the time of photo acquisition. Third, while our research is meant to focus on the cleft nasal reconstruction, the raters are likely to have noted the presence of a lip scar in the study subjects and/or remnants of a jaw deformity (8/10 underwent jaw reconstruction). Either of these two variables may have influenced the ratings. In addition, the rating group in our study may not replicate the population that each specific subject interacts with on a daily basis. Lastly, although the Likert scale responses to questions were generated from validated studies, the transference of the perception of these studied personality traits and emotional facial expressions to real world scenarios remains unknown (Mazzaferro et al., 2017; Lin et al., 2018).

## 5. Conclusions

We confirmed that laypeople consistently report improved positive social perceptions of cleft lip and palate adolescent subjects after definitive nasal reconstruction using a rib cartilage caudal strut graft compared to before surgery. The improved social perceptions reported in the cleft lip and palate study subjects are for a broad spectrum of the individual's personality traits and perceiving emotional facial expressions. Those with BCLP achieved more profound positive changes compared to those with UCLP. Overall, the positive changes between cleft and non-cleft adolescents after rhinoplasty were largely comparable.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcms.2019.06.005>.

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