COMPARISON OF NASALANCE SCORES IN NON NATIVE ENGLISH SPEAKERS

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ABSTRACT

Nasal sounds are characterized by nasal resonance which is a subjective perception of nasal components of speech. The Nasometer was developed to quantify the nasal resonance (Nasalance), and has been found to be a valid and reliable measure for evaluating nasality objectively. Nasalance is the ratio of nasal acoustic energy to nasal and oral acoustic energy. Nasalance of normal speech is influenced by phonetic composition of the speech stimulus, native language, age and gender. The aim of the study was to find out the influence of Malayalam and Tamil, on nasalance values while reading English. The study included two groups of subjects in which Group A has 30 subjects (15 males and 15 females) with Malayalam as their native language and Group B has 30 subjects (15 males and 15 females) with Tamil as their native language in the age range of 18 to 25 years. The subjects were asked to read the Zoo passage which is loaded with high pressure oral consonants and Nasometer II (model no 6450) was used to measure the nasalance. The results revealed a significant difference in nasal resonance between Malayalam and Tamil speakers while reading the English passage.

Key words: Nasal resonance, Nasalance, Nasometer II, Zoo passage

Introduction

Speech production is achieved with pulmonary pressure provided by the lungs which generates sound by vibration of vocal folds in the larynx that then is modified by the vocal tract. The air stream is shaped into specific speech sounds by the articulators. The tongue and the lips are the most evident articulators but also the soft palate plays an important role. During speech production, the soft palate is raised for a large part of the speaking time to close the opening between the oral and the nasal cavities (velopharyngeal port). Normal speech production depends on the ability to rapidly couple and decouple the nasal cavity from the oral cavity. Nasal speech sounds require oral nasal coupling, oral sounds require oral nasal decoupling. The process of coupling and decoupling the oral and nasal cavities for speech is called velopharyngeal valving. This valving is controlled by elevation of the velum and constriction of the pharyngeal walls (Sudarshan Reddy, Sheela and Kishore Pebbili, 2012)

Nasality is an aspect of voice quality that is produced by nasal resonators which is used for assessment and treatment of resonance disorders. Nasality is disordered speech as well as in normal speech. Sensitive tools to assess the individuals with
Nasalance is the proportion of nasal energy to the total acoustic energy in a speech signal. It helps the speech-language pathologist to support the perceptual assessment and to provide a quantitative measure of perceived nasality. Nasalance measure acts as a supplement for the speech evaluation of individuals with resonance disorders resulting from cleft palate and other craniofacial disorders (Sudarshan Reddy, Sheela and Kishore Pebbili, 2012).

Nasalance is measured by a computerized instrument called Nasometer and it is a noninvasive personalized computer based device and is used to measure the amount of nasality of speech at any point of the sample, by measuring the acoustic output from both the nasal and the oral cavity by using two microphones, separated by an acoustic shield that rests on a headset which gives appropriate position for the microphones.

The Nasometer 6200 (Kay Elemetrics Corp., Lincoln Park, NJ) was developed by Fletcher, Adams, McCutcheon in 1989, and it is commonly used in the assessment of hypernasal speech. The Nasometer 6200 comprises a headset with a sound-separator plate and two microphones. An analog preamplifier filters the signal with a bandwidth of 300 Hz around a 500 Hz center frequency. The filtered signal is then converted to DC voltage and fed to the application software for further analysis. Nasometer II, Model 6450 (Kay Pentax), is a version of the Nasometer 6200 developed in the year 2002. The value of nasalance obtained through the nasometer reflects the relative amount of nasal acoustic energy present in the speech of an individual, providing an acoustic correlate of speech nasality (Trindade, Genaro, Dalston, Kalyan, Sweeney, Dalston, & O’Regan, 2004).

Nasalance is usually done with several speech samples and materials and reading materials. Zoo passage is a standard English passage used to assess nasalance. This paragraph contains a variety of oral consonants (plosives, fricatives, glides). The zoo passage has 83 syllables in length and it is sufficiently long to obtain valid and stable measures of nasalance. Nasalance is influenced by many parameters such as age, dialect, native language and gender. Anderson (1996) reported native language as a factor that influences nasalance of normal speech.

Sunita, Roopa & Prakash (1994) conducted a study to establish the normative nasalance data in Tamil speaking individual. In the first phase, ten meaningful sentences using the various sound classes in Tamil were developed. These were repeated by 120 children (60 boys and 60 girls) in the age range of 5 to 15 years. The data was analyzed using the Kay Nasometer (Model 6500) and the results revealed that girls showed higher nasalance value than boys. The results showed the normative for oral stimuli (9-15%), nasal stimuli (58-62%), and predominately oral stimuli (20-40%). The nasalance cut-off ranged between 13% and 17% across the gender and age for Tamil language.

Gnanavel, Gopisankar & Pushpavathi (2013), did a study to see the effect of stimuli (two sets of meaningful Malayalam words and sentences were prepared. One set consisted of nasal sentences and nasal words, which had predominantly nasal consonants and other set was oral sentence and oral words, which predominantly consisted of oral consonants. Each category consisted of 5 words and 5 sentences) and gender differences on nasalance scores in Malayalam speaking adult population. The females showed significantly higher mean nasalance scores than males.

Devi & Pushpavathi (2009) stated higher nasalance values for Malayalam speaking females than Malayalam speaking males across nasal and oral stimuli. In females, nasalance value for nasal sentences was 57.55%, for nasal paragraph was 56.93%, for oral sentences was 24.78% and for oral paragraph was 23.16%. In males, the nasalance value for oral sentence was 51.19%, nasal paragraph value was 51.43%, oral sentences value was 21.64% and oral paragraph value was 21.36%.

Sweeney, Sell, & O’Regan (2004) evaluated 70 normal Irish children evaluated 70 normal Irish children with age range of 4 years to 13 years. The children repeated each of the 16 sentences individually. The sentences were presented in groups according to consonant type (High pressure, low pressure and nasal consonant). Normative nasalance scores were obtained for three groups of sentences. The group mean nasalance score for boys was 26% (SD 4.18), and the group means nasalance score for girls was 27% (SD of 4.12). There was no significant difference in nasalance scores between males and female speakers.

Seaver, Dalston, Leeper & Adams (1991) studied nasalance values for a large number of normal adult subjects speaking a variety of dialects of English. The Nasometer was used to measure the amount of nasal acoustic energy in the speech of 148 normal adults from four geographical regions of North America. Means and standard deviations for the nasalance and deviation scores are presented for each of these different reading passages. The Mid-Atlantic speakers were found to have significantly higher nasalance scores on all three reading passages. In addition, the female subjects had significantly higher nasalance scores on the Nasal Sentences.

Kalyani, Sinha, Kumar, Hota & Das (2016) studied influence of Mizo language on nasal and oral passage in English and obtained mean nasalance scores for zoo passage, rainbow passage and nasal sentences in females and males. They reported significant differences between males and females for Zoo and Rainbow Passages but not in Nasal Sentences.
Many studies reported a difference in nasalance scores across gender and native languages. However, there are not many studies that have focused on comparison of nasalance scores in non-native English speakers. Hence the present study aims to find out the influence of two classical Dravidian languages - Malayalam and Tamil, on nasalance values while reading English.

**Objectives of the study**

1. To study gender differences on nasalance scores in non-native English speakers
2. To compare the nasalance scores in Tamil and Malayalam speakers while reading English.

**Method**

The study consisted of two groups (Group A and Group B) with 30 subjects in each group. Group A consisted of 15 males and 15 females, who had Malayalam as their native language. Group B had 15 males and 15 females, who had Tamil as their native language; both in the age range of 18-30 years. The subject selection criteria were: a) The subjects in Group A should have Malayalam as their first language and Group B should have Tamil as their first language; b) All the subjects should have learned English as their second language during their school education; c) All the subjects had normal structure and function of oro-facial structures. The participants having any speech and language problem, perceived resonance disorder, suffering from cold or other upper respiratory tract infections and any hearing problem were excluded from the study.

Instructions were given in English. The subjects were asked to read the ‘Zoo passage’, a standard English passage which is loaded with only high pressure oral consonants. Nasometer II (Model no. 6450) was used to measure the nasalance. Prior to data collection, the instrument was calibrated. The subjects were seated in an acoustically treated room with the Nasometer headset placed and adjusted appropriately, so that the separation plate rested comfortably on the subject’s upper lip and perpendicular to the plane of the face. Nasalance is expressed as a percentage value computed from the ratio \( \text{Nasalance} = \frac{\text{Nasal}}{\text{Oral}+\text{Nasal}} \times 100 \). The mean nasalance scores along with the minimum and maximum nasalance scores were noted for each subject.

**Results**

The present study aimed at investigating the influence of native language on English in Malayalam and Tamil speakers in the age range of 18-25 years. The subjects were asked to read the ‘Zoo passage’, a standard English passage which is loaded with only high pressure oral consonants. The samples of Malayalam and Tamil speakers were recorded. The total scores of occurrence of nasalance in Malayalam and Tamil speakers were scored and tabulated.

The SPSS software was used to carry out the statistical analysis. The mean scores of occurrence of nasalance and standard deviation were calculated for the data of the samples of Malayalam and Tamil speakers belonging to the age range of 18-25 years. Independent sample t test was conducted to find out the significance of difference in the mean scores of occurrence of nasalance within the males and females of among each group and between the Groups (Malayalam and Tamil speakers) in the age groups of 18-25 years, while reading English.

The results are composed of four phases:

A) Mean value of nasalance scores of native Tamil speakers (while reading English passage).
B) Mean value of nasalance scores of native Malayalam speakers (while reading English passage).
C) Comparison of nasalance scores between Native Tamil male speakers and Native Malayalam male speakers (while reading English passage).
D) Comparison of nasalance scores between Native Tamil female speakers and Native Malayalam female speakers (while reading English passage).

A) Mean value of nasalance scores of native Tamil speakers

The mean scores of occurrence of nasalance in Tamil speakers are shown in Table 1

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>14.20</td>
<td>1.190</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>15.40</td>
<td>1.313</td>
</tr>
</tbody>
</table>

Table 1. Mean and standard deviation of nasalance in Tamil speakers.
Figure 1: Mean values of nasalance scores for male and female Tamil speakers

In Tamil speaking males the mean score of occurrence of nasalance was 14.20 and the standard deviation was 1.190. In Tamil speaking females the mean score of occurrence of nasalance was 15.40 with the standard deviation being 1.313. The mean nasalance scores for females were greater than males in Tamil speakers while reading the English passage.

Independent sample t test was carried out to compare between Tamil male and female speakers. Table 2 shows that there was a significant difference (p<0.05) in nasalance between Tamil male and female speakers while reading English

Table 2. Independent sample t test for comparison of occurrence of nasalance between Tamil male and female speakers.

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Tamil male and female speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>t value</td>
<td>Significance</td>
</tr>
<tr>
<td></td>
<td>-2.616</td>
</tr>
<tr>
<td></td>
<td>.014</td>
</tr>
</tbody>
</table>

B) Mean value of nasalance scores of native Malayalam speakers

The mean scores of occurrence of nasalance in Malayalam speakers are shown in Table 3

Table 3. Mean and standard deviation of nasalance in Malayalam speakers.

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>15</td>
<td>22.33</td>
<td>1.672</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>19.33</td>
<td>2.028</td>
</tr>
</tbody>
</table>

Figure 2: Mean values of nasalance scores for male and female Malayalam speakers
In Malayalam speaking males the mean score of occurrence of nasalance was 22.33 and the standard deviation was 1.672. In Malayalam speaking females the mean score of occurrence of nasalance was 19.33 with the standard deviation being 2.028. The mean nasalance scores for males were greater than females in Malayalam speakers while reading the English passage.

Table 4. *Independent sample t test for comparison of occurrence of nasalance between Malayalam male and female speakers.*

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Malayalam male and female speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>t value</td>
<td>Significance</td>
</tr>
<tr>
<td>4.421</td>
<td>.000</td>
</tr>
</tbody>
</table>

Independent sample t test was carried out to compare between Malayalam male and female speakers. Table 4 shows that there was a significant difference (p=0.00) in nasalance between Malayalam male and female speakers while reading English.

C) Comparison of nasalance scores between Native Tamil male speakers and Native Malayalam male speakers while reading English passage

The mean scores of occurrence of nasalance between Tamil male and Malayalam male speakers are shown in Table 5.

Table 5. *Mean and standard deviation of nasalance for Tamil male and Malayalam male speakers.*

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Males</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil</td>
<td>15</td>
<td>14.20</td>
<td>1.190</td>
<td></td>
</tr>
<tr>
<td>Malayalam</td>
<td>15</td>
<td>22.33</td>
<td>1.672</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 3: Mean nasalance scores for Tamil male and Malayalam male speakers in English](image)

The average mean nasalance scores for native Malayalam male speakers were greater than native Tamil male speakers while reading English. The mean score of occurrence of nasalance for Tamil male speakers was 14.20 and the standard deviation was 1.190. The mean score of occurrence of nasalance for Malayalam male speakers was 22.33 and the standard deviation was 1.672.

Table 6. *Independent sample t test for comparison of occurrence of nasalance between Tamil male and Malayalam male speakers.*

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Tamil and Malayalam male speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>t value</td>
<td>Significance</td>
</tr>
<tr>
<td>-15.332</td>
<td>.000</td>
</tr>
</tbody>
</table>
Independent sample t test was carried out to compare between Tamil male and Malayalam male speakers. Table 6 shows that there was a significant difference ($p=0.00$) in nasalance between Tamil male and Malayalam male speakers while reading English.

D) Comparison of nasalance scores between Native Tamil female speakers and Native Malayalam female speakers while reading English passage

The mean scores of occurrence of nasalance between Tamil female and Malayalam female speakers are shown in Table 7.

Table 7. Mean and standard deviation of nasalance for Tamil female and Malayalam female speakers.

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Females</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil</td>
<td>15</td>
<td>15.40</td>
<td>1.313</td>
<td></td>
</tr>
<tr>
<td>Malayalam</td>
<td>15</td>
<td>19.33</td>
<td>2.028</td>
<td></td>
</tr>
</tbody>
</table>

![Mean values of nasalance scores for Tamil and Malayalam female speakers](image)

**Figure 4: Mean nasalance scores for Tamil female and Malayalam female speakers in English**

The average mean nasalance scores for native Malayalam female speakers were greater than native Tamil female speakers while reading English. The mean score of occurrence of nasalance for Tamil female speakers was 15.40 and the standard deviation was 1.313. The mean score of occurrence of nasalance for Malayalam female speakers was 19.33 and the standard deviation was 2.028

Table 8. Independent sample t test for comparison of occurrence of nasalance between Tamil female and Malayalam female speakers.

<table>
<thead>
<tr>
<th>Nasalance</th>
<th>Tamil and Malayalam female speakers</th>
<th>t value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t value</td>
<td>-6.294</td>
<td>.000</td>
</tr>
</tbody>
</table>

Independent sample t test was carried out to compare between Tamil female and Malayalam female speakers. Table 8 shows that there was a significant difference ($p=0.00$) in nasalance between Tamil female and Malayalam female speakers while reading English.

**Discussion**

Various studies have done to develop normative data in Indian languages. But the present study aims to compare the influence of Malayalam and Tamil, on nasalance scores while reading English. The result of this study shows that there is a significant difference in the nasalance values for males and females. The mean nasalance scores for females were slightly greater than males in Tamil speakers and the mean nasalance scores for males were slightly greater than females in Malayalam speakers while reading the English passage.

Mean nasalance score varies across gender and it can be due to the basic structural and functional differences of the velopharyngeal mechanism across gender. Hutchinson, Robinson & Nerbonne (1978) and Devi & Pushpavathi (2009) reported that
female speakers have significantly higher nasalance scores than male speaker on passage containing nasal consonants. However Fletcher (1978) reported of higher nasal value for normal men on nasal sentences.

Van Lierde, Wuyts, Bodt and Van Cauwenberge (2003) evaluated 33 children (15 girls and 18 boys) in Flemish language. Three different types of stimuli were used. (Oral, oronasal and nasal text). They recorded children producing sounds and the read three texts. They compared the nasal resonance data from the children with those of 58 adults that have been obtained in a previous study. Results suggested that women had higher scores than men during the production of the /u/ in the oro nasal text and the nasal text. But it was not statistically significant.

The current study also reported that the average mean nasalance scores of male and female native Malayalam speakers were greater than male and female native Tamil speakers while reading in English passage. The results of the study support the findings of Leah Philip, Pushpavathi & Sangeetha Mahesh (2009) who reported variation in the nasalance value across various languages. The study reported significant differences in nasalance scores comparing native and non-native English speakers. They investigated the influence of three native languages (Kannada, Malayalam and Hindi) on nasalance values for standard Zoo passage. The results revealed greater nasalance scores for Malayalam and Hindi native speakers than for Kannada speakers. Phonemic characteristics of a language can influence the mean nasalance scores.

Conclusion

Nasality can be influenced by various factors such as age, gender, structural and functional deficits and native language. Gender related differences and cross-linguistic differences are studied in this current study. These factors have to be taken into account during assessing the patients and also while planning intervention. In the Indian context, studying the influence of a native language on nasalance scores is necessary and important for an accurate diagnosis and intervention. Further studies can be carried out in various languages and its comparison.

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References