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The Relationship Between Communicative Participation and Post-Laryngectomy Speech Outcomes

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Abstract

BACKGROUND—This study examined relationships between communicative participation and post-laryngectomy speech outcomes including: a) listener-rated speech intelligibility and acceptability; and b) patient-rated speech acceptability and voice handicap.

METHODS—Thirty-six laryngectomized individuals completed the *Communicative Participation Item Bank* short form and the *Voice Handicap Index-10*. They provided recordings from the *Sentence Intelligibility Test* (SIT) and a reading passage, and rated their own speech acceptability. Forty-eight inexperienced listeners transcribed the SIT sentences to derive intelligibility scores. Eighteen additional listeners judged speech acceptability using rating scales.

RESULTS—Listeners judged tracheoesophageal speakers significantly more intelligible and acceptable than electrolaryngeal speakers ($p < .05$). Speech acceptability was significantly more acceptable to speakers than listeners ($p < .05$). Weak, non-significant relationships were found between communicative participation and listener-rated outcomes. Stronger, significant relationships were found between communicative participation and self-rated speech acceptability and voice handicap ($p < .05$).

CONCLUSIONS—Patient-reported communication outcomes are complementary to listener-rated outcomes.

Keywords

total laryngectomy; speech outcomes; intelligibility; communication; outcomes

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INTRODUCTION

After total laryngectomy, individuals experience great challenges to verbal communication. These changes may lead to social isolation and significantly impact a person's quality of life.^{1,2} Difficulties in communication may arise from total removal of the larynx, from secondary effects such as changes in body image, and from the psychosocial impact of cancer and its treatment.^{3,4,5}

After total laryngectomy, voice and speech rehabilitation is achieved through various options including electrolaryngeal (EL) speech, esophageal (ES) speech, and tracheoesophageal (TE) speech. However, in the past three decades, TE puncture voice restoration has been used increasingly in post-laryngectomy voice rehabilitation.^{6,7} On acoustic parameters such as fundamental frequency, sound level, speaking rate, and maximum phonation time, TE speech has been reported to more closely approximate typical laryngeal speech than either ES or EL speech.^{7,8} Further, when unfamiliar listeners judge the intelligibility and acceptability of alaryngeal speech, TE speakers are typically ranked highest among the alaryngeal speech modes.^{8–10}

Despite findings that many TE speakers perform high at levels of speech intelligibility, communication limitations do exist within this group of speakers. Finizia and colleagues^{11,12} found that TE speakers are judged by listeners as having worse voice quality and as having less acceptable voices than typical laryngeal speakers as well as those with laryngeal cancer who have been treated with radical radiotherapy. For individuals who have undergone a total laryngectomy, these results may directly influence social interactions and reactions from communication partners.⁸

While there are clear acoustic and listener-rated differences among alaryngeal methods, there is some controversy about whether patient-reported outcomes show similar results.^{13–17} Inconsistencies are revealed when different types of outcome measures are used. For example, common patient-reported measures after head and neck cancer include: a) composite measures of a person's well-being, such as health-related quality of life (QOL); b) disease-specific QOL (e.g., how head and neck cancer symptoms affect perceived QOL); or c) discipline-specific QOL (e.g., how voice-related symptoms affect QOL). Farrand and Duncan¹⁴ investigated health-related QOL outcomes among 226 individuals who had undergone total laryngectomy. They found no significant differences in health-related QOL scores as a function of alaryngeal speech mode. However, when participants rated their own speech intelligibility in quiet, in noise, and on the telephone, they found that TE speakers rated their performance as being significantly better than ES or EL speakers. Based on this finding, Ferrand and Duncan concluded that while TE speakers exhibited better self-rated speech intelligibility, differences did not extend to health-related QOL.

Evans, Carding and Drinnan¹⁸ investigated voice-related QOL in 62 individuals who had undergone total laryngectomy. While the group as a whole reported a moderate degree of voice handicap, no significant differences were found in regard to the speech method used by participants. These results are also consistent with those reported by Eadie et al.¹⁹ In contrast, Robertson et al¹⁷ investigated patient-reported outcomes among 179 individuals

who had undergone total laryngectomy. TE speakers (n=156) reported significantly better disease-specific and voice-related QOL scores than did those who used other alaryngeal modes. Similarly, Moukarbel et al¹⁶ found that TE speakers reported no significant differences in voice-related QOL when compared to ES speakers, but that both groups reported significantly better voice-related QOL than EL speakers.

Collectively, past research findings have suggested uncertainty relative to potential relationships between listener-rated and patient-reported outcomes; this uncertainty has persisted because very few studies have investigated both types of outcomes in the same group of speakers. Yet, even among the few studies that have been conducted, results have only revealed weak relationships between these measures.^{13,15,20,21} Meyer et al²¹ did not find any significant relationships between clinician-rated speech intelligibility and patient-reported outcomes in 16 individuals who had undergone total laryngectomy. Eadie et al¹³ similarly found weak relationships between listener ratings of both speech intelligibility and acceptability with patient assessments of voice-related QOL. Law et al¹⁵ also examined relationships among listener-rated speech intelligibility and acceptability measures with patient-reported communication outcomes in 49 alaryngeal speakers. Participants included those who used TE, ES, and EL speech, as well as those who used pneumatic devices. Of particular interest in this study was the fact that listeners judged speakers who used the pneumatic devices as significantly most intelligible and acceptable. No significant differences were found among the ES, EL and TE speakers with regard to speech intelligibility and acceptability. However, TE speakers reported the best self-rated communication scores, exceeding those who used pneumatic devices. The authors concluded that high speech intelligibility does not always translate to high self-reported outcomes. Collectively, results from these studies suggest that a communication partner's impressions about alaryngeal speech may not always predict how patients perceive their own communicative functioning.

While some differences have been noted among alaryngeal speakers when voice-related QOL measures are used,¹⁶ it is unknown whether these results extend to more global communication-related difficulties, above and beyond voice symptoms. Danker et al¹ found that up to 40% of patients post-laryngectomy reported that they spoke as little as possible, left things unsaid, and spoke only if there was no other way to communicate. Baylor et al²² also reported changes in the way communication goals are achieved. However, these types of difficulties may not be captured in current voice-related QOL measures.²³ To address this gap, our team recently developed and validated a new discipline-specific patient-reported outcome measure called the *Communicative Participation Item Bank* (CPIB).²⁴ The CPIB and its 10-item generic short form measure communicative participation, defined as "taking part in life situations in which knowledge, information, ideas or feelings are exchanged"(p. 309).²³ For example, this might include everyday communication situations such as talking to a clerk in a store or ordering food in a restaurant.

While a few previous studies have examined relationships between traditional listener-rated and patient-reported measures post-laryngectomy, to date, no study has examined these relationships systematically using a discipline-specific measure focused on communication. Consequently, this study was designed to answer the following question: What is the

relationship between communicative participation and traditional post-laryngectomy speech outcomes including a) listener-rated speech intelligibility and acceptability; and b) patient-rated speech acceptability and voice handicap. Investigating both listener- and patient-rated outcome measures within the same group of speakers also provided the opportunity to determine which of these measures might be sensitive to differences related to alaryngeal speech mode. Results have implications for rehabilitation and counseling within this clinical population.

MATERIALS AND METHODS

Two groups of participants included 1) individuals who had undergone total laryngectomy (speakers); and 2) inexperienced listeners. All participants were native English speakers and reported no other speech, language, or voice symptoms above and beyond those associated with laryngectomy in the speaker group. All listeners passed hearing screening tests at 20 dB for the octave frequencies of 250–8000 Hz. All participants were paid for their participation. Procedures were approved by the University of Washington Institutional Review Board.

Subjects

Speakers—Thirty-six individuals (29 males, 7 females) were recruited through support groups, professional listservs, and professional contacts. Individuals had undergone total laryngectomy at least 1 year prior to participation to avoid the fluctuation of patient-rated outcomes that occur immediately post-treatment.²⁵ The mean age for the entire group of speakers was 64.1 years, with a mean of 64.9 years (range, 50–86y) for men and 60.4 years (range, 39–75y) for women. Only speakers who used alaryngeal speech as their primary method of communication were included in the study.

Listeners—Forty-eight (35 females, 13 males; mean age=24.1y; age range=19y–45y) individuals were recruited from the broader community at the University of Washington to serve as listeners for the intelligibility protocol. An additional 18 listeners (15 females, 3 males; mean age=24.6y; age range=20y–39y) were similarly recruited to perform speech acceptability judgments. No listeners had prior experience with or exposure to alaryngeal speech.

Patient-Reported Measures

Demographic measures—Speakers completed a set of questionnaires that included information related to age, sex, race/ethnicity, marital status, education, and primary alaryngeal speech method. Medical history included date of cancer diagnosis, date of total laryngectomy, and type(s) of medical treatment.

CPIB Short Form—The CPIB short form is a validated 10-item patient-reported measure derived from the CPIB.²⁴ The CPIB short form measures communicative participation in community-dwelling adults with a range of speech-related communication disorders. Validation studies have included those who have undergone total laryngectomies.^{19,24} Items on the CPIB short form ask individuals to rate how much their condition (e.g., laryngectomy) interferes with participation in a wide range of daily speech communication

activities using a 4-point Likert scale (not at all = 3, a little = 2, quite a bit = 1, and very much = 0). For example, items include talking to people you do not know and having a conversation in a noisy place.

CPIB short form summary scores are derived by summing scores across the 10 items. Total scores range from “0” (severely restricted communicative participation) to “30” (high levels of communicative participation). A person (theta) score is determined using a translation table, based on a normative sample.²² Theta scores typically range from –3.0 to +3.0 logits, with 0 representing the mean of the calibration sample. Higher scores indicate better communicative participation.

Voice Handicap Index-10 (VHI-10)—The VHI-10 is a frequently used, validated 10-item questionnaire that measures the impact of voice disorders, including those related to total laryngectomy, on voice-related QOL.²⁶ Participants respond to each item using a 5-point Likert scale that indicates how frequently they have had each experience. Responses are summed to derive a VHI-10 total score ranging from “0” (no voice handicap) to “40” (high voice handicap).

Speech recordings and self-rated speech acceptability—Speakers were recorded using a headset microphone (Shure PG-81 or AKG C420) connected to a pre-amplifier (M-Audio Fast Track Pro) and acquired on a laptop computer using a specialized sound card and acoustic software (Sona-Speech II, Model 3650, KayPentax), as well as a portable digital audiotape recorder (Tascam DAP1). All speech samples were recorded in a quiet environment with low ambient noise at a sampling rate of 44.1kHz with 16-bit quantization. Speakers recorded six sentences of increasing length from the *Sentence Intelligibility Test* (SIT).²⁷ Sentences for each speaker were randomly chosen, and included sentences that were 5, 7, 9, 11, 13, and 15 words in length (n=60 words per speaker). Speakers also provided recordings of a standard reading passage, the Rainbow Passage.²⁸

After recording the samples, speakers judged their own speech acceptability using a 100 mm visual analog scale (VAS), with the endpoints labeled “very unacceptable” (0) to “very acceptable” (100). They were familiarized with the rating scale and provided a definition of speech acceptability, in which they were asked to “give careful consideration to pitch, rate or speech, understandability, and voice quality. In other words, is the voice pleasing to listen to, or does it cause you some discomfort as a listener?” (p. 610).²⁹

Preparation of Speech Samples

Speech stimuli from the SIT and the Rainbow Passage were normalized for peak intensity using acoustic software (Sony Soundforge Pro 10). Sentences from the SIT and the second sentence of the Rainbow Passage were then entered into a custom-made software program (Ruby on Rails). The program was designed to randomly generate speaker order for presentation of stimuli. It was used to record typed responses to yield intelligibility scores from the SIT,²⁷ as well as capturing speech acceptability responses on rating scales.

Listener Procedures

The first group of 48 listeners transcribed the SIT sentences for speech intelligibility using the standard SIT protocol.²⁷ Listeners were familiarized with the task, and speech samples were presented over headphones (Samson Stereo Headphones, RH600) at a comfortable volume. Listeners transcribed the words they recognized and were allowed to listen to each sample sentence up to two times. Each listener transcribed a total of 180 words (3 speakers×60 words per speaker = 180 words) such that no listener heard any repetitions of sentences. Each speaker's mean intelligibility rating (% words understood) was based on scores from three listeners.

The second set of 18 listeners participated in the speech acceptability rating protocol. Listeners were familiarized with the task, and judged the speech acceptability of the samples using the same instructions and definitions provided to the laryngeal speakers.²⁹ Listeners also made their judgments using a similar rating scale. To calculate intrarater reliability, 19% (n=7) of the speech samples were repeated randomly (N=43 speech samples total per listener).

Data Analysis

Descriptive analyses were completed for the demographic data. Means, ranges, and standard deviations were calculated for continuous variables such as age and time since laryngectomy. Frequencies were calculated for categorical variables such as treatment type.

CPIB short form summary scores and VHI-10 total scores were obtained by adding up all responses to items in each measure for each speaker, and then by transforming the summary scores to theta scores for the CPIB short form.²² Both the CPIB short form and VHI-10 scoring were conducted according to standard procedures for these measures.

Patient-rated assessments of speech acceptability were determined for each speaker based on responses on the 100mm visual analog scales. Listener-rated speech intelligibility was calculated as a percentage by determining the number of words correctly identified (words understood/total number of words). Each speaker's intelligibility was based on scores for 6 sentences, averaged across three listeners (n = 180 words per speaker × 3 listeners per speaker = 540 words per speaker). Finally, listener-rated speech acceptability scores for each speaker were based on responses on the visual analog scales ranging from 0 to 100 (mm), and then averaged across 18 listeners.

Relationships between the CPIB short form with the listener-rated measures (speech intelligibility, acceptability) and the patient-reported measures (VHI-10, acceptability) were determined using Pearson Correlation Coefficients. Strengths of relationships were examined using variance scores (r^2). A pre-determined level of statistical significance ($p < .05$) was used for all analyses.

To determine intrarater reliability for listener-rated speech acceptability, 19% (n=7) speaker samples were randomly repeated, and a Pearson Correlation Coefficient was calculated between original and repeated values. The mean reliability value (r) was .74 ($SD=0.18$). Interrater reliability of speech acceptability was analyzed with an Intraclass Correlation

Coefficient, with the group average being 0.96. These results indicate that reliability was adequate for judgments of listener-rated speech acceptability.

RESULTS

Speaker Demographics

Alaryngeal speakers were on average 8.1 years (range=1–33y) post-laryngectomy, 94% (n=34) reported receiving radiation treatment, and 64% (n=23) used tracheoesophageal (TE) speech as their primary method of communication. Additional demographic information is presented in Table 1.

Patient-Reported Measures

Overall, the mean CPIB short form theta score was 0.60 ($SD=0.88$). Speakers also reported a mean VHI-10 total score of 16.44 ($SD=6.69$), consistent with a moderate level of voice handicap. The mean self-rated speech acceptability score was 64.06 ($SD=23.68$) (see Table 2). To determine whether the mode of alaryngeal speech influenced patient-reported outcomes, a post-hoc analysis was performed. ES speakers were not included in this analysis because of the small sample size (n=2) of this group. No significant group differences were found between TE and EL speakers for any of the patient-reported outcome measures (CPIB short form; VHI-10; speech acceptability; $p > .05$).

Listener-Rated Measures

The mean speech intelligibility score for all speakers was 89.91% ($SD=8.02$). For speech acceptability, the mean listener-rated score was 41.71 ($SD=21.88$). Average scores and scores differentiated by alaryngeal speech mode are reported in Table 3. A post-hoc analysis comparing TE with EL speakers revealed that TE speakers were rated significantly more intelligible ($t(32) = 3.28, p < .05$) and acceptable ($t(32) = 3.94, p < .05$) than EL speakers.

Finally, a comparison between listener- and patient-rated speech acceptability also revealed a significant difference ($t(34) = 4.13, p < .05$). Specifically, alaryngeal speakers judged their own speech acceptability ($M = 64.06; SD=23.68$) to be significantly better than listeners ($M=41.71; SD=21.88$).

Relationships between the CPIB with Patient- and Listener-Rated Measures

Relationships between the CPIB short form theta scores with listener-rated measures (speech intelligibility, acceptability) and patient-reported outcomes (VHI-10, speech acceptability) are shown in Table 4. Weak, non-significant relationships were found between the CPIB short form theta scores with listener-rated intelligibility ($r = 0.055$) and speech acceptability ($r = 0.293$). In contrast, statistically significant relationships were found between the CPIB short form theta scores and both patient-rated outcomes. A statistically significant and moderately strong relationship was found between the CPIB short form theta scores and patient-rated speech acceptability ($r = .596, p < .05$), predicting 36% of the variance. Finally, a strong, statistically significant relationship also was found between the CPIB short form theta scores and the VHI-10 total scores ($r = -0.756, p < .05$), accounting for 57% of the variance (see Table 4).

DISCUSSION

This study investigated the relationships between communicative participation and traditional post-laryngectomy speech outcomes including listener-rated speech intelligibility and acceptability, as well as patient-rated speech acceptability and voice handicap. Results revealed weak relationships between communicative participation and listener-rated outcomes. In contrast, communicative participation was significantly and strongly related to other patient-rated measures. Listener-rated measures also differentiated speaker performance by alaryngeal speech mode. Specifically, TE speakers were judged significantly more acceptable and intelligible than EL speakers. However, patient-reported measures did not reveal differences across these same speakers. Together, results suggest that patient-reported and listener-rated measures are complementary and that different information may be garnered from these types of measures. Implications for research and clinical practice are discussed next.

Patient-Reported Measures

Overall, results from this study revealed that alaryngeal speakers who were on average 8 years post-laryngectomy continue to report a moderate impact on their voice, speech, and communication function. Specifically, the CPIB short form theta scores for the 36 speakers (mean theta score=0.60, $SD=0.88$) were relatively consistent with a larger independent group of individuals who had undergone total laryngectomy and who completed the CPIB (entire item bank).¹⁹ Speakers also reported a mean VHI-10 total score of 16.44 ($SD=6.69$), consistent with a moderate degree of voice handicap. These values are comparable with those reported for other alaryngeal speakers in the literature.^{18, 30–32} Finally, the mean self-rated speech acceptability score was 64.06 ($SD=23.68$) (see Table 2). These values are consistent with those reported by Finizia et al.⁹ In that study, 14 TE speakers reported a mean score of 67 when they judged their own speech acceptability using a similar rating scale. The consistency of these results strengthens the external validity of the present findings.

Results from this study also indicated no patient-reported differences related to alaryngeal speech mode (TE vs. EL speech). Specifically, no differences were found with regard to communicative participation, voice handicap, or self-rated speech acceptability between TE and EL speakers. These findings are consistent with others who have reported no long-term patient-reported differences in QOL outcomes among alaryngeal speakers.^{14,18} However, they are inconsistent with a few studies^{16,17} demonstrating poorer voice-related QOL for those who use EL speech. Our data suggest that despite the unique nature of EL speech, individuals in this study reported that their communication goals were met as effectively as those using TE speech. However, the significance of this result needs comparison with listener-rated outcomes.

Listener-Rated Outcomes

In this study, speech intelligibility ranged from 71.89% to 99.63% (mean = 89.91%) across the speakers, consistent with previous literature.⁸ In addition, results revealed that listener-rated speech acceptability for all alaryngeal speakers was on average more unacceptable

(mean = 41.71) than acceptable (see Table 3).^{11,13,20,29} For both listener-rated measures, the subgroup (n=11) of EL speakers was judged significantly less acceptable and less intelligible than TE speakers. These findings are consistent with others who have suggested that the mechanical nature of the electrolarynx, which is clearly distinguishable from both TE and ES speech, may not only affect intelligibility, but also its social acceptability.⁸ Therefore, these results support the use of listener-rated outcomes such as speech acceptability for differentiating performance across alaryngeal speakers. They also highlight the social penalty that alaryngeal speakers often encounter when communicating with unfamiliar people due to the obvious changes in their voice and speech.

A comparison between listener- and patient-rated speech acceptability showed that speakers judged their own speech acceptability ($M = 64.06$; $SD = 23.68$) to be significantly better than listeners ($M = 41.71$; $SD = 21.88$). These results are similar to those reported by Finizia et al,^{11,12} who found that TE speakers rated their own speech significantly better than experienced clinicians and unfamiliar listeners. This finding suggests that speakers and listeners may be using different standards with which to judge speech acceptability. Specifically, alaryngeal speakers appear to adapt to their voices and change their expectations about what might be considered “acceptable”,⁸ but unfamiliar listeners continue to penalize these speakers for the “differentness” of their speech. Future studies should examine how ratings might differ as a function of the familiarity of the communication partner, and should include both quantitative and qualitative designs to better understand adaptations related to speech acceptability. In addition, we need to explore how patients’ expectations change over time using longitudinal designs.

Relationships between Communicative Participation with Listener- and Patient-Rated Outcomes

This study investigated relationships between communicative participation and traditional listener- and patient-rated speech outcomes. Weak, non-significant relationships were found between communicative participation with listener-rated intelligibility ($r = 0.055$) and speech acceptability ($r = 0.293$). These results are consistent with others who have found weak to moderate relationships between listener-rated measures and patient-rated outcomes, such as disease-specific and voice-related QOL.^{13,20,21} However, this study not only reinforces past results, but more importantly broadens the scope of our findings. Specifically, we showed that traditional listener-rated measures were only weakly related to communicative participation, above and beyond voice symptoms.

One possible reason why weak relationships emerged may relate to the multidimensional nature of communicative participation. For example, many factors may affect a patient’s perception of communication success.²² The variables may range from physical symptoms and reduced capacity for performing tasks (e.g., fatigue, reduced speech intelligibility), to coping strategies,²² to changes in body image,³ to reactions of communication partners or presence of background noise.^{4,33} Thus, patient-reported communication success is multidimensional, and even speech and voice impairments when measured by speech intelligibility or acceptability may not necessarily be the strongest predictor of success.

In contrast to relationships with listener-rated measures, statistically significant relationships were found between communicative participation with patient-rated speech acceptability ($r = .596$) and voice handicap ($r = -0.756$). Eadie et al¹⁹ reported a similar relationship ($r = -0.79$) between the CPIB (full item bank) and VHI-10 total scores in 195 individuals treated for head and neck cancer. The strong relationships demonstrated between the CPIB short form and voice-related QOL as well as self-rated speech acceptability support the concurrent validity of the CPIB short form. It also reinforces the fact that voice- (as opposed to speech-) related symptoms are among the most important considerations when evaluating patient-perceived communicative function post-laryngectomy.

Future Research and Clinical Implications

Results of this study must be considered with regard to sample demographics. Participants were similar to the laryngectomy population described in other studies.² However, many participants were recruited through support groups, had received radiation, and primarily used TE speech. While some of these factors could decrease function (e.g., radiation effects on dentition and speech intelligibility), other factors (e.g., participation in a support group; living with family) could increase performance. Results related listener- and patient-rated outcomes and should be interpreted with these demographics and potential biases in mind.

Investigation of relationships between listener-rated and patient-reported outcomes offers an improved understanding of the associated disability that occurs with alaryngeal communication. The results showed that while unfamiliar communication partners may penalize alaryngeal speakers (and in particular, EL speakers), these effects may not necessarily be perceived by alaryngeal speakers. As such, our findings suggest that listener-rated outcomes cannot serve as a proxy for patient-reported measures, and that they measure different constructs. Understanding these relationships is critical for providing intervention strategies, documenting outcomes, and providing adequate pre- and post-laryngectomy counseling.

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TABLE 1

Selected Demographic Characteristics (N=36 subjects).

Characteristic	No. (%)	Mean (SD)	Range
Sex			
Female	7 (19)		
Male	29 (81)		
Age (y)		64.03 (9.96)	39–86
Marital Status			
Married/committed relationship	24 (67)		
Single/widowed/divorced	12 (33)		
Education			
Some high school	2 (5.6)		
High school graduate	5 (13.9)		
Vocational or technical school	2 (5.6)		
Some college	15 (41.7)		
College graduate	10 (27.8)		
Post-graduate (e.g., Master's; Ph.D.)	2 (5.6)		
Time since head and neck cancer diagnosis (yrs)		10.25 (9.63)	1–46
Time since Total Laryngectomy (yrs)		8.17 (7.81)	1–33
Cancer treatment			
Surgery alone	2 (5.6)		
Surgery and radiation	26 (72.2)		
Surgery and radio(chemo)therapy	8 (22.2)		
Alaryngeal Speech Mode			
Tracheoesophageal speech	23 (64)		
Esophageal speech	2 (5.5)		
Electrolaryngeal speech	11 (30.5)		

TABLE 2

Patient-rated scores as a function of alaryngeal speech mode.

Speech Mode	CPIB short form Thetas		VHI-10 Totals		Self-Rated Speech Acceptability
	n	M (SD)	n	M (SD)	
TE	23	0.48 (0.81)	23	16.52 (7.03)	63.82 (23.91)
EL	11	0.70 (1.03)	10	17.56 (5.98)	60.82 (24.62)
ES	2	1.45 (0.32)	2	10.50 (4.95)	84.50 (6.36)
Group Average	36	0.60 (0.88)	35	16.44 (6.69)	64.06 (23.68)

Note: One EL speaker did not complete the VHI-10, and one TE speaker did not rate his own speech acceptability. Consequently, group averages are based on N=35 speakers for the VHI-10 total scores and self-rated acceptability scores.

TABLE 3

Listener-rated scores as a function of alaryngeal speech mode.

	n	Intelligibility (%)	Acceptability
		M (SD)	M (SD)
Speech Mode			
TE	23	92.27 (6.12)	49.09 (20.95)
EL	11	83.75 (8.90)	22.67 (10.29)
ES	2	96.58 (0.05)	61.53 (1.77)
Group Average	36	89.91 (8.02)	41.71 (21.88)

TABLE 4

Pearson Correlation Coefficients and variance (r^2) demonstrating relationships between the CPIB short form theta scores with patient-rated (VHI-10 and speech acceptability) and listener-rated (speech intelligibility and acceptability) measures for 36 laryngeal speakers.

Patient-Rated Measures		Listener-Rated Measures		
VHI-10	Speech Acceptability	Intelligibility	Speech Acceptability	
CPIB short form	Correlation (variance)	Correlation (variance)	Correlation (variance)	Correlation (variance)
	-0.756 (0.571) *	0.596 (0.355) *	0.055 (0.003)	0.293 (0.086)

Note:

* Correlation is significant at the 0.05 level (2-tailed)