Speaking rate and articulation rate of native speakers of Irish English

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ABSTRACT

Previous studies have shown apparent difference in speaking rate and/or articulation rate between different dialects of English. In addition, native speakers of Irish English are perceived to be speaking very fast; however, there is very little information in the current literature regarding speech rate of speakers of this variety of English. Establishing regional norms might be needed for various reasons, such as speech intervention, if speakers of Irish English do have a higher speaking and articulation rates than individuals who speaks other English dialects. This study measured the speaking rate and articulation rate of 22 men and 22 women who were native speakers of Irish English. The study compared the speech rates between the male and female speakers, and across different speech tasks – first and second reading the Rainbow Passage and spontaneous speech elicited in a conversation. Overall, the male speakers seemed to speak faster than the females, although significant difference was found only in the articulation rate for the second reading of the passage. The speakers showed significantly higher speaking rate during passage reading than in conversation but the difference in articulation rate between the two tasks was not significant. Finally, the Irish English speakers in this study appeared to have relatively higher speech rates than most of the English dialects reported in previous studies.

Keywords: speaking rate, articulation rate, adult, Irish English

Introduction

This study was motivated by the authors' observations that native speakers of Irish English (IE) seems to speak faster than native speakers of other varieties of English. However, a search of the literature showed that there is currently no speech rate data for typical adult speakers of IE, except the study by Fitzsimmons, Sheahan and Staunton (2001), where speech rate was measured in terms of mean duration (in seconds) of sentences (10 sentences with number of syllables ranged from three to nine syllables). Mean duration of utterances is perhaps not the most common parameter for quantifying speech rate. The most frequently used measures of speech rate are speaking rate and articulation rate. Speaking rate, the traditional method, is typically defined as the number of output units (i.e., syllables or words) per unit time with pause intervals and disfluencies included (Cotton, 1936; Hall, Amir, & Yairi, 1999; Tsao & Weismer, 1997). The resulting unit of measure is either syllables per minute (spm) or words per minute (wpm). The spm measure is considered as a more precise metric of speaking rate because wpm measure is associated with greater variability between individuals due to words of varying syllabic length in connected speech samples (see Robb, Maclagan, & Chen, 2004). Some studies have suggested an even more precise measure, phones (individual speech sound) per unit time, for capturing the speed of speech coordination (see Hall et al., 1999). A second, more recent measure of speech rate is articulation rate, which is defined in the same way as speaking rate, but with the silent intervals/pauses removed from the computation (Goldman-Eisler, 1968; Tsao & Weismer, 1997). This measure is regarded as a more sensitive estimate of the actual speech execution time than speaking rate because the latter may vary considerably with factors, such as speaker's emotional state and the type of speaking situation, and it is regarded as a global estimate of verbal output (Hall et al., 1999; Miller, Grosjean, & Lomanto, 1984).

Speech rate is an important parameter in speech therapy services for individuals with speech rate disturbances due to various causes, such as stuttering, motor speech disorders (dysarthrias and apraxia of speech), and hearing impairment. For example, speech rate control is a strategy employed in nearly all stuttering treatment approaches to improve speech fluency (e.g., see Culatta & Goldberg, 1995). In managing early childhood stuttering, parents are suggested to control their speech rate by speaking more slowly to their child (e.g., Starkweather, Gottwald, & Halfond, 1990). Aside from targeting the speech rate problem itself, the strategy of rate control has been suggested for enhancing the clarity of speech in some speakers with dysarthria who show imprecise articulation due to reduction in muscle forces (e.g., Turner & Weismer, 1993). Hence, normative data on speech rate is important for speech-language therapists (SLTs) for the purpose of diagnosis, planning treatment and documenting treatment outcome. However, speech rate might vary between dialects (see e.g. Clopper & Smiljanic, 2015; Jacewicz, Fox, O'Neill , & Salmons, 2009; Robb et al., 2004) and that means establishing regional norms might be necessary for some dialects.

A number of studies have examined the speaking rate and/or articulation rate of typical adult speakers of different varieties of English, namely American English (AE; e.g., Clopper & Smiljanic, 2015; Jacewicz et al., 2009; Robb et al., 2004), New Zealand

English (NZE; Robb et al., 2004), Australian English (AuE; Block & Killen, 1996) and British English (BE; Tauroza & Allison, 1990). Generally speaking, among the four varieties of English, adult speakers of NZE has the highest speaking rate, followed by speakers of BE and AE, and the speakers of AuE showed the lowest speaking rate (Robb et al., 2004). (See Table 1 for a summary of the previous findings on speaking rate and articulation rates of different English dialects.) Data of articulation rate has been reported for AE and NZE. Overall, speakers of NZE seemed to show a higher articulation rate than the speakers of AE except for a couple of regional dialects of AE reported in the study by Clopper and Smiljanic (2015). It should be noted that the speech tasks used varied between these studies, which might have an effect on the results of speech rates. In fact, previous results are contrasting regarding this effect, for example, Block and Killen (1996) reported slower speech rate for oral reading than conversation although the difference was not statistically significant, whereas earlier studies reported higher speaking rate for reading than conversation (Duchin & Mysak, 1987; Lutz & Mallard, 1986).

Insert table 1 about here

Aside from the difference due to dialects and type of speech task, findings in the literature are also inconsistent regarding the effect of gender on speech rate. A few studies found that the male speakers spoke significantly faster than the females (Byrd, 1994; Fitzsimmons et al., 2001; Lutz & Mallard, 1986), while there were two studies that reported no significant difference (Block & Killen, 1996; Robb et al., 2004). The study by Jacewicz et al. (2009) reported significantly higher articulation rate in men than women during sentence reading but the gender effect was not significant in spontaneous speech. Hence, this study was carried out with a primary aim to explore whether IE speakers do have higher speaking rate and articulation rate as compared to the data of other varieties of English reported in the literature. If this is the case, further larger scale study would be needed to establish the normative data of speech rates for IE speakers. Second, the study investigated the difference in speaking rate and articulation rate between men and women across speech tasks (i.e., passage reading and spontaneous conversation). The study also examined whether there is a significant difference between the first and second reading of a passage. Horii (1983) reported shorter speaking time for the second reading but the difference was not tested statistically. Although previous studies showed the advantage of measuring phone per time unit, this study employed syllable per minute because this is a less time-consuming measure which is more practical for clinical use.

Method

Speakers

A total of 44 participants – 22 males and 22 females – took part in this study. The sample size was calculated using the method stated in Altman (1999), based on the standard deviation and smallest true difference reported in Robb et al. (2004). It was estimated that 22 participants per group is required to detect a difference of 26 spm

between the male and female speakers at a power of 0.9 and 5% significance level (Altman, 1999). The age of the speakers ranged from 19-22 years for the male speakers (mean age = 20.5 years) and 18-24 years for the females (mean age = 20.8 years). All speakers were native monolingual IE speakers, with no history of speech, language and/or hearing disorders, according to self-report and judgements by the second author. They were either undergraduate or graduate students, recruited in University College Cork (UCC) via email. Ethics approval was obtained from the Clinical Research Ethics Committee of the Cork Teaching Hospital and written consent was obtained from each speaker prior to data collection.

Speech recording

Samples of spontaneous conversation and oral reading were collected from the speakers. First, they were instructed to read aloud the first paragraph of the Rainbow Passage (Fairbanks, 1960) two times consecutively, at their habitual level of loudness, pitch and rate (Robb et al., 2004). This part of the passage is often used as the stimulus in speech evaluation in clinic and research. The speakers then engaged in a 3- to 5-minute spontaneous conversation with the second author. A list of topics of conversation was prepared in advance for eliciting connected speech samples (see Appendix). The topics were in the form of open-ended question, so that there would be no predetermined response schedule into which the speaker must fit their responses (Polgar & Thomas, 2000). The topic of conversation was not held constant across speakers. All speech samples were recorded in a quiet room using a Sony mini-disc recorder and a microphone maintained at a mouth-to-microphone distance of about 30 cm. The speech samples were then transferred at a sampling frequency of 44.1 kHz onto a secure computer for storage and acoustic analysis.

Acoustic analysis

The first and second reading of the Rainbow Passage and the conversation sample for each speaker were analysed using Praat (Boersma & Weenink, 1992-2009) and the duration data were entered into a spreadsheet for calculating the speaking rate and articulation rate. The analysis procedure reported in Robb and colleagues' study (Robb et al., 2004) was used.

Speaking rate

The onset of the first syllable and the offset of the last syllable in each of the passages were identified and annotated based on waveform display and wide-band spectrogram. The syllable onset was defined as the point where acoustic energy could be first detected and the offset of the last syllable was the point where acoustic energy could no longer be detected. The time interval between the onset and offset was the total passage duration and it was measured for each speaker. The total number of syllables produced for the Rainbow Passage was counted for every speaker and mistakes and/or revision of

words made by some speakers were counted as extra syllables. The total number of syllables produced in the passage was then divided by the total passage duration to give the speaking rate in spm.

The conversation samples were analysed in a similar way. The entire conversation was listened to in full by the second author and the portion that demonstrated the speakers' more fluent speech was selected. Fluent speech was defined as utterances that do not show prolongations, blocks, repetition, or revisions (see, e.g. Lickley, Hartsuiker, Corley, Russell, & Nelson, 2005). Hesitations have been considered as a feature that disrupt speech fluency (e.g. Lickley et al., 2005) and these were taken as verbal pauses in this study (see below). Using this criterion, approximately 30 to 45 seconds of conversation was extracted for each speaker for analysis. The conversation extract was transcribed orthographically and the number of syllables was counted. The syllable counts were based on occurrences of syllables as heard by the investigator, with caution to avoid any discrepancy between the number of idealised syllables and the actual utterances, which could slightly elevate the results (Tauroza & Allison, 1990). Each conversation extract contained about 123-168 syllables, which is comparable to the number of syllables in the Rainbow Passage (128 syllables). For some speakers, two conversation extracts were analysed because the number of syllables was far less than 128 in any single extract.

Articulation rate

The articulation rate in spm was determined by dividing the total number of syllables in the passage (or conversation extract) by the time taken to produce the sample with all silent intervals/pauses removed. Robb et al.'s (2004) definition of pause, which was also used in the study by Robb and Gillon (2007), was employed in this study. The authors reviewed the various time frames used in previous studies (see also Kent, 1994, for a review) and concluded that silent interval less than 50 ms is assumed to reflect an articulatory process, while silent interval in excess of 50 ms reflects a combination of hesitancy and articulatory pauses. Hence, silent periods of 50 ms or longer were regarded as pauses in this study and they were removed from computation. In addition, verbal pauses that signal hesitation, such as 'um', 'ah, 'uh', were counted as part of the silent period. Another type of verbal pauses, such as 'you know', 'like', 'and', 'yeah, but', were bridging words, which were often used when deciding what to say next. They were counted as syllables in the study. The onset and offset of each silent interval was identified and the segments were annotated. A Praat script was then used to total the silent intervals in each sample.

Twenty-five percent of the speech data (i.e., the two readings of the Passage and the conversation extracts of 11 speakers) was randomly selected by the second author and re-analysed for assessing intrajudge reliability. The first author also analysed 25% of the samples to check interjudge reliability. Pearson product-moment correlation coefficient (r) was 0.99 ($p < 0.05$) for intrajudge reliability and 0.96 ($p < 0.05$) for interjudge reliability.

Results

Speaking and articulation rates

The results of speaking rate and articulation rate for the first and second reading of the Rainbow Passage and spontaneous conversation are summarised in Table 2.

Insert table 2 about here

Difference in speech rates between the male and female speakers

Overall, the male speakers seemed to show higher speech rates than the female speakers across the speech tasks, except the speaking rate for spontaneous conversation. Six independent-samples *t*-test with Bonferroni adjustments (i.e., 0.05/6, significance level = 0.008) were conducted using SPSS (version 14.0) to test the difference between the male and female speakers for the six dependent variables (two speech rates for three speech tasks). Multivariate analysis of variance was not used because the assumption of multicollinearity was violated. The male speakers showed a significantly higher articulation rate (mean = 363 spm, SD = 26) than the female speakers (mean = 340 spm, SD = 31) for the second reading of Rainbow Passage ($t = -2.761$, $p = 0.008$). The males and females did not show significant difference for the other five variables: speaking rate for the first reading (mean rate was 293 spm for the males and 282 spm for the females; $t = -1.333$, $p = 0.190$), second reading of the passage (males = 307 spm, females = 292 spm; $t = -1.688$, $p = 0.099$) and spontaneous conversation (males = 266 spm, females = 275 spm; $t = 0.837$, $p = 0.408$), articulation rate for the first reading of the passage (males = 341 spm, females = 323 spm; $t = -2.098$, $p = 0.042$) and conversation (males = 353 spm, females = 335 spm; $t = -1.567$, $p = 0.125$).

Differences in speech rates across the speech tasks

Since the male and female speakers differed in only one variable, the data were collapsed across gender for each of the six dependent variables. One-way repeated measures ANOVA were conducted using SPSS (version 14.0) to assess the difference across the three speech tasks (i.e., the first and second reading of the passage and spontaneous conversation) for speaking rate and articulation rate. There was a significant effect for speech task on speaking rate (Wilks' Lambda = 0.493, $F(2, 42) = 21.554$, $p < 0.001$). Post hoc comparison with Bonferroni adjustments (i.e., 0.05/6, significance level = 0.008) showed that there was a significant difference among the three tasks (see Table 3), with the second reading of the passage being the fastest (mean = 299 spm, SD = 31), followed by the first reading (mean = 288 spm, SD = 29) and the spontaneous conversation (mean = 271 spm, SD = 35). For articulation rate, there was also a significant effect for speech task (Wilks' Lambda = 0.222, $F(2, 42) = 73.391$, $p < 0.001$). Post hoc comparisons with Bonferroni adjustments showed that the speakers had a significantly higher articulation rate for the second reading of passage (mean = 352 spm, SD = 30) than the first reading (mean = 332 spm, SD = 30). The difference

between the two readings of passage and conversation was not significant statistically (see also Table 3).

Insert table 3 about here

Discussion

This study explored whether typical adult speakers of IE do have higher speaking and articulation rate and tested the effect on speech rates due to speech tasks and gender of speakers. The present results generally supported the findings of some previous studies that men tend to speak faster than women in reading task (Byrd, 1994; Fitzsimmons et al., 2001; Jacewicz et al., 2009; Lutz & Mallard, 1986). In this study, the male speakers showed a significantly higher articulation rate than the females when they read the Rainbow Passage again. However, the difference was not significant for speaking rate for the same task. In conversation, the males seemed to show a lower speaking rate than the females but once the pauses are eliminated, they showed a higher articulation rate than the females on average. These reflect that the male speakers had relatively longer total pause time than the females when they read and talk. Similar findings of longer pause duration have been reported in the literature; for example, the study on pause and pause fillers in connected speech produced by speakers of Mandarin Chinese by Yuan, Xu, Lai, and Liberman (2016) and other studies reviewed in their paper. The cause of gender difference in pause duration is unclear; however, most studies in the literature seem to suggest that it is related to sociolinguistic variations (Kendall, 2013). It is known that the anatomical structures and physiology involved in speech production differ between men and women in many aspects (see e.g. Hixon, Weismer, & Hoit, 2008); however, further research is warranted to find out how anatomy and physiology contributes to longer pause time in connected speech in men.

Regarding the difference in speech rates across speech tasks, all speakers consistently showed a significantly higher speaking rate and articulation rate in the second reading of the passage than in the first. The result was expected (as shown in previous study by Horii, 1983) because it was assumed that the rates would increase as the speakers were more familiar to the speech material and more comfortable with being recorded. All speakers reported that it was easier to read the passage on the second occasion as they were less apprehensive about the task at hand at this stage. The speakers also reported that they felt the second reading of the passage was a better estimate of their usual speech rate, as they had felt nervous and had made more mistakes with the first reading. Analysis of the data for both readings of the passage did show that more mistakes were made in their first reading than in the second. Hence, it is agreed that the second reading of the Rainbow Passage is a truer reflection of actual speed of speaking, and it is this data that should be used in clinical assessment and future research.

For the difference in speech rates between oral reading and spontaneous conversation, the speakers spoke significantly slower during conversation than in passage reading (both readings of passage), which agreed with earlier findings by Lutz and Mallard (1986) and Duchin and Mysak (1987). No significant difference in

articulation rate between reading and conversation was found, yet inspection of the means showed higher articulation rate for conversation than the first reading of passage. This was because the speakers used a lot of verbal pauses of hesitation (e.g., um, ah, uh) and bridging words (e.g., you know, like) during conversation but not in reading. Conversation is a task that demands planning and other cognitive load and the use of the verbal pauses is commonly observed in conversation, especially when answering questions (Bortfeld, Leon, Bloom, Schober, & Brennan, 2001). The verbal pauses, bridging words in particular, were often associated with prolonged silent intervals; hence, the removal of these verbal pauses and silent periods in conversational extracts yielded a high articulation rate.

Comparing the present results to the findings reported in the literature, IE speakers were found to have higher speaking and articulation rates than the speakers of NZE and AE (Robb et al., 2004) and higher speaking rate than the speakers of AuE and BE (Block & Killen, 1996; Tauroza & Allison, 1990). However, the articulation rate of the IE speakers in this study was lower than some of the AE dialects reported by Clopper and Smiljanic's (2015) – particularly, New England, Mid-Atlantic, and South. This difference in articulation rate between different English dialects is probably attributed to linguistic factors, such as the varied vowel features in the different accents of English (Robb & Gillon, 2007; Tsao & Weismer, 1997), however, further investigation is needed.

Accents and dialects of Irish English vary immensely across Ireland (Hickey, 2004). The present study investigated the speech rates of speakers from the south-east region of the country, namely the Waterford and Kilkenny counties. It is uncertain whether individuals' speech rates vary in different parts of the country and between rural and urban areas, hence, further investigation on the possible difference in speech rates in different parts of the country as well as using temporal measures (see e.g. Jacewicz et al., 2009) would be useful.

Conclusion

To conclude, this study reported data on speaking rate and articulation rate for typical adult speakers of Irish English. Overall, the male speakers seemed to show higher speech rates than the females, although significant difference was observed only in the articulation rate for the second reading of the passage. The speakers showed lower speech rates in conversation than in oral reading in general. The present findings showed that speakers of Irish English have relatively higher speech rates than most of the varieties of English studied previously.

Acknowledgements

We would like to thank the speakers for their participation.

Declaration of interest

The authors report no declarations of interest.

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Appendix

List of topics used for eliciting connected speech samples in spontaneous conversation.

1. Tell me about your life since you completed the Leaving Certificate.
2. Tell me about your home town.
3. Tell me about where you live in Cork.
4. Tell me about what you do at the weekends.
5. Describe a typical week for me.
6. Tell me about the programmes you watch on television.
7. Tell me about the sports you play, or are interested in.
8. Why do you like living in Cork?
9. What are your plans for this coming summer?
10. How have you spent your summers during your years at college?

Table 1

Summary of previous results of speaking and articulation rates in spm (mean, standard deviation in brackets) for typical adult English speakers.

		Speaking rate			Articulation rate		
English	Speech task	Male	Female	All speakers	Male	Female	All speakers
American[1]	Reading	--	--	260	--	--	300
	Spontaneous speech	--	--	220	--	--	--
American[2]	Rainbow Passage (second reading)	245 (29)	254 (20)	250 (25)	315 (28)	318 (19)	316 (24)
American[3]	Sentence reading	--	--	--	209 (26)	200 (24)	196-212
	Spontaneous speech	--	--	--	312 (34)	302 (37)	289-325
American[4]	Rainbow Passage + Goldilocks fairytale	--	--	--	--	--	322-344
Australian[5]	Rainbow Passage + Grandfather Passage	230 (30)	231 (26)	230	--	--	--
	Conversation	237 (21)	240 (21)	238	--	--	--
British[6]	Radio monologue	--	--	249 (26)	--	--	--
	Conversation	--	--	263 (31)	--	--	--
New Zealand[2]	Rainbow Passage (second reading)	277 (30)	284 (24)	280 (27)	346 (31)	341 (25)	342 (28)

Note: 1 = Previous studies on American English reviewed in Robb et al. (2004); 2 = Robb et al. (2004); 3 = Jacewicz et al. (2009); 4 = Clopper and Smiljanic (2015); 5 = Block and Killen (1996); 6 = Tauroza and Allison (1990).

Table 2

Results of the speaking rate and articulation rate for the first and second reading of the Rainbow Passage and spontaneous conversation for the male and female speakers and all speakers as a whole.

	Speaking rate			Articulation rate		
Speech task	Male	Female	All speakers	Male	Female	All speakers
Rainbow passage 1						
Mean (SD)	293 (28)	282 (30)	288 (29)	341 (27)	323 (30)	332 (30)
Range	241-348	223-337	223-348	300-394	257-375	257-394
Rainbow passage 2						
Mean (SD)	307 (30)	292 (31)	299 (31)	363 (26)	340 (31)	352 (30)
Range	256-355	231-349	231-355	322-406	273-392	273-406
Spontaneous conversation						
Mean (SD)	266 (35)	275 (35)	271 (35)	353 (42)	335 (35)	344 (39)
Range	214-345	232-357	214-357	292-463	273-407	273-463

Note: Rainbow passage 1=First reading of the Rainbow passage; Rainbow passage 2=Second reading of the Rainbow passage; SD=Standard deviation.

Table 3

Results of one-way repeated measures ANOVA and Post Hoc tests comparing the speaking rate and articulation rate across three speech tasks – the first and second reading of the passage and spontaneous conversation.

			Post hoc comparisons					
	ANOVA		Rainbow 1 vs. Rainbow 2		Rainbow 1 vs. Conversation		Rainbow 2 vs. Conversation	
Speech rate	*F*(2,42)	*p*	*t*(43)	*p*	*t*(43)	*p*	*t*(43)	*p*
Speaking rate	21.554*	0.000	-6.036**	0.000	3.103**	0.003	4.849**	0.000
Articulation rate	73.391*	0.000	-12.248**	0.000	-2.307	0.026	1.415	0.164

Note: *Significance level=0.025 (two comparisons conducted, 0.05/2=0.025); **Significance level=0.008 (six comparisons conducted, 0.05/6=0.008); Rainbow 1=First reading of the Rainbow passage; Rainbow 2=Second reading of the Rainbow passage.