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HOW DO LANGUAGE EXPERIENCE AND PROCESSING SPEED INFLUENCE THE ACQUISITION OF NARROW PHONETIC TRANSCRIPTION?

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ABSTRACT

Between 2010 and 2014, one-third of undergraduate and graduate students enrolled in Communication Disorders programs in California, Texas, and Florida were culturally and linguistically diverse (CLD). No published studies report on how CLD students acquire phonetic transcription of non-disordered and disordered spoken English, a critical skill for assessing and treating clients with articulation and/or phonological disorders. We tested whether language experience (i.e., monolingual English experience, early Spanish experience) and processing speed predict acquisition of narrow phonetic transcription. In this retrospective exploratory study, self-reported data on transcription accuracy across 15 periods from 44 undergraduates majoring in Communication Disorders were analyzed using growth curve models. For disordered spoken English, early Spanish experience students initially reported significantly lower transcription accuracy rates and grew at a faster rate than their monolingual English peers. The groups did not differ significantly in processing speed. For non-disordered spoken English, neither processing speed nor language experience predicts acquisition. Although narrow transcription of disordered spoken English is difficult for all students, it may tap a speech perception threshold for students with early Spanish experience.

KEY WORDS: Phonetics, phonetic transcription, bilingual, speech perception, speech-language pathology students

INTRODUCTION

Hispanics comprise 17% of the United States' population (Stepler & Brown, April 19, 2016), with over half residing in California, Texas, and Florida (Brown & Lopez, 2013). In these three states between 2010 and 2014, approximately 37% of undergraduate students and 36% of graduate students enrolled in Communication Disorders (CDIS) programs were members of a culturally and linguistically diverse (CLD) minority group (CAPCSD & ASHA, 2010-2014). All CDIS programs accredited by the American Speech-Language-Hearing Association (ASHA) include coursework in or coverage of the assessment and treatment of articulation and phonological disorders in English (Standards IV-B and IV-C of "the Standards and Implementation Procedures for the Certificate of Clinical Competence in Speech Language Pathology", ASHA, 2014). Phonetic transcription, a visual record of speech sounds using a phonetic writing system such as the International Phonetic Alphabet (IPA) (Shriberg & Kent, 2013; Small, 2015) is required for pre-professional students within either a dedicated course or as a learning module covered in another course (Lesser, 1992).

The small body of phonetic transcription research focuses on monolingual English service providers (Lockart & McLeod, 2013; Robinson, Mahurin, & Justus, 2011), so it does not address how CLD students acquire this skill. We examine whether language experience (i.e., monolingual English experience, early Spanish experience) and processing speed predicts acquisition of phonetic transcription. To explain how our preliminary findings inform clinical education and basic research, we define phonetic transcription and summarize its research basis. We discuss the formation of speech perceptual categories in infancy and we explain why phonetic transcription, though challenging for all students, is particularly challenging for CLD students.

Phonetic Transcription

Two levels of analysis in phonetic transcription are broad transcription and narrow transcription. While broad transcription is a record of only the phonemes produced by a client, narrow transcription is a record of how the client actually produced the phonemes. Only narrow transcription is able to capture slight differences or allophonic variations in the client's production of a single phoneme because it includes a subset of special symbols called diacritic markers that describe variations in phoneme production (Duckworth, Allen, Hardcastle, & Ball, 1990; Shriberg & Kent, 2013; Small, 2015). For example, if the client intends to say *dog* [dɑg] but actually produces the [d] speech sound with his tongue against the back of the upper teeth, the clinician will add the dentalization diacritic marker under the [d] to capture this variation [d̪ɑg]. Although narrow transcription is considered to be a much more demanding task than broad transcription (Howard & Heselwood, 2002), it is critical that students master narrow transcription so they can accurately diagnose disordered speech (Duckworth et al., 1990; Howard & Heselwood, 2002; McLeod, Verdon, Bowen, & the International Expert Panel on Multilingual Children's Speech, 2013; Teoh & Chin, 2008).

Knight (2010) summarizes factors affecting phonetic transcription accuracy in terms of Baddeley's (1986) model of working memory. First, the transcriber must receive the speech signal (and possibly the visual signal if the transcription is video-recorded). The speech signal is temporarily stored in the phonological loop—a specialized area in working memory responsible for retaining verbal information through rehearsal for very short periods of time. While the signal is stored in the phonological loop, it is automatically analyzed into segments and compared to representations stored in long-term memory. Once the representations of the signal are retrieved, they are paired with the appropriate IPA symbols so the transcriber can record them. Three issues related to processing speed and working memory that may affect students' accuracy when acquiring phonetic transcription are (a) the ability to inhibit English spelling ('orthographic') conventions, (b) differences in processing speed related to language experience, and (c) the tendency of students to falsely identify phonemes based on the categorical boundaries of their primary language.

Our experience teaching undergraduate students clinical phonetics indicates that, when initially learning to apply IPA symbols during live transcription, many students struggle to inhibit their selection of English spelling conventions in favor of the correct IPA symbols. They particularly struggle with: (a) vowel digraphs (two graphemes that represent one vowel sound) such as in the words *leisure, applesauce, lassoed,* and *great,* (b) consonant digraphs (two graphemes that represent one consonant sound) such as in the words *Churchill, finish, laughed, phonetics, the,* and *Martha,* (c) vowels preceding [ɾ] such as in the words *here, sport, hair,* and *are*, (d) the graphemes *g* and *j* that represent the sound [ʤ] such as in the words *judge* and *jelly,* (e) the graphemes *q, x, c, ck*, and *ch* that represent the sound [k] such as in the words *quick, extra, cookie, clack* and *orchestrates*, (f) the grapheme *c* that represents the sound [s] such as in the word *recess*, and (g) the grapheme *y* in initial position that represents the sound [j] such as in the words *yellow* and *yucky*. Although we can find no studies that address whether or how English graphemic interference affects processing speed during narrow transcription, there is extensive evidence from cognitive psychology indicating that participants process information more slowly when they receive stimuli with distracting information than when they do not (see Hommell, 2011).

Another issue that may affect the accuracy of students when acquiring phonetic transcription is processing speed related to language experience. Although processing speed and language experience interact in children and older adults, with bilinguals achieving faster reaction times than monolinguals (Bialystok, Martin, & Viswanathan, 2005), processing speed and language experience do not interact in young adults in their twenties (Kousaie & Phillips, 2012). In fact, undergraduate university students specifically are at the "peak of cognitive efficiency" and no difference between monolingual and bilingual young adults is observed in processing speed as measured by the Simon Task, described later in this study (Bialystok et al., 2005, p. 110). For this reason, we do not hypothesize a difference in processing speed due to language experience.

A third issue that may affect the accuracy of students when acquiring phonetic transcription skill is the tendency of students to falsely identify phonemes based on the categorical boundaries of their primary language. In other words, the transcribers quickly and automatically filter the information they hear through the "phonological sieve" of their language and thus cannot help but misperceive sounds peripheral to their established categorical boundaries (Buckingham & Yule, 1987, p. 118). Existing research indicates that monolingual English students and clinicians tend to misperceive allophonic variations (different ways one phoneme can be spoken) as categorically different phonemes when transcribing disordered speech and speech from a foreign language.

To our knowledge, there have been no published studies that have directly compared the ability of students or professionals in speech language pathology (SLP) to transcribe non-disordered and disordered speech. Given that non-disordered speech does not include phonetic distortions that could cause transcribers to mis-classify a phonetic aberration as a phonemic substitution, we hypothesized that students will achieve higher accuracy rates when transcribing non-disordered speech than when transcribing disordered speech earlier in their phonetics training.

Very little evidence exists on how the SLPs' language experience affects their ability to transcribe speech from a foreign language. Lockart and McLeod (2013) tested the ability of monolingual English SLP students, who had already been trained in IPA transcription of English, to transcribe Cantonese accurately. The students heard sets of five single syllable words with one set of non-disordered Cantonese spoken by an adult and one set of disordered Cantonese spoken by a child. Students could refer to a standard IPA chart and could replay the audio recordings as many times as they wanted while listening to the word lists. Students correctly transcribed 35% of the words (consonants only) from the adult non-disordered speech and 41% of the words (consonants only) from the child disordered speech. An error analysis showed that students were more likely to transcribe correctly consonants in common between the two languages and more likely to transcribe incorrectly consonants specific to Cantonese or consonants that were transcribed with diacritic markers. Lockart and McLeod (2013) establish that SLP students already trained in IPA achieved higher transcription accuracy on phonemes held in common between their language and the foreign language. Our interest is in how students from CLD backgrounds acquire phonetic transcription skills in English. To explain how false phonemic evaluation might differ based on the language experience of students, we next describe the differences in how the categorical boundaries of phonemes develop in monolingual and bilingual infants and how these differences extend into adulthood.

Differences in Monolingual and Bilingual Categorical Boundary Development

Phonemic category boundaries are different for monolingual and bilingual infants. Bosch and Sebastian-Galles (2003) suggest that 8-month-old bilinguals acquire a shared perceptual space for phonemes common to both languages. For example, when presented with non-word minimal pairs based on Catalan that were differentiated by the /e/ and /ɛ/ phonemes, Spanish-Catalan simultaneous bilingual 8-month-olds were less accurate in differentiating the phonemes than Catalan monolingual 8-month-olds, possibly because /e/ and /ɛ/ could be grouped together as one vowel for Spanish speakers.

For simultaneous bilingual infants, this shared perceptual space for phonemes that is common to both languages has consequences for how these infants acquire new phonemes. For example, Fennell and Byers-Heinlein (2014) tested how English monolingual and French-English simultaneous bilingual 17-month-olds learned minimal pairs when the stimuli were presented by English monolingual adults and French-English bilingual adults. The infants learned minimal pairs only when the speakers matched the infants' language learning environment. So, monolingual English infants only learned minimal pairs produced by monolingual speakers and French-English bilingual infants only learned minimal pairs produced by French-English bilingual speakers.

Thus far, we have contrasted the differences in the speech perception categories of monolingual and simultaneous bilingual infants. What about sequential bilinguals who learn a second language later in childhood? Are their phonemic categories more similar to monolinguals or simultaneous bilinguals and do these differences extend into adulthood? It depends upon when the sequential bilinguals acquire their second language.

When sequential bilinguals acquire the second language early in childhood (by age 3 years), they tend to categorize speech sounds similarly to simultaneous bilinguals. For example, early sequential Spanish-Basque bilingual adults performed similarly to Spanish-Basque simultaneous bilingual adults when evaluating whether the second of three non-words had either an apical /s/ or a laminal /s/ that matched the first or third non-word (Larraza, Samuel, & Onederra, 2016). However, when sequential bilinguals do not acquire their second language until they enter school (at age 6), their phonetic boundaries for their first language develop similarly to monolinguals (Antoniou, Tyler, & Best, 2012). For example, on the evaluation of non-words including apical /s/ or laminal /s/, late sequential Spanish-Basque bilinguals, who learned Basque after the age of six years, did not evaluate phonemes as accurately as the simultaneous and early sequential Spanish-Basque bilinguals. Therefore, the later the individuals learned Basque, the more difficult it was for them to differentiate the two phonemes in Basque (Larraza, et al., 2016).

Thus far, we have discussed the research basis for IPA transcription for clinical purposes, and how early language experience creates distinct phonetic boundaries that persist into adulthood. What about students who acquire a second language later in life? Can they create distinct phonetic boundaries that affect their ability to perceive phonetic boundaries? To answer this question, we turn to Flege's Speech Learning Model (SLM).

The SLM proposes that there is not a critical period for learning speech sounds and individuals have the ability to learn language-specific properties of another language across the lifespan (Flege, 2007). This means that individuals can form new categories for phonemes regardless of the age at which they learn a second language (Flege, 2007). Despite their ability to form new categories for phonemes from a different language, late language learners, in general, do not perceive vowels the same as native speakers of a language. However, some late language learners do learn how to perceive vowels similarly to native speakers of a language if the second language becomes their dominant language (Flege & MacKay, 2004). For example, using an oddity discrimination task in which the participants had to identify which vowel within nonsense words was unlike the others, Flege and MacKay (2004) found that adult English-Italian bilinguals who learned Italian early and used English later in life but within an educational setting perceived the English vowels /ɒ / vs /ʌ/, /ɛ/ vs /a/, /i/ vs /ɪ/ similarly to native speakers of English. These results suggest that CLD students educated in the United States in the process of acquiring IPA in a clinical phonetics class might achieve similar transcription accuracy rates as monolingual English students. However, one must remember that clinical phonetic transcription, particularly of disordered speech, is a much more complex task than an oddity discrimination task when participants simply have to determine which phoneme of a set is different from the others. To understand how task complexity might affect perception of category boundaries, we turn to Strange's (2011) Automatic Selective Perception Model (ASP).

The Automatic Selective Perception Model

The ASP model explains how the speech perception of adult non-native and second language learners (L2) is affected by stimulus complexity and task demands (Strange, 2011). Therefore, the ASP model describes speech perception of a very different population than CLD students enrolled in a clinical phonetics class who have matriculated in school systems that use English for instructional purposes. We turn to this model because it is the only model of speech perception that allows for the complex stimuli and task demands inherent in phonetic transcription of non-disordered and disordered speech.

In the ASP model, speech perception is conceptualized as a set of over-learned selective perception routines (SPRs) that "constitute mastery of phonological procedural knowledge" (p. 47). The ASP model also includes two modes of speech perception: the phonological mode and the phonetic mode. Adult listeners automatically access the phonological mode of their L1 when processing continuous speech. They access the phonetic mode when processing detailed allophonic information (such as the minimal pairs often used in speech perception discrimination tasks), particularly when learning a new language. Accessing the phonetic mode is less automatic and taxes cognitive resources. Adult L2 listeners gradually develop SPRs for the second language. When task demands are low, adult L2 listeners are able to make categorical discriminations of phonemes and allophones in the second language. However, when task demands are high, both non-native and adult L2 listeners, fall back on their over-learned L1 SPRs, which can cause them to falsely evaluate many phonemes in the second language. These false phonemic evaluations are most likely to occur when the adult L2 listener is processing non-native segments or segments that occur in both languages but are produced differently (Strange, 2011).

Although the ASP model does not address how early language experience of bilinguals effects their perception of spoken English, we suspect that (a) Spanish-English simultaneous bilinguals maintain strong SPRs for the shared phonemic perceptual space they acquired in infancy and that (b) early Spanish-English sequential bilinguals will maintain strong SPRs for Spanish. Also, because narrow phonetic transcription is a demanding perceptual task, we think it may activate the overlearned dominant language SPRs in Spanish-English simultaneous bilinguals and early sequential bilinguals. For this reason, we grouped Spanish-English simultaneous bilinguals and early sequential bilinguals together in our study. Going forward, we refer to these two groups as students with early Spanish experience. Therefore, we are extending for descriptive purposes the ASP model to a new population, students with early Spanish experience, and to two new complex speech perception tasks, narrow phonetic transcription of non-disordered and disordered speech.

We view narrow phonetic transcription as essentially a speech perception task. We predicted that students with monolingual English experience will demonstrate higher levels of transcription accuracy initially and across time than students with early Spanish experience because of how the speech perception categories are formed in development. We also predicted that differences in the acquisition of phonetic transcription based on language experience would be more pronounced when the students transcribed disordered spoken English than when they transcribed non-disordered spoken English.

Summary and Research Questions

For all students, acquiring narrow phonetic transcription in English is a challenging task because they have to quickly process the speech signal while overcoming the distractions of (a) English orthographic spelling conventions and (b) the tendency to process phonetic distortions as phonemic substitutions. Our experience teaching phonetics suggests that some students are better at overcoming these distractions than others, particularly early in the phonetics course. Secondary evidence from cognitive psychology suggests that tasks with distracting information reduce processing speed (see Hommell, 2011). Students with early Spanish experience may face an additional challenge. Evidence suggests that they, at least initially, formed different phonemic category boundaries than their monolingual English peers. However, evidence from Flege and MacKay's (2004) phonemic discrimination tasks suggests that early Spanish experience students may perceive English phonemic category boundaries similarly to their monolingual English peers. Our experience teaching clinical phonetics suggests that the complexity of the task may cause these early Spanish experience students to draw on the phonemic category boundaries they formed early in life. Support for this possibility comes from Strange's (2011) ASP model.

Thus, the purpose of this study was to test whether language experience (i.e., monolingual English experience, early Spanish experience) and processing speed predicts acquisition of narrow phonetic transcription ability in undergraduates when they transcribe *non-disordered* and *disordered* speech. For each data set, we asked the following question:

For undergraduate students learning to transcribe spoken English, will language experience (i.e., early monolingual English experience, early Spanish experience) or processing speed predict growth rates in narrow phonetic transcription at the word-level?

For both types of speech (non-disordered and disordered), we predicted that both processing speed and language experience would predict initial differences in transcription accuracy but only language experience would predict growth rates in transcription accuracy, with the early monolingual English experience group surpassing the early Spanish experience group. We also predicted that the effect would be larger for transcription of disordered speech because disordered speech often contains distorted sounds.

METHODS

We conducted a preliminary retrospective exploratory study of self-reported transcription ratings for 15 time periods collected during an undergraduate clinical phonetics course. The original purpose of this data was to track two student learning outcomes over the course of one semester for accreditation through the Southern Association of Colleges and Schools (SACS). The learning outcomes were:

- Transcribe normal child and adult speech with 90% accuracy as measured by inter-scorer reliability (2014 ASHA Certification Standard IVB: Basic Human Communication Processes)
- Transcribe disordered child and adult speech with 90% accuracy as measured by inter-scorer reliability (2014 ASHA Certification Standard IVC: Articulation and Phonology)

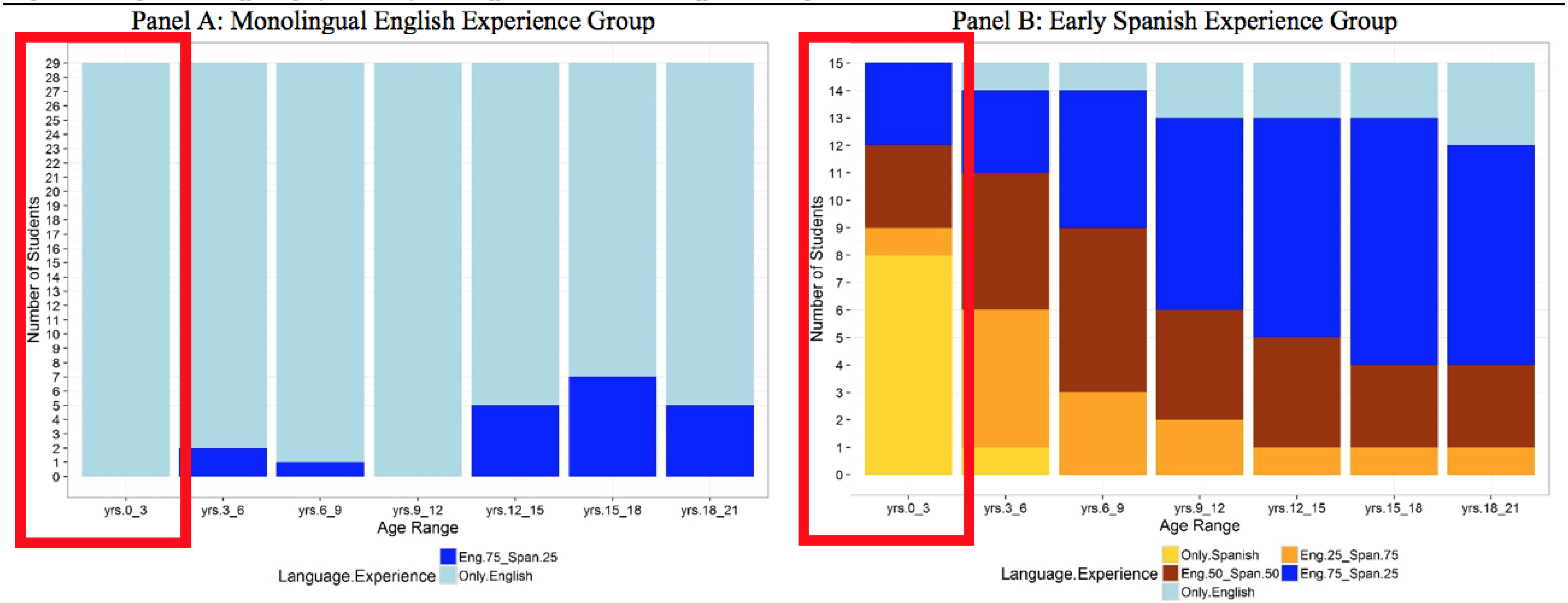
Anecdotal evidence from class discussions and office hour meetings with monolingual English students and bilingual English-Spanish students suggested two error patterns. First, regardless of language experience, many students made transcription errors because they used English orthographic spelling conventions instead of IPA symbols. Second, many Spanish-English bilingual students made transcription errors because of phonemic interference from Spanish. In a very initial effort to discover whether the anecdotal evidence is in fact patterns in the data, we conducted this retrospective exploratory study.

Participants

Forty-seven upper-division undergraduate students (*M* = 22 years, 2 male) majoring in Communication Disorders at a public university participated in this study. Three students were excluded because of hearing loss (two students) and prior knowledge of IPA (one student). To determine language use and proficiency, participants completed an adult language-use questionnaire (Kiran, Pena, Bedore, & Sheng, 2014). Spanish was the only other language these participants listed. Given that phonetic transcription is essentially a listening activity, we focused on the participants' receptive language abilities to determine the language experience groups. Participants who heard only English between birth and 3-years old were classified as the monolingual English experience group (*n* =29, *M* = 21.96 years, *SD* = 2.97 years). Participants who heard only Spanish or heard a combination of Spanish and English between birth and 3-years old were classified as the early Spanish experience group (*n* =15, *M* = 20.87 years, *SD* = 1.19 years, 1 male). Figure 1 graphs the composition of languages the participants heard most of the time from birth through age 21. Note that the language experience groups used in this study are based on the students' language experience in the first column marked by the red box (birth to 3 years). Given that the students were 18 years or older when enrolled in the phonetics course, we wanted to show how their language experience had changed over time as well as their language experience during the phonetics course.

Figure 1.

The composition of languages most heard across time by students in the monolingual English experience group (Panel A) and the early Spanish experience group (Panel B) during a 14-week undergraduate phonetics course.



For the Monolingual English group, Figure 1 shows that English was the language they mostly heard from birth through early adulthood. For the early Spanish experience group, Figure 1 shows that although they received a large amount of Spanish input from birth to 3 years of age, they received a large amount of English input as young adults.

To estimate the participants' processing speed when faced with distracting information, we used an online version of the Simon Task (Stoet, 2010) that the students took on their personal computers at the end of the course. In this task, participants saw a series of left-pointing arrows and right-pointing arrows presented on a computer screen. Participants were instructed to immediately press the "A" key on the keyboard when they saw left-pointing arrows and the "L" key when they saw right-pointing arrows. The placement of the arrows on either the left-hand side or right-hand side of the computer screen determined whether the information was distracting. When the placement of the arrow on the computer screen (e.g., left-hand side) matched the direction of the arrow (e.g., left-pointing arrow), the trial did not include distracting information. However, when the placement of the arrow on the computer screen (e.g., left-hand side) was different from the direction of the arrow (e.g., right-pointing arrow), the trial included distracting information. Participants tend to complete trials with distracting information more slowly than trials with non-distracting information (Hommel, 2011). For this study, processing speed for each student is the average response time for distracting information less the average response time for non-distracting information (M = 40.20 ms, SD = 34.08 ms, low = -24.98 ms, high = 127.33 ms).

Stimuli

The stimuli (see the appendix) were 150 sentences, with 75 non-disordered (M = 3.38 words, min = 1 word, max = 6 words) and 75 disordered sentences (M = 3.83 words, min = 1 word, max = 5 words). The stimuli were created to highlight different aspects of transcription that were important to instruction. Note that the stimuli were not created in a controlled fashion and no systematic effort was made to control for difficulty level of the sentences across the 15 time periods. Although a weakness in our study, we believe the stimuli are adequate to explore, in a very preliminary fashion, whether the anecdotal evidence of differences in language experience and processing speed describe student transcription accuracy rates when acquiring the skill.

Our interest was in capturing participants' word-level accuracy when transcribing casual continuous speech at the sentence level. This type of speech contains phonetic words, which do not conform to orthographic word boundaries (Shriberg & Kent, 2013). We defined word boundaries according to natural pauses in continuous speech. In other words, two or more words could be transcribed as one phonetic unit (Shriberg & Kent, 2013). For example, *the table*, would be transcribed as it is actually said in continuous speech:

[ðəte͡ɪbl̩]

An example of non-disordered speech stimuli is the sentence *I can go running*, which when said was transcribed narrowly as [a͡ɪ kəngo͡ʊ rʌnɪŋ]. An example of disordered speech stimuli is the sentence *Sam sure is surly*, which when said was transcribed as:

[s͎æm s͎ɝɪz͎ s͎ɝlɪ].

The diacritic marker used in the last example indicates that the speaker produced a whistling sound on the voiceless and voiced lingua-alveolar fricative consonants.

We conducted two post hoc descriptive analyses of the stimuli. In our first post-hoc analysis of the stimuli, we used Cummings (1998) and our own experience teaching phonetics to select English orthographic spelling conventions that were most likely to interfere with the acquisition of phonetic transcription. We estimated that English orthographic spelling conventions could interfere with the correct phonetic transcription of 22% of the phonemes in the non-disordered sentences and 25% of the phonemes in the disordered sentences. Vowel digraphs (e.g., *leisure*) and r-colored vowels (e.g., *here*) occurred in 10% of phonemes in the non-disordered and 10% of phonemes in disordered sentences. Consonant digraphs (e.g., *Churchill*) occurred in 7% of phonemes in the non-disordered and 10% of phonemes in disordered sentences. The remaining possible English orthographic intrusions were (a) the graphemes *g* and *j* that represent the sound [ʤ] (e.g., *judge*), (b) the graphemes *q, x, c, ck,* and *ch* that represent the sound [k] (e.g., *quick*), (c) the grapheme *c* that represents the sound [s] (e.g., r*ecess*), (d) the grapheme *y* in initial position that represents the sound [j] (e.g., yellow). These remaining intrusions occurred in 5% of non-disordered and 3% of disordered sentences.

In our second post-hoc analysis, we analyzed which vowel and consonant sounds in Spanish might have interfered with the students' ability to transcribe English, thus increasing the likelihood that the early Spanish experience students would falsely evaluate phonemes. Monophthongs that are present in English but absent in Spanish ([ɪ, ɛ, æ, ʊ, ʌ, ə, ɝ, ɚ]) occurred in 67% of the non-disordered and 61% of the disordered speech stimuli. The diphthongs that are present in English and absent in Spanish ([a͡ɪ, a͡ʊ, ɔ͡ɪ]; see Bauman-Waengler, 2012) occurred in 40% of the non-disordered and 27% of the disordered speech stimuli. Consonants that are present in English but absent in Spanish ([v, z, ð, θ, ʃ, ʒ, ʤ]; see Bauman-Waengler, 2012) occurred in 40% of the non-disordered and 24% of the disordered speech stimuli. Consonants that are alveolarized in English and dentalized in Spanish ([t, d, n]; see Bauman-Waengler, 2012) occurred in 66% of the non-disordered and 40% of the disordered speech stimuli. The [ŋ] consonant, which is velarized in English and palatalized in Spanish (see Bauman-Waengler, 2012), occurred in 5% of the non-disordered and disordered speech stimuli. The [tʃ] consonant, which has variable pronunciation in Spanish (see Bauman-Waengler, 2012), occurred in 3% of the non-disordered and 2% of the disordered speech stimuli. The diacritics used were:

- unreleased stop (intended [læp] but said [læp̚])
- nasalization (intended [bæd] but said [bæ̃d])
- lengthening (intended [si] but said [siː])
- syllabification (intended [fɪʃŋ] but said [fɪʃn̩])
- rising terminal juncture ([tʊde͡ɪ↑])
- dentalization (intended [wɪdθ] but said [wɪd̪θ])
- palatalization intended [sil] but said [sʲil])
- lateralization (intended [slip] but said [s̯lip])
- whistle (intended [si] but said [s͎i])

For non-disordered speech, only unreleased stop, pronounced nasalization, lengthening, syllabification, and rising terminal juncture occurred and had a frequency ranging from 2% to 5%. For disordered speech, all the diacritics except rising terminal juncture occurred with pronounced nasalization (12%) and lengthening (14%) occurring with the greatest frequency. The remaining diacritics occurred with a frequency ranging from 2% to 7%.

Procedure

The phonetics class met bi-weekly for lecture for one hour and 20 minutes for 20 class periods and included a one-hour weekly transcription lab. Data were collected during 15 class periods of the lecture portion of the class beginning on the first day. The course instructor (first author) was the examiner. At the beginning of classes when data were collected, participants were instructed to only have a blank sheet of paper and a writing utensil in front of them. They were also instructed to narrowly transcribe the sentences spoken by the examiner. The examiner's voice was amplified using the built-in microphone attached to the podium that was positioned at the front of the classroom. The participants heard two blocks of sentences, with non-disordered sentences always preceding disordered sentences. Each sentence was said four times with a 15-second pause between sentences.

After transcribing all of the sentences, participants were shown the correct transcription for the 10 sentences that included the total number of phonemes, words, and diacritic markers for each sentence and for each block of sentences (i.e., non-disordered, disordered). Although there was no formal transcription instruction while the students corrected their transcriptions, the examiner answered any questions they had about transcription patterns they thought they saw in the sentences. To correctly transcribe a word, the word had to include: (a) all of the correct vowels and consonants, (b) the correct word boundary, and (c) the correct diacritic marker(s). Additionally, the sentence in which the words occurred had to be enclosed by square brackets to indicate narrow transcription. Each participant calculated his or her proportion of correctly transcribed words for both non-disordered and disordered sentences and entered those proportions on an excel spreadsheet that was submitted at the end of the semester. Importantly, the students were reminded regularly that they were not being graded on the accuracy of their transcription during these assignments and, therefore, had no incentive to inflate their self-graded scores. Students were encouraged to identify error patterns in their transcriptions to help them know where to invest their study time.

Data Analysis Plan

We conducted growth curve analysis (a.k.a., multi-level modeling of time course data; Mirman, 2014) to test whether processing speed and/or language experience predicted the accuracy of narrow phonetic transcription over time at the word level for non-disordered and disordered speech. We selected growth curve analysis instead of traditional methods for repeated measures analysis (e.g., repeated measures analysis of variance, multivariate analysis of variance, raw and residual change scores) because growth curve analysis is particularly well-suited for data sets with partially missing data, unequally spaced time points, and complex non-linear trajectories (Curran, Obeidat, & Losardo, 2010).

The basic assumptions of growth curve modeling depend upon the complexity of the design, the number of nested variables, the number of participants, and the number of repeated measures. Our design was simple with only one nesting relationship (time) so having 44 participants was adequate to model change across time (see Curran et al., 2010). Our design included 15 repeated measure data points per participant, which surpasses the minimum requirement of three repeated measures per participant (see Curran et al., 2010). Growth curve modeling assumes that (a) the individual growth trajectories based on the residuals reflect the hypothesized growth pattern (i.e., functional form assumption), (b) the residuals for the whole data set and for any experimental groups are normally distributed (i.e., normality assumption), and (c) the residuals for the experimental groups have equal variance (i.e., homoscedasticity assumption, Singer & Willett, 2003). Following Singer and Willett (2003), we checked the assumptions of growth curve modeling for each data set twice, first for the initial model that best described change over time without predictors and then for the final growth curve model that best explained the data sets when predictors were added to the models.

In models that included the language experience groups, the early Spanish experience group was treated as the reference category and parameters were estimated for the monolingual English experience group. In models that included either or both predictors (i.e., language experience, processing speed), the models also included random effects of participants on all time terms. The fixed effects of language experience (categorical variable) and processing speed (continuous variable) were evaluated using model comparisons. Improvements in model fit were evaluated using -2 times the change in log-likelihood, which is distributed as chi square with degrees of freedom equal to the number of parameters added. All analyses were carried out in R version 3.2.3 using the lme4 package version 1.1-11.

RESULTS

Transcription of Non-Disordered Speech

Descriptive statistics. Panel A of Figure 2 displays a scatter plot of the participants' mean proportion of transcription accuracy against processing speed when presented with distracting information. Table 1 displays the means and standard deviations for the proportion of accurately transcribed English words across all time points for the non-disordered spoken English stimuli.

Figure 2.

Descriptive statistics for phonetic transcription of non-disordered speech for processing speed (Panel A) and language experience (Panel B) during a 14-week undergraduate phonetics course.

Panel A Non-Disordered: Scatterplot of Processing Speed

Panel B Non-Disordered: Means and Standard Errors

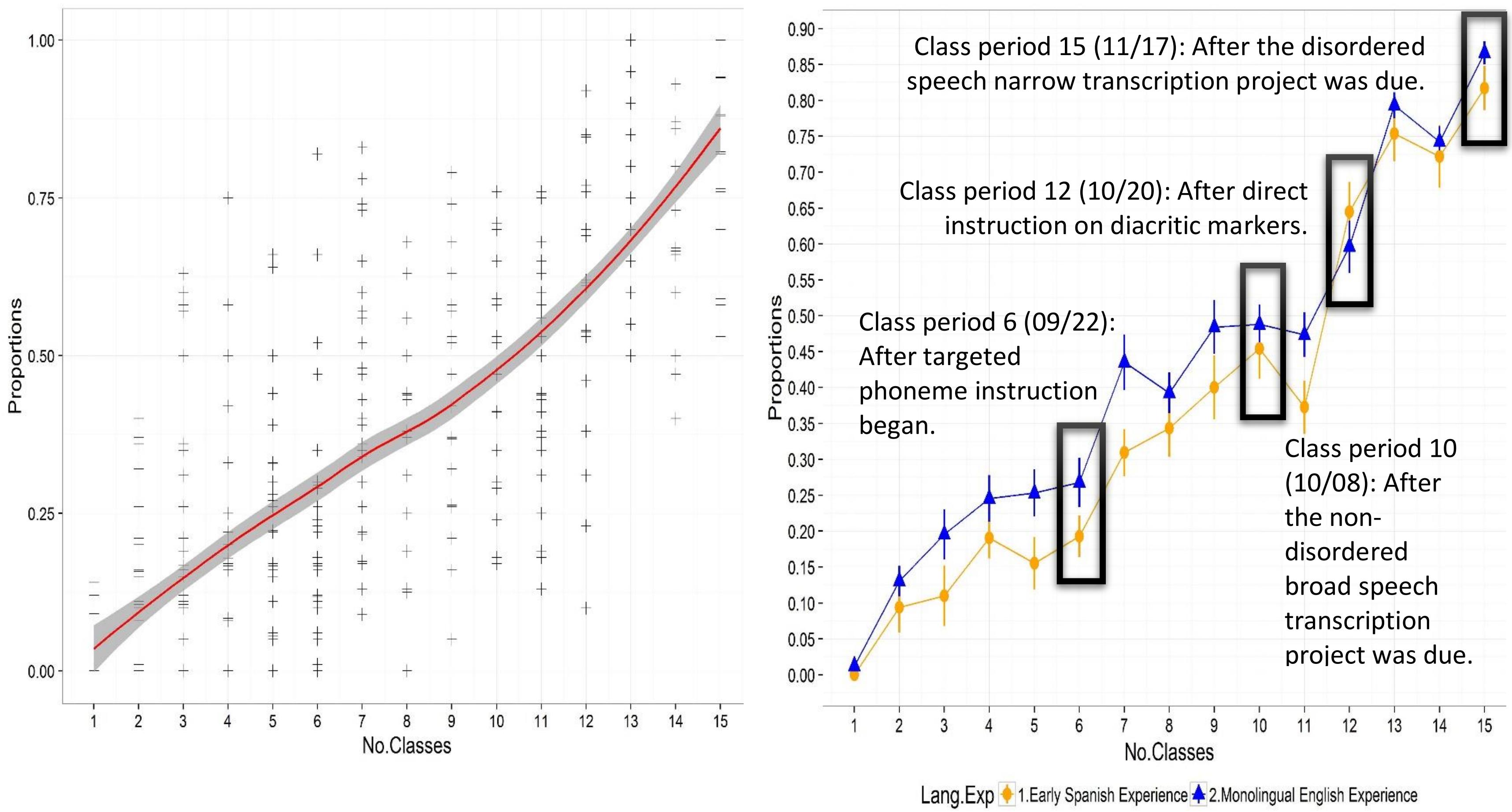


Table 1.
Descriptive statistics for the proportion of accurately transcribed English words within sentences spoken with non-disordered speech.

	Aug.27	Sept.03	Sept.08	Sept.10	Sept.15	Sept.22	Sept.24	Sept.29	Oct.01	Oct.06	Oct.13	Oct.27	Oct.29	Nov.03	Nov.17
Monolingual English Experience Group															
Mean	0.01	0.13	0.20	0.25	0.25	0.27	0.44	0.39	0.48	0.49	0.47	0.60	0.79	0.74	0.87
SD	0.04	0.11	0.19	0.17	0.17	0.19	0.21	0.15	0.20	0.15	0.16	0.19	0.10	0.11	0.09
Minimum	0.00	0.00	0.00	0.00	0.05	0.05	0.09	0.00	0.05	0.17	0.13	0.10	0.60	0.47	0.53
Maximum	0.14	0.40	0.63	0.75	0.66	0.82	0.83	0.68	0.79	0.76	0.76	0.92	1.00	0.93	1.00
Early Spanish Experience Group															
Mean	0.00	0.09	0.11	0.19	0.16	0.19	0.31	0.34	0.40	0.45	0.37	0.64	0.75	0.72	0.82
SD	0.00	0.14	0.16	0.11	0.14	0.11	0.13	0.16	0.17	0.16	0.14	0.16	0.14	0.17	0.12
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.13	0.21	0.18	0.18	0.31	0.50	0.40	0.58
Maximum	0.00	0.37	0.57	0.33	0.50	0.35	0.48	0.68	0.63	0.71	0.60	0.85	0.95	0.93	1.00

Note. SD = standard deviation

The spread among data points and the shape of the regression line in Panel A of Figure 2 suggests: (a) a positive gradient with larger accuracy rates associated with higher processing speeds, (b) a basic linear shape, and (c) a weak association between transcription accuracy and processing speed because of how disperse the data points are in relation to the regression line. Panel B of Figure 2 displays the participants' mean proportion and standard error of transcription accuracy for the two language experience groups. The annotations in Panel B indicate the class period that occurred after key class lectures and assignments were due. Both groups were unable to accurately transcribe phonetically at the word level on the first day of class. Beginning the second class period, differences in the proportion of accurate phonetic transcription emerged. Students in the monolingual English experience group consistently reported higher proportions than students in the early Spanish experience group for the next 10 class periods (August 29th to October 13th) in which data were collected. During the last four class periods in which data was collected (October 27th, 29th, November 3rd, and 17th), the two groups of students generally reported similar proportions of accurate transcription.

Growth curve analysis. Linear and curvilinear growth curves were initially conducted to determine which type of curve best fit the data when no predictors were added. These initial models indicated that linear growth best described the non-disordered data set.

Assumptions and initial models. For both the initial linear model and the final linear models, the individual growth trajectories based on the residuals demonstrated upward growth. The residuals for both models were not normally distributed, but instead were left skewed. This is not surprising given that all students scored at least one zero at the beginning of data collection. When the model included language experience as a predictor, the residuals of the language experience groups had equal variance.

When processing speed was added to the model, the effect did not improve model fit X^2 (1) = 1.60, p = .21. When the effect of processing speed was additionally allowed to effect growth rate, there was no significant effect on the growth rate (i.e., linear term, X^2 (1) = 0.18, p = .67). When language experience was added to the model, the effect also did not improve model fit X^2 (1) = 2.88, p = .09 and did not have a significant effect on the growth rate (i.e., linear term, X^2 (1) = 0.43, p = .51). In other words, neither processing speed nor language experience predicted student's acquisition of phonetic transcription at the word level when narrowly transcribing non-disordered speech.

Transcription of Disordered Speech

Descriptive statistics. Panel A of Figure 3 displays a scatter plot of the participants' mean proportion of transcription accuracy against processing speed when presented with distracting information. Table 2 displays the means and standard deviations for the proportion of accurately transcribed English words across all time points for the disordered spoken English stimuli.

Figure 3.

Descriptive statistics for phonetic transcription of disordered speech for processing speed (Panel A) and language experience (Panel B) during a 14-week undergraduate phonetics course.

Panel A Disordered: Scatterplot of Processing Speed

Panel B Disordered: Means and Standard Errors

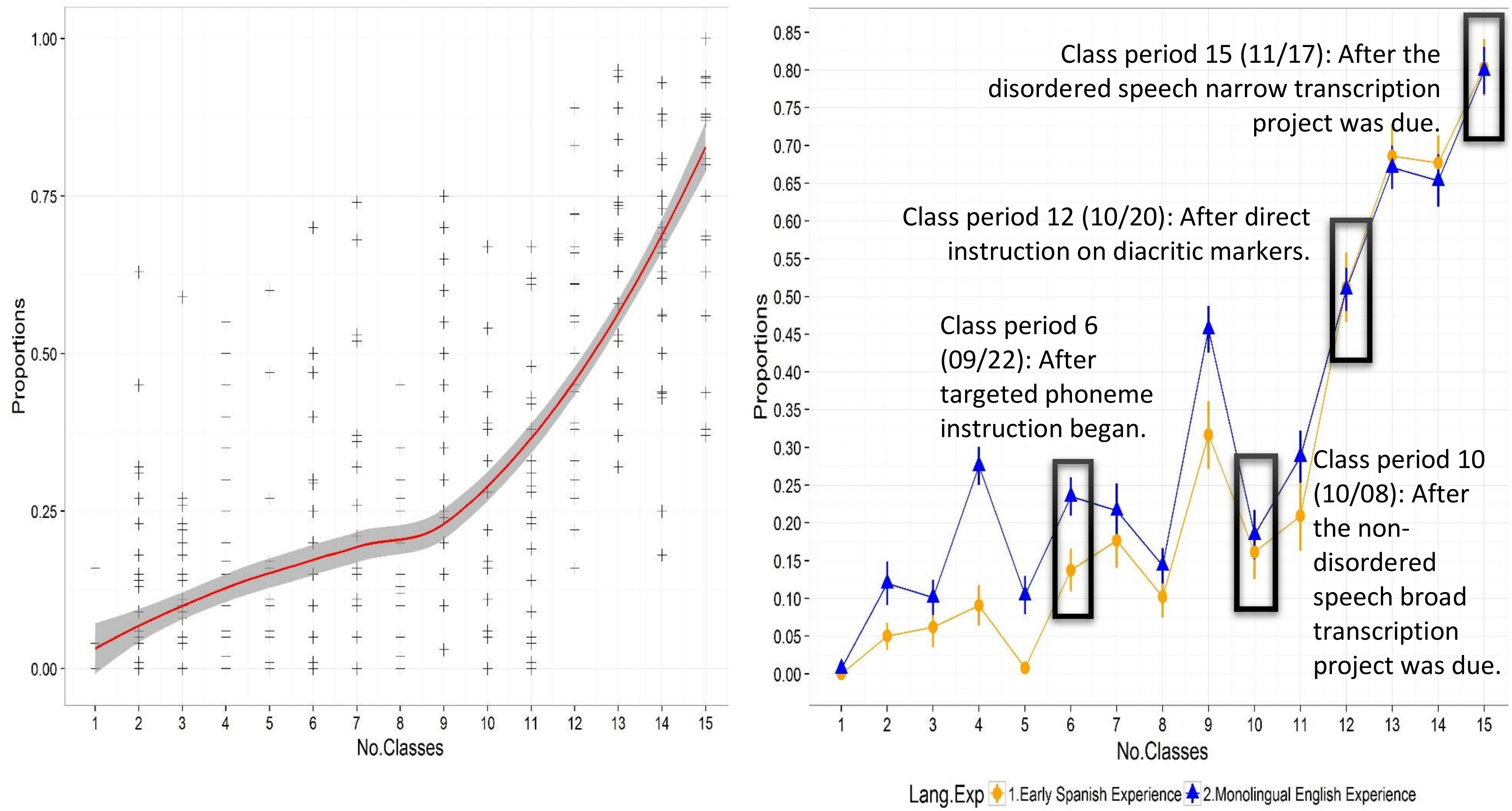


Table 2.
Descriptive statistics for the proportion of accurately transcribed English words within sentences spoken with disordered speech.

	Aug.27	Sept.03	Sept.08	Sept.10	Sept.15	Sept.22	Sept.24	Sept.29	Oct.01	Oct.06	Oct.13	Oct.27	Oct.29	Nov.03	Nov.17
Monolingual English Experience Group															
Mean	0.01	0.12	0.10	0.28	0.10	0.23	0.22	0.14	0.46	0.18	0.29	0.51	0.67	0.65	0.80
SD	0.03	0.15	0.12	0.14	0.14	0.14	0.19	0.13	0.17	0.18	0.18	0.15	0.15	0.18	0.17
Minimum	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.00	0.10	0.00	0.00	0.16	0.37	0.18	0.37
Maximum	0.16	0.63	0.59	0.55	0.60	0.70	0.74	0.45	0.75	0.67	0.67	0.89	0.94	0.88	0.94
Early Spanish Experience Group															
Mean	0.00	0.05	0.06	0.09	0.01	0.14	0.18	0.10	0.32	0.16	0.21	0.51	0.69	0.68	0.80
SD	0.00	0.07	0.10	0.10	0.02	0.11	0.14	0.10	0.17	0.14	0.18	0.18	0.16	0.14	0.14
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.22	0.32	0.44	0.44
Maximum	0.00	0.27	0.27	0.30	0.06	0.30	0.53	0.30	0.60	0.39	0.62	0.83	0.95	0.93	1.00

Note. SD = standard deviation

The spread among data points and the shape of the regression line in Panel A of Figure 3 suggests: (a) a positive gradient with larger accuracy rates associated with higher processing speeds, (b) a curvilinear shape, and (c) a weak association between transcription accuracy and processing speed because of how disperse the data points are in relation to the regression line. Panel B of Figure 3 displays the participants' mean proportion and standard error of transcription accuracy for the two language experience groups. As with the non-disordered speech data, group differences emerged beginning the second class period with students in the monolingual English experience group reporting higher proportions of transcription accuracy for the next 10 class periods. During the last four class periods in which data were collected, students in both language experience groups reported similar proportions of accurate transcription.

Growth curve analysis. Initial linear and curvilinear models indicated that curvilinear growth best described the disordered data set.

Assumptions and initial models. For both the initial curvilinear model and the final curvilinear models, the individual growth trajectories based on the residuals demonstrated upward growth. The residuals for both models were not normally distributed, but instead were left skewed. When the model included language experience as a predictor, the residuals of the language experience groups had equal variance. When predictors were added to the model, the effect of processing speed did not improve model fit X^2 (1) = 0.35, p = .55. When the effect of processing speed was additionally allowed to effect growth rate, there was no significant effect on the growth rate (i.e., linear term, X^2 (2) = 0.46, p = .80).

Final model. The effect of language experience did improve model fit X^2 (1) = 5.83, p = .016, R^2 = .76. When the effect of language experience was additionally allowed to effect growth rate, there was an effect approaching but not achieving significance on the growth rate (i.e., curvilinear term, X^2 (2) = 5.60, p = .061, R^2 = .76). Table 3 shows the fixed effect parameter estimates and their standard errors along with p-values estimated using the normal approximation for the t-values for both models.

Table 3.

Parameter estimates for analysis of effect of processing speed on undergraduate students' ability to phonetically transcribe disordered speech at the word-level.

	Estimates	Standard Error	*T*	*p*
Language experience: X^2 (1) = 5.83, p = .016, R^2 = .76				
Intercept	0.262	0.019	13.657	.000
Linear slope: Number of classes (No.Classes)	0.827	0.031	26.903	.000
Curvilinear slope: Number of classes	0.289	0.027	10.790	.000
Intercept: Monolingual English Experience	0.059	0.022	2.632	.008
Language experience and growth over time: X^2 (2) = 5.60, p = .061, R^2 = .76				
Intercept	0.265	0.021	12.655	.000
Linear slope: Number of classes (No.Classes)	0.892	0.051	17.447	.000
Curvilinear slope: Number of classes	0.360	0.041	8.167	.000
Intercept: Monolingual English Experience	0.054	0.026	2.084	.043
Linear slope x Monolingual English Experience	-0.986	0.063	-1.567	.123
Curvilinear slope x Monolingual English Experience	-0.109	0.054	-2.002	.050

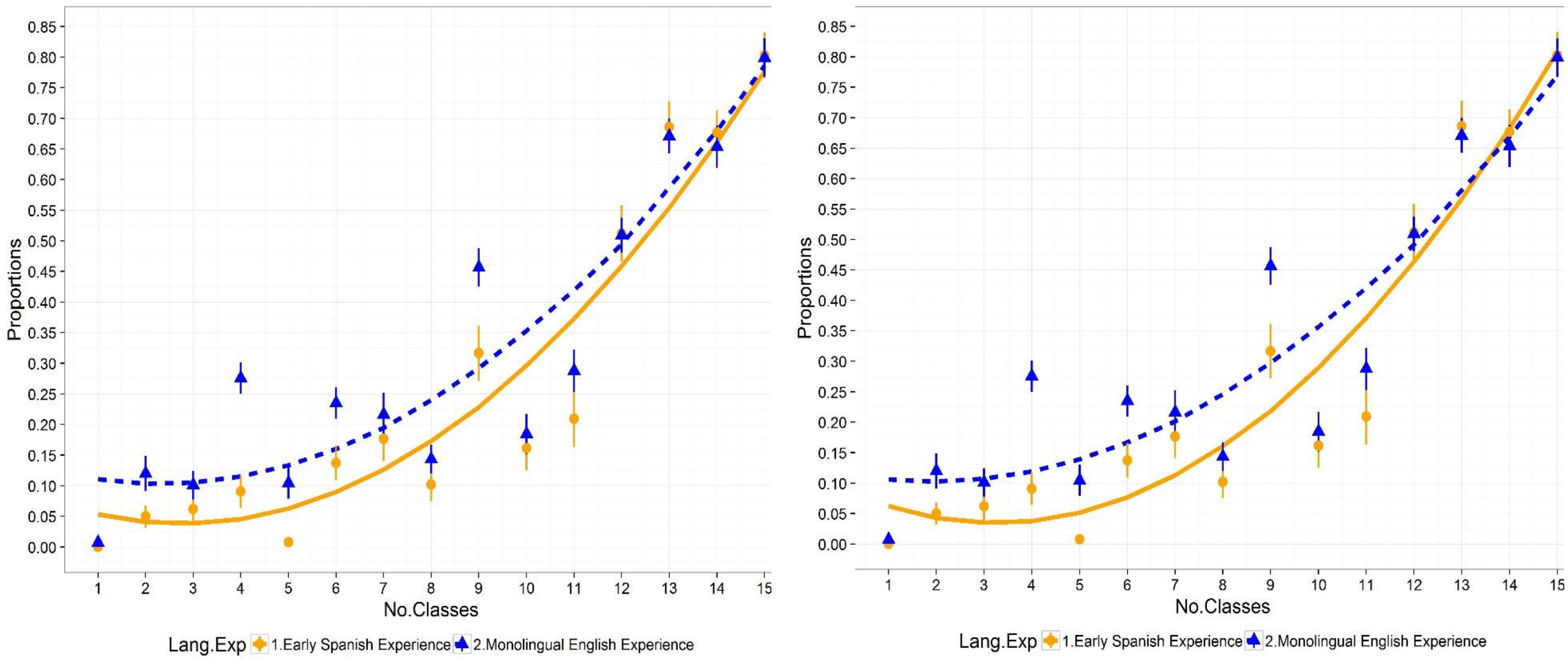
In both models, the monolingual English experience group reported higher transcription accuracy rates than the early Spanish experience group. In the model approaching significance, the early Spanish experience group grew in transcription accuracy at a faster rate than the monolingual English group. Figure 4 displays the curvilinear growth model that included only language experience as a predictor (Panel A) and the curvilinear growth model that allowed language experience to effect growth over time (Panel B).

Figure 4

Curvilinear model of the effect of language experience (Panel A) and the interaction between language experience and time (Panel B) on the acquisition of phonetic transcription skills of disordered speech during a 14-week undergraduate phonetics course.

Panel A: Language Experience Improved Model Fit
X^2 (1) = 5.83, p = .016, R^2 = .76

Panel B: Language Experience & Time Improved Model Fit
X^2 (2) = 5.60, p = .061, R^2 = .76



DISCUSSION

We conducted a preliminary retrospective exploratory study of the acquisition of clinical phonetic transcription as part of an undergraduate course in Communication Disorders. We predicted that both processing speed and language experience would affect the accuracy of phonetic transcription initially but that only language experience would predict growth over time. Specifically, we predicted students with monolingual English experience would achieve higher transcription accuracy rates than students with early Spanish experience at the beginning of the course and that students with early Spanish experience would grow at a faster rate in transcription accuracy during the course than their monolingual English peers. We also predicted that the effect would be more pronounced for the transcription of disordered speech than for non-disordered speech. For the transcription of disordered speech, only language experience predicted transcription accuracy at the beginning of the course (p = .016) and over time (p = .061). At the beginning of the course, students with monolingual English experience achieved higher transcription accuracy rates than students with early Spanish experience. Over time, students with early Spanish experience grew in transcription accuracy at a faster rate than students with monolingual English experience, suggesting that students in the early Spanish experience group had to work harder than their peers to reach the same level of transcription accuracy by the end of the course. For the transcription of non-disordered speech, neither processing speed nor language experience predicted transcription accuracy.

Clinical and Potential Theoretical Importance

These preliminary findings have both practical and potential theoretical implications. The practical implications concern the teaching of phonetics. Instructors of clinical phonetics courses need to be aware of the extra challenges in speech perception facing students with early Spanish experience when initially learning to narrowly transcribe disordered speech. We suggest that students who are learning phonetic transcription not receive grades on live transcription of disordered speech when the unit of analysis is word-level accuracy within sentences until the last few weeks of the course. Given that our students with early Spanish experience overcame their initial speech perception differences by the end of a 14-week course, we do not see a need for targeted intervention for these students. To create an equitable learning environment between students with early Spanish experience and those with monolingual English experience enrolled in our 14-week course, we plan to make students with early Spanish experience aware of the similarities and differences between English phonology and Spanish phonology at the beginning of the course and encourage them to include minimal pairs practice for sounds that are present in English but absent in Spanish. However, if the phonetics course is a 6-week or 9-week course, we strongly suggest providing students with early Spanish experience a minimal pairs intervention that focuses on differences between English and Spanish phonologies.

The potential theoretical implications are best viewed within Strange's (2011) ASP model of second language acquisition, which we used only for descriptive purposes in our study. We suspect that when narrowly transcribing non-disordered English speech, all students were able to draw on the selective perception routines (SPRs) in procedural memory for processing English phonology. We also suspect that when narrowly transcribing disordered English speech, monolingual English students continued to draw on the same selective perception routines for processing English phonology while the early Spanish experience students did not. We suspect that the task of narrowly transcribing disordered speech was so taxing at the beginning of the course that early Spanish experience students automatically reverted to the SPRs they acquired in infancy. For the simultaneous bilingual students (N = 8) in the early Spanish experience group, these SPRs are likely based on the shared phonemic perceptual space of Spanish and English (see Bosch & Sebastian-Galles, 2003). For the early sequential Spanish-English bilinguals (N = 7) in the early Spanish experience group, these SPRs are likely based on Spanish. Accessing the Spanish and Spanish-influenced SPRs would lead the early Spanish experience students to make more false phonemic evaluations than they would have if they were still accessing routines for English phonology.

Study Limitations

There are three main limitations to our study. First, students took the Simon Task at the end of the phonetics course. We do not think that acquiring phonetic transcription skill or mastery will reduce reaction times on the Simon Task because phonetic transcription is essentially an auditory task, not a visual one (see Soetens, Maetens, & Zeischka, 2010 for results of how visual tasks reduce reaction times on the Simon Task). Second, our students heard each sentence four times while transcribing. We do not believe the repetition increased the students' accuracy rates because Knight (2010) found that transcription accuracy did not increase until undergraduate students heard the stimuli six to 10 times. Third, we would have needed to include an error analysis of each student's transcriptions to demonstrate unequivocally that the early Spanish experience group made false phonemic evaluations when transcribing disordered Spoken English.

Future Studies

Based on population surveys for the United States, there has been a 47% increase in the number of people speaking languages other than English in the home since the 1990s (U.S. Census Bureau, 2000) and 21% (out of 291 million) of people age 5 years and older speaking a language other than English in the home (Ryan, 2013). It is inevitable that the linguistic diversity of students in our field and of the clients we serve will continue to expand. Our retrospective study only explored how early Spanish language experience influenced the acquisition of phonetic transcription of spoken English. Will the effects we found hold true for other languages and when English is not the target transcription language? Will our students need more advanced clinical phonetics training to develop the perceptual acumen needed to judge whether a mispronounced sound is a distortion or a false phonemic evaluation across different languages? Given these unanswered questions and the increasing linguistic diversity of the United States, we propose that the acquisition of phonetic transcription across languages be a separate line of research. We think Strange's (2011) Automatic Selective Perception (ASP) model of second language acquisition, which we used only for descriptive purposes, should be experimentally extended to include the acquisition of phonetic transcription across language experience groups.

Conclusion

Factors that predict students' acquisition of narrow phonetic transcription vary based upon the type of spoken English they are transcribing. Language experience predicts acquisition of narrow transcription skills for disordered spoken English. It is critical for students to be competent at narrow phonetic transcription so they can accurately assess and diagnose articulation and phonological disorders (e.g., Duckworth et al., 1990; Howard & Heselwood, 2002; McLeod et al., 2013; Teoh & Chin, 2008). By framing narrow phonetic transcription within the ASP model, we can begin to understand how the complex relationship between different types of language experience, stimulus complexity, and task demands impact the students' perception of spoken English.

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Appendix

Stimuli Sentences for Non-Disordered and Disordered Speech Used in this Study

Date, Type of Speech, & Orthographic Transcription of Intended Sentences	Narrow Phonetic Transcription of the Spoken Sentences
August 27th	
Non-Disordered Speech Sentences	
The cat and the fiddle.	[ðəkæ̃t æ̃n ðəfɪdl̩]
The cow jumped over the moon.	[ðəka͡ʊ ʤʌmpt o͡ʊvɚ ðəmun]
The little dog laughed.	[ðəlɪɾl̩ dɑg læ̃ft]
To see such sport.	[təsi sʌʧ spɔrt]
And the dish ran away with the spoon.	[æ̃nðə dɪʃ ræ̃nəwe͡ɪ wɪθðəspun]
Disordered Speech Sentences	
I called my mom on the telephone.	[ɑ͡ɪkʊd mɑ͡ɪmɑ ɑ ðətɛfon]
I saw sally	[ɑ͡ɪ s̢ɑ s̢ælɪ]
Give me the scissors	[gɪb mɪ tə dɪdɚz]
Her baby is nice.	[hɑ bɑ͡ɪbɪ ɪ nɑ͡ɪ]
Her needs are vast	[hɝ nɛds ɑr bæst]
September 3rd	
Non-Disordered Speech Sentences	
I love geometric shapes.	[ɑ͡ɪ lʌv ʤiamɛtrɪk ʃe͡ɪps]
I can go swimming.	[ɑ͡ɪ kəngo͡ʊ swɪmɪŋ]
They decided to study.	[ðe͡ɪ dəsɑ͡ɪdəd tə stʌdɪ]
What's your major now?	[wʌts jɝ me͡ɪʤɚ nɑ͡ʊː↑]
Gummy bears are poison.	[gʌmɪ bɛːz ɑː pɔ͡ɪzən]
Disordered Speech Sentences	

Those boys are nice.	[do͡ʊz bo͡ʊz ə nʌs]
She eats pink jelly beans.	[ʃ̯ iː its kɪŋk ʒ̖ ɛlɪ bims]
Bring me the box please.	[grɪŋ iː gə gɑks gliz]
Stop tickling me.	[dɑp dɪkl̩ ɪŋg mɪ]
He is chewing corn.	[hi ɪs ʃ uɪŋ kɔr̃ ŋ]

September 8th

Non-Disordered Speech Sentences

Bring me a burger and fries.	[brɪŋmi əbɝgɚ ænd fra͡ɪz]
My cousin is on vacation.	[ma͡ɪ kʌzɪn ɪzɑn veke͡ɪʃən]
Never put a bikini on a cat.	[nɛvɚ pʊt əbɪkinɪ ɑnəkæt]
Measuring cups are expensive.	[mɛʒɚɪŋ kʌps ɑr ɛkspɛnsɪv]
What choices do I have?	[wʌt tʃɔ͡ɪsəz dua͡ɪ hæv↑]

Disordered Speech Sentences

We both got a green pin.	[wiwo͡ʊ dɑrə twipɪn]
Those boys each have feathers.	[to͡ʊ bo͡ʊ i hæ dɛdɚ]
They had a bake sale.	[ðe͡ɪ hædə be͡ɪk de͡ɪl]
Gus whistled for his horse.	[gʌ wɪə fɔː hɪ hɔː]
Trains and planes move fast.	[twe͡ɪnz ænd pwe͡ɪnz muv mæst]

September 10th

Non-Disordered Speech Sentences

Find sanctuary.	[fa͡ɪnd sæŋkʃuɛrɪ]
He isn't here.	[hiɪzn̩ hɪr]
Polly wants a cracker.	[pɑlɪ wʌnts ə krækɚ]

He's not a murderer.	[hiznɑt əmɝdɚɚ]
Today is Wednesday.	[təde͡ɪ ɪz wɪnzde͡ɪ]

Disordered Speech Sentences

Get up and get dressed.	[gɛʔ ʌp æɪ̃ ngɛʔ gwɛst]
Cheese and pickles please.	[tʃiz̪ æn pɪkʊᵊz piz]
I do for myself.	[ɑ͡ɪ do͡ʊ fo͡ʊ mɑ͡ɪ sɛʊf]
I play with toys.	[ɑ͡ɪ pᵊwe͡ɪ wɪf tɔ͡ɪz]
Climb the ladder.	[kᵊlɑ͡ɪm ðə mædɚ]

September 15th

Non-Disordered Speech Sentences

The apple core was spoiled.	[ðəæpl̩ kɔr wʌz spɔ͡ɪld]
I poured over my notes.	[ɑ͡ɪpɔrd o͡ʊvɚ mɑ͡ɪno͡ʊts]
Eleven times three is thirty-three.	[əlɛvən tɑ͡ɪmz θri ɪzθɝɾɪθri]
Don't judge my mulching.	[do͡ʊnt̚ ʤʌʤ mɑ͡ɪmʌltʃɪŋ]
The kitten ran under the table.	[ðəkɪɾn̩ ræn ʌndɚ ðəte͡ɪbl̩]

Disordered Speech Sentences

Listen to Red Ridinghood.	[lɪʔn̩ wɛ̃ wɑ͡ɪ̃ ʔɪŋhʊ]
Wolf appears as grandma.	[wʊ əpɪː æ̃ wæ̃mə]
He eats the girl up.	[hĩ ɪts͍ ətɝ ʌt̚]
The lumberjack slices his stomach.	[əlʌmɚæ̃p s̪əs̪ɪs̪ hɪtəmɪt̚]
The ship has already sailed.	[tæʃ̑ ɪp hæz̑ ɑlrɛdɪ s̑e͡ɪld]

September 22nd

Non-Disordered Speech Sentences

My dad gave me a dollar.	[ma͞ɪdæd ge͞ɪvmɪ ədalɚ]
Jesse swapped it for chicklets.	[ʤɛsɪ swapt˺ɪt fɔrtʃɪklɪts]
I want a quartz watch.	[a͞ɪ wʌnə kwɔrts watʃ]
No blubbering in phonetics.	[no͞ʊ blʌbɚɪŋg ɪn fənɛtɪks]
He orchestrates covert operations.	[hi ɔrkəstrets ko͞ʊvɚt apɚe͞ɪʃənz]

Disordered Speech Sentences

Hello yellow bear.	[hɛːo͞ʊ jɛːo͞ʊ bɛː]
I think that one's best.	[e͞ɪ tɪŋk dæːdwənz dɛt]
Bad dog bit my mouth.	[bæː daːk ɪt˺ ma ma͞ʊf]
Oh, that is a kitty.	[o͞ʊ dæː ɪ ətɪɾɪ]
He has a brown collar.	[hi hæ æba͞ʊən tawə]

September 24th

Non-Disordered Speech Sentences

That grocery boy annoys me.	[ðæt gro͞ʊʃrɪ bɔ͞ɪ ənɔ͞ɪz mi]
Mockingbirds attack cats.	[makɪŋbɚdz ətæk kæts]
Put the baby in the cradle.	[pʊt ðəbe͞ɪbɪ ɪn ðəkre͞ɪdl̩]
One more ladle of soup.	[wʌn mɔr le͞ɪdl̩ əv sup pliz]
Her hair has really grown.	[hɝ hɛr hæz rilɪ gro͞ʊn]

Disordered Speech Sentences

Sally sat by the shore.	[s̯ ælɪ s̯ æt˺ ba͞ɪðə ʃ̯ ɔr]
Tuesday was yesterday.	[t̪ ud̪ e͞ɪ wʌs̪ jɛs̪ əd̪ e͞ɪ]
Jan's toothache is throbbing.	[ʤænz tũ fe͞ɪ̃ k ɪ̃ z fɑ̃ bɪŋ]

Riley runs really fast.	[wa͡ɪwɪ wʌnz wiwɪ fæf]
We play next Saturday.	[wi pe͡ɪ nɛks˞ s˞ ætəje͡ɪ]

September 29th

Non-Disordered Speech Sentences

Put the horses in the stable.	[pʊt ðəhɔrsəz ɪn ðəste͡ɪbl̩]
What time is it?	[wʌɾta͡ɪm ɪzɪt↑]
Give me some moisturizer.	[gɪmɪ sʌm mɔ͡ɪstɚa͡ɪzɚ]
My ear is infected.	[ma͡ɪ ɪr ɪzɪnfɛktəd]
That cupcake is stale.	[ðæt˺ kʌpke͡ɪk ɪz ste͡ɪl]

Disordered Speech Sentences

Mable cried all night.	[me͡ɪ̃ bl̩ kra͡ɪ̃ ː ɑ̃ ː na͡ɪ̃ ː]
Sam fells sick today.	[s˞ æm s˞ ilz˞ s˞ ɪk t̪ ud̪ e͡ɪ]]
Someday I'll go soon.	[s̭ ʌms̭ e͡ɪ a͡ɪ s̭ o͡ʊ s̭ u]
Come here collie now.	[kʌ hɪː kajɪ ka͡ʊː]
My mother knows you.	[ba͡ɪ͌ bʌ͌ ðɚ bo͡ʊ͌ z ju]

October 1st

Non-Disordered Speech Sentences

Yellow jello is yucky.	[jɛlo͡ʊ ʤɛlo͡ʊ ɪz jʌkɪ]
Churchill ruled England.	[tʃɝtʃɪl ruld ɪŋglɛnd]
Chimpanzees eat bananas.	[tʃɪmpænziz it bənænəz]
Sleeping is my leisure activity.	[slipɪŋ ɪzma͡ɪ liʒɚ æktɪvɪtɪ]
Sean ate mutton with jelly.	[ʃɑn e͡ɪt mʌtn̩ wɪθ ʤɛlɪ]

Disordered Speech Sentences

Cut the carrots and pears.	[tʌt ðə tɛːəts ænd tɛːz]
Timmy tattles too much.	[kɪkɪ kækl̩z ku kʌtʃ]
Sisi lives on industrial.	[s̡is̡ɪ lɪvz̡ ɑn ɪndʌs̡triəl]
Get orange lollipops.	[jɛt ɔːæntʃ jɑjɑps]
Let's eat at Applebees.	[ɛ i æ æpʊpi]

October 6th

Non-Disordered Speech Sentences

My garage is big and beige.	[mɑ͞ɪ gərɑʒ ɪz bɪg ænd bɛʒ]
Martha flew to Seattle.	[mɑːθɑ flu tu siærl̩]
Did you finish?	[dɪddʒufɪnɪʃ↑]
Welcome to the profession.	[wɛlkəm tu ðəprəfɛʃən]
Texas State University.	[tɛksəs ste͞ɪt˺ unɪvɝsɪtɪ]

Disordered Speech Sentences

Sam sure is surly.	[s̻æm s̻ɝ ɪz̻ s̻ɝlɪ]
My matches are new.	[bɑ͞ɪ͊ bæ͊tʃəs ɑː bu͊]
Insufficient closure.	[ɪ̃n sə̃fɪ̃ʃə̃nt klo͞ʊ̃ʒɚ̃]
Those cost fifty pounds.	[ð̯o͞ʊz̯ ka͞ʊs̯ fɪfθ̖ɪ pa͞ʊnz̯]
Out darn spot.	[ʌt dɑːn s̡pʌt]

October 13th

Non-Disordered Speech Sentences

Your gloves are on the stove.	[jɔrglʌvz ɑrɑn ðəsto͞ʊv]
You're making an assumption.	[jɚme͞ɪkɪŋ ænəsʌmʃən]
Sherlock just ate cheese.	[ʃɝlɑk dʒʌst e͞ɪt tʃiz]

The ring on my pogo stick broke.	[ðərɪŋ anma͡ɪ po͡ʊgo͡ʊ stɪk bro͡ʊk]
Sit crisscross applesauce.	[sɪt̚ krɪskrasæpl̩ sas]

Disordered Speech Sentences

Yellow stop sign fall.	[jɛjo͡ʊ tap̚ s̢ a͡ɪn s̢ a]
You left your car in the yard.	[jəlɛft jəkaː ɪnðə jaːd]
The policeman came to school today.	[ðəpəlis̪ mən ke͡ɪm t̪ us̪ ʊl t̪ ud̪ e͡ɪ]
Five more cookies please.	[fa͡ɪ̃ mɔ̃ ː kʊ̃ kɪ̃ pĩ]
On Wednesdays, I swim.	[an wɛnz̪ e͡ɪz̪ a͡ɪ s̪ wɪm]

October 27th

Non-Disordered Speech Sentences

I went to the battle.	[a͡ɪ wɛntu ðəbæɾl̩]
You saw war games?	[juː sa wɔrge͡ɪmz↑]
Where's the fire?	[wɛrz ðəfa͡ɪɚ]
Have you decided to transcribe?	[hævju dəsa͡ɪɾəd tutrænskra͡ɪb↑]
Sing me a new song.	[sɪŋmiː ənusaŋ]

Disordered Speech Sentences

Did you hear the fog horn?	[dujə hɪː fəfa hɔː↑]
Southside Sandwich shop is great.	[s̢ a͡ʊθs̢ a͡ɪd s̢ ænwɪtʃap̚ ɪz̢ gɛt]
I don't know why.	[a͡ɪ̃ do͡ʊnt do͡ʊ̃ ː da͡ɪ̃ ː]
The Miami dolphins won.	[ðəməamɪ dalfɪz wʌː]
Don't lick the sticker.	[do͡ʊn nɪ nənɪɾɚ]

October 29th

Non-Disordered Speech Sentences

Rowdy Ryan rode the horse.	[rɑ͞ʊdɪ rɑ͞ɪɪn ro͞ʊd ðəhɔrs]
Ricardo lassoed the bull.	[rɪkardo͞ʊ læsod ðəbʊl]
Come to the barrel races.	[kʌm tuðə bɛrl̩ re͞ɪsəz]
Let's meet at Bee Cave Road.	[lɛts miɾæt bike͞ɪv ro͞ʊd]
You brought me presents?	[ju brɑt mi prɛsənts↑]

Disordered Speech Sentences

Put the ship inside.	[pɪp ðəsɪp ɪnsɑ͞ɪd]
Sam scored six points.	[s̡ æm s̡ kɔrd s̡ ɪks pɔ͞ɪnts̡]
Thomas lost his saddle.	[t̪ aməs̪ las̪ hɪs̪ s̪ æɾ̪ l̩̪]
Should they shut it?	[ʃʊd̪ ðe͞ɪ ʃʌt̪ ɪt̪ ↑]
Susie knitted a silver scarf.	[s͇ us͇ ɪ nɪɾɪd əs͇ ɪlvɚ s͇ karf]

November 3rd

Non-Disordered Speech Sentences

Take exit 240.	[te͞ɪk ɛksɪt tufɔɾɪ]
Walmart didn't have it.	[walmɑːt dɪɾn hævɪt]
I hate eggplant.	[ɑ͞ɪhe͞ɪt ɛgplænt]
Roadrunners jump on my roof.	[ro͞ʊdrʌnɚz ʤʌmp ɑnmɑ͞ɪ ruf]
I need new tires.	[ɑ͞ɪnid nu tɑ͞ɪːz]
	[ɑ͞ɪnid nu tɑ͞ɪjəːz]
	[ɑ͞ɪnid nu tɑ͞ɪəːz]

Disordered Speech Sentences

They played bingo.	[ðe͞ɪ pe͞ɪ bɪŋgo͞ʊ]

Peter Rabbit is coming.	[pirəː wæbɪt ɪzkʌmɪŋ]
Summer is over.	[s̪ ʌməː ɪz̪ o͡ʊvəː]
She’s a craggy old bat.	[ʃĩ zə̃ kræ̃ gɪ̃ o͡ʊ̃ ld bæ̃ t]
Sean ate applesauce.	[ʃɑn e͡ɪt æpl̩ s̢ ɑs̢]

November 17th

Non-Disordered Speech Sentences

I hate round shapes.	[a͡ɪ he͡ɪt ra͡ʊnd ʃe͡ɪps]
I can go running.	[a͡ɪ kəngo͡ʊ rʌnɪŋ]
They decided to work.	[ðe͡ɪ dəsa͡ɪrəd təwɝk]
What’s for lunch now?	[wʌts fɔː lʌntʃ na͡ʊ↑]
Candy is sweet.	[kændɪ ɪz swit]

Disordered Speech Sentences

Those boats are pretty.	[do͡ʊz bo͡ʊz ɑː pɪɾɪ]
She eats salad.	[ʃ̪ i its̪ s̪ ælɪd]
String me a bean please.	[gɪŋ iː əgin giz]
Stop doing it.	[dɑp duɪŋɪt]
Sammy is singing.	[s͎ æmɪ ɪs͎ s͎ ɪŋɪŋ]