A CORPUS-BASED STUDY OF SPEECH FLUENCY ACROSS ENGLISH DIALECTS

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Abstract:

The main purpose of the current study was to investigate whether differences in speech fluency exist across three English dialects. The study consisted of a total number of 128 participants including 40 American English, 28 British English and 60 New Zealand English speakers. For each participant, 600 words of a conversation sample were selected to analyze the rate characteristics and frequency of disfluencies. Rate metrics included both articulation and speech rate and disfluency metrics included stuttering-like and normal disfluencies. The relationship between rate and disfluencies was also tested. Results indicated that articulation rate was significantly different between New Zealand and British English with an average of 318spm (SD=0.9) and 293spm (SD=0.59) respectively and frequency of normal disfluencies was significantly different between British and American English with an average of 7.74 (SD=3.38) and 10.29 (SD=4.59) respectively. There was also a significant relationship between rate and stuttering-like disfluencies suggesting that clinicians may have to be mindful that measures of speech rate may be influenced by the presence of more disfluencies. Findings from this study provide information on rate and disfluency characteristics in people who do not stutter across dialects for clinical practice.

1. BACKGROUND

Speech production is a complex process. Spontaneous speech therefore often consists of disfluencies (Culatta & Leeper, 1989). While every person may experience disfluencies, those that mostly occur in fluent speakers (People Who do Not Stutter - PWNS) are referred to as Normal Disfluencies and those mostly occurring in People Who Stutter (PWS) are called stuttering-like disfluencies (SLDs). Differentiating between these types of disfluencies allows us to identify speech disorders such as stuttering. Both types of disfluencies can be seen in PWS and PWNS but the differences lie mainly in the frequency and the duration of the disfluencies (Cordes & Ingham, 1995).

Data on disfluencies seen in PWS plays a vital role in the diagnosis of fluency disorders. Therefore, a large number of studies have been focused on identifying characteristics of the disfluencies in PWS. Those studies have investigated the localization of the disfluencies within the speech sample, the type, and frequency of occurrence of the disfluencies and factors that may influence the occurrence of the same (Sawyer, Chon, & Ambrose, 2008) (Kleinow & Smith, 2000). Hence, there is ample data on stuttering and relatively less attention has been given to disfluencies in PWNS in Speech-Language therapy literature. Nevertheless, information on disfluencies in PWNS is important to help build our understanding of normal and pathological conditions. In addition, it has been shown that variations in disfluencies may occur due to the speaker and listeners' characteristics. While influences of age, gender, years of education, sample length, topic familiarity, relationship to the listener and speaking context have been well-researched (Broen & Siegel, 1972) (Logan & Conture, 1995) (Logan & Conture, 1995) (Merlo & Mansur, 2004), considerably less attention has been given to dialect variations. Dialect is a variety of a language with its own rules, different from other varieties of the same language in terms of pronunciation, vocabulary, and structure. Hence, dialects of the same language show variations in the aspects mentioned above which may, in turn, lead to variations in the rhythm, stress, and rate of speech. These are the important attributes of speech fluency (Trofimovich & Baker, 2007). Therefore, dialect could be considered as a factor that may alter fluency and one that needs further exploration.

Initially, before discussing the current study, an overview of the terminology related to Normal disfluencies and SLDs will be presented. Later, the existing literature on disfluencies in PWS and PWNS will be reviewed, with special consideration of the factors that may influence the occurrence of these disfluencies.

1.1. Speech Fluency vs Disfluency:

To obtain optimal speech production, conjunctive working between respiration, articulation, and phonation should be achieved. These processes combine to form a speech system. A disruption in the working of this speech system at any stage can affect the fluency of speech. Hence, Broen & Siegel (1972) stated that there cannot exist a smooth, continuous, word to word, flow of speech. Thus, fluent speech is not easy to define (Ingham et al., 2009). However, it is often described to be an effortless flow of speech or speech with relatively little effort, normal rate of speech and a natural sound quality (Valente & Jesus, 2011). The interruptions that occur in the effortless flow of speech of PWS and PWNS are known as disfluencies. These disfluencies may have different explanations for their emergence such as psychogenic disfluencies, neurogenic disfluencies, developmental stuttering, normal disfluencies and language delay but the two main classifications of disfluencies in the clinical speech fluency literature are normal disfluencies and stuttering-like disfluencies (SLDs).

1.2. Normal disfluencies Vs Stuttering-like disfluencies:

"Normal" disfluencies are the ones that are seen in non-stuttered speech. The occurrence of these disfluencies has no apparent cause or particular pattern (Yairi, 1972). They could be due to many reasons such as situation, topic spoken about, time to think, etc. These forms of speech interruption called normal disfluencies are virtually seen in all speakers (Broen & Siegel, 1972). It is also said that these disfluencies in fluent speakers help in better communication (Lake, Humphreys, & Cardy, 2011). The most common normal disfluencies seen in everyday speech are fillers, interjections, word and phrase repetition, false starts and unfilled pauses for less than 250 ms (Love & Jeffress, 1971). They are also called typical disfluencies or more typical disfluencies or normal discontinuity or "between words" disfluencies (Yaruss, 1997).

SLDs are the disfluencies seen more in PWS and are also called less typical disfluencies or "within words" disfluencies. The three main SLDs are:

- blocks,
- prolongations and
- repetitions.

The SLDs are distinguished from normal disfluencies mainly based on the frequency and duration of an occurrence.

1.2.1. Normative fluency data:

The table below gives an overview of normative fluency data (Gregory, Hill, & Campbell, 1996)

Table 1:

An overview of normative fluency data

Type of Disfluencies	Considered Normal if :
Less Typical Type-LTT (stuttering-like disfluencies - sound/syllable/whole word repetitions, blocks, and prolongations)	≤ 2 stutters in 100 syllables Or ≤ 2 stutters in 1-minute speaking sample
More Typical Type- MTT (Normal disfluencies- interjections, revisions, phrase/word repetitions)	≤ 8 disfluencies in 100 syllables

This table explains that speech could be considered normal if the number of SLDs is 2 or less in 100 syllables and the number of normal disfluencies is 8 or less in 100 syllables. This means that SLDs have lower limit compared to normal disfluencies, indicating that SLDs are less apparent in PWNS compared to normal disfluencies. In other words, SLDs are more characteristic of PWS and Normal disfluencies are more characteristic of PWNS. However, both these types may be seen in PWS and PWNS (Cordes & Ingham, 1995).

1.3. Contributing factors to speech disfluency:

The disruption in speech fluency may occur due to various factors. Maclay and Osgood (1959) have stated that the rate of disfluency can be affected by within/between speaker factors. “Within speakers” factors can also be called internal factors which comprise of age, gender, linguistic processing required for speech (Eisler, 1968), the emotional state of the individual. “Between speakers” factors can be called external factors which include situational factors and topic spoken.

The factors could also be classified based on their ability to be altered. Some factors can be altered and some cannot. For instance, age, gender or linguistic processing of brain in a person cannot be altered whereas the topic chosen to speak about or the situation can be altered. However, if we consider dialect as a factor, it is interesting to know that it may not fit in either of the categories.

Dialect is a characteristic feature of a geographical location. Any feature of a geographical location usually remains unaltered but the dialect is continuously altered for various purposes like “for better communication”. This factor is discussed in detail in the later sections.

Apart from the factors affecting speech, Siegel, Lenske, and Broen (1969) were interested in knowing if the speakers have the ability to control these factors to produce speech without disfluencies. They conducted a study on five college students, where they ‘charged’ one penny for each disfluency during spontaneous speech. The disfluencies considered for the study were solely interjections (um, er, uh, and so on) and repetitions of sound, syllable, word and so on, as these they cover 85% of the disfluencies in fluent speakers. Pauses and prolongations were not considered as they were difficult to judge immediately. The results suggest that it is possible to completely suppress the disfluencies (interjections and repetitions) by charging one penny for each disfluency. Though it is accepted that disruptions in the speech are inevitable and they occur in the fluent speakers also due to various factors, the above study explains that disfluencies could be minimized voluntarily by the speakers.

The effect of contributing factors (situational factors, topic familiarity, sample length, age, gender, and bilingualism) on speech fluency are discussed in the following paragraphs

1.3.1. Situational factors:

Situational factors can be considered as one of the major factors that influence disfluencies in PWS. Yaruss (1997a) has supported the above statement. There are many studies showing that situations can have an influence on the severity of stuttering. Just like in PWS, this factor can affect fluency in PWNS also.

Broen and Siegel (1972) also studied the situational factors affecting normal speech disfluencies. Different situations like being alone, in front of an audience, on TV, and in a conversation were considered. The subjects were asked to speak in these different situations for 12 minutes each and then complete a questionnaire. The first part of the questionnaire asked the subject to judge the importance of speaking “properly or carefully” in each situation on a 5 point rating scale, in which 1 was “did not concern me at all” and 5 as “I felt it was very important”. The second part asked the subject to estimate the number of disfluencies in each situation. The participant was asked to estimate whether his/her disfluencies had fallen within the range: 0-10, 10-20, 20-30, 30-40, 40-50, more than 50. Later the answers from the questionnaire and the number of disfluencies from different situations were compared. The results of this comparison declared that disfluencies do vary in a predictable way with changes in the situations. Speakers tend to be more fluent when they thought speaking carefully was important.

Lutz and Mallard (1986) studied the rate of disfluencies in two different situations- conversation and reading in PWNS. They considered 25 males and 25 females with a mean age of 20. Initially, about 10 questions were asked which are related to their studies, university, hometown, and family. Then they had to read the first paragraph of the rainbow passage. Participants were informed that their speech was being recorded. Later, results showed that during the conversation, every subject had some disfluency whereas, while reading, about 32% of them did not have any disfluencies. The results suggest that disfluencies are reduced while reading compared to the conversation.

1.3.2. Topic familiarity:

"Topic familiarity" is determined by the amount of knowledge and experience a person has about a particular topic. It is assumed that the topic which is more familiar is easy to think of and to talk about, leading to fewer disfluencies.

Hence, Merlo and Mansur (2004) conducted a study to address the questions about topic familiarity and disfluencies during the oral discourse of adult speakers. Fifty-two adults between the age range of 22 years and 55 years were considered. They were first asked to judge 6 different topics as familiar and not familiar and then to talk about the most familiar topic first, followed by the least familiar topics. The recordings of the most familiar and the least familiar topics were compared to conclude that, topic familiarity did not affect the number of normal disfluencies in the discourse.

Roberts, Meltzer, and Wilding (2009) examined disfluencies in PWNS, across topics. The study included 30 men and they were asked to talk about 3 different topics (job, hobby, and sport) followed by rainbow passage reading. The results showed that there were no significant differences seen across topics. However, there were more disfluencies seen when the person was asked to explain how to play a sport. The author understands that the slight difference with the particular question may have been due to the complexity of the question and not knowing the answer.

1.3.3. *Sample length:*

The length of the speech sample (sample length) is one of the factors considered by researchers to check for the variations in normal disfluencies because it is important to know how long a sample is needed to be to reliably measure disfluency rates in adults. If disfluency rates in adults are stable over different sample lengths, then there is no need to analyze long samples and if sample length matters then different sample lengths can't be used to diagnose.

Kleinow and Smith (2000) studied the effect of syntactic complexity and sample length on the speech motor stability in PWS and PWNS. The study included 8 PWS and 8 PWNS. They used the stimuli which were used by Maner et al. in 2000. The stimuli set consisted of 5 utterances with 1 "baseline phrase utterance" and 4 "increased length and syntactic complexity utterances". For example "Buy Bobby a puppy" is a baseline phrase and will be embedded in the longer utterance like "They asked us to buy Bobby a puppy this week". In addition, they used two sentences with increased length but not complexity like "one two three buy bobby a puppy four five six". The results stated that the speech motor ability was unaffected in PWNS whereas it decreased in PWS due to an increase in syntactic complexity and sample length.

Roberts et al. (2009) also looked into different sample lengths in their study and the participants spoke on 3 topics for several minutes and each transcript was segmented into 3 different lengths, each starting from the starting of the monolog: 300, 500 and 800 to 1000 syllables. The results determined that the mean of total disfluencies were 6.4 to 7.8 across topics and sample length and the mean of SLDs were within 3 across topics and sample lengths. They concluded that sample length or topic spoken about did not have any significant effect on speech fluency.

1.3.4. Age and Gender:

The above are a few studies on variations in normal disfluencies with respect to different factors which could be altered. Now looking at the factors which cannot be altered. The speakers' age and gender are factors that cannot be changed for our convenience.

Bortfeld, Leon, Bloom, Schober, and Brennan (2001) investigated various situational and demographic factors that have been argued to affect speakers' disfluency rates. Here, they examined disfluency rates within one large corpus which contained approximately 192,000 words uttered by 48 pairs of people. Out of these, 16 were younger-age (mean age 28), 16 were middle-age (mean age 47) and 16 were older-age (mean age 67). Disfluencies assessed were repeated words, repeated phrases, restarts, and fillers. Different factors such as age, gender, familiarity with the partner, conversational role and topic were considered. One of the results stated that disfluency rate was slightly higher in older-age speakers (6.67)compared to young (5.55) and middle-age people (5.69). Horton (2010) also stated that increasing age is associated with longer and more complex sentences with a greater number of disfluencies such as fillers 'uh' and 'um'.

Duchin and Mysak (1987) studied the disfluency and rate characteristics in young adult, middle aged and old aged people. The study includes 75 male participants who are divided into 5 groups based on their age. The 5 groups are young adults (21-31years), Middle age (45-54), Middle-age II (55-64), Elder I (65-74), Elder II (75-91). They were studied in three situations, oral reading, picture description and conversational speech. Participants were asked to read the rainbow passage for oral reading, then were given three Norman Rockwell pictures for picture description followed by an interview by the researcher concerning their summer activities, job, hobby, and family until 10 minutes for conversational speech. The results did not show any significant difference in disfluencies across age but there was a significant rate difference. The rate of speech was decreasing from young age to old age. Hence, the author believes that the reducing rate of speech along the years assist them in maintaining the speech fluency. In other words, reduced rate of speech helps balance speech fluency.

Now looking into gender, Bortfeld et al. (2001) questioned the effect of gender on disfluencies. The results showed that men produced a higher rate of disfluencies (6.80) overall per 100 words than women (5.12).

Lutz and Mallard (1986) also checked for differences in disfluencies and rate of speech between males and females. Twenty-five males and twenty-five females participated in the study which consisted of conversation followed by reading the rainbow passage. The results determine that males' rate of speech was faster in both the conditions (conversation and reading) and the disfluencies like incomplete phrases, repetition, and revisions than females; while females had more incoherent sounds in their speech.

1.3.5. Bilingualism:

A bilingual person is someone who speaks two languages. A person who speaks more than two languages is called 'multilingual' person(although the term 'bilingualism' can be used for both situations). Multilingualism isn't unusual; in fact, it's the norm for most of the world's societies. It's possible for a person to know and use three, four, or even more languages fluently. This is another factor which cannot be altered. A person cannot unlearn the language just to become monolingual.

Byrd, Bedore, and Ramos (2015) studied disfluencies in bilingual Spanish-English children. The primary purpose of this study was to describe the frequency and type of disfluencies produced by bilingual Spanish-English children who do not stutter and the secondary purpose were to determine whether their disfluent speech was mediated by language dominance and/or language produced. Spanish and English narratives were elicited from all 18 participants and analyzed relative to the frequency and types of speech disfluencies produced. All the data was compared with the monolingual English-speaking guidelines for the differential diagnosis of stuttering. They concluded that the bilingual Spanish-English children produced more SLDs with a range of 3-22% when compared to monolingual English standard of 3% SLDs.

1.4. Disfluencies compared between two languages:

In the previous section, the speech fluency differences between children who speak two or more languages and children who speak one language were discussed. Further, the studies comparing the fluency of two different languages will be discussed.

Boey, Wuyts, Van de Heyning, De Bodt, and Heylen (2007) compared the occurrence of normal disfluencies between two languages to find if there could be any difference between languages. They focused on characteristics of SLDs in Dutch-speaking children (including both stutterers and fluent speakers) and compared them with the several studies done on English speaking children. The main purpose of the study was to compare the characteristics of SLDs between PWNS and PWS. They considered 693 children diagnosed as stutters and 79 normally fluent children and concluded that characteristics of SLDs (including frequency, duration, and physical tension) in Dutch-speaking children were slightly different from English-speaking children though not clinically significant. As the results suggests the mean Stuttering-like disfluencies for normally fluent Dutch speaking children was 0.42% and this was compared with some of the studies done with native English speaking children like Yairi and Hubbard in 1988 stated 2.59% overall SLD, Pellowski and Conture in 2002 reported 1.1% overall SLDs, Yairi and Lewis in 1984 said 3.02% overall SLDs and were compared with a few more studies done on normally fluent native English speaking children. The overall percentage of SLDs in native Dutch speaking children who stutter was 15.71% and the results from some of the other studies on native English speaking children who stutter mentioned by the author are 11.99% by Yairi et al. in 1993, 8.7% by Pellowski and Conture in 2002, 8.4% by Zebrowski in 1994, 11.3% by Yairi and Ambrose in 2005 and a few more were mentioned. However, based on the average of the results of the other studies on English speaking children, Boey et al. stated that there were slight differences in characteristics of SLDs between Dutch and English speakers who stutter and who do not stutter but they are not clinically significant.

Also, considering two different languages, Van Borsel and de Britto Pereira (2005) investigated how well individuals can judge stuttering in clients who spoke languages other than their own. There were 14 native speakers of Brazilian-Portuguese who identified and judged stuttering in Dutch speakers and in Portuguese speakers. Fourteen native speakers of Dutch identified and judged stuttering in Brazillian-Portuguese and in Dutch speakers. They concluded that the judges of both the Brazillian-Portuguese and the Dutch-speaking panel performed better in identifying stutterers and non-stutterers in the native language than in foreign language.

The above studies showed that the variations in languages led to differences in diagnosis and occurrence of disfluencies. However, this could be due to the complexity of the languages. The present study focuses on a variation of the language called dialect. Dialect may not be as complex as a language yet differences exit between dialects.

1.5. Dialect:

As mentioned earlier, the dialect is a variation of a spoken language. Dialects sound different because they differ in articulation, intonation, vowels and grammar.

When looked deeper into it, we can understand that dialect is a factor which cannot be altered as it is considered a characteristic of a group of people belonging to a particular geographical region. However, we still see people changing their dialect for their convenience or for a better communication which makes it an interesting topic to study more.

Every language has different dialects depending on the geographical location of the group of people speaking a particular language.

There are a few studies related to dialect and speech disorders, which are discussed below.

1.5.1. Dialect and speech disorders:

Toohill, Mcleod, and Mccormack (2012) focused on the effect of the dialect on identification and severity of speech impairment. Fifteen indigenous Australian children participated in the study. These children were identified by their parents/caregivers/teachers as having "difficulty talking and making speech sounds" and were assessed using "Diagnostic Evaluation of Articulation and Phonology" (DEAP). The results showed that 14 children were identified with speech impairment when used standard Australian English (AuS) as the target pronunciation, whereas 13 were identified with Australian Aboriginal English (AAE) as a target. Apart from this, there was a statistically significant decrease in seven children's severity classification and statistically significant increase in all children's percentage of a vowel, consonants, and phoneme correct when compared AAE with AuS. Hence, the author suggests that it is important to consider children's dialect during the diagnosis.

Oder, Clopper, and Ferguson (2013) examined the effect of dialect on vowel acoustics and intelligibility. The goal of the study was to understand the acoustic and perceptual difference between dialects of America (Mid-Atlantic, Southern, and Midland). They also checked whether Midland dialect is closely related to Mid-Atlantic or Southern dialect. There were 150 tokens in total (10 vowels X 3 talkers X 5 tokens per vowel) talkers and only |hVd| words like head, had and hid were used for the analysis. Acoustic analysis was done using Linear predictive coding and for perceptual recognition, there were 31 listeners to whom 150 tokens were presented in a random order and they had to recognize the vowel. The results showed that Midland and Mid-Atlantic dialects are acoustically and perceptually more similar than Midland and Southern. It was also stated that similar dialect speech was more intelligible than a different dialect.

1.5.2. Dialect and speech rate:

Speech rate is one of the major attributes of speech fluency. Variation in the speech rate can alter the speech fluency. According to Yaruss (1997b) reducing speech rate for several utterances in a row or maintaining it over a period of time may improve speech fluency.

Robb, Maclagan, and Chen (2004) investigated the articulation rate difference between two English dialects (New Zealand and General American English). The study consisted of 80 participants in total, 40 from each dialect group. An oral reading sample from the rainbow passage was collected from each participant. They found that the overall speaking rate was significantly faster in New Zealand English compared to American English with an average of 342spm and 316spm respectively.

Jacewicz, Fox, O'Neill, and Salmons (2009) examined the regional variation in the rate of speech in the US population, stated that northern speakers had faster articulation rate than southern speakers in both reading and informal speech by as much as 8% in reading and 12.5% in an informal speech, supporting the argument that the dialect variation can alter the speech rate.

1.6. Relationship between Speech rate and Speech fluency:

In the existing literature, there is no consistency with the results obtained on the relationship between speech rate and speech fluency. To examine the relationship between rate and fluency, Yaruss (1997b) did a study on PWS. He reduced the speech rate of the individuals to check if there is a reduction in the disfluencies but no significant relationship was found. HeeCheong Chon, Sawyer, and Ambrose (2012) studied the influence of articulation rate on SLDs and found that there is no influence of speech rate on SLDs. However, Logan and Conture (1995) have mentioned that speaking rate was faster in fluent utterances than in stuttered utterances. And Howell and Sackin (2000) stated that fluent speakers under rate pressure produce SLDs in content words. Tumanova, Zebrowski, Throneburg, and Kayikci (2011) studied the influence of articulation rate of the frequency of the different type of disfluencies in children who stutter. They found a significant negative correlation between the rate and SLDs. These were the different views and conclusions that were derived from different authors when looked into the relationship between articulation rate and disfluencies.

Despite the results of these studies, it has been suggested that a reduction in the speech rate (or monitoring the speech rate in stutterers), may reduce disfluencies leading to smooth speech. It has been noted that if a consistent slow speech rate could be maintained and practiced, it will eventually lead to less disfluent speech (ASHA).

From the above literature, we know that speech rate varies across dialects also is an important factor of fluency. In addition, dialects differ in other aspects such as articulation, intonation, and vocabulary. Thus, it is possible that rate and the other differences between dialects may have an effect on speech fluency across dialects. Hence, the current study focuses on examining the effect of variations of dialects on speech fluency in PWNS.

Statement of the problem and the aim of the current study:

As discussed above, the two types of speech disfluencies are normal disfluencies and stuttering-like disfluencies. Stuttering-like disfluencies are more associated with stuttering and have gained more attention compared to studies on normal disfluencies. The existing studies on normal disfluencies have been shown to vary with respect to different factors but the effect of dialect as a contributing factor has been completely unaddressed. The studies which considered dialect have examined different aspects such as rate of speech, speech naturalness and speech intelligibility with dialect variation. Hence, data on disfluencies with respect to dialect is missing.

Considering rate as a major factor of variations in fluency, rate differences identified between dialects and slight variations identified in disfluencies between two different languages, it could be assumed that dialect may be a factor that affects speech fluency and hence, the current study makes an attempt to see if there are variations of normal and SLDs across dialects.

Accurate data with respect to these variables is necessary for a clinician to make a right diagnosis. Therefore, Speech Language Therapists might have to take dialect into account if any significant difference in speech fluency among dialects.is found.

As mentioned earlier, Robb et al in 2004 studied rate differences between New Zealand and general American dialect. Hence, the current study attempts to cross-check the results and also compare it with an additional dialect. So the three English dialects chosen for the proposed study are New Zealand, American (Columbus OH), and British (Liverpool) English dialects.

1.7. Hypotheses:

The above studies have led to the consideration of the following hypotheses:

a) Speech and articulation rate characteristics will differ between dialects (here we test rate differences between New Zealand, American, and British English).

b) Across different English dialects, there will be differences in the type and frequency of speech disfluencies present.

c) A positive correlation between speech rate and the number of disfluencies will occur across dialects.

2. METHOD

As mentioned in the introduction, three dialects were selected for the proposed study: New Zealand, American, and British dialects. Speech samples of the selected dialects were obtained from different corpora and needed detailed investigation.

2.1. Corpora:

Corpora could be referred to a large collection of texts which represent a particular variety or use of language(s) that are presented in machine readable form (Acharya & Fröberg, 2016).

The selected corpora for the study are ONZE for New Zealand English, OLIVE for British English and Buckeye for American English. All three corpora contain an extensive amount of conversational speech samples.

The ONZE (Origins of New Zealand English) corpus is an archive of New Zealand English speech. It has three sub parts in it: Mobile unit, intermediate corpus, and Canterbury corpus. Maclagan and Gordon (1999) have summarized all three sub parts in detail. Mobile unit corpus is the oldest and contains the recordings made between 1946 and 1948. Whereas, the intermediate corpus consists of recordings made between 1900 and 1925.

The third corpus was the Canterbury corpus and the biggest corpus. It has been collecting since 1994 and the speech samples have been added every year since then. It almost has an equal number of men and women and an equal number of old age (45-60) and young age (20-30) people. It approximately consists of speakers from all age range starting from 16 to 65 years. All speakers were born in New Zealand, and none spent significant periods of time outside the country. Most speakers are from Canterbury region but some were from other parts of the country. Each speaker reads the New Zealand English list of 200 words, and then student interviewers also engaged their subjects in the conversation for thirty minutes. The aim was to obtain material as close to casual speech as possible(Gordon et al., 2004).

The OLIVE (The Origins of Liverpool English) corpus is an archive of British English speech. It is a large collection of audio recordings of speakers born between 1897 and 1994, representing over 100 years in apparent time. This is the biggest collection of spoken data from three localities in North-West England (Liverpool, Skelmersdale, and St Helens). It was created to track changes over a 100-year period, to understand the change in accent during that time. The recording was done in a quiet room with an interviewer and two participants. They were engaged in a conversation for approximately 30 minutes. This corpus categorizes speakers into teenage speakers (16 - 19 years) and old age speakers with an age range of 55 - 70 years. This has the same structure as the ONZE corpus.

The Buckeye Speech Corpus of conversational speech is an archive of American speech. It contains high-quality recordings from 40 speakers in Columbus, Ohio conversing with an interviewer. The sample collected was stratified for age (under 30 and over 40) and sex. It includes 20 old (45-65 years) and 20 young (20-35years) speakers with an equal number of males and females in each category. The speech samples have been transcribed and phonetically labeled. The audio and text files, together with time-aligned phonetic labels, are stored in a format for use with speech analysis software(Pitt, Johnson, Hume, Kiesling, & Raymond, 2005).

All three of these corpora have been orthographically transcribed and then force-aligned at the phoneme level using the LaBB-CAT software.

For the current study, only conversational speech transcripts were considered from each corpus. In ONZE, only Canterbury corpus was used which is the biggest corpus compared to the OLIVE and the Buckeye with a wide range of participants. Buckeye is relatively small with 40 participants. OLIVE consists of a large collection of speakers but has a limited number of speakers from each locality. For example, there are 41 speakers from Liverpool.

2.2. Participant Selection:

The study included a total number of 128 participants of which 40 were from the Buckeye, 28 were from the OLIVE and the remaining 60 were from the ONZE corpus. The main criteria for the selection of participants were age and gender of the speakers. The participant selection procedure is explained in detail below.

Buckeye corpus had a total of 40 speakers, 20 old (45-65 years) and 20 young (20-35 years) speakers, with an equal number of males and females in each category. All 40 speakers were included in the study.

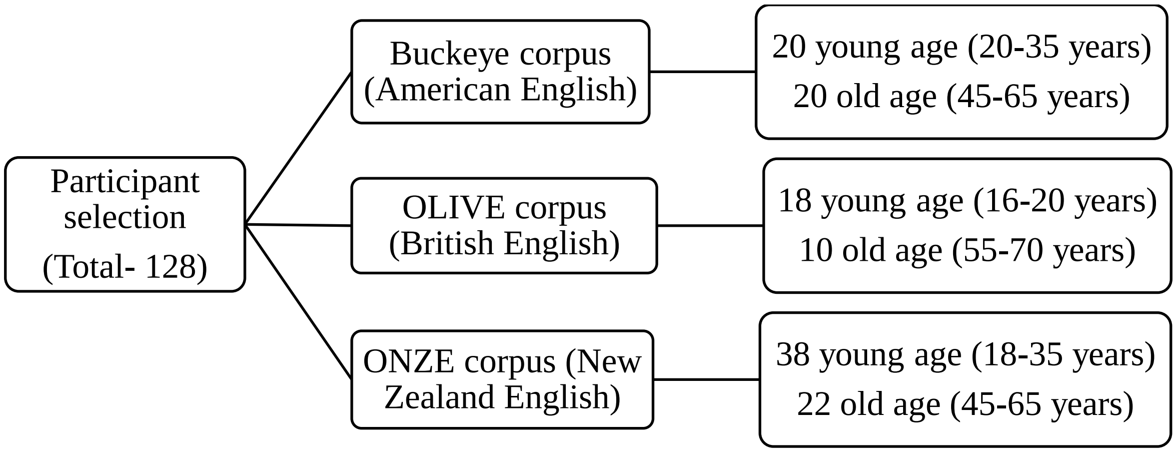
Then, participants from OLIVE corpus were selected. There was a total of 41 speakers. Similar to the Buckeye corpus the participants here were also divided into two sets: teenage and older age with 23 older (60 years and above) and 18 teenage (16 - 19 years) speakers. All the participants were included in the study.

After selecting participants from Buckeye and OLIVE, we found that the age range and gender of participants were approximately matched between the two corpora. Hence, we decided to select the participants from the ONZE corpus to match the participants from other two corpora with respect to age and gender. As the ONZE corpus is large, it was possible to get an accurate match for 68 participants from both other corpora with respect to age and gender.

Firstly, participants from ONZE were selected to match the participants from Buckeye. There were 40 participants from ONZE where 20 were old (45-65 years) and 20 were young (20-35 years). Then participants from the ONZE corpus were selected to match with OLIVE. During this process, it became evident that there were about 12 participants out of 41 with an age range of 80-90 years for which there was no match found from the ONZE or Buckeye corpus such that the participants of all three groups are uniform to allow comparison across corpora. Also, one participant's speech sample only consisted of word list reading which was not sufficient for the study. Therefore, those 13 participants were not included in the analysis. This resulted in a selection of 28 speakers from the OLIVE corpus. Out of these 28, 10 were older (55-70 years) and 18 teenage (16- 19 years) participants with an equal number of males and females. Eight older-aged participants from the ONZE corpus matched the participants in both corpora as they were in the same age range with the same gender. Hence, the total number of participants from the ONZE corpus were 60 with 38 young (18-35) and 22 old (45-65 years) speakers.

Finally, the whole process led to a selection of 128 participants for the study. The participants of OLIVE, Buckeye and ONZE were compared with each other with respect to age and gender to reduce variables as much as possible. The figure below gives an overview of participant selection for the study.

Figure 1: *An overview of Participant Selection*



2.3. Sample Selection:

To reduce the effect of topic familiarity, conversation samples with similar topics were included as speech samples.

In all three corpora, the conversation of each participant takes about 30 minutes and the initial 10 minutes of conversation may not be completely natural as the speaker will be aware that their speech is being recorded which can make them conscious. Hence, the middle 600 of the conversation was chosen. Six hundred words were mostly decided because this will approximately be 10 minutes of the conversation including interviewer's speech. This would be sufficient to assess all the disfluencies and also rate characteristics. It was made sure that this middle 600 words must constitute only casual talk which could be about their hobbies, childhood, work, life experiences, and so on.

In the Buckeye and the ONZE corpus, each participant's conversation was divided into a few chunks called transcripts. Out of all the transcripts, one transcript was chosen where the speaker mostly speaks about the general topic and nothing more stressful. In the chosen transcript, the middle 600 words were used for assessment. However, for some participants, the word count was less than 600 in the transcripts. In cases where the total word count was 300 to 450 in a transcript, two transcripts from the same participant were considered and the disfluencies were calculated including both transcripts. In some cases, where the word count was 500-600, the same transcript was used and the disfluencies were calculated using the total word count. Thus, four participants from the ONZE and one from the Buckeye required 2 transcripts as a sample. Ten participants from the ONZE corpus had 500-600 words and the disfluencies were calculated using the same samples.

In the OLIVE corpus, the interview was done with two participants at a time and hence, two speakers' speech is recorded at the same time. Here, the conversation is mostly about their birthplace, language, dialect, and location. Here, one participant had 365word sample and disfluencies were calculated using the same samples as the conversation was not divided into transcripts in the OLIVE corpus.

2.4. Data Analysis:

The recorded conversations in the corpora were already transcribed. These were manually transcribed and automatically segmented at phoneme level. These phoneme segments were also labeled with respective phonemes. In the current study, the precision of the word boundaries and phoneme boundaries were manually checked and corrected wherever necessary. This manual correction was done in praat by relating the transcribed speech and the waveform for the speech.

2.4.1. Disfluencies:

The different disfluencies considered for the investigation are: 1) Mono-syllabic word repetition 2) Multi-syllabic word repetition 3) Part-sentence repetition 4) Revisions 5) Unfinished sentences 6) Interjections 7) Disfluent pauses 8) Sound repetition 9) Syllable repetition 10) Blocks 11) Prolongations 12) Broken words. The first seven were categorized as normal disfluencies and the rest were SLDs. Appendix (A) gives the definition and the example for each disfluency measured.

2.4.2. Coding:

Coding of disfluencies includes manual and automatic coding. Automatic coding was completed by a software called LaBB-CAT. It allows both automated and manual coding.

LaBB-CAT (Fromont and Hay 2008) software was formerly known as ONZE Miner. It is a browser-based, searchable database tool for time-aligned transcripts of speech produced using transcriber, a transcription and annotation tool given by Barras et al. (2000). LaBB-CAT can store audio and video recordings, text transcripts and other annotations(Fromont & Hay, 2012).

Although, automatic coding was achieved for the following disfluencies: monosyllabic word repetition, multi-syllabic word repetition, part sentence repetition, interjections, and pauses, a manual check was required for mono-syllabic word, multi-syllabic word and part sentence repetition. Manual coding was done for the rest of the disfluencies. Also, word interjections such as “like”, “you know”, “I mean” and “well” were manually coded. These words were not included in automatic coding as they can make sense in some places.

If multiple disfluencies occur on the same word, each disfluency was counted. Prolongations were coded manually based on the perceptual analysis. Fricatives or vowels which sounded abnormally long were marked as prolongation. Usually, the prolonged duration for fricatives was 0.3s or longer and for vowels, it was 0.5s or longer. This measurement was determined as it was perceived abnormally long. If interjections were prolonged, they were not counted as prolongation. Laughter, coughing or any such instances leading to disfluencies were not counted as one. Also, disfluencies occurred due to a cough, laughter, sneeze etc., were not counted. Pauses exceeding 1 second occurring in his own utterance were counted as a disfluent pause.

2.4.3. *Word count and syllable count:*

For the current study, initially, middle 750 words were considered for the coding of the disfluencies. With the help of LaBB-CAT software, there was a filter in the speech transcripts to obtain the middle 750 words. The disfluencies were coded only for the words that fall between the boundaries of this middle 750 words layer. The middle 750 words were considered to code disfluencies initially in order to obtain the middle 600 fluent word layer which helps in finding the rate characteristics. Hence, the syllable count was completed for the 600-word count, excluding disfluent words/syllables. Later, considering the first and the last word of the middle 600 fluent word layer, the disfluencies between them were calculated. For 10 participants from the ONZE and 1 from the OLIVE and 1 from the Buckeye corpus, the word count was less than 600 in one transcript and Hence, all the disfluencies in the transcript were calculated using the total word count. For the samples with 300–450 word count, disfluencies from two transcripts were calculated using the sum of total word count from two transcripts.

2.4.4. *Articulation rate ad speech rate:*

The rate characteristics were also automatically obtained by the software LaBB-CAT. The difference between articulation rate and speech rate is discussed below:

Speech rate was measured as the number of syllables produced in a speech sample divided by the time needed for completing the sample. This excludes the silent pauses exceeding 1s in the sample whereas articulation rate was measured as the number of syllables produced in a timed speech sample excluding the silent intervals exceeding 50ms in the sample (Jacewicz et al., 2009; Robb et al., 2004). It is to be noted that the disfluencies were excluded in both speech and articulation rate measurement.

2.5. Reliability:

Initially, all the speech samples used for the study were analyzed by the author. Twenty percent of the speech samples were randomly selected for both inter-rater and intra-rater reliability measures. Two months following the first analysis, the selected speech samples were re-analyzed by the author to get the intra-rater reliability. For inter-rater reliability, the same samples were re-analyzed by the second investigator, independently listening to the samples and coding the transcripts. Both the investigators were speech language pathologists and trained together in coding transcripts using the LaBB-CAT software. Using a “total percentage agreement” index (i.e. {smaller total count divided by larger total count} x 100) (Pellowski, 2011), intra-judge (and inter-judge) agreement percentage with arson correlation coefficient include the following: a) stuttering-like disfluencies: 95.8% (and 97.2%) with a Pearson correlation coefficient of 0.94 (0.92) and b) normal disfluencies: 94.2% (and 92.2%) with a Pearson correlation coefficient of 0.99 (0.96). This showed high agreement for both inter-judge and intra-judge reliability. This verifies the accuracy of the coding.

2.6. Statistical analysis:

Non-parametric Kruskal-Wallis test was used to examine the difference in rate and frequency of disfluencies between the dialects. To know the difference between specific groups, multiple comparisons were conducted with adjusted p values (Bonferroni correction). These values were automatically calculated for multiple comparisons in Kruskal-Wallis test. It is to be noted that a non-parametric test was chosen to calculate the rate and disfluency difference as the homogeneity among the groups could not be assumed. After analyzing the difference in rate and disfluency, Pearson correlation test was conducted to check if there was a relationship between the rate and the frequency of disfluencies across dialects.

3. RESULTS:

The main purpose of the current study was to investigate whether differences of dialects have an influence on speech fluency. Firstly, we examined whether speech rate, one important feature of fluency, is different across dialects. Secondly, we examined the percentage of stuttering-like and normal disfluencies across dialects to determine if these differ across dialects. Lastly, we investigated whether a relationship exists between speech rate and the frequency of disfluencies.

Conversational samples from 128 participants were used to measure the rate characteristics and frequency of disfluencies across three English dialects. New Zealand English, American English and the British English.

In this section, we are going to discuss the results for each hypothesis in detail, including the results of the statistical tests.

3.1. Rate differences across dialects:

Robb et al. (2004) stated that speech rates differ between New Zealand and American English. The current study considers the same two dialects with an additional dialect being the British dialect and examines the rate characteristics in conversation across these three dialects.

Based on the results of the above-mentioned study, our first hypothesis was speech and articulation rate characteristics will differ between the three dialects. Rate characteristics was measured as both articulation rate and speech rate

3.1.1. Articulation rate across dialects:

Articulation rate was measured as the total syllable count divided by the total duration following removal of silent intervals longer than 50ms. There are a few studies which have included pauses up to 250ms pauses for the calculation of articulation rate (Chon, Sawyer, & Ambrose, 2007) but we have used a threshold of 50ms to allow direct comparison with Robb et al. (2004)'s study.

The average articulation rates in New Zealand English, American English, and British English are M=5.3, 5.3 and 4.9, respectively. Therefore, based on average, the articulation rate is the same in New Zealand and American English and are higher than the British English.

Table 2 gives detailed statistics for articulation rate across dialects with mean, SD, and the range. These data consist of two outliers, seen in New Zealand English with slower articulation rate of 3.04 and 1.91 and one outlier in BE with an articulation rate of 3.29.

Table 2:

Descriptive statistics of Articulation rate across dialects

Dialects	Mean(SD)	Min-Max
New Zealand English	5.3(0.9)	1.9 - 6.8
American English	5.3(0.58)	4.1 - 6.4
British English	4.9(0.59)	3.3 – 5.8

The Kruskal-Wallis test showed a significant difference in articulation rate across the 3 different dialects (H(2)=9.15, p=0.01). Pairwise comparisons with adjusted p values showed a significant difference in articulation rate between the British and New Zealand dialects (0=0.024, r=-0.31). There was no significant difference between British and American dialects (p=0.07, r=0.31) or between American and New Zealand dialects (p=1, r=-.02).

Figure 2:

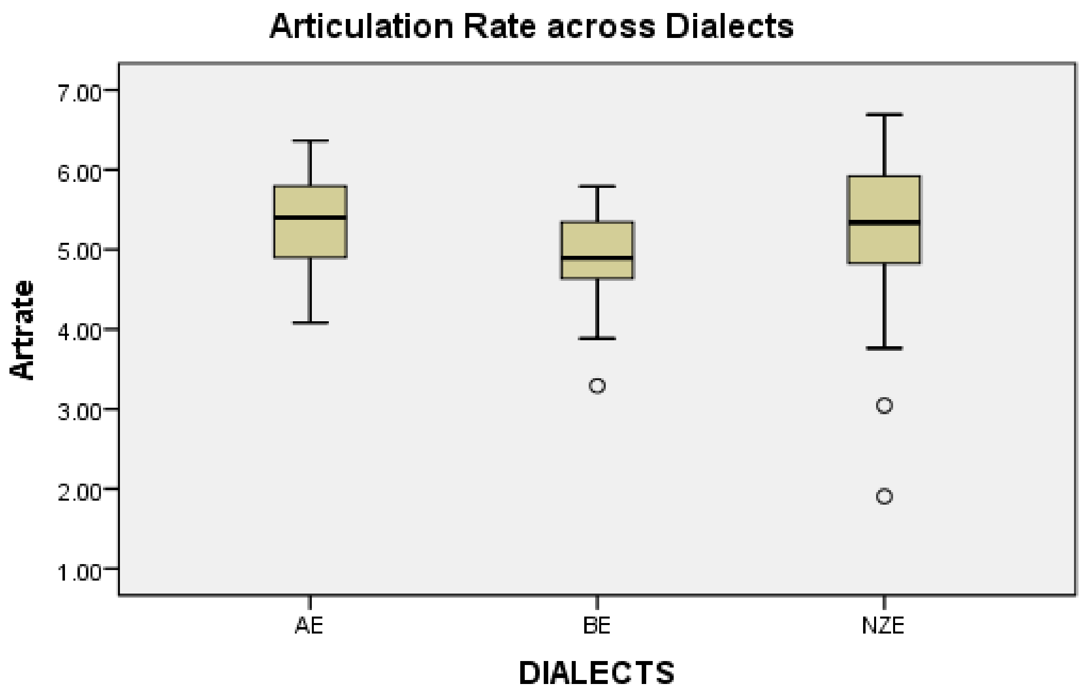


Figure 2 shows the distribution of articulation rate across dialects.

3.1.2. *Speech rate across dialects:*

Speech rate was measured as a number of speech syllables produced in the speech sample divided by the total duration excluding the silent intervals exceeding 1 second. A silent interval longer than a second was considered as a disfluent pause and the rate measurements were done excluding the disfluencies in the sample.

The average speech rate in New Zealand English, American English, and British English are M=4.6, 4.7 and 4.6 respectively. Table 2 gives the detailed statistics for speech rate.

This data includes two outliers in New Zealand English with slower speech rate at 2.72 and 1.79.

Table 3:

Descriptive statistics for Speech rate across dialects

Dialects	Mean(SD)	Min-Max
New Zealand English	4.6(0.71)	1.7 - 5.9
American English	4.7(0.53)	3.7 - 5.7
British English	4.7(0.67)	3.1 – 5.6

The Kruskal-Wallis test showed no significant difference in speech rate across dialects (H(2)=0.38, p=0.83). The figure below explains the distribution of speech rate across diaects.

Figure 3:

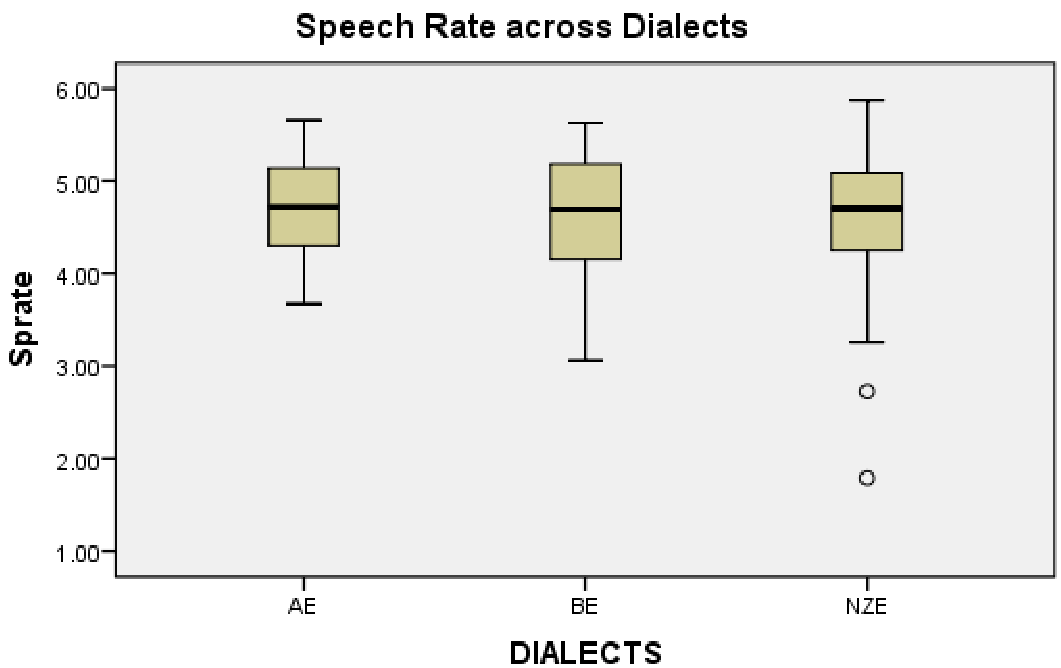


Figure 3 shows the distribution of speech rate across dialects.

3.2. The difference in frequency of disfluencies across dialects:

The different aspects of dialects may lead to variations in speech fluency. Hence, the second hypothesis was that the type and frequency of disfluencies differ across the three dialects.

Two main types of disfluencies frequency used in the field of speech therapy research (stuttering-like disfluencies and normal disfluencies) are discussed.

Initially, we tested the difference in disfluencies between dialects. Disfluencies in each dialect were identified and were categorized into two groups (SLDs and Normal disfluencies). A total of each group was calculated, expressed in percentage of disfluencies per 100 syllables spoken.

3.2.1. Stuttering-like disfluencies across dialects:

The average percentage of SLDs in New Zealand English was M=0.18 (range 0 - 2.32) with SD=0.26, in American English was M=0.2 (range 0, 2.16) with SD=0.35 and British English was M=0.18 (range 0, 1.49) with SD=0.26. There were two outliers in New Zealand English at 1.49 and 1.09, three outliers in American English at 1.34, 1.42 and 0.83 and one outlier in British English at 1.16. Though these were the outliers, they were still within 2% which is mentioned earlier as a threshold for diagnosis of stuttering.

Table 4:

Descriptive statistics for Stuttering-like disfluencies across dialects

Dialects	Mean(SD)	Min-Max
NewZealand English	0.18(0.26)	0- 2.32
American English	0.2(0.35)	0- 2.16
British English	0.18(0.26)	0 -1.49

Kruskal-Wallis test showed that there was no significant difference in SLDs across dialects, H(2)=0.04, p=0.98. The box-plot indicates the distribution of SLDs across dialects including the outliers.

Figure 4:

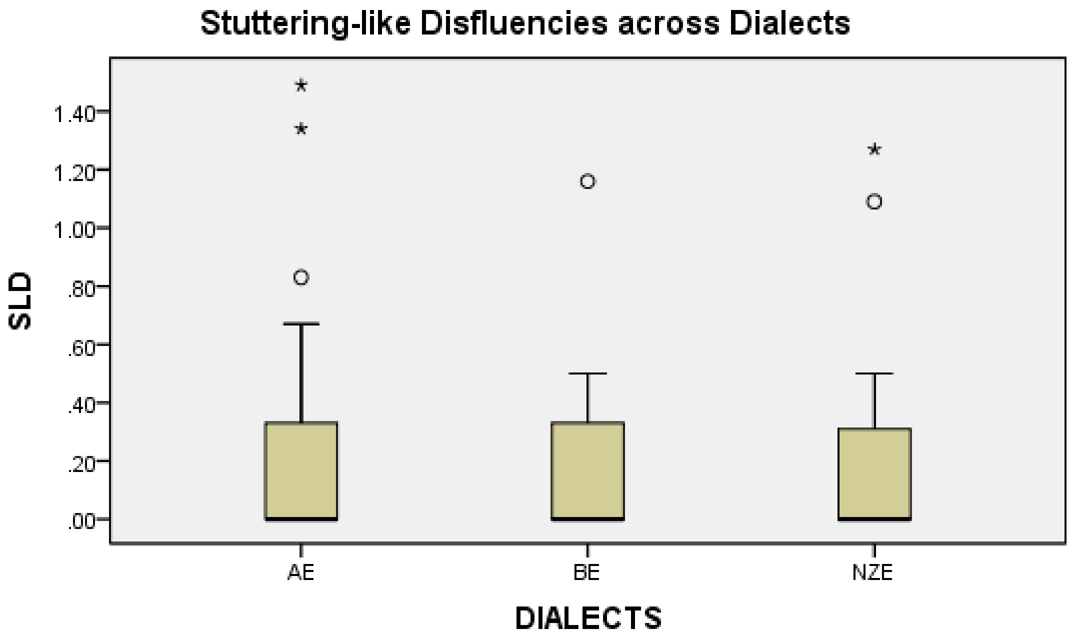


Figure 4 Percentage of stuttering-like disfluencies per 100 syllables across dialects

3.2.2. Normal disfluencies across dialects:

The average percentage for Normal disfluencies in New Zealand English was M=8.85 (range 1, 18.66) with SD=2.89, in American English average was M=10.29 (range 0, 24.32) with SD=4.59 and in British English M=7.74 (range 1.17, 17.44) with SD=3.38. The above values indicate that the normal disfluencies were highest in American English, followed by New Zealand English and the British English.

Table 5:

Descriptive statistics for Normal disfluencies across dialects

Dialects	Mean(SD)	Min-Max	Median
NewZealand English	8.85(2.89)	1-18.67	8.1
American English	10.29(4.59)	0-24.32	10.1
British English	7.74(3.38)	1.17-17.44	6.9

The Kruskal-Wallis test revealed that the distribution of normal disfluencies was significantly different across dialects, H(2)=6.4, p=0.040. pairwise comparisons with adjusted p-values showed the significant difference of Normal disfluencies was between British and American dialect (p=0.034, r=0.307) but there was no significant difference between British and New Zealand dialect (p=0.421, r=0.157) and between New Zealand and American dialect (p=0.162, r=0.485). The figure 5 below illustrates the distribution of normal disfluencies across dialects.

Figure 5:

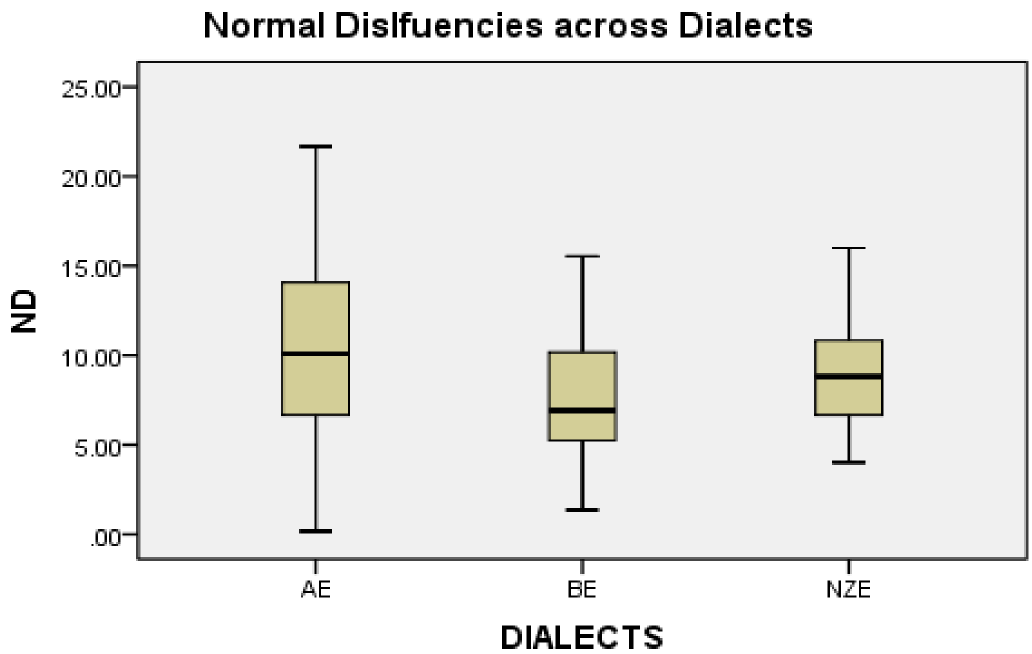


Figure 5. Percentage of normal disfluencies per 100 syllables across dialects.

From the results above it was inferred that the disfluencies were different across dialects. Hence, it was important to look at the specific types of disfluencies within SLDs and Normal disfluencies categories. Table 6 reports the frequency of each disfluency type with mean, standard deviation and range.

Table 6:

Frequency of each disfluency across dialects

	New Zealand English	American English	British English
Disfluencies	Mean(SD) Min - Max	Mean(SD) Min-Max	Mean(SD) Min-Max
Monosyllabic word repetition	0.71 (0.66) 0 - 3.21	1.18 (0.94) 0 - 3.83	0.86 (0.54) 0 - 1.83
Multisyllabic word repetition	0.03 (0.07) 0 - 0.22	0.07 (0.15) 0 - 0.66	0.05 (0.1) 0 - 0.33
Unfinished sentences	0.74 (5.03) 0 – 3.9	0.18 (0.21) 0 – 1	0.14 (0.2) 0 - 0.83
Part sentence repetition	0.34 (0.4) 0 - 1.67	0.4 (0.61) 0 - 2.5	0.39 (0.36) 0 - 1.33
Revision	0.46 (0.33) 0 - 1.39	1.15 (0.82) 0 – 4	0.67 (0.59) 0 - 2.83
Interjection	5.12 (2.12) 1- 10.5	5.43 (2.85) 0-12.33	5.16 (2.6) 1.17-10.3
Sound repetition	0.04 (0.16) 0 – 1.1	0.02 (0.07) 0-0.33	0.03 (0.08) 0-0.33
Pause	2.28 (1.85) 0- 8.5	2.02 (1.58) 0-1	0.46 (0.72) 0-3
Prolongation	0.06 (0.13) 0- 0.5	0.15 (0.26) 0-1	0.04 (0.1) 0-0.33

Syllable repetition	0.06 (0.12) 0- 0.5	0.01 (0.05) 0-0.33	0.1 (0.19) 0-0.83
Blocks	0.01 (0.04) 0- 0.22	0.01 (0.06) 0-0.33	0 (0) 0-0
Broken words	0 0	0.004(0.03) 0-0.17	0.14 (0.2) 0-0

The Kruskal-Wallis test was done for each disfluency from SLDs and Normal disfluencies group to check whether a difference in frequency of occurrence of each disfluency exists across dialects.

Firstly, normal disfluencies were examined. It was inferred that the distributions of Monosyllabic word repetition (MoWr), Unfinished sentences (US), Revision (R), and Pauses (P) showed significant difference across dialects.

Pairwise comparisons with adjusted p values showed that there was a significant difference of MoWR between New Zealand and American dialects (p=0.034, r=0.277) but not between British and New Zealand dialects (p=0.93, r=0.152) and not between British and American dialects (p=1, r=0.118). Also, the US was significantly different between New Zealand and American dialect (p=0.038, r=0.273) but there was no significant difference between British and New Zealand dialect (p=1, r=0.144) and between British and American dialect (p=1, r=0.122). And the significant difference of revision was between New Zealand and American dialect (p=0, r=0.493), British and American dialect (p=0.026, r=0.345) and no significant difference between British and New Zealand (p=1, r=0.142). Pauses were significantly different between British and American

English (p=0.00,r=0.603) and between British and New Zealand English (p=0.00,r=-0.575) but not significantly different between New Zealand and American English (p=1,r=-0.004).

However, there was no significant difference in the distribution of Multisyllabic word repetition with H(2)= 0.944, p=0.624; Part-sentence repetition with H(2)= 1.113, p=0.573 and Interjections with H(2)= 0.113, p=0.945 across dialects. Table 6 reports the Kruskal-Wallis test results for normal disfluencies.

Table 7:

Kruskal-Wallis test results for normal disfluencies

Normal disfluencies	Test statistic (H)	Significance(p)
Monosyllabic word Repetition	7.89	0.02*
Unfinished sentences	7.64	0.02*
Revision	24.6	0.00*
Pauses	33.1	0.00*
Multisyllabic word Repetition	0.94	0.62
Part sentence Repetition	1.11	0.57
Interjections	0.11	0.95

Now, each disfluency from SLD category was examined. The results showed that only distribution of Syllable repetition (Syr) was significantly different across dialects H(2)=11.378 p=0.003.

Pairwise comparisons with adjusted p values showed that the significant difference of Syr was between New Zealand and American dialect (p=0.031, r= -0.28) but there was no significant difference between British and American dialect (p=0.015, r= -0.367) and between New Zealand and American dialect (p= 1, r=0.081).

The results of the Kruskal-Wallis test for the different types of SLDs are reported in Table7

Table 8:

Kruskal-Wallis test results for stuttering-like disfluencies

Stuttering-like disfluencies	Test statistic (H)	Significance(p)
Syllable repetition	11.38	0.003*
Sound repetition	1.02	0.60
Prolongation	4.94	0.08
Broken words	2.22	0.33
Blocks	1.44	0.48

3.3. Correlation between Speech and articulation Rate and frequency of disfluencies across dialects:

There currently is a discussion in the literature regarding the relationship between rate and disfluencies. Howell and Sackin (2000) found that speakers produced more SLDs in content words when under rate pressure. H Chon et al. (2007) have stated that as a treatment for stuttering, adults and children who stutter are often asked to reduce their rate of speech. Hence, with reference to these studies, we hypothesized that there could be a relationship between rate and disfluencies.

Articulation rate was significantly different across dialects, as were normal disfluencies. Later, using Pearson correlation test we checked if this articulation rate or speech rate had any relationship with the normal disfluencies whose occurrence was different across dialects and relationship with SLDs whose occurrence was not significantly different across dialects was also checked.

Articulation rate was first tested with the SLDs and then Normal disfluencies. Then Speech rate was tested with SLDs and Normal disfluencies.

The table below explains the correlation with p values, r values and bootstrap 95% Cls reported in Brackets. The star next to the number represents the significant correlation between the categories.

Table 9:

Correlation between rate and disfluencies:

	Stuttering-like disfluencies	Normal disfluencies
Articulation rate	p = 0.01* r = -0.224 [-0.361, -0.095]	p = 0.52 r = 0.057 [-0.109, -0.215]
Speech rate	p = 0.004* r = -0.221 [-0.378, -0.076]	p = 0.8 r = 0.013 [-0.176, 0.200]

Ns=not significant(p>0.05) *.p<0.05. BCa bootstrap 95% Cls reported in brackets, N=128

There was no significant relationship between articulation rate and normal disfluencies, r=0.057, p=0.5 and also between speech rate and normal disfluencies r=0.013, p=0.8.

Articulation rate was significantly related to SLDs, r= -0.224 [-0.361, -0.095] and Speech rate was also significantly related to SLDs, r= -0.0221 [-0.378, -0.076].(all ps<0.05)

3.4. Summary of results:

The findings of the current study are as follows:

1) The distribution of articulation rates was significantly different across dialects (British and New Zealand dialects) but no significant difference was seen in speech rate

2) The percentage of normal disfluencies demonstrated a significant difference across dialects (British and American dialects) whereas stuttering-like disfluencies showed no significant difference across dialects
3) The percentage of normal disfluencies was significantly higher than stuttering-like disfluencies across dialects
4) Pearson correlation test revealed that the rate characteristics were significantly related to stuttering-like disfluencies.
5) There was no significant correlation between rate and normal disfluencies

4. DISCUSSION

Fluent speech is hard to describe (Ingham et al., 2009). Spontaneous speech from a fluent speaker usually consists of disfluencies (Culatta & Leeper, 1989) and such disfluencies often help the listener to understand the speech better (Lake et al., 2011). Within the field of speech therapy, disfluencies are usually classified into normal disfluencies and SLDs. Normal disfluencies are more characteristic of PWNS and SLDs are more characteristic of PWS (Yairi & Clifton, 1972). There are many studies on PWS regarding various factors that may influence the type and frequency of disfluencies. Relatively fewer studies have focused on PWNS which help us build our understanding of normal and pathological conditions. There are many factors which could affect speech fluency such as age, gender, sample length, the rate of speech, topic familiarity etc. In addition to these factors, dialects could also have effects on speech fluency. However, this factor has received very less attention over the years. Hence, the present study focused on examining the occurrence of disfluencies across three English dialects in PWNS.

The following cases were investigated:

- Rate characteristics (Articulation and Speech rate) across dialects.
- Frequency of disfluencies (SLDs and Normal disfluencies) across dialects
- The relationship between the rate characteristics and the frequency of disfluencies.

Knowing whether differences across dialects are present, will help clinicians to decide whether they have to take a speaker's dialect into account when diagnosing speech disorders.

The current study consisted speech samples of 128 participants including 40 participants speaking American English, 28 speaking British English and the remaining 60 speaking New Zealand English. A different corpus for each dialect was used to get the speech samples from the participants selected. The analysis was conducted for the middle 10 minutes of a normal conversation on general topics such as hobby, childhood, life experiences and so on. Although LaBB-CAT automatically annotated some of the disfluencies, some were manually done. While manually annotating, the automated annotations, the word, and phoneme boundaries were cross-checked and corrected wherever necessary. Upon annotating all the samples, they were counted, calculated and statistically analyzed for differences in speech rate and frequency of disfluencies across dialects. The relationship between the rate and frequency of disfluencies was also tested.

The results lent some support to all the hypotheses of the study. Note that the results of each hypothesis are discussed in detail with reference to the literature in the section below along with the limitations to the current study.

4.1. Speech and articulation rates across dialects:

The rate is one of the major attributes of speech fluency (Trofimovich & Baker, 2007). Speaking rate could be vulnerable to many factors such as individual, demographic, cultural, linguistic, psychological and physiological factors (Yuan, Liberman, & Cieri, 2006). From the above literature and the study by Robb et al. (2004) which revealed the rate differences between dialects, we hypothesized that rate differences will be present between English dialects.

Similar to Robb et al. (2004)'s study, both articulation rate and speech rate were investigated. Speech samples of New Zealand dialect, American dialect, and the British dialect were analyzed to determine the difference in rate characteristics between the three dialects. Articulation rate was calculated as the total number of syllables divided by the total duration, excluding pauses exceeding 50ms. Speech rate was calculated as the total number of syllables divided by the total duration, including pauses from 50ms to 1s as pauses exceeding 1s were considered disfluent. Both rate measurements were calculated excluding the disfluencies in the sample.

Although the results showed significant articulation rate difference between the three dialects with $H(2)=9.15$, $p=0.01$, there was no significance in the speech rate with $H(2)= 0.38$, $p=0.83$.

When checked articulation rate difference in detail, it was seen that the difference was only between the British and New Zealand dialects with $p=0.024$, $r=0.307$ and did not differ between the British and American dialects and also between New Zealand and American dialects.

There were two outliers seen in New Zealand English for articulation rate at 3.04 and 1.91. These rates were reasonably low and both participants were females with the age of 50 years and 24 years respectively. There was one outlier seen in British English at 3.29 which was a 60 years old female which was much lower than the other participants. For speech rate also, there were outliers seen in New Zealand English from the same participants at 2.72 and 1.79.

However, the possible reason for having a difference in articulation rate but not in speech rate could be the difference in the recordings of each corpus and the manner of interviewing. One such difference is that the speech samples from the OLIVE corpus were recorded with two participants in the room whereas the recordings from other corpora were with one participant. Thus, in the OLIVE corpus, the questions asked during the interview were sometimes answered together by both participants as they were not specific to one participant. This could be one of the reasons for the observed difference in results between articulation rate and speech rate.

Rate differences between dialects have been studied by a few authors (Jacewicz et al., 2009; Robb et al., 2004). Robb et al (2004) investigated the rate characteristics between New Zealand

and American English dialects but the current study included the British dialect as well. Results from Robb et al. 2004 study revealed that the articulation rate of New Zealand English was significantly faster with 342spm (SD=28) than the American English with 316spm (SD=24) and the speaking rate was also faster in New Zealand English with 280spm (SD=27) than American English with 250spm (SD=25). However, the current study results do not match with Robb's study as there were no significant articulation rate difference seen between New Zealand and American with an average of 5.3syll/s (318spm) and 5.32syll/s (319spm) respectively and 4.89syll/s (293spm) in the British English which was slightly different from the other two and the same applies to speech rate with 4.6syll/s (276spm) in New Zealand and 4.73syll/s (284spm) in American English and 4.65syll/s (279spm) in British English. The articulation rate of New Zealand English 318spm is much lower compared to Robb et al. study results on New Zealand English with 342spm.

However, Robb's study and the current study method differed in various aspects. Firstly, the speech samples used for both the studies were different. Robb and colleagues used two consecutive reading of the first paragraph of the rainbow passage which contained a total of 127 syllables. But for the current study, middle 600 words of the conversation with the interviewer was used. Jacewicz et al. (2009) studied and compared the articulation rate between reading sentences and spontaneous talk. There was about 66.4% difference between the rates of read sentences and spontaneous speech indicating that rate in reading is much slower than the free speech which contradicts the results obtained by Robb et al. The reading rate obtained by Robb et al. is higher than the spontaneous speech rate obtained by the current study in New Zealand dialect. However, it is to be noted that the sample used by Robb et al was repeated reading of a paragraph from the rainbow passage. Dowhower (1989) studied the benefits of repeated reading for children and one of the observations of the investigation was, repeated reading could increase the rate of reading. This result could reason out why the rate of speech could have slightly increased for reading for New Zealand dialect in the study by Robb et al. However, despite those differences, there is similarity in the articulation rates of American dialect between the studies.

Another factor which differed between the present study and Robb's study was the selection of participants. Robb's study included 40 participants from each dialect with the age range of participants 18- 24 years whereas the current study included the participants of young age with a range of 18-35 years and old age with a range of 40-60 years. Duchin and Mysak (1987) and Yuan et al. (2006) have stated that older people tend to have a slower speaking rate compared to younger people. The current study included 52 old age participants out of which, 22 speaking New Zealand English, 20 speaking American English and 10 speaking British English. This makes nearly half of the participants in each dialect which could have reduced the overall rate of speech.

Hence, these above-mentioned factors could have led to the observed discrepancy between the studies.

Jacewicz et al. (2009) studied articulation rate differing between two American dialects. They found a significant difference of 9.6% between the two dialects and the current study statistical results showed a significant rate difference of 7.9% between British and New Zealand dialects. The calculation of articulation rate and the methodology used for the study were similar to the current study with a similar age range of the participants (young age 220-24 years and old age 51-65 years) and one of the stimuli being the spontaneous speech.

Although the average articulation rate was the same for New Zealand and American dialect, the statistical analysis revealed a significant difference of 7.9% in articulation rate between British and New Zealand dialects. This difference highlights the importance of accurate normative data on speaking rate for clinicians. Speaking rate is a major component in the treatment of various speech disorders, such as stuttering (Robb et al, 2004). Jacewicz et al. (2009) have stated that 5% articulation rate difference could be considered as the just noticeable difference(JND). This JND indicates that a 5% or more difference of rate in speech fragments could be perceived by the listener as faster (or slower). Hence, with this literature, we may be able to conclude that the variety of English spoken by a client should be considered as a clinical variable.

4.2. The difference in frequency of speech disfluencies across dialects:

Speech disfluencies are apparent in every speaker's spontaneous speech as an interruption due to various factors. These disfluencies are of two types: normal disfluencies and SLDs

Both these types of disfluencies can be seen in PWS and PWNS (Cordes & Ingham, 1995). The normative fluency data explains that 2 or less SLDs per 100 syllables and 8 or less normal disfluencies per 100 syllables could be considered normal.

Boey et al. (2007) compared SLDs between two languages, Dutch and English. They stated that there are slight differences of SLDs between the languages but not significant. The overall percentage of SLDs in normally fluent native Dutch speakers was 0.42% and in children who stutter was 15.71%. This was not significantly different from all the studies mentioned by Boey et al. but they were significantly different from a few studies. Pellowski and Conture in 2002 reported the overall SLDs as 8.4% in English-speaking children who stutter. For the comparison on children who stutter, the study does not report the severity of stuttering of each participant that was considered in other studies so there may not be a match with the severity level of the stuttering participants selected due to which there could have been some differences in the results of English speakers and Dutch speakers who stutter. Yairi and Hubbard in 1988 stated that overall SLDs in English speaking children who do not stutter is 2.59% which is reasonably different from Boey's results on children who do not stutter. However, there were other studies mentioned by Boey et al which showed similar results. Thus, Boey et al compared the results on Dutch speakers to the average of the results of studies on English speakers and concluded that the difference of SLDs was not clinically significant between languages in both children who stutter and who do not.

Similar to a language, dialects also differ in various aspects like the rate of speech as studied by Robb et al. (2004). Hence, with this variations, speech fluency may be altered. Thus, the current study looked into the difference in the occurrence of disfluencies between different dialects. The variations in both normal disfluencies and SLDs were investigated and with the hypothesis that there will be differences in type and frequency of speech disfluencies across dialects.

From the analysis, we inferred that the normal disfluencies were the highest in American English with an average of $M=10.29$($SD=4.59$), next is New Zealand English with $M=8.85$($SD=2.89$) and the least in the British English with $M=7.74$($SD=3.38$). The statistical test revealed that there is a significant difference in normal disfluencies across the three dialects with $H(2)=6.423$, $p=0.04$ whereas no difference in SLDs with $H(2)=0.038$ $p=0.981$. The difference in normal disfluencies only differed significantly between British English and American English with $p=0.034$, $r=0.307$ and not between other dialects. A few outliers were observed for SLDs in all three dialects but none of them crossed 2% threshold for SLDs stated in the normative data.

Later, each disfluency type was analyzed separately and 4 out of 7 normal disfluencies and one out of 5 SLDs showed a significant difference across dialects.

The four normal disfluencies that differed are monosyllabic word repetition (MoWR) Unfinished sentences (US) Revisions (R) and Pauses (P).

MoWR and US were different only between New Zealand and American English. R was different between New Zealand and American, and also between British and American English. The disfluency P was the only disfluency out of the 4 which was not different between New Zealand English and American English but significantly different between British English and New Zealand English, and British English and American English. The average of P in New Zealand English was M=2.28, in American English was M=2.02 and in BE the average was M=0.464. From the values, a large difference between British and the other two dialects can be noticed. As mentioned earlier, it is possible that the huge variation in pauses is due to the difference in the method of recording in each corpus.

The speech recordings in the OLIVE corpus includes two participants in each interview and the questions asked were not specific to one participant. Hence, either of the participants could answer the question and there were instances when both participants answered together and when one participant pauses during answering, the other would take over within one second is completed leading to a less than one second pause. As a result, disfluent pause counts reduced in the OLIVE corpus leading to the observed variation in pause count across dialects detected by the LaBB-CaT software.

The calculation of total normal disfluencies included pauses and as mentioned pauses are the least with a very low average in British dialect (M=0.46). Therefore, this could be a reason for getting a significant difference in normal disfluencies between American and British English dialects.

The only SLD which was different across dialects was Syllable repetition and it was different between New Zealand English and American English, and American English and British English. The average of SyR in New Zealand English was M=0.064, in American English was M=0.008 and in British English was M=0.1. Thus, British English had the highest SyR.

Byrd et al. (2015) studied speech disfluencies in bilingual Spanish-English children and the results revealed that all children regardless of language dominance produced more SLDs in the Spanish language than in English. The balanced bilingual children produced an average SLDs of M=1.5 in English and M=6.1 in Spanish and the Spanish-dominant children M=3.1 in English and M=4.83 in Spanish and English dominant children produced M=3.41 in English and M=6.41 in Spanish. It is stated that the characteristics and the complexity of the language (Spanish) could be the cause for the difference in SLDs which is not the case with dialects. Though variations exist between dialects, they are not as complex as it is between two languages. Thus, SLDs may not have varied between dialects. The difference between the two studies is that Byrd et al. considered bilingual children and the samples used were narratives but here the participants were adults and sample was spontaneous speech.

4.3. Correlation between Disfluencies and Rate characteristics:

There are various factors which lead to variations in the occurrence of disfluencies but one factor which attracts attention could be the rate of speech. The rate of speech is an important attribute which constitutes fluent speech. Max and Caruso (1997) and H Chon et al. (2007) have stated that reducing the speech rate can reduce the occurrence of disfluencies. ASHA (2016) have stated that rate control is an effective therapy technique to use for stuttering. Based on this literature we hypothesized that there could be a relationship between rate and frequency of disfluencies.

The Results of the current study revealed that there is a significant correlation between rate and SLDs. Articulation rate is significantly correlated to SLDs with r = -0.224, p= 0.01 and speech rate is also significantly correlated to SLDs with r = -0.0221, p= 0.004. It is interesting that there was rate difference across dialects and also normal disfluencies were different across dialects but the relationship was found between rate and SLDs.

As mentioned earlier, there is no consistency with the results obtained on the relationship between speech rate and speech fluency in the existing literature. There is an ongoing discussion in the literature regarding the relationship between rate and disfluencies. Sawyer and Ambrose (2012) have stated that articulation rate had no influence on SLDs in fluent speakers contradicting the current study results.

However, Tumanova et al. (2011) also studied the influence of articulation rate of the frequency of the different type of disfluencies in children who stutter. They found a significant negative correlation between the rate and SLDs with ($r = -0.49$, $p<0.05$). The results of this study directly support the current study results. As stated by Sawyer and Ambrose in 2012, Meyer and Freeman in 1985 also stated that the articulation rate was significantly slower in children who stutter than normally fluent children but this difference occurred due to stuttering. However, in the current study the rate measurements did not include disfluencies but due to the automatic calculation of speech rate, the pauses between the disfluent words were also included. Hence, it is possible to say that rate of speech may have been influenced by the presence of more disfluencies. The current study results may also support the statement by Howell and Sackin (2000) that there is a relationship between the rate of speech and SLDs in PWNS. They mentioned that SLDs increased when speakers were under rate pressure and the results stated that the average stuttering rate across speakers on content words was 8.5% for slow rate,7.9% for medium rate and 17% for fast rate suggesting that rate and fluency are related. It is to be noted that the rate calculation here was done excluding the disfluencies and pauses similar to the articulation rate calculation of the current study.

4.4. Limitations of the study:

4.4.1. *Participant selection:*

The current study included a large sample size of 128 participants which lends better generalization. While every effort has been made to match the participants for age and gender across the corpora, it was not possible to include the same number of speakers for each dialect in our analysis. There were fewer participants for the British dialect (N=28) compared to American or New Zealand dialects. The participants from New Zealand dialect was matched with British and American dialects. While doing so, it was found that the OLIVE corpus which had 41 participants in total for British English and out of them, 12 participants were 80-90 years old who could not be matched with any participant from the ONZE corpus or the Buckeye corpus. One participant had only word list recorded so even that participant had to be excluded. Hence, excluding the 13 participants, we were left with 28 participants.

4.4.2. *Recording of the sample:*

The speech sample considered was middle 600 words which is ideal and also the middle of the conversation is usually preferred for better findings as the first 10 minutes of the conversation could be unnatural due to the speakers' awareness of their speech getting recorded. In addition, the topic of conversation of each participant was checked and only conversations on similar topics were selected in order to reduce the variability of topic familiarity to affect the results. However, the recording of speech samples of British dialect was not the same as New Zealand and American dialects. The recording of New Zealand and American dialect samples were done with one participant at a time whereas, in the British dialect, there were two participants interviewed at once. The questions asked by the interviewer were not specific to one participant and hence both participants were answering the questions together or when one stops, the other would continue within one second completes. This led to a difference in calculation of pauses and in annotating Revisions.

4.5. Directions for Future studies:

The current study focused on the effect of dialect variations on speech fluency. Future studies could investigate speech fluency with age and gender difference across dialects. Analysis of speech fluency may also be done on PWS as the current study was done on PWNS. However, a study on PWS might have to look into the severity of stuttering of each participant and maintain the uniformity in samples which could be challenging. The research can also include comparative data between the speech fluency of PWS and PWNS

4.6. Conclusion:

The current study provides information regarding the difference in the occurrence of disfluencies across three English dialects. As 128 participants were examined in this study, the large sample size consolidates findings on both normal and SLDs for adults across dialects. Rate characteristics of the three dialects were also analyzed and compared. Further, information on the relationship between rate and disfluencies is now provided due to the analysis of the current study for clinical purposes of assessment. The large sample size encourages generalization of results. The findings from this study are valuable to the literature as it provides baseline values for speech fluency of three English dialects which could be used for the future research.

While articulation rate and normal disfluencies were significantly different across dialects, speech rate and SLDs were not, possibly due to the difference in the recording of samples in each corpus. No change in SLDs and speech rate across dialects clinically would not require norms when assessing, however, these may be required for normal disfluencies and articulation rate as a difference of 24.8% was seen in normal disfluencies between British and American dialects and a difference of 7.9% was seen in articulation rate between British and New Zealand dialects. It was interesting to find a significant relationship between rate and SLDs. This result suggests that clinicians may have to be mindful that measures of speech rate may be influenced by the presence of disfluencies. Findings from this study provide information on rate and disfluency characteristics in PWNS across dialects for clinical practice.

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Appendices:

Appendix A: Coding protocol

Type of disfluencies	Codes	Examples
STUTTERING-LIKE DISFLUENCIES		
Sound repetition*	SR	A sound in a word that occurs twice or more. *f-five, b-b-back*
Syllable repetition*	SyR	Any syllable of a word occurring twice or more. *Ta- tap, ba-baby*
Broken words*	BW	A silent gap or stopping within a word equal to or greater than 250ms That is a *snow_ball*
Prolongation*	Pr	Holding on to a sound for an extended period of time. Usually seen in fricatives and nasal sounds. *Mmmmmmy, ffffffffaat.* This does not include prolonged interjections like Uhhhhh.
Blocks*	B	Tense pause. Abrupt stopping of the flow of air. Usually at the beginning of the word. *____my*
NORMAL DISFLUENCIES		
Multisyllabic word repetition	MWR	Words with more than one syllable occurring twice or more.

		coming-coming
Part sentence repetition	PSR	The phrase or a part of a phrase repeated twice or more. *I want-I want, He is -he is coming* home.
Disfluent Pause	P	A silent period longer than a second. *my car is* __________ *big*
Monosyllabic word repetition	MoWR	A one-syllable word occurring twice or more. *the-the, and-and*
Unfinished sentences*	US	Incomplete sentences *I went to... it was fun*
Interjections	Int	Extra words *um, uh, ah, etc.*
Interjections (words)*	Int	*Like, you know and I mean*
Revisions*	R	Speech is revised during the utterance *I have to go-I need to go to the store*
OTHERS		
Articulation rate pause	ARP	A silent period of time equal to or greater than 50ms.
Articulation rate	AR	Number of output unit per unit time (excludes pauses of 50ms or greater Hence, determines the length of actual sound production)
Speech rate	SpR	Number of output unit per unit time (includes pauses equal to or greater than 50ms but not the pauses longer than 1 second)
Word count	WC	Number of words
Syllable count	SC	Number of syllables

		(vowel, consonant-vowel, consonant-vowel-consonant)

Disfluencies with * are manually coded.

Rest are automatically coded.

Appendix B: Additional Disfluency Criteria

Criteria adapted from Roberts, Meltzer and Wilding (2009) were used to determine disfluencies.

1) A word revision was counted when the speaker began to produce a word and then changed it to some other word before completing the initial word. The same was followed if the speaker paused and repeated part of the phrase following a filler: “it is uh,.. it is really enjoyable.”

2) “Um” and “uh” were counted as interjections when the speaker could not immediately remember something.

3) If the speaker interjected a phrase it was not counted as a disfluency: “I’d sit in the water about, it’s a heated pool, stay in the water about five minutes.”

4)During the repetition, if an interjection was included, it was not counted as repetition.

5) If the experimenter’s questions or prompt caused the speaker to pause and repeat a phrase it was not counted as a fluency break.

6) Questions asked by the speaker were counted as part of the speech sample.

7) If the speaker changes a word which seemed to be a cause of lapse of memory it was not counted as a fluency break: “She is eighty, eighty-two years old.”

8) If a word was repeated for emphasis it was not counted as a disfluency: “it was really really nice.”

9) If a word was repeated as part of a response to the experimenter’s question it was not counted as a disfluency: “yes, yes.”

10) Instances in which the speaker corrects an error (pronunciation or grammar) or begins an utterance but does not complete it was counted as a revision.

11) If the utterance was broken due to sneeze, cough or laughter, it was not counted as a disfluency.

Appendix C: Participants information

Sl no.	Participants	Age	Gender	Word count	Transcripts chosen	Corpus
1	LIV_OlderF01	67	F	1596	1	OLIVE
2	LIV_OlderF02	55	F	2250	1	OLIVE
3	LIV_OlderF04	63	F	3262	1	OLIVE
4	LIV_OlderF05	59	F	4379	1	OLIVE
5	LIV_OlderF06	56	F	4006	1	OLIVE
6	LIV_OlderM02	73	M	5791	1	OLIVE
7	LIV_OlderM03	58	M	6951	1	OLIVE
8	LIV_OlderM04	68	M	6591	1	OLIVE
9	LIV_OlderM05	65	M	4016	1	OLIVE
10	LIV_OlderM06	63	M	779	1	OLIVE
11	LIV_TeenF01	16	F	749	1	OLIVE
12	LIV_TeenF02	16	F	835	1	OLIVE
13	LIV_TeenF03	16	F	1510	1	OLIVE
14	LIV_TeenF04	18	F	628	1	OLIVE
15	LIV_TeenF05	16	F	1339	1	OLIVE
16	LIV_TeenF06	17	F	2274	1	OLIVE
17	LIV_TeenF07	17	F	803	1	OLIVE
18	LIV_TeenF08	17	F	1313	1	OLIVE
19	LIV_TeenF09	17	F	940	1	OLIVE
20	LIV_TeenM01	16	M	670	1	OLIVE

21	LIV_TeenM02	16	M	612	1	OLIVE
22	LIV_TeenM03	16	M	4612	1	OLIVE
23	LIV_TeenM04	16	M	365	1	OLIVE
24	LIV_TeenM05	16	M	2425	1	OLIVE
25	LIV_TeenM06	17	M	1695	1	OLIVE
26	LIV_TeenM07	17	M	1747	1	OLIVE
27	LIV_TeenM08	16	M	2651	1	OLIVE
28	LIV_TeenM09	16	M	749	1	OLIVE
29	s01	34	F	1229	s0102a	Buckeye
30	s02	60	F	681	s0205a	Buckeye
31	s03	68	F	525	s0304b	Buckeye
32	s04	24	F	1193	s0403a	Buckeye
33	s05	50	F	902	s0502b	Buckeye
34	s06	25	F	891	s0602a	Buckeye
35	s07	55	F	1710	s0702b	Buckeye
36	s08	36	F	1479	s0802b	Buckeye
37	s09	30	F	1091	s0902a	Buckeye
38	s10	65	F	1896	s1003b	Buckeye
39	s11	24	F	1147	s1103a	Buckeye
40	s12	27	F	1772	s1203a	Buckeye
41	s13	26	F	1641	s1302a	Buckeye
42	s14	60	F	1479	s1402a	Buckeye
43	s15	25	F	1531	s1502a	Buckeye
44	s16	58	F	1665	s1602a	Buckeye

45	s17	54	F	1117	s1702a	Buckeye
46	s18	60	F	1540	s1803a	Buckeye
47	s19	65	F	1352	s1903a	Buckeye
48	s20	64	F	394	s2002a, s2002b	Buckeye
49	s21	30	M	1327	s2102a	Buckeye
50	s22	64	M	917	s2202a	Buckeye
51	s23	65	M	1274	s2302a	Buckeye
52	s24	49	M	1315	s2402b	Buckeye
53	s25	55	M	1560	s2502a	Buckeye
54	s26	26	M	920	s2602b	Buckeye
55	s27	51	M	1143	s2702a	Buckeye
56	s28	26	M	1807	s2802a	Buckeye
57	s29	58	M	1415	s2902a	Buckeye
58	s30	27	M	1534	s3002a	Buckeye
59	s31	27	M	1323	s3102a	Buckeye
60	s32	26	M	1322	s3202a	Buckeye
61	s33	27	M	1148	s3302a	Buckeye
62	s34	28	M	1472	s3402a	Buckeye
63	s35	60	M	998	s3502a	Buckeye
64	s36	54	M	1356	s3602b	Buckeye
65	s37	26	M	1045	s3702b	Buckeye
66	s38	60	M	1702	s3802a	Buckeye
67	s39	25	M	1412	s3902a	Buckeye
68	s40	30	M	1157	s4002b	Buckeye

69	fyn06-7	24	F	971	fyn06-7-05	ONZE
70	fyn02-1a	25	F	831	fyn02-1a-04	ONZE
71	fyn02-13a	26	F	936	fyn02-13a-02	ONZE
72	fyp00-3a	26	F	462	fyp00-3a-05, fyp00-3a-06	ONZE
73	fyp05-2	27	F	932	fyp05-2-05	ONZE
74	fyn01-2a	27	F	675	fyn01-2a-04	ONZE
75	fyn94-9b	30	F	1680	fyn94-9b-06	ONZE
76	fyn95-13	30	F	1066	fyn95-13-10	ONZE
77	fyp03-3a	34	F	754	fyp03-3a-11	ONZE
78	fon94-1a	38	F	662	fon94-1a-04	ONZE
79	fon02-12b	44	F	900	fon02-12b-12	ONZE
80	fop94-7	50	F	586	fop94-7-10	ONZE
81	fop03-4a	51	F	723	fop03-4a-04	ONZE
82	fop00-5b	54	F	639	fop00-5b-12	ONZE
83	fon99-18b	55	F	1122	fon99-18b-11	ONZE
84	fop99-21a	55	F	762	fop99-21a-08	ONZE
85	fon03-5b	58	F	661	fon03-5b-02	ONZE
86	fop97-16a	60	F	1144	fop97-16a-05	ONZE
87	fop96-2b	60	F	875	fop96-2b-02	ONZE
88	fon01-15	63	F	624	fon01-15-04	ONZE
89	myn00-17a	24	F	1165	myn00-17a-03	ONZE
90	myn05-7	25	M	562	myn05-7-04	ONZE
91	myp95-12b	25	M	870	myp95-12b-07	ONZE

92	myp01-7b	26	M	1074	myp01-7b-14	ONZE
93	myp07-6	26	M	438	myp07-6-02, myp07-6-03	ONZE
94	myp94-8c	26	M	348	myp94-8c-10, myp94-8c-11	ONZE
95	myn03-2c	27	M	760	myn03-2c-12	ONZE
96	myp00-18a	27	M	942	myp00-18a-13	ONZE
97	myp97-14b	29	M	675	myp97-14b-11	ONZE
98	myn96-8a	30	M	615	myn96-8a-03	ONZE
99	mon00-14	49	M	643	mon00-14-03	ONZE
100	mon94-33a	54	M	687	mon94-331-04	ONZE
101	mon01-2b	58	M	743	mon01-2b-09	ONZE
102	mon94-23b	60	M	761	mon94-23b-11	ONZE
103	mop06-6	60	M	666	mop06-6-03	ONZE
104	mop99-9	63	M	616	mop99-9-06	ONZE
105	mon96-18	63	M	983	mon96-18-08	ONZE
106	mop03-2b	65	M	827	mop03-2b-06	ONZE
107	mop98-6a	65	M	792	mop98-6a-04	ONZE
108	mon95-1a	63	M	831	mon95-1a-03	ONZE
109	fyn94-16a	19	F	562	fyn94-16a-02	ONZE
110	fyn94-20b	18	F	748	fyn94-20b-12	ONZE
111	fyn94-25b	19	F	905	fyn94-25b-02	ONZE
112	fyn95-25b	18	F	655	fyn95-25b-13	ONZE
113	fyn00-4b	20	F	749	fyn00-4b-13	ONZE
114	fyn00-7	20	F	775	fyn00-7-07	ONZE

115	fyn01-10a	20	F	712	fyn01-10a-05	ONZE
116	fyn01-5b	20	F	508	fyn01-5b-12	ONZE
117	fyn01-8b	20	F	878	fyn01-8b-13	ONZE
118	myn01-10b	19	M	752	myn01-10b-09	ONZE
119	myn94-6b	19	M	675	myn94-6b-13	ONZE
120	myn95-20b	19	M	675	myn95-20-11	ONZE
121	myp94-21a	20	M	740	myp94-21a-08	ONZE
122	myn02-19a	20	M	1046	myn02-19a-02	ONZE
123	myn07-1b	20	M	780	myn07-1b-02	ONZE
124	myn98-16b	20	M	1123	myn98-16b-12	ONZE
125	fop98-13c	63	F	899	fop98-13c-12	ONZE
126	fop01-12b	56	F	742	fop01-12b-10	ONZE
127	myp01-12c	20	M	389	myp01-12c-16, myp01-12c-17	ONZE
128	myp01-1b	20	M	688	myp01-1b-11	ONZE