Influence of Native Language on Nasalance Measurement

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Abstract

'Nasalance' is influenced by many parameters such as age, dialect, native language and gender. Measurement of nasalance is usually done for standard passages such as Zoo passage, Rainbow passage and standard oral and nasal speech stimuli. However, the normative data of native English speakers for the same cannot be considered, as native language influence may play a significant role. Hence, the present study aimed at investigating the influence of three native languages (Kannada, Malayalam and Hindi) on nasalance values for standard Zoo passage, and compared the same with established data. The mean nasalance values were obtained from thirty normal adult females (17-35 years) each, having native language as Kannada, Malayalam and Hindi, while they read the Zoo passage, using Nasometer II 6400. Results indicated higher nasalance scores in Hindi and Malayalam speakers. The mean nasalance score for native Kannada speakers was found to be significantly lower than that in other two languages. Comparison of the results with the standard norms provided for English speaking individuals revealed similar mean nasalance values for native Kannada speakers. However, nasalance scores of native Malayalam and Hindi speakers were found to be significantly higher. These differences can be explained based on the phonemic characteristics of these languages. These inherent features of the language are also reflected in reading English. The results indicate that mean nasometric values obtained for a specific linguistic group may not be valid with other language speakers, even though they speak the same language. Thus, the results highlight native language as a factor influencing nasalance of normal reading. It is essential that for establishing normative data for Nasometer, issues pertaining to native language and dialect need to be considered.

Key Words: Nasalance, Zoo passage, Nasometer, linguistic influence

Nasality is a common problem in subjects with repaired / un-repaired cleft palate, which in turn affects speech intelligibility. Increased nasal resonance is not only seen in disordered speech, even normal speech may have some amount of nasality (for example, perceptually, it appears that Malayalam has more nasal consonants compared to other languages (Syamala Kumari (1972). The term nasality refers to an auditory impression about speech and is not a precise physical variable. The primary underlying physical variable is the opening and closing of the velopharyngeal port. Hyper nasal speech is when there is the presence of an abnormally increased nasal airflow during oral speech sounds.

Nasality is an aspect of voice "quality" traditionally assessed by the perceptions of professionals involved in the evaluation and treatment of resonance disorders. However, despite the importance of perceptual evaluation, there is also a need for objective measurement. Many devices have been developed for objective measurement of nasality. Nasometer, a microcomputer-based instrument developed by Kay Elemetrics in 1986 is one such device. The Nasometer is an easy, non-invasive method, which provides the user with a numeric output indicating the relative amount of nasal acoustic energy in subject's speech. The Nasometer has been used both clinically and in research studies to measure the acoustic correlate of nasality. Several speech samples and reading material are included in the nasometry package for use in assessment of nasal resonance. Some of the more commonly used standard material for evaluation of nasality include Rainbow passage (Fairbanks, 1960) and Zoo passage (Fletcher, 1972).

Since the Nasometer was introduced in 1986, several articles have appeared in the literature on developing normative data in various languages. These studies have indicated that nasalance scores vary across languages (Anderson, 1996;

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Van Doorn & Purcell, 1998; Van Lierde, 2001; Whitehill, 2001; Van Lierde, Wuyts, Bodt & Cauwenberge, 2003; Sweeney, Sell, & Regan, 2004. However, there is limited data on nasometric values in Indian languages. Normative data is available for English, as most of the studies have been conducted on native English speakers. However, these studies indicated that not all native English speakers obtained the same nasalance scores.

Litzaw and Dalston (1992) studied the nasalance scores, nasal cross-sectional area and fundamental frequency of fifteen adult males (mean age of 24 years) and females (mean age of 28 years) who spoke the Mid Atlantic dialect of English. The stimuli used for nasalance measurement included standard Zoo and Rainbow passages, and, a series of nasal sentences. The mean nasalance scores, compared with mean nasalance scores for other dialects of English such as American English (Fletcher et al, 1989), Midwestern, Ontario and Southern American (Seaver et al, 1991), was higher. In the Indian context, Mahesh and Pushpavathi (2008) also reported significant differences in nasalance scores comparing native and non-native English speakers. Their subjects constituted of Indian speakers with English as second language. Several factors such as the dialect spoken and gender have been attributed to these differences in mean nasalance scores (Seaver, Dalston, & Leeper, 1991).

Anderson (1996) also reported native language as a factor that influences nasalance of normal speech. Leeper, Rochet, & MacKay (1992) obtained nasalance scores for French from bilingual Canadian subjects. The stimulus items in French were correlated with the standard English passages used to obtain the English normative data (Zoo passage and Rainbow passage). Bilingual English-French speakers obtained different mean nasalance scores across the languages. As suggested by Leeper et al. (1992) differences in phonetic contexts and differential use of nasal consonants and vowels results in differences in nasalance values across languages in these bilingual speakers. Several hypotheses were also provided to explain the differences such as: (1) different qualities of nasal phoneme (consonants and vowels) production in each language, (2) the balance of nasals between equivalent passages in the two languages, and (3) coarticulation of nasal phonemes and segments. Nasal phonemes in English are consonants and coarticulated nasalized vowels and in French a large proportion of the nasal phonemes are nasalized vowels. Hence they concluded that the VP mechanism functions in part by an articulatory set typical of a particular dialect and/or language. Results of the above studies suggest effect of cross-linguistic differences in nasalance values.

These studies would substantiate the necessity of developing normative data in different Indian languages, which becomes important as speech pathology clinics in India are using the Nasometer to confirm the perceptual judgment of abnormal levels of speech nasality.

The primary purpose in providing normative data for a given language is clinical; such information is necessary to assist in evaluation and management of persons with resonance disorders. In addition to the clinical implications, investigations and comparisons of nasalance from different languages would be of theoretical benefit because they facilitate our understanding of the influence of linguistic and socio-cultural factors on resonance judgment and measurement. Hence, it would be of significance to explore the influence of three Indian languages (Hindi, Kannada, and Malayalam) on nasalance values using standard Zoo passage. English, being a global language is widely used in India and as such, nasalance measurement is also done in English, using standard passages (Zoo and rainbow passage). However, using English normative data for comparison may not be reliable as native language may influence nasalance measurement. In this context, the present study investigated the native language influence on nasalance measurement using standard English passages.

The objective of this study was to investigate the influence of three Indian languages (Kannada, Malayalam, and Hindi) on nasalance values using standard Zoo passage and to compare these nasalance values of Zoo passage with the established data.

Method

Participants: Thirty females in the age range of 18 to 30 years, for each of the three language groups (Kannada, Malayalam, and Hindi) participated in the present study. The subjects in each group had the respective language as their first language. All the subjects had learnt English as a second language. All the subjects had normal structure and function of the orofacial structures.

Test stimuli: Zoo passage (Fletcher, 1962), a Standard English passage commonly used for nasalance measurement was used. The “Zoo passage” contains no nasal consonants and is loaded with only high-pressure oral consonants.

Instrumentation: The Nasometer II Model 6400, a microcomputer based system (Kay Elemetrics,

New Jersey) was used in the present study. The oral and nasal components of the subject's speech are sensed by microphones on either side of a sound separator that rests on the patient's upper lip. Nasometer computes a ratio of the nasal acoustic energy to the nasal – plus - oral acoustic energy from the digitized signals. Nasalance is expressed as a percentage value computed from that ratio (nasalance = nasal / {oral + nasal} * 100).

Procedure: Prior to data collection, the instrument was calibrated as per the guidelines provided in the manual. Subjects were then seated in a quiet setting with the Nasometer headpiece adjusted so the separation plate rested comfortably but firmly on the subject's upper lip and perpendicular to the plane of the face. Each subject read the standard Zoo passage. The mean nasalance score as well as minimum and maximum nasalance scores were computed for each of the subjects, using the Nasometer software package.

Results

Results indicated high nasalance percent in Hindi compared to Malayalam and Kannada. The mean, minimum and maximum score and standard deviation for the Zoo passage for the three languages are in table 1. Figure 1 depicts mean nasalance scores for all the three languages.

Language	Parameter	Mean	SD
Kannada	Min	2.40	1.25
	Max	91.57	10.30
	Mean	**19.53**	7.56
Malayalam	Min	2.87	2.09
	Max	92.57	7.06
	Mean	**24.73**	7.99
Hindi	Min	3.77	3.38
	Max	94.03	3.58
	Mean	**25.37**	7.19

Table 1: Mean and SD scores across different languages

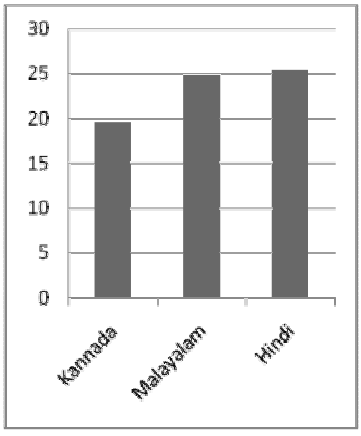

Figure 1: Mean scores for different languages

Results of One-way ANOVA showed significant differences (F [2, 87] = 5.335, $p<0.05$) across the languages. Duncan's post hoc analysis revealed that Kannada had significantly lower nasal scores compared to Malayalam and Hindi. Interestingly, no significant difference was observed between Malayalam and Hindi.

Independent t test was done to compare the mean nasalance score for each of the three groups (Kannada, Malayalam and Hindi) considered in the present study with a Western [Litzaw and Dalston (1992)] and an Indian study [Mahesh and Pushpavathi (2008)]. Results revealed that mean nasalance scores of native Kannada speakers was in consensus with that of the established data, whereas mean nasalance values of native Hindi and Malayalam speakers were significantly higher compared to the established data. The results are given in table 2.

		Studies	
		Litzaw and Dalston (1992)	Mahesh and Pushpavathi (2008)
Kannada	Subjects	Females	Females
	"t" value	T(18) = 1.10	T(18.46) = 0.77
	"p"value	> 0.05	> 0.05
Malayalam	Subjects	Females	Females
	"t" value	T(18) = 4.618	T(18.46) = 4.302
	"p"value	< 0.001	< 0.001
Hindi	Subjects	Females	Females
	"t" value	T(18) = 5.605	T(18.46) = 5.255
	"p"value	< 0.001	< 0.001

Table 2: Nasalance values across languages with established data

Discussion

The current study analyzed the influence of native language on the nasalance scores using the standard English Zoo passage. Results showed mean nasalance scores for Zoo passage obtained for native Kannada speakers to be significantly lower compared to native Malayalam and Hindi speakers. Interestingly, though mean nasalance score for native Hindi speakers was found to be higher compared to that of native Malayalam speakers, no significant difference was obtained. Also, it was seen that mean nasalance scores of native Kannada speakers was in consensus with that of the established data, whereas mean nasalance values of native Hindi and Malayalam speakers were significantly higher compared to established data. This study provides support for the intrinsic characteristics of the velopharyngeal closure which vary based on the age, gender, stimulus length and phonetic characteristics.

These differences in mean nasalance scores across native language groups may be attributed to the phonemic characteristics of these languages. Consequently, the number of nasal sounds in the respective language as well as frequency of occurrence of nasal sounds may be an important factor. This also depends on the influence of nasalized consonants on the adjacent speech sounds due to the coartculation. The difference in nasalance scores, various dialects and languages represents difference in amount of "***Inherent nasal quality***" among speakers of different regions and languages. Since Malayalam speakers have ***"Inherent nasal quality"*** they also use the same while speaking other languages. Dialects, accents or languages that use more high vowels or higher tongue positions might be expected to have higher nasalance scores as compared to those with a greater incidence of low vowels or lower tongue position. There may be a difference in dialect between the timing of velopharyngeal closure when transition is made between nasal consonants and vowels. Difference in mean nasalance scores across language may be explained by different use of vowels and oral and nasal consonants across language (Anderson, 1996).

Hindi has five nasal sounds mainly, velar, palatal, dental, alveolar and bilabial of which three are more prevalently used. In addition to these nasal sounds, nasalization is also highly prevalent, which may account for increased nasal resonance. Malayalam has six nasal consonants, all of which are prevalently used, whereas, Kannada has five nasal consonants of which only four are commonly used (bilabial, alveolar, dental and retroflex).

The frequency of usage of different sounds has been studied (Ramakrishna et al, 1962). Looking at the frequencies of nasal sounds in Kannada, Hindi and Malayalam, it can be seen that nasals are more prevalently used in Hindi and Malayalam as compared to Kannada. The frequency of occurrence of nasal sounds in Kannada, Malayalam and Hindi are given in Table 3.

	m (bilabial)	n (alveolar)	n (palatal)	ng (velar)	n (retroflex)	**Total**
Kannada	2.00	4.90	0	0.03	0.65	**7.58**
Malayalam	2.65	7.55	0.43	0.82	1.36	12.81
Hindi	2.98	4.02	0.15	0.17	0.74	8.06

Table 3: Frequency of occurrence of nasal sounds (in %)

These inherent characteristics of the native languages may influence articulatory characteristics in spoken English. Again, these factors can explain the significant difference seen between the mean nasalance scores of Mid Atlantic English (Litzaw and Dalston, 1992) speakers and native Hindi and Malayalam speakers, for standard Zoo passage.

Again, the nasal characteristics of Kannada and Mid Atlantic English (Litzaw and Dalston, 1992) may hold certain similarities which may account for similar mean nasalance scores. However, further research is warranted to validate the same. Also, similarity in mean nasalance scores of native Kannada speakers obtained in this study and the Indian study (Mahesh and Pushpavathi, 2008) may possibly be explained by the subject population chosen in the Indian study, which may have included more number of subjects with Kannada as their native language.

To conclude, the results of the present study are in consensus with that of Anderson (1996), who reported native language as a factor that influences nasalance of normal speech. Thus, it is essential that for establishing normative data for Nasometer, issues pertaining to native language and dialect need to be considered. Mean nasometric values obtained for a specific linguistic group may not be valid for use with other groups, even though they may speak the same language. This study is an initial step to ascertain the influence of native languages on nasalance measurement. This signifies the essentiality to develop normative data for different linguistic and dialectal populations. Clinically, the normative data reported in the present study may help identify the clients with resonance disorders.

Conclusions

An exploration of mean nasalance scores across native Hindi, Malayalam and Kannada speakers, for Zoo passage revealed native language as one of the factors influencing nasalance of normal speech. Thus, it puts emphasis on the necessity of considering issues pertaining to native language and dialect while establishing normative data for Nasometer especially in the Indian context as linguistic and cultural diversity are gaining more relevance.

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