Articulation and Speech rate in Hindi-speaking Adults

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MYSURU- 570006

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CERTIFICATE

This is to certify that this dissertation entitled **"Articulation and Speech Rate in Hindi-speaking Adults"** is a Bonafide work submitted in part fulfilment for the degree of Master of Science (Speech-Language Pathology) of the student Registration number P01II21S0004. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **"Articulation and Speech Rate in Hindi-speaking Adults"** is the result of my own study under the guidance of Dr Sangeetha Mahesh, Associate Professor, Department of Clinical Services, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CHAPTER I

INTRODUCTION

The audible presentation of language is called speech, having three major components: linguistic knowledge, pragmatic and prosodic features. The coordinated function of the speech systems helps in intelligible speech production. The speed at which an individual produces articulation to produce speech is defined as the speaking rate (Robb et al., 2004).

The components of speech, when produced at a speed regardless of the pauses, can be defined as articulation rate (Eisler,1961). The speech and articulation rates could be used equivalently to measure speech intelligibility as both are defined as the number of output units per time unit (Tsao et al., 2006). Speaking and articulation rates frequently coexist, especially for momentary or speech samples elicited with no pauses; one can manipulate the pause behavior by speaking relatively slowly and yet articulating fast.

According to a study by Eisler (1956), who conducted adult interviews, found that the extent of pause time correlated more with speaking rate as compared to articulation rate (r= -.94 and −.17 respectively). Since the speaking rate is directly influenced by the pause behavior, the articulation rate is more efficient in measuring the articulators in an ongoing speech rather than the speaking rate. The articulation rate reflects neuromotor constraints (Tsao & Weismer, 1997). Literature reveals that the speaker's age has the most reported impact on speech and articulation rates and that as the speaker ages, the speech rate reduces (Searl et al., 2002; Yuan et al., 2006; Martins & Andrade, 2008).

The frequency of stuttering in individuals with fluency disorder differs based on how long the core behavior lasts. In individuals with mild stuttering, the frequency of stuttering is less than 5%, whereas in severe stuttering, the frequency is more than 50% of the words (Bloodstein et al., 2008). Similarly, in cluttering due to rapid segments of speech, the occurrence of normal disfluencies is more than 10%. The rise in the rate of speech causes imprecise articulation, the occurrence of excessive disfluencies, omission of pauses and reduced speech intelligibility (Moço et al., 2010). Thus, it can be concluded that speech rate is affected more in severe cases of fluency disorders, and the occurrence of disfluencies impacts speech rate and intelligibility. To evaluate and treat fluency disorders, speech rate is important, and various studies on disordered populations have pointed out the negative correlation of speech rate with stuttering severity, which results from longer disfluent events (Sander, 1961).

Speech tempo is speaker-specific, which depends on the speed of articulatory movement, the length of utterance, complexity, age, gender, geographic region and socio-economic status. Speech tempo can be considered as both “speech rate” and “articulation rate”, but since speech rate takes “global” speaker characteristics and varies across the aforementioned factors, it does not give a good estimate of cross-dialectal difference (Jacewicz et al., 2009).

Articulation gives information on the temporal aspects of motor production and the transition required for speech production (Chon et al., 2012). However, it has received less attention in the Indian context, due to which norms have not been established in any of the Indian languages as well as the contextual difference has also not been conducted. It differs from speech rate in the sense that it does not include disfluent events when the number of outputs per unit of time is calculated (Jacewicz et

al., 2009). Thus, a normative on articulation rate in each language should be developed, which will provide a standard comparison across dialects and languages, eliminating the factors that vary.

Rate can be calculated by two means: one is by measuring the number of syllables per unit time (SPS), and the other includes measuring words per minute (WPM) (Ward, 2017). The number of syllables a word consists of depends on factors like education, age, language and culture. Thus, calculating WPM gives lesser accuracy than SPS.

As a result of varying linguistic structures among various language groups, it is obvious that the speech rate also differs. There have been studies done on establishing normative speech rates in Dravidian languages, but there is a dearth of studies for the same in other language families of India. Therefore, it is necessary to gather normative speech rate data from different languages and their dialects to set suitable goals for the disordered population.

Hindi language belongs to one of the Indo-Aryan branches of the Indo-European language family. The official languages of India include Hindi as well as English. Since the region around Delhi has been a centre of power in North India, the Khari boli dialect came to be regarded as urban and of a higher standard than the other dialects of Hindi. Hindustani and English languages are the two major lingua franca of India. Deviations in pronunciation of speech are present due to regional factors, and thus, the speech and articulation rate varies among languages as well as dialects of the same language. Thus, as a part of this study, speakers belonging to only the Delhi NCR region were included.

The context in which speech is produced has an influence on the speaking rate. The levels of language demand contrast between oral reading, picture description and conversational speech, suggesting that the level of stress differs depending on the context (Duchin & Mysak, 1987). Spontaneous speech is produced rapidly, which leads to more disfluent events in speech compared to reading, as it requires a simultaneous process of thinking, formulating the message and speaking. Conversation is an expression or exchange of thoughts with a communication partner, whereas narration is a systematic presentation of events or a series of events. Since, spontaneous speech imposes the most natural way of speech production, the development of norms on speech and articulation rates should focus on this task.

The intelligibility of speech output is affected due to the rate at which an individual speaks. Therefore, an abnormally high or low speech rate affects the listener's understanding of informational content. Rate of speech is one of the important assessment protocols for various communication disorders. Therefore, the development of norms in each language is thus essential. Hence, this study aims to develop normative on articulation and speech rate in typical Hindi speakers.

1.1) Need for the study

To the best of the researcher’s knowledge, no studies have been done yet to check for the articulation rate in Hindi speakers. For the rate of speech, except for Rathna et al. 1977 study, none reported developed norms for Hindi speakers. But, in this study as well, the number of participants (N=3) was inadequate to represent the Hindi-speaking population, creating a need to establish new norms with an adequate subject size.

While spontaneous speech can be evoked through many tasks like narration, discussion and picture description, several other studies done to establish norms in different languages have performed either one of the above tasks. Thus, it is essential to study spontaneous speech, in particular, including various spontaneous speaking tasks to elicit natural speech in order to arrive at normative values.

None of the Indian studies has yet studied the difference between articulation and speech rate, which justifies one of the needs of this study. Along with that, the frequency of normal disfluencies in typical speakers has also not been established yet.

Speech and articulation rates are important assessment protocols for various communication disorders. The development of norms in each language is thus essential, especially in spontaneous speaking tasks. Hence, the present study is planned in Hindi language.

1.2) Aim of the study

To establish normative data on articulation and speech rates in native speakers of the Hindi language aged between 18-40 years.

1.3) Objectives of the study

1. To identify the difference between articulation and speech rate in spontaneous speaking tasks in Hindi speakers.

2. To identify the frequency of occurrence of normal disfluencies like word or phrase repetitions, interjections, revisions and fillers and typical pause duration used by Hindi speakers between utterances.

3. To compare the articulation and speech rate across gender in Hindi-speaking adults.

4. To compare the articulation and speech rate of Hindi language with other studies done on different Indian languages.

CHAPTER II

REVIEW OF LITERATURE

According to the Census of India, 2011, Hindi is the most spoken language in India, which is spoken by 52,83,47,193 speakers, including speakers from various Hindi dialects. It is written in Devnagari or 'Nagari' script. The script is syllabic, so unlike English, Hindi language is pronounced as it is written. ("About Hindi | Linguistics at Illinois," n.d.)

According to ASHA, in a study done by (Zablotsky et al., 2019) in U.S., nearly 2% of children aged between 3-17 years have stuttering whereas, in adults aged between 21-50 years, the prevalence rate is 0.78%. However, considering cluttering, the prevalence rate is between 1.1% to 1.2% in school-age children (Van Zaelen et al., 2017).

Considering the number of Hindi-speaking population, the prevalence rate of fluency disorder may comprise more people from this language group than any other language group in India. Moreover, as discussed in the introduction, speech rate is the primary factor that affects the fluency aspect of speech rhythm; thus, each language and its dialects should be equipped with normative data on speech rate that will serve as a basis to assess as well as treat individuals with fluency disorders.

A normative study on the speech rate of Hindi speakers was done by Rathna et al. in the year 1977, where 3 participants from each language, i.e., Marathi, Hindi, Punjabi, Kannada and Tamil, were taken. The subjects were asked to read a chapter from a book and talk on a topic of their interest for five minutes each. As a result of this study, the speech rate on reading tasks for these languages in WPM and SPM came out as 131 and 355, 198 and 440.33, 163 and 334.67, 93 and 429.67, and 127.33 and 503.67,

respectively. For spontaneous speech, the respective WPM and SPM were 123.33 and 345, 153.67 and 275.33, 149 and 317.67, 111.33 and 422.67, and 116.33 and 448.33.

Hindi language is spoken by more than 528 million people; thus, the sample size used in the above-mentioned study is very small to derive a normative. This creates a need to establish normative by taking more participants that can represent the entire population.

2.1) Speech Rate

The speech rate is an essential aspect of evaluating and managing fluency disorders. Since deliberately reducing the rate of speech during stuttering episodes reduces the incidence of stuttering, almost all the approaches for the treatment of stuttering include reducing the rate as one of their prime targets (Adams et al.,1973; Johnson & Rosen,1937). Even for cluttering, controlling the rate is a part of management (Daly, 1986). In addition, post-treatment, an individual with fluency disorder can be evaluated perceptually to indicate the normalcy of speech rate. (Ingham & Packman, 1978). If a speech is produced extremely slowly without any disfluencies, it sounds unnatural to the listener. Individuals with speech timing disorders have difficulty attaining normal speaking rate (Robb et al., 2004). A controlled study done on Parkinson's disease reveals that there is a declining speech rate as a result of movement disorder, which affects the physiology of speech production systems (Martínez-Sánchez et al., 2016).

As described by DSM V (2013), stuttering is defined as a disturbance in normal fluency and timing pattern because of sound or syllable repetitions, sound prolongations, broken words, blocks and circumlocutions which leads to anxiety in speaking situations. As a result of a combined or individual effect of these disfluencies, one can imagine the reduction in fluency or speech rate. A theory which states, as the

severity of stuttering increases, the higher the speech disfluency, is proved by a study conducted by (Arcuri et al., 2009), where six adult stutterers between the age range of 22 and 35 years were included having varied severity levels, 2 had mild, 2 with moderate and 2 with severe stuttering severity. The task included the individuals saying three tri-syllabic words inserted in a carrier phrase. As a result, the mild and moderate groups of stutterers had similar performance, which differed significantly from that of the severe stuttering group. This is in line with the relationship that the higher the degree of severity lower the information production and rate of articulation in stutterers.

Cluttering, according to St. Louis et al., 2009, is when the conversation of a native speaker is perceived to be too fast, too irregular, or both. It is followed by excessive "normal disfluencies", deletion of syllables, abnormal pauses, and stress. In order to treat such individuals, clinicians should have bounds of normal variation, without understanding that setting goals and planning treatment is difficult.

Various studies in foreign as well as Indian languages have been done in an attempt to establish normative for speech rate. In British English, it is reported that various professions like radio broadcasters, lecturers, and interviews have respective speech rates of 150-170WPM, 125-160WPM, and 160-230WPM, with speech rate of conversation being the highest (Tauroza & Allison, 1990). In the English language, speech rate ranges from 120-260WPM (Gotz, 2013), indicating that speech rate tends to vary within the native language among speakers. In Jordanian language speakers, the speech rate in spontaneous speaking and reading tasks in adults aged between 18-25 years is 124.51 WPM and 141.36 WPM, respectively (Damhoureyeh et al., 2020). As a part of data collection, the participants were asked to speak for 3-5 minutes in response to open-ended questions, including topics like study topics, friend activities and interest

for the spontaneous speaking task, whereas, for reading, participants were asked to read a selected paragraph from a journal.

In a study by Savithri and Jayaram, 2004 a total of 401 Dravidian language-speaking participants ranging in 10 decades aged between 3-100years were assessed for speech rate across Tamil, Telugu, Kannada and Malayalam languages on picture description and reading tasks for children and adults, respectively, revealed that for Kannada speakers SPM and WPM increased from 3 years to 40 years and further decreased between 41-90years. For Telugu language SPM and WPM increased to 30 years and further decreased. Between the ages of 5 to 80 years, SPM and WPM increased for Tamil speakers, whereas, for Malayalam speakers, it increased between the ages of 11 to 30 years and decreased post 31 years to 100 years. The mean speech rates in Kannada, Tamil, Telugu and Malayalam in SPS and WPM are 6, 6, 6, 8 and 113, 111, 117 and 114 respectively. The Punjabi language has a mean speech rate of 3.44 SPS, 135.818 WPM and 4.23 SPS, 159.456 WPM in spontaneous speech and reading tasks, respectively, for adults between the ages of 18 to 40 years. For elicitation of the speech sample, a passage from the 10^{th} standard Punjabi textbook was selected, and for the spontaneous speech task, subjects were asked to retell a story (Kaushal et al., 2011).

Table 2.1

Speech rate of different languages from different studies. (+) indicates the speech rate in the particular task. For Rathna et al. (1997) study, the overall mean for both tasks was taken; therefore, (+) is marked for both tasks simultaneously

Speech Rate		Tasks		References	Languages
SPS	**WPM**	**Reading**	**Narration**		
7.3	198	+			Hindi
4.58	153.67		+	Rathna et al., 1977	Hindi
5.91	131	+			Marathi
5.75	123.33		+		Marathi
6	113	+	+		Kannada
6	111	+	+	Savithri et al., 2004	Telugu
6	117	+	+		Tamil
8	114	+	+		Malayalam
4.23	159.45	+		Kaushal et al., 2011	Punjabi
3.44	135.82		+		Punjabi

Since, there is no standardized normative in Hindi language with adequate participants, it creates a need to establish norms on speech rate.

2.2) Articulation Rate

The articulation rate depends on the personality of an individual as well as it reflects the spontaneity in speech production and is not affected by variations in verbal planning (Eisler, 1961). According to a study by Mahr et al., 2021, the articulation rate is hard to detect after 10 years of age, or due to increasing age, a plateau is achieved with a relatively sharp peak. Studies have also reported that the articulation rate differs based on slow and fast speakers. One such study was done by Tsao et al. (2006), where they found that slow speakers, when they tried speaking at a rate higher than their habitual rate, it was equal to the habitual rate of a fast speaker. The articulation rate has been shown to change after practice (Eisler, 1961). It is affected by the phrase length, i.e., in short phrases, the number of syllables is less; thus, they are spoken slower.

It has been reported that children with stuttering have relatively high articulation rates not because of limited speech motor ability but because of fluency failure suggesting that slow rate acts as a buffer for fluency breakdown causing high articulation rate (Kloth et al., 1995). Similarly, Bóna and Kohári (2021) study revealed that in a spontaneous speaking task in individuals aged between 20 to 32 years, the articulation rate of the cluttering group, which was 7.94 SPS was higher than the control group 6.25 SPS, and the rates significantly differed from each other.

Some studies have suggested that the articulatory rate can predict speech-motor deficits in dysarthric children. According to Allison and Hustad (2018), on comparing children with dysarthria with typically developing children, they found that 13 out of 20 dysarthric individuals had their articulation rate below the typically developing group; they concluded that articulation rate is a prime factor that helps in differentiation of the subgroups of dysarthric children having similar intelligibility levels.

Few studies have been done in foreign language contexts. The articulation rate in 112 New Zealand adults aged between 64 to 91 years is 4.93 SPS in conversation and 4.38 SPS in reading. Concluding that reading has a slower articulation rate. In Hebrew speakers, the articulation rate in children belonging to childhood and adolescent groups between the ages of 3- 17 can be interpreted from the following Table 2.2 (Amir & Grinfeld, 2011).

Table 2.2

Articulation rate across different age groups from childhood to adolescence in conversation and picture description tasks (Amir & Grinfeld, 2011)

Task	Metric	Age group						
		3	5	7	9	11	13	17
Conversation	WPM	137.70 (24.52)	132.95 (18.05)	162.13 (19.26)	174.64 (26.38)	181.48 (22.44)	202.83 (22.03)	237.96 (43.02)
	SPS	4.43 (0.65)	4.46 (0.54)	5.19 (0.70)	5.89 (0.71)	5.92 (0.76)	7.19 (0.60)	7.72 (0.97)
	PPS	8.97 (1.05)	9.59 (0.92)	10.94 (1.25)	12.44 (1.44)	12.90 (1.48)	14.13 (1.38)	16.39 (1.90)
Picture description	WPM	96.52 (14.22)	99.53 (14.99)	114.72 (12.68)	127.62 (22.67)	136.10 (16.03)	152.19 (15.42)	170.75 (15.82)
	SPS	4.11 (0.50)	4.31 (0.61)	4.96 (0.54)	5.39 (0.68)	6.14 (0.70)	6.37 (0.78)	7.28 (0.81)
	PPS	8.52 (1.06)	9.30 (1.34)	10.60 (1.17)	11.42 (1.44)	12.91 (1.46)	13.55 (1.59)	15.55 (1.64)

This study indicates the increase in articulation rate with age. Overall, the articulation rate in conversation is greater than in the picture description.

Determining the articulation rate is a tedious process, but it gives a good measurement of the time used by the articulators to move. As mentioned earlier, context plays a role in speech production; thus, the articulatory rate will be high in spontaneous speech. Moreover, increased articulatory rate affects intelligibility as seen in individuals with cluttering; therefore, normative must be established to identify speech with high or low articulatory rates and treat accordingly.

Normative study on articulation rate in the Indian context has not been conducted yet; thus, this study attempts to establish norms on articulation rate in Hindi speakers.

2.3) Speech and Articulation Rate between Gender

Few studies in Indian languages have compared speech and articulation rates across genders, but insignificant differences have been reported. Studies were done in Kannada (Venkatesh et al., 1982), Marathi (Jawadekar et al., 1999), and Punjabi (Kaushal et al., 2011) languages have reported no significant difference in the rate in males and females.

In contrast to Indian studies, few international studies have reported gender differences. A study examining the characteristics of read speech in 3 men and 3 women with a British General Northern accent. Results revealed that women had longer mean sentence durations with high standard deviations. Pause occurred more frequently in women than men (Whiteside, 1996). In the case of adult Jordanian speakers, it was found that in a group of 51 participants between the age of 18-25 years, both articulation and speech rate was faster during reading and spontaneous speech in males than females (Damhoureyeh et al., 2020). Verhoeven et al., (2004) assessed 160 male and female Dutch speakers on a 15-minute conversation and reported that men spoke 6% faster than women, i.e., men had a speech rate of 4.23 SPS while females had 4.01 SPS and articulation rate of 4.79 SPS in men and 4.50 SPS for women. A similar but significantly smaller difference was reported by Yuan et al., (2006) in their study, where male speakers of English and Chinese language had a 2% faster conversational articulation rate.

In the Hindi language, no studies have been done yet to identify the difference in rate across genders. For this purpose, the present study aims to identify if any gender discrepancy exists.

2.4) Occurrence of normal dysfluencies

Disfluencies, be it typical or atypical, reflect momentary disruptions in the ongoing flow of the message. As mentioned by David Ward (2018) in his book, “No person is completely fluent, and even the most fluent speaker will make speech errors”. The most common disfluencies include hesitation and phrase revisions. Single-word repetitions and insertion of interjections may also be present.

The distinction between stuttering-like and normal disfluencies depends on the severity of the disfluent moment, the frequency and extra effort in terms of tension (Ward, 2018). In a comparison of PWC (Persons With Cluttering) and PWNC (Persons With No Cluttering), interjections were more and predominantly typical disfluencies occurred more in both groups (Myers et al., 2012). Thus, this study concludes that the type and frequency of disfluencies are similar in typical and PWC.

In spontaneous speech, disfluencies can occur at a rate of 6/100 words (Bortfeld et al., 2001). Disfluent events occur at a higher rate in complex (Lickley, 2001) and longer utterances (Shriberg, 1994). Following Goldman- Eisler’s assertion, many researchers accepted 250 ms as the minimum within sentence hesitation pauses, longer than which is accounted as a cognitive process. In a study (Lickley, 2017), it was concluded that typical disfluencies are shorter, i.e., around 400 ms; however, a stutter can last around 1 second and can be extended to 5 seconds. Similarly, repetition in typical disfluency is not more than 1 repeat, whereas, in stuttering, multiple repetitions are present. Considering prolongations, it is relatively shorter, and blocks are very rare in typical speech.

To identify the frequency of disfluencies in a typical Hindi speaker, this study attempts to develop norms that will help in setting a target for individuals with fluency disorders in reducing the occurrence of disfluent events.

CHAPTER III

METHOD

The present study aims to establish normative data on articulation and speech rates in native speakers of the Hindi language.

3.1 Participants

A total of 63 native Hindi speakers from the Delhi-National Capital Region (NCR) between the age range of 18- 40 years were included in this study. All the participants were literate and belonged to a mid-high socio-economic background. It can be identified from Table 3.1 that most participants were from North East part of Delhi. Out of 63 participants, the speech sample of 3 participants, which was less than 350 syllables, was rejected due to inadequate data. Thus, this study is conducted on 60 typical Hindi speakers.

Table 3.1

Demographic details of all 60 participants.

SL. NO.	NAME	AGE	GENDER	PLACE
1.	AB	21yrs	Female	North East Delhi
2.	AM	23yrs	Female	North East Delhi
3.	AL	22yrs	Female	North East Delhi
4.	EM	25yrs	Female	North East Delhi
5.	ES	18yrs	Female	South Delhi
6.	LK	27yrs	Female	North Delhi
7.	HR	19yrs	Female	South Delhi
8.	NS	21yrs	Female	South Delhi
9.	MS	22yrs	Female	Gurgaon
10.	NP	22yrs	Female	North East Delhi
11.	NT	21yrs	Female	North East Delhi
12.	RP	18yrs	Female	South West Delhi
13.	SS	24yrs	Female	South West Delhi
14.	SD	25yrs	Female	South West Delhi
15.	SK	24yrs	Female	South Delhi
16.	SS	22yrs	Female	Noida
17.	SR	36yrs	Female	North East Delhi
18.	PK	30yrs	Female	South Delhi
19.	UK	30yrs	Female	North East Delhi

20.	RK	31yrs	Female	North East Delhi
21.	CR	32yrs	Female	South West Delhi
22.	MK	35yrs	Female	South West Delhi
23.	MG	39yrs	Female	North Delhi
24.	VD	34yrs	Female	North East Delhi
25.	SC	21yrs	Female	Gurgaon
26.	BN	24yrs	Female	South West Delhi
27.	BS	23yrs	Female	Gurgaon
28.	PK	38yrs	Female	Noida
29.	ST	22yrs	Female	North East Delhi
30.	VK	29yrs	Female	Noida
31.	AT	26yrs	Male	North east Delhi
32.	NS	22yrs	Male	North Delhi
33.	AM	24yrs	Male	Noida
34.	AK	22yrs	Male	Noida
35.	AC	29yrs	Male	North East Delhi
36.	AE	22yrs	Male	South Delhi
37.	BH	24yrs	Male	South West Delhi
38.	DS	23yrs	Male	South West Delhi
39.	DI	18yrs	Male	South Delhi
40.	HG	24yrs	Male	North East Delhi
41.	HK	24yrs	Male	South East Delhi
42.	IS	22yrs	Male	South East Delhi
43.	JU	21yrs	Male	South Delhi
44.	KA	22yrs	Male	Gurgaon
45.	KU	21yrs	Male	South Delhi
46.	LO	24yrs	Male	South Delhi
47.	SA	26yrs	Male	South Delhi
48.	NL	21yrs	Male	South West Delhi
49.	SE	24yrs	Male	South Delhi
50.	UJ	23yrs	Male	Noida
51.	PR	25yrs	Male	Noida
52.	JB	30yrs	Male	North East Delhi
53.	MK	40yrs	Male	Noida
54.	MN	33yrs	Male	South West Delhi
55.	DE	33yrs	Male	South East Delhi
56.	PR	30yrs	Male	South Delhi
57.	VS	40yrs	Male	North Delhi
58.	DK	30yrs	Male	South East Delhi
59.	RJ	25yrs	Male	North West Delhi
60.	RS	26yrs	Male	South Delhi
61.	DC	37yrs	Male	North West Delhi
62.	RN	35yrs	Male	North West Delhi
63.	AS	20yrs	Male	North East Delhi

Inclusion Criteria

- All subjects included were native speakers of the Hindi language and had been brought up in the ambient Hindi environment.
- Hindi speakers from the urban areas in Delhi-NCR were included in the present study.
- Individuals between the age group 18-40 years were considered as this study aimed to develop normative on adult speaking population.

Exclusion Criteria

- Subjects with co-morbid conditions like fluency disorders, neurological impairment, motor speech disorders or any other conditions were excluded from the study.
- Subjects with oro-facial deficits were excluded.

3.2 Stimulus material

1. A set of 10 questions was prepared, leading to a natural conversation.

Figure 3.2

Questions for conversation.

आपका नाम क्या है, और आप कितने साल के हैं?
1. मुझे अपनी शिक्षा के बारे में बताएं?
2. अपने परिवार के बारे में कुछ बताएं?
3. आप अपने खाली समय में क्या करते हैं?
4. आपके शौक क्या क्या है?
5. अपनी नौकरी के बारे में बताओ?
6. आप खुद को फिट रखने के लिए क्या करते हैं, और कितनी बार?
7. आप अगली बार किस जगह की यात्रा करना चाहते हैं और क्यों?
8. आपको सबसे ज्यादा क्या परेशान करता है?
9. आप किस तरह की फिल्म देखना पसंद करते हैं और क्यों?
10.आप किस चीज़ से सबसे ज्यादा डरते हैं?

2. For the narrative task client was given two topics to speak on: Hometown and College/school life.

3.3 Procedure

A verbal consent which included the description of the aim and objectives of the study and willingness to participate, was obtained from each participant, following which speech samples were obtained over a span of 15 minutes, including both the tasks of conversation and narration on the given topic.

The speech samples were collected face-to-face using PRAAT software (6.3 Version). Prior to recording, participants were instructed that the recording would be done in 2 parts. The first was the conversation, where they were instructed to speak as naturally as possible and at a comfortable pace, responding to all questions elaboratively. Similarly, in the second part, which was a narrative task, subjects were instructed that the examiner would not speak in between and that they had to speak for 2-3 minutes on the topic given. The participants were instructed to be seated in a quiet room.The speech was recorded using a Portronics 0922 earphone, and the participant was asked to hold the mic 30 centimetres away from the mouth.

Speech samples obtained were not less than 350 syllables in each task. The speech samples were transcribed orthographically for 350 syllables. Manually the speech transcript was segmented at the syllable level, and any participant who spoke less than 350 syllables was excluded from the study. Participants 31, 32, and 63 were excluded from the study as utterances for both tasks were less than 350 syllables and required more prompts to elicit a representative speech sample.

3.3.1 Speech Rate

The examiner's part of the conversation or any utterance that was produced by the examiner and the use of any English word was excluded. All disfluencies like syllable and word repetition, revision, prolongation and pauses were included. During conversation speech sample analysis, the utterance duration was marked from the beginning of the answer to the question asked till the end of the utterance, as depicted on the PRAAT waveform and audio recording. The narrative speech sample analysis included a continuous speech marked from the onset of the utterance till adequate speech was obtained. For both tasks, speech onset was marked after 10 to 15 seconds of speech onset. This time duration was taken to obtain a steady speech production. To calculate the speech rate, the following formula was used:

$$\text{SPS (Syllables per second)} = \frac{\text{Total number of syllables}}{\text{Overall utterance duration (seconds)}}$$

$$\text{and WPM (Words per minute)} = \frac{\text{Total number of words}}{\text{Overall utterance duration (minutes)}}$$

3.3.2 Articulation Rate

The same procedure as speech rate was followed to mark the onset and offset boundaries for speech. All the disfluencies, including syllable, word and sentence repetition, word revision, repetition, interjections, and speaker attributes that include tongue clicking, laughter and pauses exceeding 250 msec both within and between the sentences, were excluded.

$$\text{SPS} = \frac{\text{Total number of syllables}}{\text{Overall utterance duration (seconds) [after eliminating disfluencies]}}$$

and, WPM = Total number of words

Overall utterance duration (minutes) [after eliminating disfluencies]

3.3.3 Frequency of occurrence of normal disfluencies

The disfluencies that were identified more were transcribed as FP (filled pause), UFP (unfilled pause), SR (syllable repetition), WR (word repetition), PR (phrase repetition), R (revision) and (P) prolongation. After transcription of both conversation and narration tasks, the frequency of occurrence of disfluent events in each task was identified in typical Hindi speakers. The following formula was used to calculate the percentage of the occurrence of disfluencies:

$$\frac{\text{Total number of disfluencies}}{\text{Total number of syllables uttered}} \times 100$$

3.4 Reliability

To establish the inter-rater reliability of Speech rate and Articulation rate, 10% of randomly selected speech samples of participants were manually recoded by 3 SLPs. To establish intra-rater reliability, the primary researcher analyzed and recoded 10% of the samples.

3.5 Statistical Analysis

SPSS version 26 was used for statistical analysis. Shapiro Wilk test was used to check for the normality of data. Post confirmation of normal distribution, appropriate parametric tests were conducted. To obtain the mean and standard deviation of speech and articulation rate across genders and tasks and total disfluencies in both the tasks, Descriptive statistics was performed. Mixed ANOVA was performed to check the effect of gender and task on both rates and the interaction of gender with respect to the

occurrence of disfluencies. One sample t-test was performed to assess the difference between the values of speech and articulation rates of the present study with that of the values obtained by other Indian studies. A p value less than 0.05 was considered significant with a confidence interval 95%. Inter- and intra-reliability check for speech and articulation rate was done using Cronbach's alpha coefficient.

CHAPTER IV

RESULTS AND DISCUSSION

The present study aimed to establish normative on speech and articulation rates in Hindi-speaking adults between the age range of 18-40 years in conversation and narration speech tasks.

4.1) Normative for speech and articulation rates

The sample size for the present study comprised 60 participants between the age range of 18- 40 years. An equal number of male (N=30) and female (N=30) participants were taken. Since there was an interaction effect of the articulation and speech rate on the genders, the normative differs for males and females. The overall speech rate for males during the conversation task was 3.86 ± 0.60 SPS, whereas the speech rate for the narrative task was 4.03 ± 0.62 SPS. Similarly, the articulation rate in males for conversation was 5.12 ± 0.64 SPS, and for the narrative task, it was 5.26 ± 0.55 SPS (Table 4.1a). In females, the overall speech rate in conversation was 4.22 ± 0.67 SPS, and in narration, it was 4.39 ± 0.73 SPS. The articulation rate in females for the conversation task was 5.24 ± 0.72 SPS, and in the narration task, 5.30 ± 0.80 SPS (Table 4.1a). Similarly, in WPM, the speech rate for the conversation task in males was 159.57 ± 26.39 WPM and in narration, 167.82 ± 29.93 WPM. The articulation rate in males for the conversation task was 208.50 ± 28.46 WPM; in the narration task, it was 216.99 ± 25.88 WPM (Table 4.1b). In females, the speech rate in conversation task was 177.02 ± 32.24 WPM and in the narration task, 184.63 ± 31.92 WPM. The articulation rate for females in conversation task was 218.55 ± 31.70 WPM, and in the narration task, 230.13 ± 35.38 WPM (Table 4.1b).

It can be noted that females have higher speech and articulation rates than males and there is a significant difference between the speech and articulation rates in males and females, where p= 0.05 with a very small effect size of d= 0.128. There was an increase in both speech and articulation rates from conversation to narration tasks ($p = 0.03$, $p < 0.05$), but the effect size (d= 0.076) was very less, which concludes that either of the spontaneous speech tasks, i.e., narration or conversation, can be taken to assess the speech and articulation rates. Overall, it can be concluded that the speech and articulation rates are higher in narrative task for both males and females, but not much significant difference is present across tasks.

The speech rate results from Rathna et al.'s (1977) study were 4.58 SPS and 153.66 WPM for three speakers. The present study has proved that there is a significant difference between the speech and articulation rates in both males and females; thus, taking a cumulative mean will affect the values. But in comparison with Rathna et al.'s study, the mean speech rate of the present study, i.e., SR= 4.21 SPS, is slightly less, whereas, in WPM, the value of the current study, SR= 176.22 WPM is greater compared to the previous study. This difference can be due to the fact that in Rathna's (1977) study, only 3 participants were taken, and there is no description of gender provided in the study.

Table 4.1a

Normative of speech and articulation rate in SPS (Syllable per second) for males and females

RATE	**MALES**		**FEMALES**	
	CONVER-SATION	NARRATION	CONVER-SATION	NARRATION
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Speech Rate	3.86 ± 0.60	4.03 ± 0.62	4.22 ± 0.67	4.39 ± 0.73
Articulation Rate	5.12 ± 0.64	5.26 ± 0.55	5.24 ± 0.72	5.30 ± 0.80

Table 4.1b

Normative of speech and articulation rate in WPM (Words per minute) for males and females

RATE	**MALES**		**FEMALES**	
	CONVER-SATION	NARRATION	CONVER-SATION	NARRATION
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Speech Rate	159.57 ± 26.39	167.82± 29.93	177.02± 32.24	184.63±31.92
Articulation Rate	208.50 ± 28.46	216.99 ± 25.88	218.55± 31.70	230.1 ± 35.38

4.2) Differences between Articulation and Speech rate

Mixed ANOVA revealed an overall significant difference in the mean speech and articulation rate with F (1, 58) = 539.810, p= 0.00 (p < 0.05), with a large effect size of d= 0.903 in SPS. This difference can be noted in Figures 4.2a and 4.2b, where the blue and red lines represent speech and articulation rates in males and females, respectively. These figures reveal that the articulation rate is greater than the speech rate. It is due to the fact that while calculating the articulation rate, all the disfluent events were excluded, which ultimately reduces the overall duration of utterance. Since gender has an interaction effect on the rates; thus, separate plots have been obtained to indicate the difference between rates across genders.

Figure 4.2a:

Mean Speech Rate (SR- blue) and Articulation Rate (AR- red) in SPS in males across conversation and narration tasks

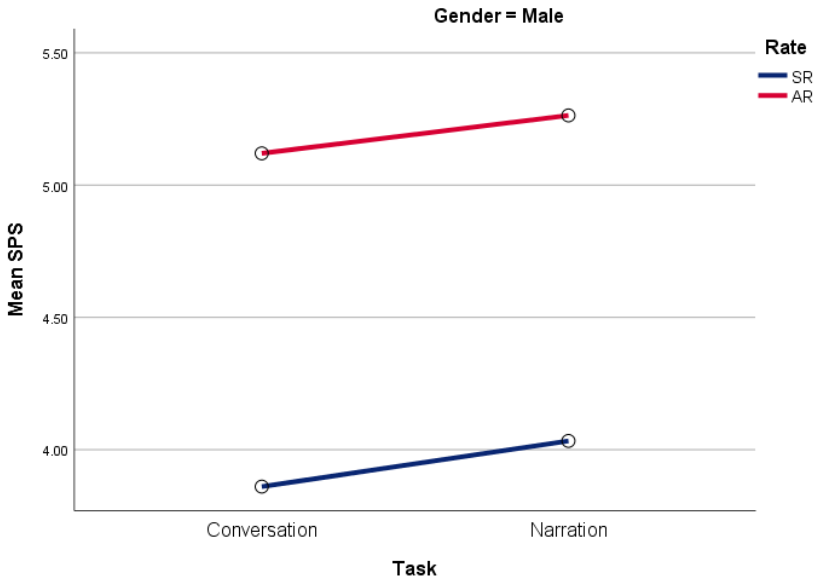
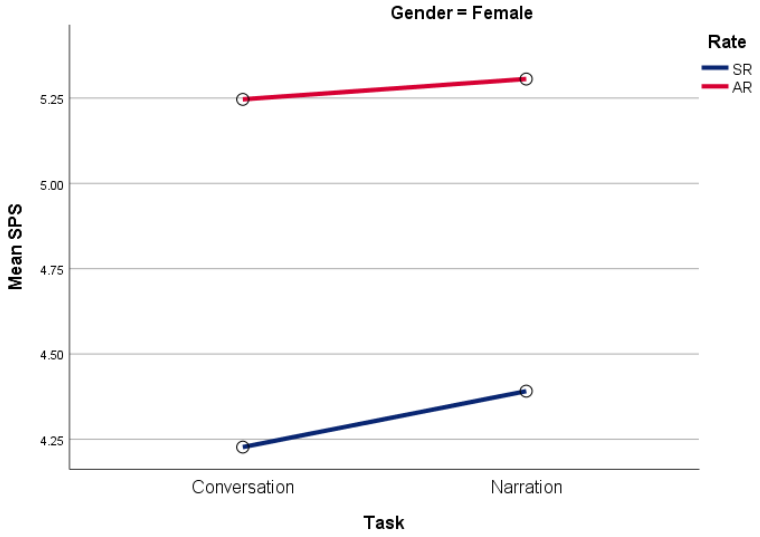


Figure 4.2b:

Mean Speech Rate (SR- blue) and Articulation Rate (AR- red) in SPS in females across conversation and narration tasks



Similarly, in WPM significant difference in the rates can be observed, F (1, 58) = 400.499, p = 0.00 (p < 0.05), with a good effect size of d= 0.874.

Figure 4.2c:

Mean Speech Rate (SR- blue) and articulation rate (AR- red) in WPM in males across conversation and narration tasks

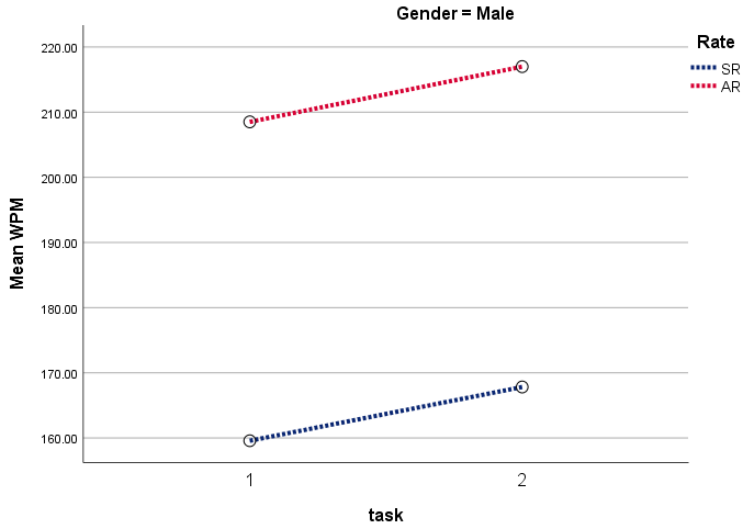
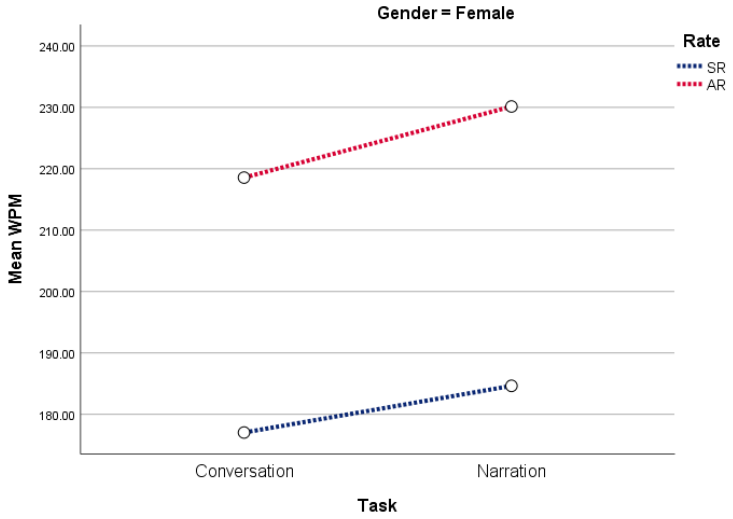


Figure 4.2d:

Mean Speech Rate (SR- blue) and Articulation Rate (AR- red) in WPM in females across conversation and narration tasks



In Figure 4.1a, it can be noted that both speech rate from conversation (M= 3.86 SPS and M= 159.57 WPM) to narration (M= 4.03 SPS and M= 167.82) and articulation rate from conversation (M= 5.12 SPS and M= 208.50 WPM) to narration (M= 5.26 SPS and M= 216.99) are increasing in a linear and parallel manner in males with not much difference. Whereas, in Figure 4.2b, it is seen that in females, there is a slightly steep increase in speech rate from conversation (M= 4.22 SPS and M= 177.02 WPM) to narration (M= 4.39 SPS and M= 184.63 WPM), while articulation rate shows a steady increase from conversation (M= 5.24 SPS and M= 218.55 WPM) to narration (M= 5.30 SPS and 230.1 WPM). There was no interaction between the two tasks and rate ($p= 0.314$, $p > 0.05$), suggesting that both articulation and speech rates do not differ across spontaneous speaking tasks, which in the present study were conversation and narration. Although a very minimal rise can be seen from conversation to narration, selecting a spontaneous speech task between conversation and narration does not make a big difference in obtaining values.

No Indian as well as international studies have been done to investigate the difference between speech and articulation rates across spontaneous speaking tasks; thus, the results of the present study cannot be compared with other studies. The only international study done on both articulation and speech rates is the study done on adult Jordanian speakers between the age range of 64- 91 years. The study concludes that the difference between speech rate was not significant between reading and conversation, indicating that speech rate was similar across the two contexts. However, the articulation rate in reading was found to be significantly slower than in conversation (Sullivan, 2016). The finding from the present study is not in consensus with Sullivan, (2016) study as the task taken up in the current study focused on spontaneous speech task which included conversation and narration.

As discussed in the literature review, speech rate gives information about the overall utterance, including pause duration and other types of disfluencies. Speech and articulation rates go hand in hand, signifying that the other will be affected if one increases or decreases. This is also proved by the motor skill theory of stuttering, which claims that PWS (Persons With Stuttering) if speaking at a faster speech rate, tends to lose flexibility and will have very limited articulatory strategies to maintain fluency (Lieshout et al., 2004). Persons with fluency disorders can manipulate the pause behavior and still can articulate fast; thus, normative for both speech and articulation rates in the native language is necessary. In fluency disorders, the treatment effect will only be positive if the speech and articulation rate falls within the normal limits of a particular language. The rates identified in this study can be taken to set a goal for controlling the rate during therapy, depending on gender.

4.3) Comparison of Speech and Articulation rate across gender.

From figures 4.2a to 4.2d, it can be noted that males and females follow the same speech pattern, i.e., a gradual increase in the rates across tasks can be seen. In males, mean speech rate (M= 3.86 SPS, 159.57 WPM) and articulation rate (M= 5.12 SPS, 208.50 WPM) and in females mean speech rate (M= 4.22 SPS, 177.02 WPM) and articulation rate (M= 5.24 SPS, 218.55 WPM) in conversation task. Similarly, for the narrative task, in males, the mean speech rate (M= 4.03 SPS, 167.82 WPM) and articulation rate (M=5.26 SPS, 216.99 WPM) for males and females speech rate (M= 4.39 SPS, 184.63 WPM) and articulation rate (M= 5.30 SPS, 230.13 WPM) respectively. From the mean values mentioned in Tables 4.1a and 4.1b, it can be interpreted that females have higher speech and articulation rates than males. However, gender having an overall effect is insignificant $F(1,58) = 2.132$, $p = 0.150$ ($p > 0.05$). From Figure 4.2a, it can be inferred that there is an increase in both speech (blue) and articulation rates (red line) in males in a parallel manner. However, in Figure 4.2b, it can be seen that articulation rate shows only a smaller increase from conversation to narration task, whereas, in speech rate, a steep rise can be observed from conversation to narration, concluding that even though gender does not have an overall effect, it does have a significant interaction with the rates in terms of SPS, where, $F(1,58) = 8.515$ and $p= 0.005$ with a small effect size of $d= 0.128$. However, in WPM (Words per minute), $F(1,58) = 1.432$, $p = 0.236$ ($p> 0.05$), no gender interaction with speech and articulation rates can be observed. Thus, there is a slight difference in the way females produce speech than males.

The literature review in Indian studies does not state the difference in speech rates across genders. In the Kannada language, Venkatesh et al. (1982) study, included 64 participants, revealing no gender differences. In the Punjabi language, a study by

Kaushal et al. (2011), including 40 participants aged 18- 40 years, revealed insignificant difference across gender. Study done by Rathna et al. (1977) did not report any gender difference, probably because of limited number of participants. The results of the present study differ from those done by Sullivan (2016), where speech and articulation rates of older New Zealand adults do not differ by gender in conversation task. The female's speech and articulation rates were slightly higher, but the difference was insignificant.

With regard to the articulation rate in the spontaneous speech of Seoul Korean speakers, gender disparity is only seen in the age group of 10 to 19 years (Kim, 2018). Considering speech rate, dialectal as well as gender differences exist in American English speakers. A study by (Jacewicz et al., 2009b) reveals that men speak slightly faster than women. Discrepancy persists regarding which gender has a faster speech and articulation rate or whether is it neutral among the genders.

The present study found that speech and articulation rates in SPS were slightly higher in females with a small effect size. Whereas in WPM, there was no gender effect seen on the rates. To understand more about the gender effects in Hindi speakers, the study can be conducted on a larger population.

Across tasks, i.e., conversation and narration, there was no statistically significant interaction of rate with the tasks. In SPS, $F(1, 58) = 1.033$ and $p = 0.314$ ($p > 0.05$) and in WPM $F(1, 58) = 0.417$ and $p = 0.521$ ($p > 0.05$). It can be observed in the figures from 4.2a to 4.2d a rising trend in rates in both SR and AR, but it is not significantly different. Similarly, no change in rate with respect to tasks across genders can be seen. In SPS, $F(1, 58) = 0.140$ and $p = 0.709$ ($p > 0.05$), whereas, in WPM, $F(1, 58) = 0.074$ and $p = 0.787$ ($p > 0.05$). Concluding that males and females follow the

same speech pattern across tasks, i.e., the speech and articulation rates increase from conversation to narration, though the effect size is minimal.

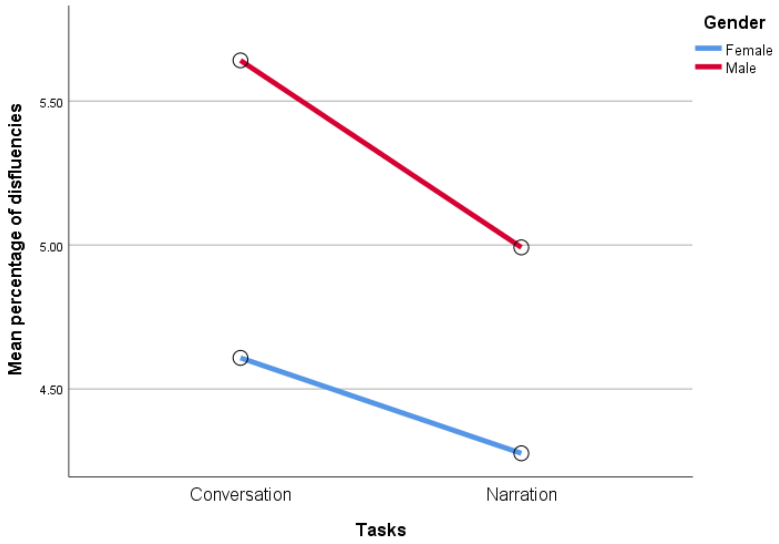
4.4) Frequency of normal disfluencies.

Mixed ANOVA analysis revealed an overall significant effect of task on the frequency of disfluencies where $F(1, 58) = 5.439$ and $p = 0.023$ ($p < 0.05$) with an effect size of $d = 0.086$. Figure 4.4 shows that the percentage of disfluent events in conversation ($M = 4.60 \pm 1.53$ in females and $M = 5.64 \pm 1.59$ in males) is more than in narration ($M = 4.27 \pm 1.89$ in females and $M = 4.99 \pm 1.71$ in males). This also reveals that males have a higher percentage of disfluent events than females in both tasks, which can be interpreted by the gap between the red (males) and blue (females) lines in Figure 4.4. In terms of stuttering, in preschool children, the ratio of males to females is 2:1, which indicates that males are more prone to stuttering than females. Whereas, in this study, in terms of the occurrence of disfluencies, males have higher percentage values in both tasks.

The analysis showed no interaction between gender and task $F(1, 58) = 0.571$ and $p=0.453$ ($p > 0.05$). This result can be interpreted from Figure 4.4; both genders follow the same pattern, where the percentage of disfluent events drops from conversation to narration.

Figure 4.4:

The frequency of disfluencies across tasks



Slight steepness can be observed in males in the narration task, but it does not statistically differ from that of females. It was found that the type of disfluencies that occurred more during conversation and narration tasks were filled pauses (M= 5.23 ± 3.80) and unfilled pauses (M= 11.17 ± 5.32), the occurrence of which was high during conversation task in males. It can be concluded that since conversation includes asking questions from the subjects, they take time to formulate the answer, resulting in more disfluent events like filled pauses and unfilled pauses. The descriptive statistics of the frequency of normal disfluencies can be interpreted from Table 4.4a. The abbreviations used in Table 4.4a can be interpreted from Table 4.4b.

Table 4.4a

Descriptive Statistic for frequency of normal disfluencies

Type of Disfluency	Gender	Mean	Median	SD	Interquartile range
CFP	Female	5.30	5.50	3.22	4
	Male	5.23	4.00	3.80	4
CUFP	Female	8.40	7.50	4.15	7
	Male	11.17	9.50	5.32	9
CSR	Female	0.67	0.00	0.99	1
	Male	1.73	1.50	1.70	2
CWR	Female	0.33	0.00	0.60	1
	Male	0.90	0.00	1.62	1
CPR	Female	0.13	0.00	0.34	0
	Male	0.23	0.00	0.43	0
CR	Female	0.53	0.00	0.86	1
	Male	0.50	0.00	0.68	1
CP	Female	1.80	2.00	1.24	2
	Male	1.80	1.50	1.47	2
C-Total Disfluencies	Female	17.30	17.00	6.37	10
	Male	21.57	21.00	6.58	9
C-Total syllables	Female	375.93	364.50	43.90	23.25
	Male	384.53	365.00	60.06	27.00

C- %disfluency	Female	4.60	4.25	1.53	2.78
	Male	5.64	5.61	1.59	2.35
NFP	Female	4.00	3.00	3.80	5
	Male	3.87	3.00	2.81	3
NUFP	Female	9.00	8.00	4.66	7
	Male	10.87	11.00	4.53	8
NSR	Female	0.57	0.00	0.72	1
	Male	1.07	1.00	1.28	2
NWR	Female	0.70	1.00	0.75	1
	Male	0.97	1.00	1.18	1
NPR	Female	0.00	0.00	0.00	0
	Male	0.33	0.00	0.80	0
NR	Female	0.43	0.00	0.77	1
	Male	0.60	0.00	0.85	1
NP	Female	1.17	1.00	1.17	2
	Male	1.43	1.00	1.33	3
N-total disfluencies	Female	15.86	15.00	7.30	8.25
	Male	19.20	19.00	6.12	7.50
N-total syllables	Female	369.10	360.00	37.63	25.00
	Male	391.30	364.00	73.62	23.50
N% Disfluencies	Female	4.27	4.12	1.89	2.09

	Male	4.99	4.93	1.71	2.01

Table 4.4b

List of abbreviations used in table 4.4a

ABBREVIATIONS	EXPANSION
CFP	Conversation Filled Pauses
CUFP	Conversation Un-Filled Pauses
CSR	Conversation Syllable Repetition
CWR	Conversation Word Repetition
CPR	Conversation Phrase Repetition
CR	Conversation Revision
CP	Conversation Prolongation
C- Total Disfluencies	Total Disfluencies in conversation
C- Total syllables	Total syllables in conversation
C- % disfluency	Percentage of disfluency in conversation
NFP	Narration Filled Pause
NUFP	Narration Un-Filled Pause
NSR	Narration Syllable Repetition
NWR	Narration Word Repetition
NPR	Narration Phrase Repetition
NR	Narration Revision
NP	Narration Prolongation
N-total disfluencies	Total disfluencies in Narration
N- total syllables	Total syllables in narration
N-%Disfluencies	Percentage of Disfluencies in Narration

Disfluent events like syllable/ word repetitions and prolongations were also present but minimally. In stuttering, it is known that the core behaviors comprise repetitions, prolongations and blocks (Guitar, 1991b) (Ward, 2017a); it is due to the fact that the occurrence of these disfluencies is more in stuttering, however in the present study it was found that the core behaviors of stuttering occur very less in the speech of a typical speaker.

As reported in the review of literature, the stuttering-like disfluencies differ greatly from typical disfluencies on the basis of quantity as well as quality. As given by Barry Guitar (1998) in his book "Stuttering: An Integrated Approach to its Nature and Treatment", in persons with stuttering (PWS), the frequency of disfluencies will be more than 10%. However, the present study found that the percentage of disfluencies is less than 10% in typical Hindi-speaking adults. In PWS, the chief difficulty is in the coordination of motor programs for the execution of existing plans (Lickley, 2017). Individual differences exist in how a person speaks, and disfluencies vary despite belonging to the same cultural or ethnic groups. Still, a mean regarding the normal occurrence of disfluencies in a particular group can be established such that goals for PWS or PWC can be taken to reduce the number of disfluent events.

4.5) Comparison of Speech rate across languages

One sample t-test was done to compare the speech rates cross-linguistically. In the present study, the mean speech rate in SPS is 4.21 and 176.22 in WPM for Hindi-speaking adults. The mean values of other studies can be interpreted in Table 4.5. The comparison shows that the mean speech rate of the Hindi language in the present study is higher than the Punjabi language, whereas it is less compared to the other languages.

Table 4.5

Speech Rate of Indian Languages in SPS and WPM

LANGUAGES	MEAN	
	SPS	**WPM**
Hindi (Present study)	4.21	176.22
Hindi (Rathna et al., 1977)	4.58	153.66
Marathi (Rathna et al., 1977)	5.75	156.66
Kannada (Savithri et al., 2004)	6	113
Telugu (Savithri et al., 2004)	6	111
Tamil (Savithri et al., 2004)	6	117
Malayalam (Savithri et al. 2004)	8	114
Punjabi (Kaushal et al., 2011)	3.44	137.9

Compared to Rathna and Bharadwaja's (1977) study on speech rate for Hindi and Marathi languages, there is a statistically significant difference with the present study p-value was less than 0.05 for both Hindi and Marathi languages in comparison to the present study. It can be observed that the speech rate in SPS is less in the current study compared to that in Marathi and Hindi languages; however, the WPM is greater in the current study. The Marathi language is the third most spoken language in India (Census, 2011), primarily spoken in Maharashtra and is a part of the Indo-Aryan language family of India. Since this state is linguistically sandwiched between the Dravidian (Telugu and Kannada, spoken in the Southern border) and Indo-Aryan (Hindi

and Gujarati, spoken in the Northern border) language families, it is influenced by both, but the topographical closeness of this state is more with the Dravidian languages and thus, the lexicon and syntax of Marathi language is influenced by Kannada and Telugu. The Telugu language, official language of Andra Pradesh and is the 4th, Tamil official language of Tamil Nadu is the 5th, Kannada official language of Karnataka is the 8th and Malayalam official language of Kerala is the 10th most spoken language in India, belonging to the Dravidian family. Since the Dravidian languages are agglutinating in structure, it can be interpreted that the syllable length of a word in Dravidian languages is more than that of any of the Indo-Aryan languages. Thus, the syllables per second of Marathi, Kannada, Telugu, Tamil, and Malayalam languages are higher compared to that of Hindi, whereas word usage per minute is less.

The results of the present study statistically differ ($p < 0.05$) from Savithri et al. (2004) study on the rate of speech in Dravidian Languages. It can be interpreted from the table that the rate in SPS of the present study is less than in Kannada, Telugu, Tamil and Malayalam languages, whereas WPM is higher in the present study.

Also, a statistically significant difference ($p < 0.05$) was observed in comparison with the Punjabi language, where, both in SPS and WPM, the speech rate of the present study is more than that of the Kaushal et al. (2011) study. Punjabi is the official language of Punjab and the 11th most-spoken language of India. Punjabi and Hindi languages both belong to the Indo-Aryan language family of India and have a lot of similarities. The difference between the two exists in the vocabulary, punctuation and grammar. For example, a horse in Hindi is *ghora,* whereas in Punjabi, it is *kora*.

4.6 Results of Test-retest Reliability

Using Cronbach's alpha test, both inter and intra-rater reliability were measured. Three SLPs were asked to recode the speech sample and analyze the speech and articulation rate for 10% of the participants to check inter-rater reliability. Whereas for intra-rater reliability, the primary researcher re-evaluated the speech and articulation rates for the same 10% of the participants. Test results are given in Table 4.6 for speech and articulation rates in both SPS and WPM for conversation and narration tasks.

Table 4.6

Cronbach's Alpha value for SR (Speech Rate) and AR (Articulation rate) in SPS (Syllables per second) and WPM (Words per minute)

RATER	**SR SPS**	**CAR SPS**	**NSR SPS**	**NAR SPS**	**CSR WPM**	**CAR WPM**	**NSR WPM**	**NAR WPM**
Inter (α-value)	0.996	0.996	0.999	0.995	0.997	0.995	0.999	0.998
Intra (α-value)	0.972	0.988	0.993	0.989	0.998	0.999	0.937	0.999

The test results for both inter and intra-rater reliability reveal ($\alpha \geq 0.9$), indicating high consistency between the original and retest values of speech and articulation rates across both tasks.

CHAPTER V

SUMMARY AND CONCLUSIONS

The present study attempted to establish normative for speech and articulation rates in spontaneous speech (Conversation and Narration) in adults aged between 18 to 40 years.

Literature review suggests that having norms in every language for speech and articulation rates helps set goals for individuals with fluency disorders belonging to a particular geographical region. In the Hindi language, only one study was done in 1977 by Rathna et al, which included only three participants. The sample size to determine the normative was very small. Thus, it created a need to establish norms in the Hindi language over an adequate sample size. The current study included 60 participants, with equal number of male and female participants. Disfluencies occur more during spontaneous speech due to its rapidity, thus, the present study focused on spontaneous speech, which included conversation and narration tasks. This study also concentrated on identifying the percentage of disfluencies in typical adult Hindi speakers.

The conversation task included the presentation of 10 questions to which participants were instructed to respond elaboratively, while the narration task required them to present a monologue on two given topics. The analysis of speech and articulation rates was done by calculating the total number of syllables/ words per unit time. To determine the percentage of disfluencies, the total number of disfluencies was divided by the total number of syllables. Though both speech and articulation rates provide information on the number of outputs per unit time, differences exist between the two.

All the values extracted for speech and articulation rates were subjected to statistical analysis using SPSS version 26. Results revealed a statistically significant difference between articulation and speech rates with a good effect size. Gender differences were also statistically significant, considering speech and articulation rates value in SPS, but no gender differences with respect to the percentage of disfluent events in both tasks could be found. The results of the present study differed from those of the previous studies done in Indian and International contexts regarding gender differences. The present study reveals females speak faster than males; however, the previous studies done on speech and articulation rates present contradictory results, which may be due to the language that the speakers use, i.e., in some languages, both genders have equal speech and articulation rates like in Punjabi language. But to have a conclusive finding on the effects of gender on speech and articulation rates, the present study can be done on a larger subject size. The study also revealed no difference between the speech and articulation rates across the spontaneous speech tasks (conversation and narration), concluding that either task can be used for spontaneous speech elicitation. Inter and intra-rater reliability was also performed to check the consistency of the calculation in SPS and WPM. The results indicated high consistency between the original and the retest values.

Developing normative for both rates provides additional information. In a therapeutic context, where one focuses on managing the speech rate, even articulation rates can be targeted because, as mentioned in the review of literature, individuals with fluency disorders tend to articulate fast post a disfluent event. Thus, the speech rate may be slow, but the articulation rate may be fast in such individuals, impacting intelligibility as well. This concludes that developed norms can be utilized in clinical

setups to create appropriate goals for the patients as well as to compare the norms developed in one language with other languages.

Implications of the Study

- The present study provides established norms on articulation and speech rate of a typical speaker of Hindi language, which will help to assess and treat persons with communication disorders.
- The present study compared the difference between articulation and speech rate, which has not yet been performed in the Indian context. Thus, the necessity of such measures was justified.
- This study will help us to understand the frequency of normal disfluencies in typical Hindi speakers.
- The difference between articulation and speech rates across genders was established in the present study which will further help in appropriate assessment and management.
- The norm values of speech rate in the present study have been compared with that of the other Indian languages, which will help us in assessment and making appropriate treatment goals based on the linguistic differences of the patient population.

Limitations of the study

1. Considering the Hindi-speaking population, more participants should be evaluated to represent the typical one.
2. Face-to-face speech sample acquisition causes the participants to get anxious and speak less than required in the testing environment.

Future Directions

1. The development of new norms in each of the Indian languages is required to set a target for management in individuals with fluency disorders.
2. Since speaking style varies from individual to individual, culture to culture, it can be assessed in different languages to identify if a difference between articulation and speech rate exists.
3. To understand the effect of gender on speech and articulation rates in Hindi speakers, a more extensive study, including a larger subject size, can be conducted.
4. Norms can also be established for the children and geriatric population.
5. The present study's norms can be compared with studies on individuals with fluency disorders in Hindi-speaking groups.

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