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Accent Discrimination Across Different Language Families

Jee Mei Yeoh

Abstract

The present study examined native English listeners sensitivity to foreign-accented speech. The study assessed four different non-native accents (French, Spanish, Korean and Mandarin), examining the effect of stimulus length (sentence and word) and speaker gender (female and male). Each subject was presented with the four non-native accents and different item length while randomly assigned to speaker gender. Two speakers of respective foreign-accented speech were included. The results indicated that listeners were more sensitive to sentence condition than word condition and were consistent across the different accents. The main effect of speaker gender was not significant, however, the interaction between gender and accents were significant. Listeners show greater sensitivity to different accent pairings in female speakers of French-Spanish and male speakers of French-Mandarin. Despite that, this interpretation is limited by the size of study. The overall accent discrimination performance indicated that European language family performance was better than Asian language family. The findings suggest that stimulus length and perceived degrees of foreign accents affect the sensitivity of listeners.

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Accent Discrimination Across Different Language Families

By

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Accent Discrimination Across Different Language Families

Speech perception involves a mapping of acoustic signals into representations of linguistic patterns. These acoustic signals manifest in layers that correspond with linguistic structures such as semantics, phonetics, and pragmatics. Phonetics includes vowels and consonants as the basis for recognizing and distinguishing words. When producing speech, there is always variation in the pronunciation of consonants and vowels, which can make word identification difficult. For example, a foreign accent is an extreme form of variation that affects speech intelligibility (Bradlow & Bent, 2008) and is common among learners of a second language. Second language learners have limited representations of the new language, thus producing speech which significantly differs from the norms of native speakers.

Typical language acquisition of a second language tends to result in foreign accents after reaching puberty. Hence, the onset of puberty is inclined to influence the outcome of speech production. Most adult speakers have established a fluency in phonetics in their native language, leading to less adaptability to acquire phonetic features of another language. When there is a variation in phonetics, this creates interference, causing the second language to be more demanding. As a result, listeners who perceive accented speech undergo perceptual adaptation and discrimination of foreign accents.

Language Acquisition in Typical Development

Language acquisition occurs at a young age. Infants start to babble sounds based on the language they hear from their parents. Eventually, they begin uttering one to two words and gradually form longer sentences. When a language is acquired from infancy or

early childhood, vowels and consonants are established with native-like precision. Children who start speaking two languages before puberty can develop the fluency of a native talker in both languages. This is due to plasticity in the language learning system that enables them to adapt to languages rapidly and flexibly. On the other hand, second language acquisition in adults happens much slower and results in a greater need for accuracy in producing speech close to a new language.

The interference of a child's language acquisition is limited compared to adults. Children have yet to achieve full language ability, thus, learning a second language does not interfere with language acquisition (Scovel, 1969). On the other hand, adults have already established language acquisition in their native tongue, which interferes with learning another language (Scovel, 1969). The differences in acoustic patterns of a native language may differ from a second language, thus producing speech patterns that deviate from native speakers. In addition, Scovel (1969) mentioned that language serves different functions for adults and children. Children learn a language as a tool to enhance their communicative ability, while adults adopt the language as a set of skills (Scovel, 1969). This contrasting core of learning makes language acquisition lead to different outcomes. As a result, an adult's attempt to attain fluency in a new language is much more challenging and a foreign accent is likely prominent. Although specific accent identity can be easily identified, accented speech is more likely difficult to perceive in some ways.

Most individuals who learn a second language as adults end up speaking with a foreign accent. This is likely due to a critical period for language acquisition that affects the acquisition of native fluency (Flege et al., 1995). After reaching puberty, a foreign accent becomes more noticeable and cannot be easily overcome. The ability to acquire

proficient vowels and consonants similar to native talkers may be reduced. Flege et al. (1995) examined the strength of foreign accents at different ages of second language acquisition. Native English listeners rated Italian-accented speech to evaluate the accent strength. The findings showed that learning English as a second language before reaching puberty results in better proficiency (reduced foreign accent) than those who started learning after puberty. Native Italian talkers who started using English at a younger age demonstrated milder accented speech than those who began later. Learning a second language at a younger age constructs a stronger mastery of the language, thus, develops a lower prevalence of foreign-accented speech. Robust development of a second language is less likely to impair speech production, leading to increased perception of speech in a second language.

There is also a variation in a native language, whether an accent is considered standard or regional. English language, for example, has diverse forms, whether in American and British English or Southern versus Northern American accents. These variations highlight that second language acquisition based on these accents can result in different perceptions of non-native speakers in learning another language. Few studies have examined second language learners on regional accents, since foreign accents would still be greater than regional accents. Nevertheless, considering the influence on regional accents for second language learners are perspective. Alford and Strother (1990) examined accent discrimination by native and second language learners of English in a matched guise technique. The recordings presented speakers of male and female respectively, from southern (South Carolina), northern (New York) and midwestern (Illinois) accents. The scorings were evaluated using the Likert scale on listeners in native

English and second language learners of English based on their attitudes toward different English accents. The results reported that perceptions of accents were evident among native and second language learners. Despite that, second language learners' perceptions varied from native speakers, which showed a more positive attitude among second language learners across all the accents. Nevertheless, regional accents are not as imperative as foreign accents, especially in evaluating accented speech's perceptual sensitivity.

Foreign Accent Adaptation and Perception

Word misidentification and prolonged processing time are common issues related to foreign accents (Clarke & Garrett, 2004). Clarke and Garrett (2004) examined the effect of accented speech on word identification in noise. They presented native English speakers with Spanish and Mandarin-accented speech and measured the timing of word identification in single versus mixed accent conditions. The study found longer processing times in word identification in the mixed accent condition than in the single accent condition. This indicates that accent adaptation is more difficult in the mixed accent condition because listeners have to adapt to two accents instead of just one. Meanwhile, listeners in a single accent condition initially took longer in word identification, however, as time passed, they could adapt to the accented speech and reduce their response times. Clarke and Garrett (2004) concluded that repeated exposure to the same accent enables perceptual adaptation and increased sensitivity to accented speech.

Different talkers and accents can also affect adaptation to foreign-accented speech. A study by Baese-Berk et al. (2013) on systematic variability examined the listener's

ability to adapt to non-native accents in trained and untrained conditions. The trained condition included non-native speakers in Thai, Korean, Hindi,Romanian and Mandarin and untrained condition had different speakers with a different accent (Slovakian). During the testing phase, they included different foreign accents and the Slovakian accent that was not part of the training. The training phase included three different conditions, control group (with no foreign accent), single foreign accent (five different talkers of the same accent) and multiple foreign accents (all five accents) and their performance was assessed in three conditions. The task required listeners to jot down sentences after both training and post-tests to evaluate an overall score of accuracy (correctly identified words) based on three to four keywords in each sentence that will either be scored as correct or incorrect. The study reported that listeners could generalize to an untrained foreign accent (Slovakian) despite being exposed to completely different foreign accents during training in multiple foreign accents condition. However, the adaptation of the untrained talkers and accents (Slovakian) was not as good as the foreign accents they heard during training. This indicates that listeners were able to generalize to other foreign accents despite getting exposed to a newly introduced accent. Therefore, listeners are able to generalize different accents during foreign accent adaptation.

The perception of foreign accents may link to speech intelligibility which listeners can adapt and accommodate accented speech. When there is high intelligibility in non-native speakers, adaptation to speech occurs more rapidly than for those with low intelligibility. Van Wijngaarden (2001) examined the intelligibility of foreign-accented speech in Dutch. Native listeners of Dutch assessed the sentence and phoneme intelligibility of utterances produced by native Dutch speakers and American English

learners of Dutch. The study found that when vowels are difficult to pronounce by second language learners, it becomes harder for listeners to recognize. Therefore, native Dutch listeners have more difficulty understanding accented speech than native speech. In a milder accented speech, less variability exists in phonetics that makes speech easily understood by native listeners. As a result, speakers with high intelligibility enable rapid adaptation to foreign accents than speakers of low intelligibility. The rate of adaptation determines how accurately and quickly listeners are able to become sensitive to foreign accents.

Perceptual Sensitivity to Foreign Accented Speech

Speech signals are able to convey subtle information regarding the background of speakers, such as gender, native language and emotional state (happy, angry, sad) (De Jong, 2018). The use of acoustic signals can help establish listeners' ability to a foreign-accented speech by enhancing this ability to identify and discriminate different foreign accents. In particular, additional acoustic signals are needed to include more information on foreign accent identities that are hard to comprehend.

Park (2013) studied the effect of stimulus orientation on the perceptual identification of accented speech in a series of perceptual experiments. Park (2013) examined monosyllabic utterances using four types of syllabus structures in consonant (C) and vowel (V), CV and CCV (permissible), CVC and CCVC (impermissible), on Korean learners of English and native English speakers. Listeners engaged in two alternative forced-choice tasks to identify if talkers were native or non-native. Listeners managed to distinguish Korean-accented English despite a high fluency in English. The use of monosyllabic structures enables listeners to detect the slight presence of non-native

accents. Therefore, subtle details in speech can deliver such descriptive information to listeners.

Atagi and Bent (2017) examined in a same-different accent discrimination study that varied the number of accents and item length. It was hypothesized that longer utterances like sentences could result in greater sensitivity than single words. Atagi and Bent (2017) incorporated different foreign accents (German, Korean, and Mandarin) in a paired discrimination task using words and sentences of different accents. In some conditions, they compared native and foreign-accented speech, and in other conditions, they compared the same and different foreign-accented speech. For example, a same-accent trial might compare Mandarin and Mandarin accented speech, while a different-accent trial might compare Mandarin and Korean accented speech or native English and Mandarin accented speech. The performance was measured using d-prime to assess the accuracy in detecting different accents. The results indicated sensitivity in sentence-length utterances was higher than single-word utterances when comparisons with native speakers were included. Also, among the non-native accents with German accented speakers included, sentences yielded better performance than words. Meanwhile, the Mandarin-Korean pairings indicated words were better than sentences. Overall, the study found that accent discrimination was good but only limited between native and non-native accents. These findings motivate the current study to examine comparisons of additional non-native accents to determine listener's sensitivity to accented speech.

The present study is a replication and extension of Atagi and Bent (2017). Atagi and Bent (2017) found a significant difference between materials (sentences and words) in perceptual sensitivity to accented speech, which performance of sentences was better

than with words. One limitation of the study by Atagi and Bent is that they only used three types of foreign-accented speech, which included two accents from the Asian language (Korean and Mandarin) and one from the European language (German). In order to permit a comparison between two European language families, the current study included French and Spanish accents, instead of German (mainly because these were available in the dataset). Mandarin and Korean remained unchanged to further explore the relationships of these two different language families. It was hypothesized that native English listeners would be more sensitive to the European language family than the Asian language family due to greater familiarity with these accents among the present participant population. Another factor that has been added to the present study is the inclusion of both male and female speakers (Atagi and Bent (2017) had only female speakers in their study).

The following sets of hypotheses were examined in the study:

- Hypothesis 1: It was hypothesised that there will be a significant difference in sentence and word condition, that performance with sentences would be better than words.
- Hypothesis 2: The second hypothesis will observe a similar pattern, that sentences and words will have a consistent difference across different accent pairings. In particular, the Korean-Mandarin comparison was found to have the opposite effect by Atagi and Bent (2017), but the finding may not expected to replicate with the addition of talkers.
- Hypothesis 3: There will be a significant difference in accent families, particularly in the European and Asian accents. The performance of the European accent

family will be greater than the Asian accent family, while the mixed accent family is somewhere between the two.

Method

Participants

The study recruited 80 native English speakers (53 female, 25 male, 2 unknown gender) from Montclair State University to participate in same-different perceptual discrimination tasks. Most of the listeners reported experience with other spoken languages, such as Spanish (N = 46), French (N = 11), Italian (N = 9), Mandarin (N = 5), Polish (N = 3), Arabic (N = 3), Hebrew (N = 2), and Hindi (N = 2). Additional languages with only one participant each were Bengali, Croatian, Japanese, Ghana, Kapangam, Liberia, Punjabi, Russian, Sanskrit, Tagalog, Turkish, Urdu, and Yoruba. Their mean age was 20 years with a range of 18 - 59 years. Thus, 66 participants reported experience with relevant European languages, only 6 participants reported experience with relevant Asian languages and 6 participants with no other language experience apart from English. All participants reported no speech or hearing impairment. Their participation in the study was awarded SONA credits.

Materials - Speakers

A total of eight speakers of different languages were selected from Hoosier Database of Native and Non-native Speech for Children, adopted from Atagi and Bent (2013). Two males and two females with French, Spanish, Korean, and Mandarin native languages were included. The overall degree of accentedness across the four language ranges is presented in Table 1, ranging from 3.7 to 7.9, where 1 indicates no foreign accent and 9 indicates a strong foreign accent. Despite levels of comprehension typically

being inversely related to accentedness, the overall intelligibility rate by native listeners revealed above average performance with 90 percent (Atagi & Bent, 2013). Therefore, intelligibility was good regardless of accent strength.

Table 1
Average ratings of perceived foreign accents (Atagi & Bent, 2013).

	Korean	Mandarin	French	Spanish
Female A	5.1	4.4	4.1	6.2
Female B	5.5	4.8	4.3	6.8
Male A	5.8	4.1	6.3	5.9
Male B	5.8	3.7	4.7	7.9

Materials - Items

There were 160 monosyllabic words and 160 sentences. Items presented in the monosyllabic wordlist included the Lexical Neighborhood Test (LNT), Northwestern University-Children's Perception of Speech test (NU-CHIPS), Phonetically Balanced Kindergarten test (PB-K), and Pediatric Speech Intelligibility-Words test (PSIW) (Atagi & Bent, 2013). The items for the sentences list were selected from Hearing in Noise Test - Children's Version (HINT-C) (Atagi & Bent, 2013). The sentences range from 3-7 words, with simple syntax (e.g., The shirts are hanging in the closet). The words and sentences are listed in Appendix A.

Procedure

The experiment consisted of two blocks, with 160 trials each in monosyllabic word and sentence blocks. The order of presentation of the blocks was counterbalanced across listeners. Figure 1 shows the structure of the same-different discrimination trials in the experiment. On each trial, a word or sentence was printed on the screen, followed by two versions of the audio of the word or sentence that has been visually presented, with 500ms ISI between each event. Both of the words or sentences comprised different

talkers but of the same gender. The items presented were either from the same native language background or different native language backgrounds (randomly presented so that 50% of the trials were same/different). The different native language comparisons were further divided into speakers of the same language family (Korean and Mandarin or French and Spanish) or different language families (Korean and French, Korean and Spanish, Mandarin and French, and Mandarin and Spanish). The same and different accent pairings were presented by two different talkers of the same gender. After both audios were presented, participants pressed a key on the keyboard, either number 1 (for the same accent) or number 0 (for a different accent). After a response, another stimulus followed after 1000ms ITI. Data were analyzed to examine the effects of materials, accent differences, accent family, and speaker gender.

Figure 1

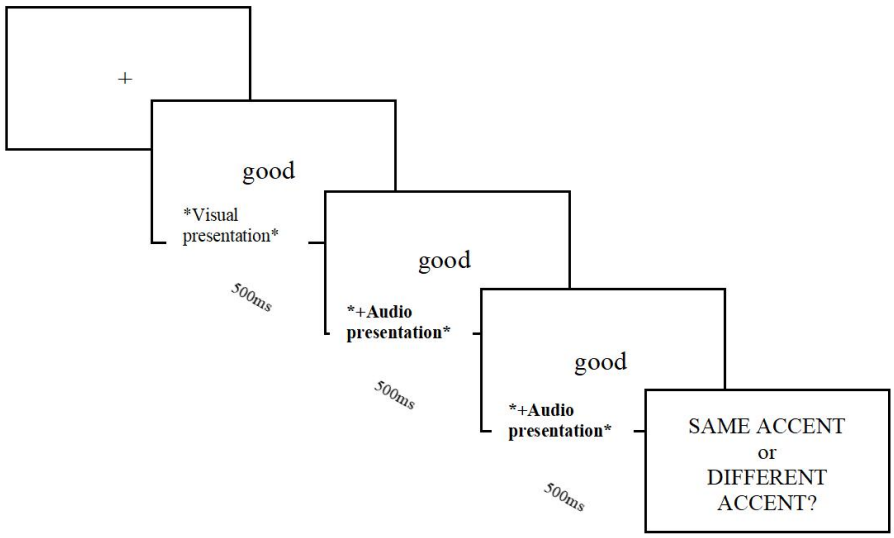

Figure 1: A sample of the procedure in the experiment on one trial

Participants completed a consent form prior to the experiment to ensure voluntary participation and to inform that SONA credits will be awarded. Participants were

randomly assigned to one of the following four conditions: Male Talkers Words first, Male Talkers Sentences first, Female Talkers Words first, and Female Talkers Sentences first. Each condition of the experiment was completed by 20 participants. Data collection took place on iMac computers running Superlab 5.0 (Cedrus) in the *Speech and Communication Laboratory*, with materials presented over Sennheiser HMD headphones.

D-prime calculation

The data was analyzed in R Statistical Platform (version 4.1) using R studio (version 4.1). Signal detection theory was applied to overcome response biases in same-different tasks. As such, measures of accuracy were converted to d-prime scores (z-Hit rate minus z-False alarm rate) to ensure a bias-free measure of perceptual sensitivity (Macmillan & Creelman, 2005). To calculate d-prime, first, the percent correct was calculated separately for same and different trials. The Hit rates consisted of percent correct of different trials, while the False Alarm rates converted percent correct of same accent pairings (100 - percent correct same trials). Table 2 shows how the Hit rates and False Alarm rates were paired when converting to d-prime scores in evaluating the listener's sensitivity to accents. Higher d-prime shows better accent discrimination and sensitivity. The present study measures positive d-prime scores greater than 0, indicating perceptual sensitivity to differences between foreign accents.

Table 2

Trial pairings for the calculation of d-prime scores. False Alarm rates were averaged across the two same-accent pairing types that were present in the corresponding different accent trials.

HIT Trials (Different-Accent Pairs)	False Alarm Trials (Same-Accent Pairs)
French-Korean	French-French, Korean-Korean
French-Mandarin	French-French, Mandarin-Mandarin
French-Spanish	French-French, Spanish-Spanish

Korean-Mandarin	Korean-Korean, Mandarin-Mandarin
Korean-Spanish	Korean-Korean, Spanish-Spanish
Mandarin-Spanish	Mandarin-Mandarin, Spanish-Spanish

Results

To examine perceptual sensitivity to accented speech, the d-prime scores were analyzed in two three-way mixed effects analyses of variance. The first ANOVA included speaker gender (female vs. male) as a between-subjects factor and materials (words vs. sentences) and accent pairing (levels in Table 1 left column) as within-subjects factors. This analysis most closely resembles the structure of the study by Atagi and Bent (2017), but includes speaker gender. A second ANOVA coded the accent pairing factor according to accent family (European, Asian, and Mixed), which was not possible in the study by Atagi and Bent. Fisher's Least Significant Difference (FLSD) values were calculated to facilitate post-hoc comparisons between conditions.

Different Accent Pairing Analysis

The main effect of materials (sentences vs. words) was significant. Replicating Atagi and Bent (2017), d-prime measures were higher in the sentence condition (M = 0.40, SD = 0.32) than word condition (M = 0.25, SD = 0.26), F(1, 79) = 10.99, p = 0.001, η^2 = 0.06. Fisher's Least Significant Difference (0.15) indicated d-prime values greater than zero for both conditions. As discussed below, this effect does not persist across all levels of accent comparisons.

As part of an extension of Atagi and Bent (2017), the current study included both male and female talkers. However, the main effect of speaker gender did not yield any significant difference, with female speaker d-primes (M = 0.33, SD = 0.22) equal to male speaker d-primes (M = 0.32, SD = 0.21), F(1, 78) = 0.30, p = 0.86, $\eta^2 < 0.0001$.

There were six levels of different accent pairings—French-Korean, French-Mandarin, French-Spanish, Korean-Mandarin, Korean-Spanish, and Mandarin-Spanish (see "different" responses in the hits and false alarm rates as indicated in Table 2). The means and standard deviations of respective pairs are French-Korean ($M = 0.20$, $SD = 0.31$), French-Mandarin ($M = 0.39$, $SD = 0.45$), French-Spanish ($M = 0.35$, $SD = 0.51$), Korean-Mandarin ($M = 0.20$, $SD = 0.34$), Korean-Spanish ($M = 0.35$, $SD = 0.39$) and Mandarin-Spanish ($M = 0.48$, $SD = 0.43$), $F(5, 395) = 6.72$, $p < 0.0001$, $\eta^2 = 0.06$. Fisher's Least Significant Difference in these accent pairings were 0.28, indicating that the two lowest-scoring conditions (French-Korean and Korean-Mandarin) differed from the highest-scoring condition (Mandarin-Spanish).

Performance in the Korean-Mandarin accent pairing (M = 0.20) concurred with Atagi and Bent (2017) study that these two accents were less likely to sound different among listeners. Fisher's Least Significant Difference was not greater than 0. The other accent pairings have presented findings not possible in Atagi and Bent (2017) study.

In general, Atagi and Bent (2017) observed overall d-prime measures greater than the current study. The German-Korean and German-Mandarin accented pairs in Atagi and Bent (2017) were statistically significant, and sentence condition had better performance than word condition. The d-prime scores of both accent pairs were above value of 1, whereas performance in the current study is below 1.

There was no statistically significant difference in a two-way interaction between materials and different accent pairing, $F(5, 390) = 1.19$, $p = 0.31$, $\eta^2 = 0.005$, unlike findings from Atagi and Bent (2017). As shown in Figure 2, the effect of materials was consistent across different accent pairs, with sentence condition higher than word

condition, except for French-Korean pairing. In particular, the accent pair of Korean-Mandarin did not observe similar finding to Atagi and Bent (2017), where word condition was better than sentence condition. This could be due to the inclusion of the additional male talkers in the present study.

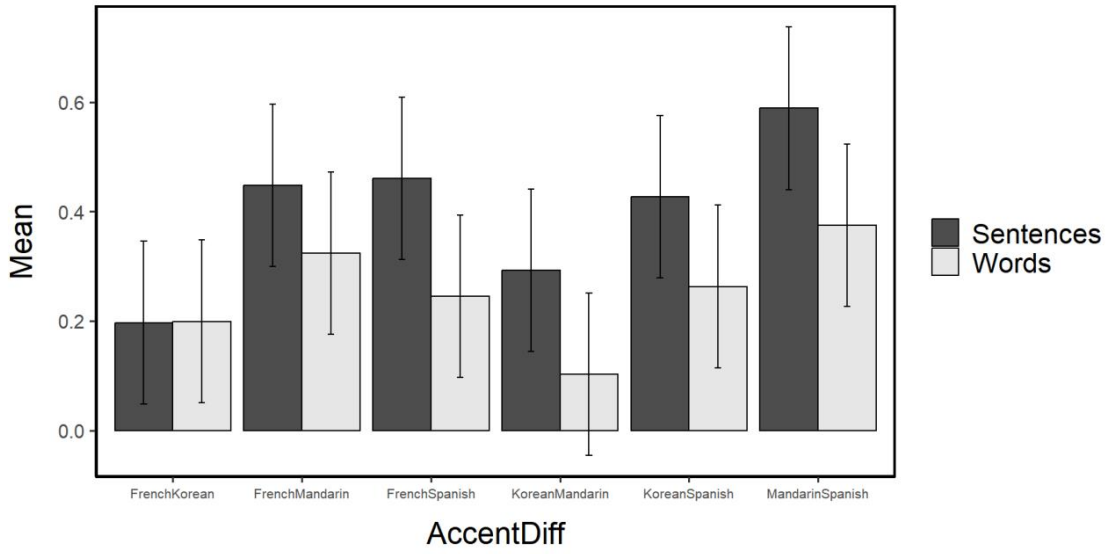

Figure 2: The mean of d-prime scores in perceptual sensitivity in different accent pairs. The x-axis shows six different types of accent pairings and y-axis shows the overall mean d-prime measures. The bars indicate materials (sentences vs. words). The error bars represent 95% confidence intervals using Fisher's Least Significant Difference.

Surprisingly, there was a statistically significant interaction between accent pairing and gender, shown in Figure 3, $F(5, 390) = 29.46$, $p < 0.0001$, $\eta^2 = 0.11$. In the female speaker condition, French-Spanish ($M = 0.63$, $SD = 0.47$) accent pairing yielded the highest performance. Meanwhile, Korean-Mandarin ($M = 0.03$, $SD = 0.27$) accent pairing in female speakers was not distinguishable to native listeners. As for the male speaker condition, the highest performance pairing was French-Mandarin ($M = 0.60$, $SD = 0.43$) and the lowest pairing was French-Spanish ($M = 0.07$, $SD = 0.34$). The

study reveals that accentedness is highly variable across speakers, thus, needs to be investigated further. The three-way interaction between materials, accent pairings and speaker gender did not show a statistical difference, $F(5, 390) = 1.07$, $p = 0.37$, $\eta^2 = 0.005$. Some of the findings were aligned with those reported in Atagi and Bent (2017), nonetheless, the inclusion of male speakers and two additional accent comparisons complicates the findings.

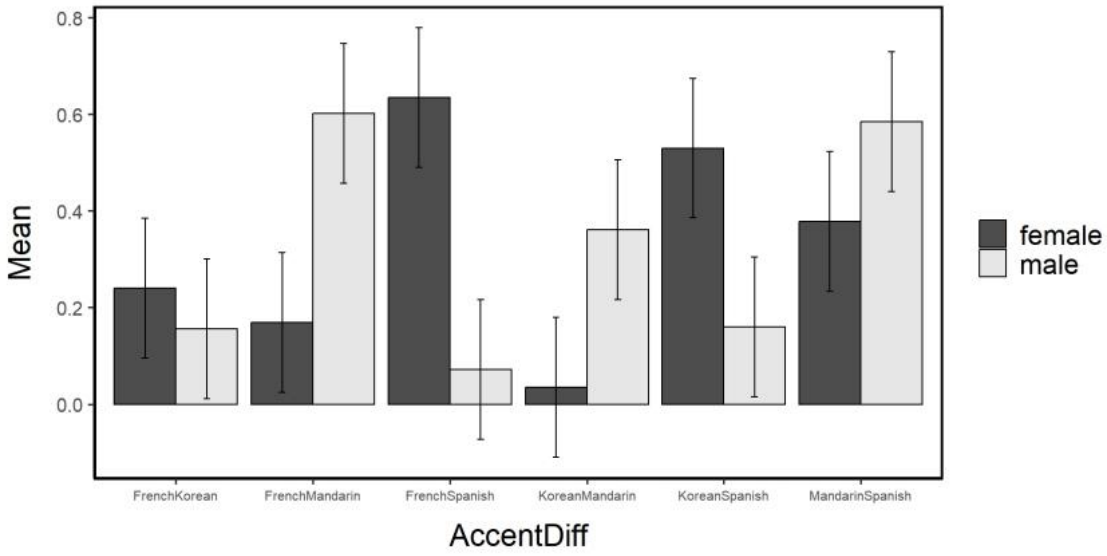

Figure 3: The mean of d-prime scores in perceptual sensitivity in gender. The x-axis shows six different types of accent pairings and y-axis shows overall mean d-prime scores. The bars indicate speaker gender (female vs. male). The error bars represent 95% confidence intervals using Fisher's Least Significant Difference.

Analyses of Accent Family

The Atagi and Bent (2017) study only included German, Korean, and Mandarin accents. There was no further analysis of language families and only limited to a mixed (German-Korean and German-Mandarin) and Asian (Korean-Mandarin) language family. In order to evaluate the effect of different language families, two European languages

(French and Spanish instead of German) have been added. This new set of analyses showed a significant difference between these three classifications. The performance of European (M = 0.35, SD = 0.51) and Mixed (M = 0.35, SD = 0.23) language conditions were higher for native listeners than the Asian language condition (M = 0.20, SD = 0.34), $F(2, 158) = 4.89$, $p = 0.009$, $\eta^2 = 0.04$. However, Fisher's Least Significant Difference of 0.16 indicated that the lower performance in the Asian condition compared to the European and Mixed conditions were not significant (but close).

There was no two-way interaction between materials and accent family, $F(2, 156) = 0.47$, $p = 0.62$, $\eta^2 = 0.001$. Figure 4 shows that performance on sentences was greater than words in both the Asian and European accent families, with a trend in the Mixed families condition.

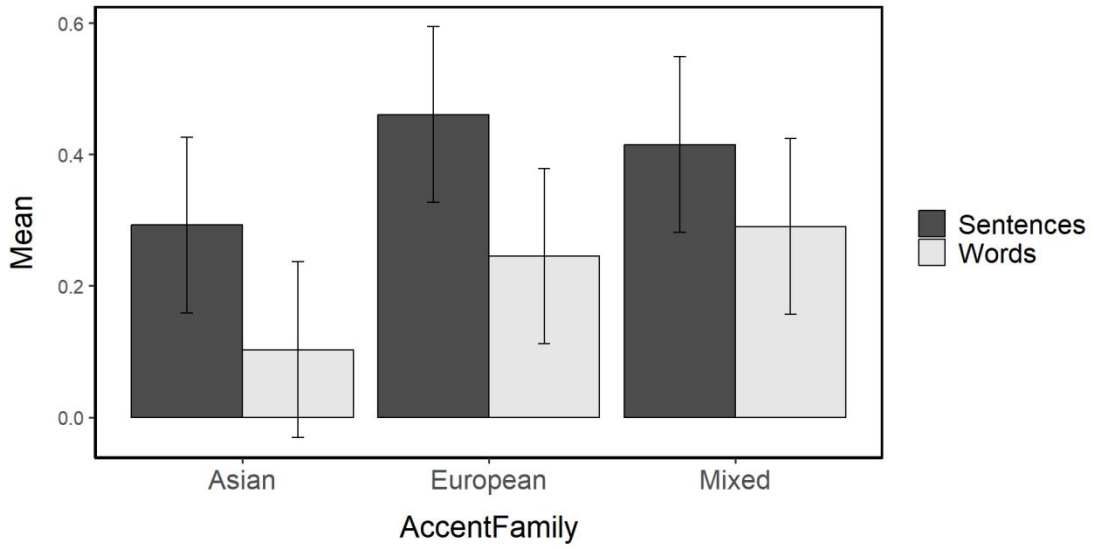

Figure 4: The mean of d-prime scores in perceptual sensitivity in accent family. The x-axis shows three accent families and y-axis shows the overall mean d-prime scores. The bars indicate materials (sentences vs. words). The error bars represent 95% confidence intervals using Fisher's Least Significant Difference.

Finally, the interaction between gender and accent family was significant, $F(2, 156) = 51.66$, $p < 0.0001$, $\eta^2 = 0.14$, shown in Figure 5. The European accent family observed better performance in female while the Asian in male speakers. The performance of mixed accent family was similar in both female and male speakers. Despite this apparent effect, the effect of gender cannot be further interpreted since there are not enough talkers to generalize. The three-way interaction between materials, accent family and gender speaker did not show a statistical difference, $F(2, 156) = 0.32$, $p = 0.72$, $\eta^2 = 0.001$, which was similar to the earlier finding.

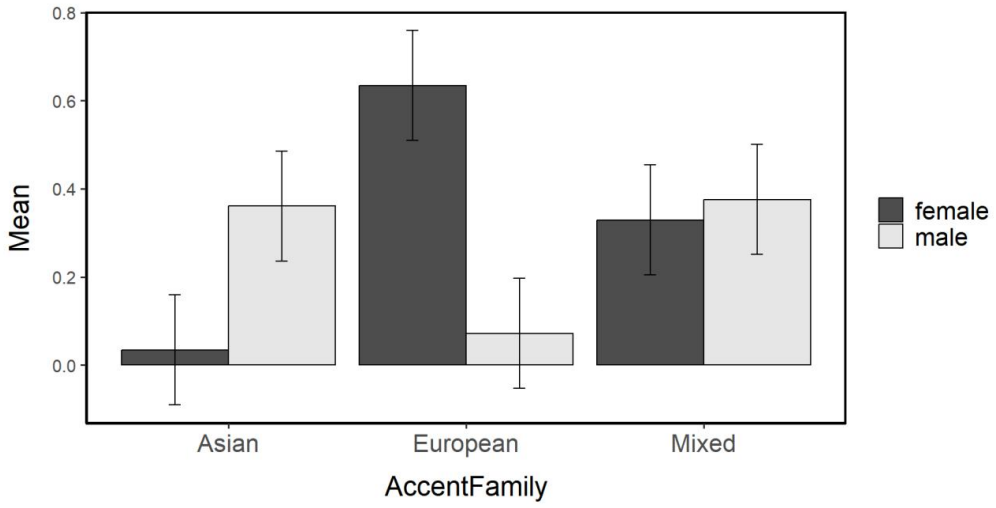

Figure 5: The mean of d-prime scores in perceptual sensitivity in accent families. The x-axis shows three accent families and y-axis shows mean d-prime scores. The bars are represented in gender (female vs. male). The error bars represent 95% confidence intervals using Fisher's Least Significant Difference.

Discussion

Non-native accents on stimulus length

The current study examined listeners' sensitivity to foreign-accented speech in accents of French, Spanish, Korean and Mandarin, manipulating utterance length

(sentences versus words). Listeners performed better when sentence stimulus was presented in different accent pairings and based on accent family. There is a possibility of higher processing required to comprehend these speech signals, thus, sentence structure provides additional information, unlike short stimuli like words. The result was consistent with previous findings of Atagi and Bent (2017) between the non-native accents, German, Korean and Mandarin. As part of an extension from the past study, the addition of French and Spanish accents in the current study was able to advance into the depth of accent classification on different language families that Atagi and Bent did not examine. The inclusion of these two accents also resulted in similar findings, which supported the hypothesis.

Non-native accents on accent pairings and accent family

The different pairing of accents generated a mixed outcome to perceptual sensitivity. The accent pairs of Mandarin-Spanish reported the most significant difference compared to the other accent pairs. One possible reason would relate to the perceived foreign accent strengths of speakers listed in Table 1. On average, Spanish speakers are more accented, while Mandarin speakers exhibit less accented speech. As a result, perceptual sensitivity involving these two accents resulted in higher discrepancy where listeners were able to differentiate these two apart easily than other pairs of accents. However, other different pairings, such as French-Korean accents, reported the least significant performance, despite a big difference in accent degree. These contrasting outcomes suggest that different accents presented may lead to greater difficulty in distinguishing them apart. Nevertheless, this gave the study a different perspective on the

type of accents which may influence listeners' perceptions and was an additional factor that was not explored in the past study.

Despite the reported significant difference in materials condition, the further breakdown in accent pairings and accent family observed performance was not significant. Most accent pairs observed an average performance where the difference between sentence and word conditions could barely lead to a difference. This is because listeners can approximately use the condition of the different materials to assess the different accents. One accent pairing, French-Korean reported relatively poor performance compared to the rest of the accent pairing. The finding may be relevant to the listener's limited experience with French and Mandarin accents.

Accent family was another factor incorporated to determine accent sensitivity when grouped as European, Asian or mixed conditions. Overall, the Asian accented family (Korean-Mandarin) reported a lower performance than the European accent family (French-Spanish). Despite both ratings of accents in Asian language families being average, listeners may be experiencing difficulty distinguishing speech signals due to their perceptual similarity. Therefore, the present study concurred with Atagi and Bent (2017) that the Korean-Mandarin pair was the hardest in perceptual sensitivity.

Similarly, there might be limited experience in recognizing Asian languages as the current population were mostly related to European-based accents. It is expected to observe better accent sensitivity among listeners in an accent that is familiar such as in European than Asian languages. There is also a larger European-speaking community in the subject pool, mainly Spanish, thus, making listeners more sensitive towards the change of accents relevant to European-accented speech.

Atagi and Bent (2017) study examined an unusual finding in which the Asian group word condition performance was better than sentences. However, this effect was not observed in the current study. One possibility to account for that could be additional male speakers in the study. Male speakers of Korean and Mandarin are more accented than female speakers of Korean and Mandarin. Hence, the effect must have been compensated through the accent strengths, thus, did not yield a different performance in words and sentences.

The inclusion of male speakers presented several variations to the findings. Although there was the presence of some interactions with speaker gender that merit further study, the current study does not incorporate enough speakers to permit the interpretation. As a result, these findings may not be reliable and remain inconclusive.

Limitations

Overall, the present study has given insight into findings that were not studied by Atagi and Bent (2017) and outlined several limitations. There was a limited sample size of speakers, with only two female and male from respective non-native accents. The insufficient number of speakers could not conclude that the gender effect was present. Therefore, future studies should include additional speakers to observe the gender effect. Also, these participants gravitated towards one accent family, which is European, given a high number of Spanish-speaking subject pool. As such, the perceptual sensitivity for another accent group may not become as familiar and will likely be treated as similar. Future studies should look into creating a larger sample size, incorporating a number of other spoken language experiences that could benefit by adding more significant effects and interactions to the variables.

The perception of accented speech also relies on the strength of accents. Different accent strengths (mild, moderate or strong) suggest affecting the listener's sensitivity to foreign accents. In particular, different accent pairings would propose findings like stronger accented speech are more distinguishable than mildly accented speech. For example, if Asian accented speech is regarded as unfamiliar, a higher or lower accented speech can create more variation, thus allowing listeners to contradict these accents easily. Another limitation was the inconsistent degree of accentedness on certain non-native accents. Although this was part of the limitation from the Hoosier database of Atagi and Bent (2013), nevertheless, given a similar degree of accentedness would provide more concrete variations across different accent pairing conditions. Therefore, a recommendation for future studies is to incorporate foreign accents of a greater range of accentedness while maintaining matched ratings of accents.

Also, the inclusion of gender as between-factor subjects. As participants engaged in one speaker gender condition, this limits how listeners assess both speaker gender.

Conclusion

Foreign accented speech in accent discrimination has examined listeners' sensitivity to different French, Spanish, Korean and Mandarin accents on different stimulus lengths. Although the stimulus length had an effect on the listener's ability where sentences condition were better, yet the performance was minimal. Nevertheless, there was a consistent performance across all accents. One factor that did not replicate the past study was the effect of Asian accents on stimulus length. The overall perceptual discrimination showed listeners were better at discriminating European accents than Asian accents since there is more familiarity to them. Both accent pairings and accent

family examined a significant effect on gender speakers with accents that certain accent pairings are significantly better than others.

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Appendix

Appendix A

List of monosyllabic words

bad	call	did	fork	hat	neck	put	sing	thank
bag	camp	dish	freeze	head	need	quick	sink	that
ball	cap	dog	fresh	his	nest	rag	sit	them
bath	car	door	friend	hit	next	rat	six	thick
bead	cart	dress	frog	horse	nuts	rich	sled	thumb
bed	cat	drop	fun	hot	pants	room	slip	tongue
beef	catch	duck	girl	hurt	park	run	song	truck
bet	choose	falls	give	juice	pass	sack	splash	turn
bird	class	farm	good	jump	path	scab	spoon	want
black	clock	fat	got	kick	peg	school	stand	watch
bless	cook	fed	grab	leave	pig	seat	stop	weed
book	cost	feed	green	lip	pinch	seed	such	wet
box	crab	few	gum	lost	pink	sell	suit	witch
bud	cup	fish	gun	man	please	set	sun	work
bug	cut	fit	had	meat	pond	sheep	swim	wreck
bus	dad	flag	ham	milk	press	ship	teach	wrong
bush	dance	food	hand	more	purse	shirt	teeth	yes
cab	darn	foot	hard	moth	push	shop	ten	

List of sentences

A ball broke the window	He broke his leg again
A boy fell from the window	He closed his eyes and jumped
A boy ran down the path	He found his brother hiding
A broom was by the front door	He got mud on his shoes
A child drank some fresh milk	He is washing his car
A child ripped open the bag	He needs his vacation
A dog was eating some meat	He wore his yellow shirt
A driver waited for me	Her shoes were very dirty
A field mouse found the cheese	Her sister stayed for lunch
A fire truck is coming	He's skating with his friend
A girl came into the room	He's washing his face with soap
A girl played with the baby	It's getting cold in here
A lady went to the store	Men normally wear long pants
A tree fell on the house	Mother picked some flowers
An apple pie was baking	Mother read the instructions
An old man was worried	Mother shut the window
Big dogs can be dangerous	School got out early today

Children like strawberries	She bumped her head on the door
Dad stopped to pick some pears	She found her purse in the trash
Father forgot the bread	She looked in her mirror
Father paid at the gate	She lost her credit card
Flowers grow in the garden	She made her bed and left
She took off her fur coat	The little girl was happy
She writes to her friend daily	The machine is noisy
She's calling her daughter	The mailman shut the gate
She's drinking from her own cup	The man called the police
She's helping her friend move	The matches are on the shelf
She's paying for her bread	The milk is by the front door
She's washing her new silk dress	The mouse ran into a hole
Strawberry jam is sweet	The neighbor's boy has black hair
Sugar is very sweet	The new road was on the map
The apple pie was good	The old gloves are dirty
The baby broke his cup	The old woman was at home
The baby has blue eyes	The oven door is open
The baby slept all night	The oven was too hot
The big boy kicked the ball	The paint dripped on the ground
The boy got into trouble	The park is near a road
The book tells a story	The picture came from the book
The bottle is on the shelf	The police cleared the road
The boy did a handstand	The policeman knows the way
The boy forgot his book	The pond water is dirty
The boy ran away from school	The puppy played with the ball
The bus leaves before the train	The rain came pouring down
The bus stopped suddenly	The rancher has a bull
The candy shop was empty	The road goes up the hill
The cat drank from a saucer	The sharp knife was dangerous
The children helped their teacher	The shirts are in the closet
The clown had a funny face	The shop closes for lunch
The cow was milked every day	The sky was very blue
The dinner plate was hot	The sun melted the snow
The dishcloth is soaking wet	The table has three legs
The dog came home at last	The team is playing well
The dog sleeps in the basket	The three girls were listening
The driver started the car	The train is moving fast
The engine was running	The truck carries fresh fruit
The fire is very hot	The tub faucet was leaking
The floor looks clean and shiny	The two children were laughing
The front yard is pretty	The two farmers are talking
The fruit was on the ground	The woman cleaned her house
The girl is washing her hair	The yellow pears taste good
The girl was fixing her dress	The young people were dancing
The grocer sells butter	There was a bad train wreck

The ground was very hard	They are coming for dinner
The house has a nice garden	They are drinking coffee
The house has nine bedrooms	They ate a lemon pie
The ice cream is melting	They finished dinner on time
The jelly jar is full	They had a wonderful day
The kitchen clock was wrong	They had some chocolate pudding
The kitchen window is clean	They have two empty bottles
The lady packed her bag	They heard a funny noise
The lady wore a coat	They laughed at his story
The leaves turned brown and dry	They painted the wall white
The little boy left home	They rode their bicycles
The little girl is shouting	They took some food outside
They walked across the grass	They watched a scary movie
They went on vacation	They're pushing an old car
They're clearing the table	They're running past the house
They're climbing an old oak tree	They're shopping for school clothes
They're going out tonight	They're watching the train go by
They're playing in a park	Yesterday he lost his hat