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A preliminary study of normative speech rate values of Turkish speaking adults

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Abstract

Objectives: One of the main prosodic components of language is the rate. Speaking and articulation rates are two different measurements that reflect various aspects of each other. This study mainly aimed to present preliminary normative data related to speaking rate, reading rate, articulation rate and articulation rate in reading for Turkish-speaking adults and also aimed to compare these four measurements in terms of gender.

Methods: The present study included 84 university students (42 males and 42 females) aged between 19-24 years old whose native language was Turkish. Power analysis was calculated based on the articulation rate. Speech and articulation rates were measured by taking 400-syllable conversational speech samples from each participant. A text was used from the Adult II section of the Turkish version of the Stanford Binet Intelligence Test to measure their reading rates. The speaking and reading samples obtained were recorded with a voice recorder and analyzed with the PRAAT software.

Results: There was a statistically significant difference both between their speaking and reading rates, and between articulation rate and articulation rate in reading. Male participants had significantly higher articulation rates in speaking and reading than females.
Conclusion: The present study provided evidence that the speech rate is low and articulation rate is high in Turkish. It concluded that the significant difference between articulation rates by gender in many languages is also valid for Turkish.

Keywords: Articulation rate, conversational speech, reading rate, speaking rate, Turkish.

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Introduction

The rate, one of the main prosodic components of language, has an important role in conveying meaning.[1] At this point, two prominent concepts are speaking rate and articulation rate. The main distinction between these two qualities concerns whether pauses and disfluencies are included in the calculation.[2,3] Speaking rate reflects the general appearance of one's speech production.[4] It refers to the number of syllables per minute (SPM), including pauses and disfluencies during the conversation.[2,4,5] Due to this holistic feature, the speaking rate can be influenced by several factors such as mental or emotional state.[6] Articulation rate refers to a measure of the rate of speaking in which all pauses and disfluencies are excluded from the calculation.[7,8] It reflects the motor control of speech by being less affected by grammatical, emotional and environmental factors.[3,5]

Reference data on speaking and articulation rates also play an important role in the differential diagnosis of some communication disorders, in planning therapy and in measuring outcomes,[3,4,5] since these characteristics are also impaired in motor speech disorders such as apraxia and dysarthria, and fluency disorders such as cluttering.[9] Beyond this, the speaking rate can deteriorate in many health conditions from neurogenic language disorders to right hemisphere brain damage.[10] It is even possible to add to this list neurodegenerative diseases such as Parkinson and Alzheimer.[10,11]

Speaking and articulation rates have been studied in many languages, even different dialects, in spontaneous speech and reading. For example, one study compared the speech rates in seven languages by reporting the number of syllables produced per second (syllables/second). The authors found this ratio to be 5.18 in Mandarin, 5.97 in German, 6.19 in English, 6.99 in Italian, 7.18 in French, 7.82 in Spanish and 7.84 in Japanese.[12] Articulation rate varies from 3.16-5.33 in British English [13], 4.31-5.73 in French [14,15], 3.5-4.5 in Norwegian [16], 5.2 in Standard North German [17], 6.57 in Brazilian Portuguese and 7.81 in Spanish.[18]

This issue has also been examined in terms of differences between dialects. For example, Lee and Doherty found a higher speech rate in Irish English than in other English dialects.[19] Other studies determined a difference between the speaking rates of German-speaking individuals in two different cities, whereas they found no difference between the rates of those who speak American English and New Zealand English.[6,20]

Some studies report that speaking and articulation rates do not vary by age. For example, speech rates in two different American English accents, Portuguese and Russian did not vary by age.[2,21] However, most of the studies report that speaking and articulation rates vary by age.[5,22-24] Studies often suggest that young people speak faster than older ones.[21,22] One study found that reading rates varied by age for Turkish-speaking adults.[25] Studies also report that the speech rate increases until adolescence, continues stably during adulthood, and then gradually decreases.[21,26,27]

Many studies that examined the gender factor have found that speaking and articulation rates are consistently higher in males than in females.[7,19,21,23,28-32] Most studies have reported similar results for the reading rate.[19,21] However, contrary to these studies, there are also results suggesting no difference between the speaking and articulation rates of men and women.[22,30,31] İyigün et al. [25], who examined the reading rates of Turkish-speaking individuals, have also reported similar results.

The importance of well-defined data on speaking and articulation rates in a language is obvious. There are several studies on many languages, even dialects; however, there is a quite limited number of studies on Turkish. In the Turkish literature, there is only one study of the reading rate of adult individuals.[25] Other studies have examined this issue in elementary school students or in the context of various disabilities.[32,33] The main purpose of this study was to present preliminary results regarding speaking rate, articulation rate, reading rate and articulation rate in reading of native Turkish speakers. Another aim was to examine whether these four measurements varied by gender. It also aimed to examine whether speaking and articulation rates of the entire group differed in reading and speaking tasks.

Materials and Methods

Participants

The sample consisted of 84 university students aged between 19-24 years. Power analysis was calculated based on the articulation rate. Group sample sizes of 42 and 42 achieve 85% power to detect a difference of -26.3 between the null hypothesis that both group means are 391.6 and the alternative hypothesis that the mean of group 2 is 417.8 with estimated group standard deviations of 36.2 and 42.5 and with a significance level (alpha) of 0.05000 using a two-sided two-sample t-test. Participants were selected from Uskudar University undergraduate students using the appropriate sampling method. Also, a stratified sampling method was used to ensure that the study group was adequately heterogeneous in terms of age and gender. There were 14 participants for each ages composed of seven males (16.7%) and seven females (16.7%).

The inclusion criteria were as follows: (1) being a Turkish monolingual person, (2) continuing university education, and (3) being at least 18 years of age. The cognitive, auditory, psychiatric, neurological pathologies, speech-language disorders and alcohol use in the last 24 hours of the participants were determined as exclusion criteria.

A personal information form was used to determine the eligibility of the participants to the study criteria. The decision of whether the participants had any cognitive, auditory, psychiatric or motor impairment or disorder was based on the data in their personal information form. The assessments that the participants did not have speech and language disorders were made by the second, third and fourth authors under the supervision of the first author. The first author had 11 years of experience in speech and language therapy at the time of data collection. The second author had two years of experience. The third and fourth authors were Intern Therapists who continued their education in their fourth-grade year of study at that time. All authors had previous speech-related studies.

Approval for the study protocol was obtained from the Uskudar University, Non-Interventional Research Ethics Committee (61351342/2019-81) and written informed consent was obtained from the participants. The study was carried out in accordance with the Helsinki Declaration (2008).

Data Collection

Data were collected from the Department of Speech and Language Therapy at Uskudar University. Firstly, the information about the study was explained briefly. Subsequently, participants signed informed consent forms before data collection. The personal information form was given after the informed consent form. The form consisted of two parts. In the first part, sociodemographic information such as age, gender, main language and education information was obtained. The second part involved items related to exclusion criteria. The detailed purpose of the study was explained to participants after the procedure so that their typical speech performances were not affected as much as possible. They were only told that their speech and reading samples would be taken to examine their speech and reading rates.

The participants' voices were recorded using a Sony ICD-UX533 audio recorder (Sony Corp., New York, NY, USA) in a noise-proof (<25dB) speech laboratory. Their voices were recorded while paying attention to having 15 cm distance and 45-degree angle between the mouth and the recorder.

Speech Sample

An approximately one-minute conversational speech sample was taken from each participant (minimum 400 syllables). This sample included an example of a five-minute spontaneous talk with a researcher. The interviewer used proper interview methods to guide the conversation by asking open-ended questions to ensure its sustainability. The content of the conversation included questions about the participants' demographic information, education and interests.

Reading Sample

A text consisting of 155 syllables from the Adult II section of the Stanford Binet Intelligence Test was used as the

reading task. Participants were instructed as follows: "I will give you a text. Please read as you do in your daily life."

Data Processing

Voice recordings were analyzed using Praat 6.0.37, a speech analysis program (Paul Boersma and David Weenink, Institute for Phonetic Sciences, University of Amsterdam, The Netherlands). A syllabic-based calculation was used in the present study. In the speaking rate calculation, pauses (waiting, coughing, etc.) longer than 2 seconds were removed in accordance with studies in other languages.[4] The speaking rate was then calculated by dividing the total number of syllables produced by the total time (Total syllable/Total time (in seconds) X 60=Speaking rate). In the articulation rate calculation, pauses longer than 250 ms were removed in accordance with the literature.[5,7] The articulation rate was then calculated by dividing the total number of syllables produced by the total time (Total syllable/Total time (in seconds) X 60=Articulation rate).

Statistical Evaluation

Data were first analyzed using descriptive statistics including mean, standard deviation and min-max values. Differences between the rates of speech, reading, articulation and articulation in reading were compared using the Wilcoxon test. Since the assumption of normal distribution was not achieved for the variables of articulation rate, articulation rate in reading and speaking rate, Mann-Whitney U test was used to examine whether there was a difference between the variables according to gender. Also, reading rate was examined using the independent samples t-test.

Results

Examining participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements

Table 1 presents the mean, standard deviation, minimum and maximum values of the participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements.

According to the Wilcoxon test, there was a significant difference between the participants' speaking and reading rates (Z=-7,174, p=0.00), and rates of articulation in speech and reading (Z=-2.985, p=0.04) (Table 2).

Examining participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements by gender

Table 3 presents the mean, standard deviation, minimum and maximum values of the participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements by gender. Accordingly, the range between the minimum and maximum values of males was wider than that of females. According to the averages, articulation rates of men in speaking and reading were higher

Table 1. Mean, standard deviation, minimum and maximum values of the participants' speaking rate (syll/min), reading rate (syll/min), articulation rate (syll/min) and articulation rate in reading (syll/min) measurements.

Measurement	N	Mean (SPM)	SD (SPM)	Min (SPM)	Max (SPM)
Speaking rate	84	320.70	38.37	236.27	440.95
Reading rate	84	368.50	33.48	287.48	442.64
Articulation rate	84	404.91	41.63	317.59	549.57
Articulation rate in reading	84	416.59	39.88	219.58	493.10

Max: maximum, Min: minimum, N: number of patients, SD: Standard deviation, SPM: syllables per minute.

Table 2. Participants' Wilcoxon test findings regarding the comparison of speaking rate with reading rate and the articulation rate with articulation rate in reading.

	N		Mean Rank	Sum of Ranks	Z	p
Speaking rate - Reading rate	84	Positive ranks	22.06	176.50	-7.174	0.00
		Negative ranks	42.49	2294.50		
Articulation rate - Articulation rate in reading	84	Positive ranks	38.02	1026.50	-2.985	0.04
		Negative ranks	44.65	3393.50		

N: number of patients

Table 3. Mean, standard deviation, minimum and maximum values of the participants' speaking rate (syll/min), reading rate (syll/min), articulation rate (syll/min), and articulation rate in reading (syll/min) measurements by gender.

Measurement	Gender	N	Mean (SPM)	SD (SPM)	Min (SPM)	Max (SPM)
Speaking rate	F	42	321.68	36.67	236.27	414.28
	M	42	319.73	40.42	246.95	440.95
Reading rate	F	42	368.85	34.63	287.48	426.01
	M	42	368.15	32.69	289.17	442.64
Articulation rate	F	42	391.56	36.22	317.59	457.33
	M	42	417.84	42.51	344.01	549.57
Articulation rate in reading	F	42	409.21	33.75	328.97	483.61
	M	42	424.26	43.91	219.58	493.10

F: female, M: male, Max: maximum, Min: minimum, N: number of patients, SD: standard deviation, SPM: syllables per minute.

than women. The males had higher average rates of articulation in both speech and reading than the females. However, the females had a higher average speaking rate than the males.

According to the Mann-Whitney U test, male participants had significantly higher articulation rate and articulation rate in reading than women (respectively; Z=-2.648, p=.008; Z=-2.429, p=.015). However, there was no significant difference between males and females in terms of speaking rate (Z=-.671, p=.502). According to the independent samples t-test, there was no significant difference between the reading rates by gender (t=.162; p=.872).

Examining participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements by age

Table 4 presents the mean, standard deviation, minimum and maximum values of the participants' speaking rate, reading rate, articulation rate and articulation rate in reading measurements by age.

Discussion

The present study mainly aimed to present preliminary results related to speaking rate, reading rate, articulation rate and articulation rate in reading for Turkish-speaking university students aged between 19-24 years old, which could be used in both research and clinical fields. This study also aimed to compare these four measurements in terms of gender. Accordingly, the mean speaking rate of participants was 5.33 syllables/second (or 320.7 syllables/minute). Given the results of Pellegrino et al. [12] regarding other languages, Turkish is among languages with lower speaking rate, such as Mandarin (5.18) or German (5.97), compared to Spanish (7.82) or Japanese (7.84). This situation may be explained by the high syllabic complexity level of Turkish. For example, German, which has higher complexity, is slower than French, which has a lower complexity. Trouvain and Möbius [34] also stated that in languages showing high complexity, there is a slower rate due to the necessity of articulating more segments in one syllable. In addition, the mean articulation rate of participants was 6.75 (404.9). This result suggests that Turkish is among languages with a higher speaking rate, such as Brazilian Portuguese (6.57) and Spanish (7.81), compared to British English (3.16-5.33) or French (4.31-5.73).[18] This situation may be explained by the fact that Turkish is a syllable-timing language. This is because it is known that Romance languages, which are syllable-timing languages (e.g., Spanish, Italian and French), are faster than Germanic languages, which are stress-timed languages (e.g., English, Dutch and German).[35,36] While the rhythm of stress-timed languages is like a 'morse-code-rhythm', the rhythm of syllable-timed languages is almost a 'machine-gun rhythm', and there are no noticeable emphases in these languages. [37] Nevertheless, further well-designed comparative studies are required to obtain clearer conclusions on these speaking rate and articulation rate findings.

In this study, the probable reason for the results related to lower speaking rate and higher articulation rate in Turkish compared to previous studies in other languages is that Turkish participants give longer pauses than those who speak other languages. However, further studies with different communication modalities such as presentations,

Table 4. Mean, standard deviation, minimum and maximum values of the participants' speaking rate (syll/min), reading rate (syll/min), articulation rate (syll/min), and articulation rate in reading (syll/min) measurements by age.

Age	N	Speaking rate (SPM)	Articulation rate (SPM)	Reading rate (SPM)	Articulation rate in reading (SPM)
19	14	54.04	52.57	53.79	52.61
20	14	43.07	40.07	37.71	40.18
21	14	40.64	41.21	52.54	44.68
22	14	32.25	38.57	30.50	34.61
23	14	44.14	39.14	44.18	49.71
24	14	40.86	43.43	36.29	33.21

N: number of patients, SPM: syllables per minute.

radio programs or discussions are needed to determine if this answer is correct.

This study found a mean reading rate of 368.5 SPM (SD=39.88). This finding may be compared to those reported in the study by İyigün et al. [25], where the reading rate of individuals over the age of 20 was examined. This is because, in their study, the first set of participants consisted of individuals at ages of 20-35 (n=16). The authors found the mean reading rate in this set as 334.12 (SD=49.02). The finding of a higher reading rate in the current study may be explained in various ways. The first reason that comes to mind may be that our sample consisting of 84 participants had an age range of 19-24. The second reason may be the fact that different texts were selected. However, standard texts were not used in either study. Therefore, it may be recommended to use standard texts in future studies.[38] More importantly, there is a need for studies conducted with texts that are demonstrated to represent Turkish well in terms of linguistic and paralinguistic components.

A significant difference was found both between the participants' speech and reading rates and between their articulation rates in speech and reading. These results suggest that these variables have different qualities. This is because the cognitive effort we exhibit for planning verbal messages in communication causes us to use more verbal pauses in speech.[39] We exhibit lower cognitive effort in reading than in speaking, with the effect that we use less verbal pauses in reading.[19] In this study, this might have played a role in the participants' higher reading performances than their speech performances. Studies of speech rates in different tasks also support this result.[19,21] In their study addressing articulation rate, Damhoureyeh et al. [31] found a higher reading rate than speaking rate in Jordanian Arabic. On the contrary, the articulation rate in reading was found to be lower than the articulation rate in speech in American English and Irish English.[19,21] In this context, prosodic differences between languages may affect the reading and speaking performances of individuals.

In the present study, there was no significant difference between the speaking rates of women and men. This result is supported by many previous studies.[6,19,22,30,31] In contrast, some researchers found a higher speaking rate in males than in females.[23,27] The fact that the languages that were studied were quite different (e.g., Dutch, Nepal Indo-Aryan or Russian) may be the reason for the difference in terms of gender in these studies. Another important factor is methodological differences such as using the number of syllables or words per minute or determining milliseconds for pauses in the calculation.

Similar to the result regarding the speaking rates of participants in this study, there was no significant difference between the reading rates of male and female groups. Of the studies consistent with this result, Block and Killen [30] also found no significant difference between the reading rates by gender in adults aged 21-30 years. İyigun et al. [25], who examined the reading rates of adult individuals whose main language was Turkish, obtained similar results. However, some studies found higher reading rates in men compared to women.[19,33] The present study found that males had a significantly higher articulation rate than females. Similar results were obtained for both Dutch and Korean.[23,29] Although some studies reported that men have a higher articulation rate than women, this difference was not statistically significant.[19,22] The difference between male and female individuals in terms of the articulation rate was explained through various facts reported in the literature. For example, since the articulation rate reflects the motor performance of speech, it may be affected by differences in speech anatomy and physiology of men and women.[19] Also, social-contextual differences by gender due to social dominance attitudes of men and their status in society suggest that men may have a higher speaking rate.[27,40]

The present study also determined that males had significantly higher articulation rate in reading than females. Jacewicz et al. [21] found that English-speaking adult males had a significantly higher articulation rate in reading. Similarly, Lee and Doherty [19] reported that when they read a text twice, adult males had a significantly higher articulation rate in reading than adult females. Considering the formula for calculating the articulation rate, men have longer pause times than women during speaking and reading.[19] Regarding the pause times in Chinese, Yuan et al.

[24] reported that men had longer pause times. In the literature, there is no study that investigated the pause times in Turkish, and future studies could better shed light on this subject.

In our study, some precautions were taken to increase generalizability in the methodological sense. For example, data were collected from as large as possible a sample (n=84). Additionally, students were included in the study without discrimination based on departments, and using a stratified sampling method, age- and gender-based diversity was also provided. However, collection of data from a single foundation university and individuals at the ages of 19-24 limits the generalizability of our findings to the entire Turkish-speaking adult population in terms of 'age, education and socioeconomic aspects'. Although Istanbul represents Turkey better in comparison to many other provinces, and it could be estimated that the sample would not show outlier characteristics in the socioeconomic sense based on the conditions of the school, due to the limitations stated above, our study should be considered as a preliminary normative study. Thus, future studies may be recommended to use various sampling methods in terms also of province, dialect and culture.

Conclusion

The present study provides evidence that the speech rate is low and the articulation rate is high in Turkish. However, future studies using different communication modalities such as presentations, radio programs or discussions may further support this result. Also, future studies could examine the subject in terms of development, linguistic complexity, information transfer rate, dialects, emotional factors and intelligibility. Nevertheless, the results of this study may constitute the first step in the creation of normative data related to this topic in Turkish and may provide insight for speech and language therapists in the clinical field.

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Ethics Committee Approval: The study protocol was approved by the Non-Interventional Research Ethics Committee of Uskudar University (Approval number: 61351342/2019-81)

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Author Contributions: Designing the study – MEC; Collecting the data – MEC, AI, AT, ABS; Analysing the data – MEC, AI, AT, ABS; Writing the manuscript – MEC, AI, AT, ABS; Confirming the accuracy of the data and the analyses – MEC, AI.

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