Consonant Intelligibility of Alaryngeal Talkers: Pilot Data*

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Abstract

This study investigated the intelligibility of consonants produced by two highly proficient and well-matched alaryngeal talkers, one esophageal (E) and one tracheoesophageal (TE). A group of professional and a group of lay listeners orthographically transcribed their responses to the speech stimuli. The data were collapsed into confusion matrices, pooled across listener groups for each talker, and analyzed for the perceptual/productive features for each talker. The most frequent perceptual confusion observed for both talkers related to the voicing feature. Based on these pilot data, the TE talker was perceived to be more intelligible than the E talker.

Consonant Intelligibility of Alaryngeal Talkers: Pilot Data

The removal of one's larynx due to disease or injury results in the immediate loss of the primary vibratory element necessary for voice production. Unfortunately, the literature shows great variation in the amount and degree of success for speech rehabilitation following total laryngectomy. While it has been reported that as many as 65 to 70 percent of laryngectomized patients acquire esophageal speech following surgery (Snidecor, 1975), less than 50 percent of these patients are successful in the production of "acceptable" speech (Damste, 1979; Martin, 1963). More recently, others (Aronson, 1980; Gates, Ryan, Cooper, Lawlis, Cantu, Hayashi, Lauder, Welch, and Hearne, 1982; Schaefer and Johns, 1982) have estimated that less than one-third of all laryngectomized patients are capable of learning esophageal speech, whether it be due to physical limitations or psychological reasons.

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Until recently those larygectomized patients who had met with limited success in acquiring functional esophageal speech were given the sole alternative of using either externally applied or intraoral artificial laryngeal devices (Salmon and Goldstein, 1979). However, the recent development of the tracheosophageal (TE) puncture technique (Singer and Blom, 1980) and use of a prosthetic "air shunt" may offer a remarkably successful and viable alternative for the patient incapable of acquiring traditional esophageal speech. Further, TE speech has the benefit of being supplied by the pulmonary air source, thereby distinguishing it aerodynamically from the characteristics of esophageal speech. Although both TE and esophageal speech use the pharyngeoesophageal (PE) segment as an alaryngeal voicing source, the differences in aerodynamic support and esophageal insufflation for voicing are critical factors to consider in the alaryngeal speech which is ultimately produced. Aerodynamic support refers specifically to the air which is used to drive the alaryngeal voice source. Thus, the primary distinction between esophageal and TE speech lies in differences in driving capacity.

To date, objective studies comparing esophageal and TE speech have emphasized comparative acoustic analyses (Robbins, 1984; Robbins, Fisher, Singer, and Blom, 1984), and assessment of general listener preference (Clark and Stemple, 1982), as well as comparative measures of intonation contrasts and lexical stress (Gandour and Weinberg, 1983; Gandour, Weinberg, and Garzione, 1983). Results from acoustic analyses and listener preference studies indicate that TE speech is superior to esophageal speech. Similar performances between the two groups were demonstrated in studies on intonation and stress. Recent data have suggested that TE talkers demonstrate high levels of speech acceptability and intelligibility regardless of the listeners' level of expertise (Tardy-Mitzell, Andrews, and Bowman, 1985; Williams and Watson, 1985). However, no studies have investigated the relative phonemic intelligibility of TE and esophageal talkers, a logical extension when considering the essential difference in aerodynamic driving capacity between TE and esophageal talkers. In fact, Weinberg, Horii, Blom, and Singer (1982) have hypothesized that the esophageal voicing source is optimized using the TE speech method. The assumption that aerodynamic capacity and force may affect production of specific consonants has been supported within the literature on normal speech production (Arkebauer, Hixon, and Hardy, 1967; Isshiki and Ringel, 1964; Subtelny, Worth, and Sakuda, 1966). Finally, preliminary reports that consonant production of TE talkers is superior to

that of esophageal talkers (Singer, 1983) can only be substantiated through further empirical investigation.

Thus, based on this need, the present study provides preliminary data about consonant intelligibility in two alaryngeal talkers. In doing so, a representative series of 16 English consonants was investigated. The specific question addressed in this pilot investigation was whether phonemic intelligibility differences exist between two highly proficient and well-matched alaryngeal talkers and whether they may relate directly to the primary aerodynamic difference between the talkers two speech methods.

Method

Talkers

One 57 year old male having approximately 2 years experience as an esophageal (E) talker, and one 58 year old male having approximately 2 years experience as a tracheoesophageal (TE) talker served as talkers in this study. Both talkers were rated as excellent examples of their respective types of alaryngeal speech by at least three professional speech pathologists not associated with the project. Both talkers passed a pure-tone audiometric screening bilaterally at the octave frequencies 250-4000 Hz. Also, both professional and lay listeners subjectively rated the talkers as similar across a variety of speech parameters. These subjective quality ratings were based on each talker's reading of the "Rainbow Passage"; subjective judgments of overall intelligibility were based on ratings of a one minute spontaneous speech sample recorded by each talker.

Matching for Intelligibility

TASK ONE

In an effort to identify each of the two experimental talkers as exhibiting similar speech intelligibility for ongoing speech, two additional measures were obtained. First, each talker recorded the ten sentences from the Synthetic Sentence Identification (SSI) test (Jerger, Speaks, and Trammell, 1968). These sentence length stimuli were chosen due to the fact that real English words were used and correct identification of each word within the sentences by the listeners was not facilitated by contextual linguistic factors. Such stimuli considerations were deemed important particularly when using real word stimuli. These stimuli had also been used in previous alaryngeal research (Clark, 1985; Clark and Stemple, 1982).

The recordings of these sentences were then randomized and presented to three lay listeners who did not participate in the later stage of this study. Listeners were presented the randomized list of 20 sentences (10 sentences × 2 talkers) as a group in the sound-field within a sound suite, and requested to orthographically transcribe each sentence as they perceived it. Listeners' were proficient in phonetic transcription and were allowed to transcribe any word within a sentence which they found problematic to transcribe orthographically. Adequate pauses for transcription of these stimuli were provided between sentences. Following completion of this task, each listener's transcriptions were analyzed for errors to determine an overall intelligibility score for both the esophageal an TE talker on the SSI stimuli. Reliability between listeners' transcriptions was also determined.

Each talker's overall intelligibility score was based on the mean percent of stimuli words correctly identified by the three listeners. The 10 SSI sentences were each seven words in length (eight to ten syllables), with a total of 70 words comprising the entire series of 10 sentences. Thus, for each talker the overall intelligibility score was based on the correct transcription of 210 stimulus words (70 words × three listeners).

This method of quantifying each talker's speech intelligibility provided the following results. The esophageal talker was judged to be 88.1% intelligible by the three listeners (range 87.1% to 90.0%) and the TE talker was judged to be 88.6% intelligible (range 85.7% to 91.4%).

TASK TWO

As a second measure of talker intelligibility, 10 four syllable segments from an extended spontaneous monologue were randomly extracted from a master recording by each talker. Segments were always extracted from the middle portions of an utterance. An attempt was also made to insure that no less that three words were contained in each of the ten segments. Thus, single multisyllabic words were avoided in these samples. This was done in order to eliminate possible influences related to decreased voice duration often demonstrated by esophageal talkers, and which might have ultimately affected the esophageal talkers overall intellibility score on this task. Similar to the SSI task (Task One), the 10 segments extracted for each talker were randomized and presented to the same three listeners for orthographic transcription. Overall scores were also analyzed in an identical manner to that in Task One. However, the total words produced in the 10 segments by the esophageal talker was 37 and for the TE talker 35. Thus, overall speech intelligibility scores were based on responses to 111 words for the esophageal talker (37 words × three listeners) and 105 words (35 words × three listeners) for the TE talker. Scores for this intelligibility matching task revealed mean scores of 88.3% for the esophageal talker (range 83.8% to 91.9%), and 84.8% for the TE talker (range 80.0 to 88.6%). From the data obtained in intelligibility matching Tasks One and Two, it was determined that the two talkers were extremely well-matched on speech intelligibility measures. A high degree of reliability ($\geqslant$89%) between the judgments was also exhibited. Consequently, they produced the primary experimental stimuli which were investigated in this project.

Stimuli

High-quality tape recordings were made of each talker producing consonant-vowel (CV) and vowel-consonant (VC) pairings within the carrier phrase "say_____again." All recordings were made on a professional-quality reel-to-reel tape recorder/player

(Otari MX-5050) at a tape speech of 7½ ips on magnetic recording tape (Maxell 35-180). Speech stimuli were recorded within a sound-treated recording suite (IAC) using a dynamic unidirectional microphone (ARC-D202) which was positioned four inches from the talker's mouth. The speech signal input level was manually adjusted on a VU meter of the tape recorder/player for both talkers using a power amplifier (BGW Systems Model 3300) and a sound mixer (Teac Model 2A). Consequently, all speech signals were adjusted to prevent overload distortion during experimental recording. Recording levels were monitored throughout the recording and rechecked following breaks. All experimental recordings contained a 1000 Hz calibration tone at the beginning of each list. The CV and VC combinations were comprised of 16 English consonants (/p, b, t, d, k, g, f, v, s, z, ʃ, tʃ, dʒ, m, n, and l/), each paired with five vowels (/i, I, æ, ʌ, and u/). These vowels were chosen because they represent various articulatory postures associated with vowel production. Each talker produced each CV and VC item four times; all productions were randomized. The recordings were made in a single session lasting approximately two hours during which the talkers were permitted to take appropriate breaks. Thus, the experimental stimuli were tape recordings of the 40 samples (5 vowels × 4 productions × 2 positions) of each consonant for each talker.

Listeners

Three professional speech pathologists (28, 30, and 32 years of age) having a minimum of two years clinical experience and six lay listeners (between 21 and 24 years of age) having no formal experience with laryngectomized patients participated in this study. All listeners had normal hearing as determined by pure-tone audiometric testing at the octave frequencies 250-8000 Hz, bilaterally, and word discrimination scores ⩾94% bilaterally.

Procedure

Each of the professional listeners independently made their judgments in a sound suite using headphones. The six lay listeners performed their judgments as a group in a sound-treated listening laboratory; stimuli were presented via a stereophonic amplifier (NAD 2080) and two loudspeakers (AR2). The rationale for group testing was based on earlier pilot work which showed that two additional lay subjects made reliable ratings of the same stimuli in both sound-field and earphone conditions (reliability of judgments was ⩾84%).

Listeners heard all four randomized lists of the stimuli in quiet at a presentation level of approximately 70 dB SPL and phonetically transcribed their responses. Listeners' responses were scored for percent correct to determine if there were differences for the two talker types across the two listener groups. Statistical analyses were not conducted on these pilot data due to the small 'n' involved. However, the consonant confusion errors were pooled across listener groups, consonant positions, and vowel environments for each talker type, and were converted to confusion matrices. Thus, four separate matrices were constructed (i.e., one each for professional and lay listeners' pooled ratings of the E and TE talkers) and used to help evaluate the perceptual/productive features present in the data.

Results and Discussion

Analysis of the data showed that consonant targets produced by the TE talker were identified by both groups of listeners with greater success than those produced by the E talker. Overall, the professional listeners' intelligibility scores for both E and TE talkers were higher than those of the lay listeners, but the relative differences between scores for the two talkers were consistent across listener group. The overall perceived intelligibility for all consonants produced by the TE talker was 94% for professional listeners and 89% for lay listeners, while that for the E talker was 85% for the professional listeners and 79% for the lay listeners. It is important to note that all inter- and intra- judge reliability scores were better than 84% for both professional and lay listeners.

Tables 1, 2, 3, and 4 show the individual pooled confusion matrices from which the above overall scores were derived. Analyses of the error data in Table 1 revealed that 26% of the lay listeners' total erors for the esophageal talker were cognate voicing errors; 92% of these voicing errors were attributed to the identification of the voiced cognate when an unvoiced consonant was the target. Of the lay listeners' total errors for the TE talker shown in Table 2, 62% were solely attributed to cognate voicing errors; similar to the esophageal talker, 95% of these misperceptions were errors in which a voiced response was provided for a voiceless target. Table 3 shows that 27% of the professional listeners' total errors for the E talker were due to cognate voicing errors with 89% of these resulting from misperception of a voiced target when a voiceless consonant was intended. For the TE talker (Table 4), 55% resulted from cognate voicing errors with 89% of these being a result of voiced for voiceless misperceptions. All additional errors observed were related to either place or manner differences, or place-manner-voicing interactions, or to omissions. However, no omission errors were observed for the professional listener group for either the E or the TE talker. It is striking to note that when omissions were observed for lay listeners, better than seven times (7 vs. 51) as many omissions were found for the E talker. Generally, Tables 1, 2, 3, and 4 reveal that while the overall error patterns were similar across listener groups, the lay group produced more, rather than different types of intelligibility errors for each talker type than did the professionals.

Regarding the combined intelligibility of the nine voiced and the seven voiceless consonants, differences in overall perceived intelligibility were also observed. Table 5 shows that voiced consonants produced by the TE talker were 12% more intelligible than those pro-

Table 1:

STIMULUS \ RESPONSE	p	b	t	d	k	g	f	v	θ	ð	s	z	ʃ	ʒ	tʃ	dʒ	m	n	l	r	w	ŋ
p	143	45	13		6	1	11		9	1												11
b		130	1	10		11		27		4							45	6				6
t		1	186	42	4	1		1	1	3								1				
d			3	195		12												27				3
k					224	16																
g		1	1		2	231		3														2
f		4			3		155	9	55	13												1
v	1	15		1	1	10	2	140	12	46						1	4					7
s			2		1						184	26	2	1	6	10						8
z											10	208	4	1	1	13		1				2
ʃ				3		1			1				197	5	31	2						
tʃ														5	184	51						
dʒ				1		24										215						
m		1		2		2		1									175	46	2	6		5
n			2			2				1							1	233				1
l																			232		3	5

Table 2:

STIMULUS \ RESPONSE	p	b	t	d	k	g	f	v	θ	ð	s	z	ʃ	ʒ	tʃ	dʒ	m	n	l	r	w	ŋ
p	168	70					1															1
b		209															30	1				
t			211	28			1															
d				237		3																
k					194	45																1
g				12	1	218										9						
f	1						233	1	5													
v							6	233														1
s											217	23										
z											8	230										2
ʃ													157	56	22	5						
tʃ										1			2		201	36						
dʒ						14							10			216						
m																	240					
n																	38	201				1
l																		2	233	4		1

Table 3:

STIMULUS \ RESPONSE	p	b	t	d	k	g	f	v	θ	ð	s	z	ʃ	ʒ	tʃ	dʒ	m	n	l	r	w	ɹ
p	87	19	7		2		4		1													
b		97		1		7		1									14					
t			109	11																		
d				101	2	2												15				
k			1		114	5																
g		1				115		1								3						
f							84	5	24	5									2			
v		14				6	3	79	5	13												
s						1					99	11		1	2	6						
z										2	2	109				7						
ʃ													106	3	10	1						
tʃ													4	2	98	16						
dʒ					13											107						
m	1	8						3									91	17				
n		1	1	1													7	109	1			
l							1											1	118			

Table 4:

STIMULUS \ RESPONSE	p	b	t	d	k	g	f	v	θ	ð	s	z	ʃ	ʒ	tʃ	dʒ	m	n	l	r	w	ɹ
p	105	15																				
b		113															7					
t			110	9											1							
d				120																		
k					111	9																
g						115										4		1				
f				1			118	1														
v								120														
s											114	6										
z											4	116										
ʃ							1						99		9	11						
tʃ													1		100	19						
dʒ						8							1		3	108						
m																	120					
n			1														5	113	1			
l		1						1											118			

duced by the E talker to the lay listener group, and 11% more intelligible to the professional listeners. Comparatively, the lay listeners perceived the TE talker's voiceless consonants to be 6% more intelligible than those produced by the E talker. A difference in intelligibility of 7% between the talkers was observed for the professional listeners. Although smaller differences in perceived intelligibility were observed for the production of the TE talker's voiceless consonants as compared to voiced, the increases were again quite consistent. It is interesting to note, however, that while identical differences in overall intelligibility scores (5%) were observed for the lay listeners between the voiced and voiceless targets produced by both talkers, the professional listeners exhibited a smaller difference (3%) for the E talker and a larger difference (7%) for the TE talker.

Table 5: Overall percent intelligibility scores for voiced (nine consonants) and voiceless (seven consonants) targets produced by the esophageal (E) and tracheoesophageal (TE) talkers as perceived by lay and professional listeners.

	E Talker		TE Talker	
	Lay	Professional	Lay	Professional
Voiced	81%	86%	93%	97%
Voiceless	76%	83%	82%	90%

When analyzing the error data from the two largest feature categories (i.e., plosive and fricative consonants) the following information was obtained. The professional listeners' intelligibility scores for the esophageal talker's productions of plosives was 87% and that for fricatives was 80%. Lay listeners' intelligibility scores were 77% for the esophageal talker's plosives and 74% for fricatives. The TE talker's plosives were 94% and 86% intelligible for professional and lay listeners, respectively. Fricative phonemes were 95% intelligible to professional listeners and 89% intelligible to lay listeners. Overall, the intelligibility scores for the esophageal talkers' consonants were 85% and 79% for professional and lay listeners, respectively. Scores for the TE talker were 94% and 89% for the professional and lay listeners, respectively.

Based on the listeners' intelligibility scores, the results of this pilot study suggest that the two well-matched alaryngeal talkers evaluated here differed in their production of consonant phonemes. Preliminary analyses of these data lend some support to the possibility that a relationship exists between speech aerodynamics and consonant production/perception in an alaryngeal (in this case esophageal) voicing mechanism. Although these are pilot data and our conclusions are indeed limited by the small number of subjects, several findings are highly consistent across listener groups and revealed good reliability both within and between listeners. As anticipated, the professional listeners' intelligibility scores for consonant targets were somewhat better than those of the lay listeners. This finding is consistent with that recently reported by Williams and Watson (1985) who showed that intelligibility judgments are significantly influenced by listener sophistication. However, it is interesting to note that regardless of talker type, the listeners' overall intelligibility scores were extremely consistent in relation to absolute differences across talkers. That is, each listener group evidenced similar magnitudes of intelligibility difference between the E and TE talkers. This finding is interpreted as an additional observational of the reliability of listener judgments.

The perceived overall intelligibility for the E talker across the lay and professional listener groups differed by only 6% (79% vs. 85%); that for the TE talker differed by 5% (89% vs. 94%). This consistency was also noted for the analysis of data feature categories (plosive and fricative) representing manner of articulation classifications. The professionals' overall intelligibility scores for the TE plosives and fricatives were 8% and 6% better, respectively, than those of the lay listeners. For the E talker, the professional listeners' scores were 10% and 6% better than those of the lay listeners for plosives and fricatives, respectively. Intelligibility scores were also similar across listener groups for affricate, nasal, and liquid/glide targets, although professional listeners judged TE nasals to be 5% more intelligible than those of the E talker. However, peception of nasal consonants by both lay and professional listener groups revealed TE nasals to be 7% and 14% more intelligible than the E talker's production, respectively. This finding is of particular interest when considering the aerodynamic hypothesis associated with vocal tract airflows. Specifically nasals are consonants which require low airflows and presures relative to plosives, fricatives, and affricates. As such, one would assume that the TE talker would be judged by listeners to produce these targets more effectively. At least for professional listeners, The nasal consonants revealed the second greatest difference for a particular consonant manner class (14%) when compared to the esophageal talker; the greatest difference observed was only one percent better (15%) with that being for fricatives. A summary of both talkers overall intelligibility scores by manner class for each listener group is presented in Table 6. Finally, the absolute differences for intelligiblity scores between talkers was 9% — 10% regardless of listener group.

Table 6: Summary of each talker's (E and TE) overall percent intelligibility scores by manner class for both listener groups.

	Lay Listeners		Professional Listeners	
	E	TE	E	TE
Manner Class				
Plosive	77	86	87	94
Fricative	74	89	80	95
Affricate	83	87	85	87
Nasal	85	92	83	97
Liquid	97	97	98	98

The similarities noted for both the E and TE talkers' success in producing voiced sounds is likely related to the non-abductor/adductor nature of the esophageal voicing source in both talkers. That is, vibration of the esophageal pseudoglottis (pharyngoesophageal segment) is not under volitional control, and thus, is continually oscillating during alaryngeal voice production. Voiced consonants also require reduced aerodynamic airflows and pressures. The plosives and fricatives investigated here , in particular the voiceless consonants, require substantially higher relative aerodynamic driving pressures within the vocal tract than their voiced cognate consonants, or other manner classes of consonants presently studied. As a result, differences may be observed in their production dependent upon the alaryngeal talkers' ability to generate and maintain vocal tract pressures during voice production. Therefore, the overall effectiveness with which an E or TE talker can produce consonant phonemes may in some degree relate to the aerodynamic capacity of the driving source. Here, capacity would be less for the esophageal talker who has a single esophageal reservoir capacity of approximately 80cc (Diedrich, 1968) per air insufflation, than for the TE talker who has the same esophageal resevoir capacity, but is capable of maintaining its insufflation due to the driving capacity of the pulmonary air source (i.e., the lungs). Although we do not assume that the post-laryngectomy pulmonary system is normal, the respiratory driving status in TE talkers is greater than that noted during production of traditional esophageal speech (Weinberg, et al. 1982). This assumption has also been supported via the frequency, intensity, and duration data presented by Robbins (1984) and Robbins, et al. (1984). This increase in respiratory driving pressure may then result in the generation and maintenance of the high airflows/pressures associated with and required for plosives and fricatives. When one considers other physical factors associated with TE speech, such as use of a closed airway and utilization of chest wall dynamics for speech purposes, additional phonatory effects may be seen. This apparent advantage for the TE talker may in some way affect production, and hence perception, of consonants which require the greatest aerodynamic support (voiceless targets). However, this possiblity is infered based upon the present perceptual pilot data and can only be documented through comprehensive aerodynamic and perceptual studies and acoustic analyses. Should this advantage exist, it is reasonable that the TE talker should produce isolated consonatal targets with greater effectiveness than the E talker. This may then manifest in greater overall speech intelligibility than that of the traditional esophageal talker. It should be noted that this hypothesis is limited due to the non abductor-adductor nature of the pharyngoesophageal segment. Further research may help to explain such inconsistencies. It is also possible, however, that an increased respiratory driving capacity will result in more continuous oscillation of the voicing source in TE talkers. This may in part account for our observation that the TE talker was perceived to produce voiced consonants more effectively. The perceptual salience of productive features (e.g., voice onset time and vowel duration) upon listener perception of TE speech is not clear at this time. More detailed investigation of these possibilities is warranted in further research.

The present pilot data suggest that the possible influences and differences in respiratory driving pressures seen between E and TE talkers may have an effect on the production/perception of consonants. We are currently investigating this finding further using all 24 English consonants in a larger study using both E and TE talkers, and a talker proficient in both modes of alaryngeal communication. Data from this larger scale study may provide further insights into the mechanism(s) involved in the production of (tracheo)esophageal consonants and the ultimate effects upon listener perception and perceived intelligibility of E and TE talkers.

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References

Arkebauer, H.; Hixon, T. & Hardy, J. (1967). Peak intraoral air pressures during speech. *Journal of Speech and Hearing Research, 10,* 196-208.

Aronson, A.E. (1980). *Clinical voice disorders: An interdisciplinary approach,* New York: Thieme-Stratton, Inc.

Clark, J.G. (1985). Alaryngeal speech intelligibility and the older listener. *Journal of Speech and Hearing Disorders, 50,* 60-65.

Clark, J.G.; & Stemple, J.C. (1982). Assessment of three modes of alaryngeal speech with a synthetic sentence identification (SSI) task in varying message-to-competition ratios. *Journal of Speech and Hearing Research, 25,* 333-338.

Damste, P.H. (1979). Some obstacles in learning esophageal speech. In R.L. Keith and F.L. Darley (Eds.), *Laryngectomy rehabilitation.* San Diego: College-Hill Press.

Diedrich, W.M. (1968). The mechanism of esophageal speech. *New York Academy of Sciences, 155,* 303-317.

Gandour, J. & Weinberg, B. (1983). Perception of intonation contrasts in alaryngeal speech. *Journal of Speech and Hearing Research, 26,* 142-148.

Gandour, J.; Weinberg, B. & Garzione, B. (1983). Perception of lexical stress in alaryngeal speech. *Journal of Speech and Hearing Research, 26,* 418-424.

Gates, G.; Ryan, W.; Cooper, J.; Lawlis, G.; Cantu, E.; Hyashi, T.; Lauder, E.; Welch, R. & Hearne, E. (1982). Current status of laryngectomee rehabilitation: I. Results of therapy. *American Journal of Otolaryngology, 3,* 1-17.

Isshiki, N. & Ringel, R. (1964). Air flow during the production of selected consonants. *Journal of Speech and Hearing Research, 7,* 233-244.

Jerger, J.; Speaks, C. & Trammel, J.A. (1968). A new approach to speech audiometry. *Journal of Speech and Hearing Disorders, 33,* 318-328.

Martin, H. (1963). Rehabilitation of the laryngectomee. *Cancer, 16,* 823-841.

Robbins, J. (1984). Acoustic differentiation of laryngeal, esophageal, and tracheoesophageal speech. *Journal of Speech and Hearing Research, 27,* 577-585.

Robbins, J.; Fisher, H.; Blom, E. & Singer, M. (1984). A comparative acoustic study of normal, esophageal, and tracheoesophageal speech production. *Journal of Speech and Hearing Disorders, 49,* 202-210.

Salmon, S.J. & Goldstein, L.P. (1978). *The artificial larynx handbook.* New York: Grune & Stratton.

Schaefer, S. & Johns, D. (1982). Attaining functional esophageal speech. *Archives of Otolaryngology, 108,* 647-650.

Singer, M. (1983). Tracheoesophageal speech: vocal rehabilitation after total laryngectomy. *Laryngoscope, 93,* 1454-1465.

Singer, M. & Blom, E. (1980). An endoscopic technique for restoration of voice after laryngectomy. *Annals of Otology, Rhinology and Larngology, 89,* 529-533.

Snidecor, J.C. (1975). Some scientific foundations for voice restoration. *Laryngoscope, 85,* 640-648.

Subtelny, J.; Worth, J. & Sakuda, M. (1966). Intraoral pressure and rate of flow during speech. Journal of Speech and Hearing Research, 9, 498-518.

Tardy-Mitzell, S.; Andrews, M.L. & Bowman, S.A. (1985). Acceptability and intelligibility of tracheoesophageal speech. *Archives of Otolaryngology, 111,* 213-215.

Weinberg, B.; Horii, Y.; Blom, E. & Singer, M. (1982). Airway resistance during esophageal phonation. *Journal of Speech and Hearing Disorders, 47,* 194-199.

Williams, S. & Watson, J. (185). Differences in speaking proficiencies in three laryngectomy groups. *Archives of Otolaryngology, 111,* 216-219.

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Toronto, Ontario M4R 1A1

Le comité des distinctions a préparé, dans les deux langues officielles, une lettre d'appréciation à l'intention de non-membres qui consacrent temps et efforts au nom de l'Association.

Si vous connaissez de telles personnes dans votre région, qui ont ainsi oeuvré de façon bénévole (vg. temps de secrétariat) et que vous désiriez le souligner, faites parvenir leurs noms et adresses à:

Ms. Dawne Kamino
Secrétaire de direction
Association canadienne des
Orthophonistes et Audiologistes
#311-44 Eglinton avenue ouest
Toronto, Ontario M4R 1A1