

Identifying Challenges for Listeners of Belfast English: a Qualitative Investigation into Transcription Errors

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Abstract

A prior experimental study revealed that the Belfast accent was significantly more difficult to understand than the Dublin accent, even among listeners with similarly limited exposure to both varieties. The aim of the current study is to investigate the phonetic causes of the Belfast accent's lowered intelligibility for listeners from the United States, Belgium, and the Republic of Ireland. The words that were incorrectly transcribed by at least 50% of listeners were selected and the erroneous transcriptions were assessed for likely causes of confusion. Acoustic analyses were conducted to investigate whether listeners' misperceptions could be explained by the productions made by speakers of Belfast English. Findings indicate that many of the issues that listeners encountered when hearing the Belfast accent were the result of vowel productions, such as those of the MOUTH, GOOSE, SQUARE, and FACE vowels. This runs contrary to previous intelligibility research, which indicated that consonantal and suprasegmental deviations are the most detrimental to intelligibility.

Keywords: phonetics, intelligibility, English as a Foreign Language (EFL), Belfast English, language variation

1. Introduction

Since the turn of the century, the island of Ireland has experienced an unprecedented influx of immigration (Central Statistics Office, 2024; Russell, 2025). As migrants often have limited exposure to Irish English prior to arrival, spoken interaction can be challenging for them—even if they have high or native-level proficiency in English (Migge, 2012). The extent to which these listeners can understand the intended message of their interlocutors is known as *intelligibility* (Munro & Derwing, 1995), a concept which underscores the role of listening in successful communication. Ostiguy et al. (forthcoming) revealed that the Belfast accent is less

intelligible than the Dublin accent for listeners with reduced exposure to both varieties, but the root cause of this difference has yet to be explored. The current study considers which phonetic features of Belfast English reduce its intelligibility for listeners who have not yet received immersion-level exposure to this variety (henceforth, ‘unfamiliar listeners’).

2. Literature Review

2.1. Established Causes of Reduced Intelligibility

Early research on English as a Foreign Language (EFL) placed a clear emphasis on consonantal accuracy. Jenkins’ (2000) *Lingua Franca Core*, which outlines the English pronunciation features that are most crucial for EFL students, focuses more heavily on consonants than vowels. Catford (1987, p. 92) argues that “a reasonably correct pronunciation of consonants is probably more important for intelligible and acceptable English than a correct pronunciation of vowels”.

Empirical research supports these claims, demonstrating that *consonantal* and *suprasegmental* features most affect the intelligibility of accents of English. Although vowels with a high functional load (Kang et al., 2018) and tense-lax vowel differences (Magen, 1998) contributed toward intelligibility, consonantal features were much more dominant in these analyses. Among the features that most reduced the intelligibility of Korean-accented English were the epenthesis of consonant clusters and the nasalization of final stops (Barrass et al., 2020). Kang et al. (2018) explored a variety of accents of English and found that divergences in consonants, syllable reduction, and lexical stress all contributed toward reduced listening comprehension. Whether this selection of features applies to all accents of English remains unclear, as these studies primarily consider non-native accents rather than natively spoken ones.

2.2. Irish English Context

It is particularly interesting to study intelligibility within the context of Irish Englishes, which vary considerably from north to south and from urban to rural settings. Due to the heterogenous nature of Irish Englishes, unacquainted listeners find some varieties to be more intelligible than others. Northern Irish English accents, for example, were identified by immigrants to Ireland as particularly difficult to understand (Migge, 2012). One interviewee from Poland claimed that even their Irish colleagues found it difficult to understand accents from Northern Ireland.

This prevailing perception of difficulty surrounding Northern Irish English accents may partially explain the linguistic self-consciousness reported by speakers in the North. Corrigan (2010), for example, identifies the MOUTH diphthong to be so distinctive in Northern Irish English accents that one informant reported avoiding it altogether: “I never refer to the bird that, em, hoots... I try not to say, em, ‘this moment in time’, as a word” (Corrigan, 2010, p. 38). While these examples are anecdotal, they provide compelling evidence that Northern Irish English accents may pose a unique challenge to listeners.

Not only are Northern Irish English accents interesting due to their intelligibility, but they also exist within an increasingly international context (Central Statistics Office, 2024; Russell, 2025). As a result, the sociolinguistic experience of migrants in Ireland has gained particular interest in recent years (e.g., Kopečková, 2013; Diskin-Holdaway, 2024). Thus far, this research has primarily focused on the acquisition of syntactic or pragmatic markers, with little attention toward how Irish English *pronunciation* is perceived and acquired by unfamiliar listeners.

2.3. Northern Irish English Pronunciation

Given that the current study focuses on spoken Belfast English, it is worth describing a selection of this accent's features. Belfast English is an urban variety of Mid-Ulster English (MUE), one of the three major dialects within Northern Ireland (Maguire, 2020). The descriptions below are based on previous observations of spoken data collected within Belfast or otherwise within the MUE region, as formal acoustic analyses are still unavailable for this variety.

One key aspect of MUE is the centralization of key vowel sounds. For example, KIT is often pronounced with a central rounded [ɛ̞] and STRUT is variable but often pronounced with a rounded [ɔ̞] (Maguire, 2024, p. 213; Milroy, 1981, p. 69). Additionally, the GOOSE and FOOT vowels are both pronounced as a centralized, unrounded [ʊ] sound (Corrigan, 2010, p. 35; Milroy, 1981, p. 55), leading to a 'merger' wherein words like 'pull' and 'pool' sound identical.

The final component of the MOUTH diphthong is also raised and fronted to a central [ʊ] (Corrigan, 2010, p. 37; Hickey, 2024, p. 226; Maguire, 2020, p. 110), but can be pronounced as far forward as [i] (Hughes et al., 2005, p. 112) or [ɪ] in Belfast English (Corrigan, 2010, p. 37). Although it may not be a full merger, Amador-Moreno (2010) acknowledges that MOUTH words may “sound more like PRICE than like MOUTH” in Belfast English (p. 83).

Indeed, there are a few other potential 'mergers' in Belfast English. The SQUARE-NURSE merger (to [ɔ̞r] or [əː]) originated as a feature of Belfast English but has spread to Derry and other parts of the MUE region (Corrigan, 2010, p. 39; Maguire, 2020, p. 129). Additionally, DRESS may be lowered to [a] or [æ], leading to a merger between DRESS and TRAP (Corrigan, 2010, p. 36; Maguire, 2020, p. 106). In some cases, the FACE vowel may *also* create a merger with DRESS (Amador-Moreno, 2010, p. 85; Corrigan, 2010, p. 34), but this vowel is incredibly variable. Younger Protestants in Belfast appear to be innovating toward [iə] (Corrigan, 2010,

p. 34; Hickey, 2024, p. 238), but it may also be pronounced as [ɛə], [eə], or [e:] (Corrigan, 2010, p. 34; Maguire, 2020, p. 111).

Several consonantal features impact this variety as well. While Southern Irish English features the plosivization of /θ-ð/ to [t̪-d̪] (Hickey, 2012, p. 99), Belfast English may instead *front* word-initial /θ-ð/ to [f-v], particularly in working-class varieties (Corrigan, 2010, p. 41). Meanwhile, /ð/ may be dropped intervocalically (Corrigan, 2010, p. 40) and /θ/ is occasionally replaced by [h] in initial or word-medial positions (Corrigan, 2010, p. 40; Maguire, 2020, p. 67). Additionally, as in Southern Irish English (Hickey, 2012, p. 99), schwa epenthesis may occur in coda liquid-sonorant clusters like /lm/ and /rm/ (Maguire, 2020, p. 7).

Aside from these segmental features, there is a complex set of vowel length rules that govern MUE varieties. These rules entail that, for example, PRICE is long before final voiced consonants but short elsewhere, while STRUT will be short in all contexts (Maguire, 2020, p. 115-116). Additionally, Belfast English speakers are unique in that they prefer a nuclear rise-plateau intonation pattern in declarative sentences (Corrigan, 2010, p. 47; Grabe et al., 2005). This constellation of unique features makes the Belfast English accent particularly interesting as the focus of an intelligibility study.

2.4. Intelligibility Comparison of Irish Englishes

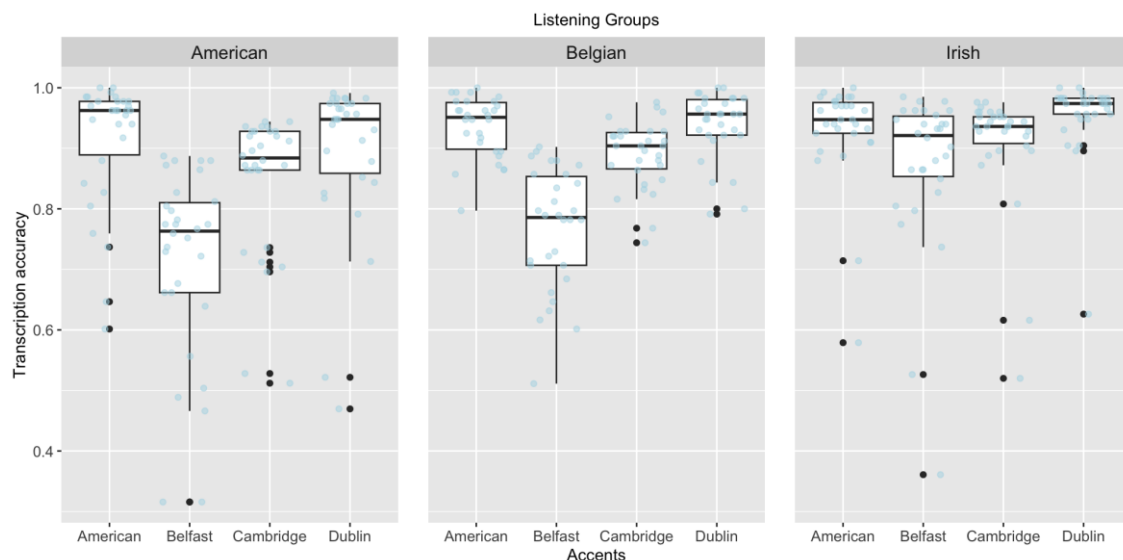
Despite anecdotal evidence that listeners struggle with some Irish English accents more than others, few quantitative studies have investigated how (and why) these varieties may differ in intelligibility. To consider this further, a study was conducted to determine the relative intelligibility of Irish Englishes with exposure as an additional explanatory variable (Ostiguy et al., forthcoming). Listeners from the U.S., Belgium, and the Republic of Ireland transcribed sentences from speakers of Belfast English, Dublin English, Standard Southern British English

(SSBE), and General American (GenAm) English. The American and Belgian listeners, who reported significantly less exposure to Irish Englishes than their Irish peers, were expected to find the Belfast and Dublin accents significantly less intelligible than the two varieties to which they had much greater reported exposure.

Results indicated that, despite reporting statistically similar levels of exposure to the two Irish Englishes, the American and Belgian listeners were significantly more accurate at transcribing sentences spoken in a Dublin accent than those in a Belfast accent (see Figure 1). One possible explanation for this phenomenon was that the *phonetic differences* between the two varieties played a role in their difference in intelligibility, with certain characteristics of Belfast English being particularly challenging for listeners.

FIGURE 1

Intelligibility of Irish Englishes to Different Listening Groups



The current study seeks to investigate the phonetic causes of reduced intelligibility in Belfast English by examining listeners' transcription errors. By comparing listeners' erroneous orthographic transcriptions with the intended message of the speaker, it is possible to deduce

the pronunciation features that listeners struggled with. Identifying these features will enable researchers to develop a better understanding of the relationship between phonetic features and intelligibility both in Belfast English and more generally.

3. Methodology

3.1. Prior Experiment

The data used in this study comes from a previous experiment conducted with three groups of listeners ($N = 30$ each) who differed in their current country of residence: the Republic of Ireland, the United States, or Belgium. The Belgian listeners spoke Belgian Dutch as their first language and a LexTALE test confirmed that they were all highly proficient in the English language (Lemhöfer & Broersma, 2012; www.lextale.com).

The stimuli used in this experiment came from four female speakers of four different varieties: Belfast English, Dublin English, SSBE, and GenAm. The recordings from Britain and Ireland were obtained from the Intonational Variation in English (IViE) corpus, which is available online for non-commercial use (Grabe et al., 2002). The speakers of GenAm were recruited from university staff and students at Vrije Universiteit Brussel. All speakers read aloud a version of the Cinderella story, which they then retold in their own words using a series of pictures. From the retell passages, five unique sentences from each speaker were selected for use in the intelligibility task, for a total of 80 sentences (5 sentences X 4 speakers X 4 accents). All sentence passages were rated by native speakers of each accent to be equally representative of their respective accent, and an analysis of speech rate determined that no clips were significant outliers.

In the main experiment, participants first rated their exposure to a variety of accents on a scale from 1-100. They then completed an orthographic transcription task where they were

presented with the speech samples in a randomized order and were instructed to type what they heard into a textbox. Intelligibility for this study was coded as a binary variable on a word-for-word basis, such that each word that a listener heard was aligned with a word from their transcription and was coded as either correct (1) or incorrect (0). In addition, incorrect responses were given an ‘error type’ that described the mistake made by the listener. These types of errors fall into two general categories: a) ‘omission’, where there was no attempt at a transcription, or b) ‘replacement’, where the participant provided an incorrect interpretation of the word.

3.2. Current Study

The current study focuses exclusively on the errors made by participants when listening to Belfast English, the variety which they understood the least (avg. intelligibility = 0.78). Over the course of the experiment, listeners heard 130 words uttered by Belfast speakers. Eleven of those words were selected with the criteria that at least 50% of all listeners did not correctly transcribe them. For most of these words, the error share from each listener group (e.g., 45% American, 35% Belgian, 20% Irish) approximated their share of total errors within the margin of error. Therefore, all listeners are pooled for further analysis.

For each word, the most common error type was determined: omission (i.e. the target word was not transcribed at all) or replacement (i.e. another word was transcribed instead of the target word). In the case of omission, it is difficult to determine the cause of listeners’ confusion as they did not provide an estimate of what they heard. If a word was mostly omitted rather than replaced and/or the incorrect transcriptions did not provide any consensus for the

cause of incomprehension, the word was not included in the current analysis. This was the case for two of the eleven words¹.

For the remaining nine words, a cause was determined through a thorough examination of the incorrect transcriptions provided by listeners. Incorrect transcriptions were grouped by shared phonetic features. Based on these features, it was possible to determine a likely cause of listeners' confusion. For example, if most incorrect transcriptions contained a replacement of the central vowel, the pronunciation of that vowel was determined to be the likely cause of lowered intelligibility for that word.

To verify these observational assumptions, measurements were conducted on the full corpus of retell task speech. GenAm was among the most intelligible accents for all three listening groups, so comparisons were made between the segmental productions of these speakers and those of the comparatively lower-intelligibility Belfast speakers.

The recordings from the four Belfast speakers and four GenAm speakers from the experiment were orthographically transcribed in Praat using breath group boundaries (Boersma & Weenink, 2025). These recordings and transcriptions were then submitted to DARLA, which creates a set of segment-level boundaries and measures all stressed vowels throughout the recording (Reddy & Stanford, 2015). To the author's knowledge, no such automation software is available for consonants, so consonants of interest were measured manually in Praat. All measurements were plotted using the ggplot2 package in R (R Core Team, 2024; Wickham, 2016). It was often possible to pinpoint a more specific cause of confusion for a given production by either a) comparing the pronunciation of two segments in the Belfast accent or

¹ These two words were 'well' and 'ran'. Half of the listeners omitted the word 'well', and those who incorrectly transcribed it often provided viable conjunctions indicating that they may not have heard the beginning of the sentence (e.g., 'when', 'and'). For 'ran', the incorrect transcriptions were too wide-ranging to determine a specific cause (e.g., 'man', 'random', '(a)round').

b) comparing the production of a certain segment or pair of segments in the Belfast versus in the GenAm accent.

Given that the IViE recordings utilized in the experiment come from younger speakers recorded between 1997 and 2000, it is possible that the current analyses are limited in scope to the variety of Belfast English that was spoken twenty-five years ago. An additional preliminary analysis was conducted using recordings made in 2025 of 18–27-year-old women living in Belfast to determine whether the current conclusions also apply to modern-day speakers of the same background. Similar results were obtained, so these analyses were not included.

4. Results

4.1. MOUTH vowel: ‘down’, ‘announcement’, & ‘town’

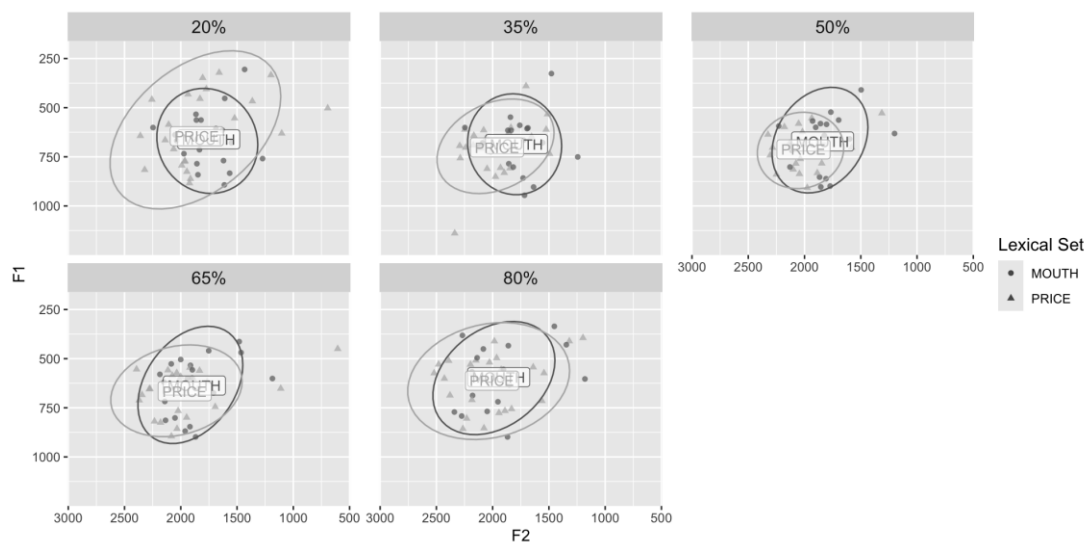
Of the least accurately transcribed words, three contained a MOUTH vowel: ‘down’ (22.2% accuracy), ‘announcement’ (50% accuracy), and ‘town’ (50% accuracy). Listeners often provided substitutions with the PRICE vowel. Most of the incorrect transcriptions (77.7%) provided for ‘announcement’ included the PRICE vowel, in words like ‘a (k)night’, ‘a (k)nightsman’, or ‘iron’. The word ‘town’ was most often inaccurately transcribed as ‘time’ (73.3% of incorrect transcriptions), which also contains a PRICE vowel. It is worth noting that both words come from the same sentence (‘There was an announcement in the town’). Finally, the word ‘down’ suffered from a parsing issue with the previous word ‘ran’ (‘... and ran down the stairs’), so that it became ‘random’ (20% of incorrect transcriptions), or was otherwise transcribed as ‘did’ or ‘didn’t’ (28% of incorrect transcriptions). At first, these transcriptions do not seem to fit the pattern, as the most common replacements contain a schwa or KIT vowel respectively. However, the transcriptions for all three MOUTH words follow the same pattern:

listeners heard a vowel that was much further forward than what would be anticipated from a MOUTH diphthong in GenAm.

The Belfast pronunciation of all MOUTH and PRICE vowels was compared throughout the progression of the diphthongs. In Figure 2, the Belfast English means of each vowel at each progression point (20, 35, 50, 65, and 80%) are labelled by the associated vowel, with the ellipses representing a 90% confidence interval. The means of MOUTH and PRICE are close or overlapping for the entirety of the vowel progression.

FIGURE 2

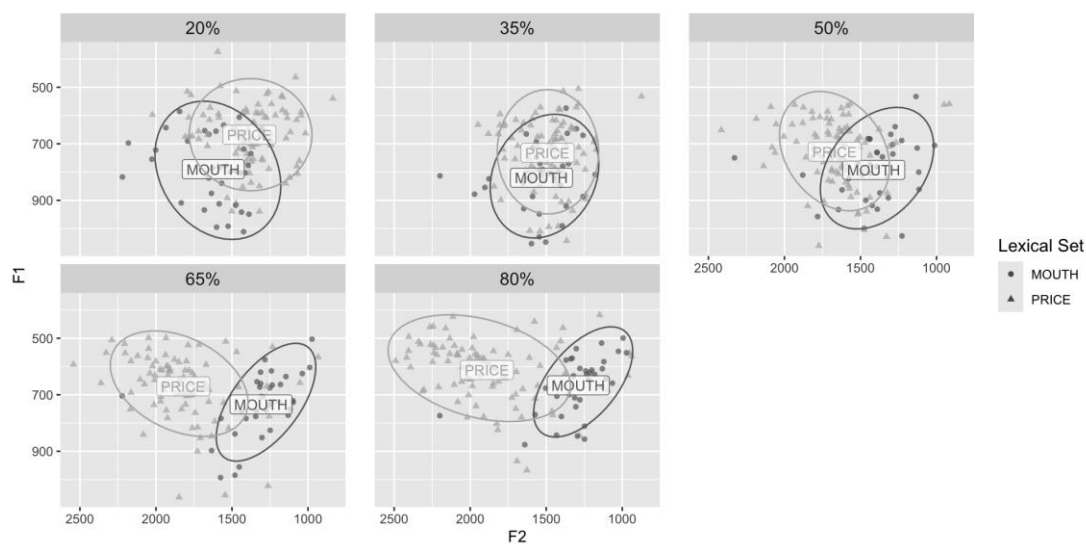
Movement of MOUTH and PRICE diphthongs in Belfast English



In GenAm, on the other hand, there is a much clearer distinction between these two vowels, especially toward the end of production (65% and 80%). Considering Figure 3, the PRICE vowel moves to a more front position than the MOUTH vowel (higher F2), though both vowels become more closed over the course of production (lower F1).

FIGURE 3

Movement of MOUTH and PRICE diphthongs in GenAm



While GenAm MOUTH becomes more closed and further back over the course of production, Belfast MOUTH instead moves further forward, following the trajectory of the PRICE vowel. This may explain why listeners tended to replace MOUTH vowels with PRICE ones in their transcriptions.

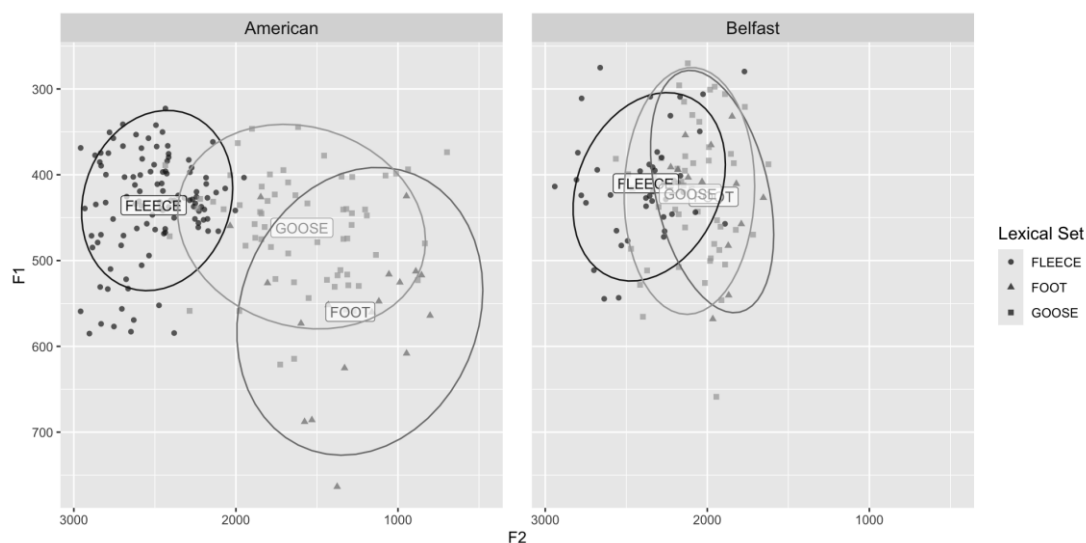
4.2. GOOSE vowel: ‘two’

For the word ‘two’ (48.9% accuracy), more of the mistaken listeners omitted this word (82.6%) than inaccurately transcribed it (17.4%). However, the inaccurate transcriptions that *are* present give clear clues as to the cause of the errors. Half of the incorrect transcriptions (50%; 4/8) contain a NEAR vowel and omit the /t/, as in ‘here’, ‘hear’, or ‘hearing’. The omission of the initial /t/ may be explained by the preceding segment, as it is a schwa (‘The two ugly sisters got...’). However, the mistaken vowel might indicate that the GOOSE vowel is being produced further forward than listeners typically expect.

The NEAR vowel is a combination of the FLEECE vowel colored by a coda /r/ sound. Due to an insufficient amount of NEAR vowel production data, it is pertinent to compare the production of Belfast GOOSE with the production of FLEECE. Figure 4 compares Belfast speakers' productions of GOOSE, FLEECE, and FOOT vowels to those of the GenAm speakers. Belfast GOOSE is close in position to both FLEECE and FOOT, with the mean sitting in the space between both vowels. This is likely contrary to listeners' expectations, as GOOSE is more closed than FOOT (lower F1) and much further back (lower F2) than FLEECE in accents like GenAm.

FIGURE 4

Midpoint formant values of FLEECE, GOOSE, and FOOT vowels in GenAm vs. Belfast English



4.3. DRESS vowel: ‘men’ and ‘ready’

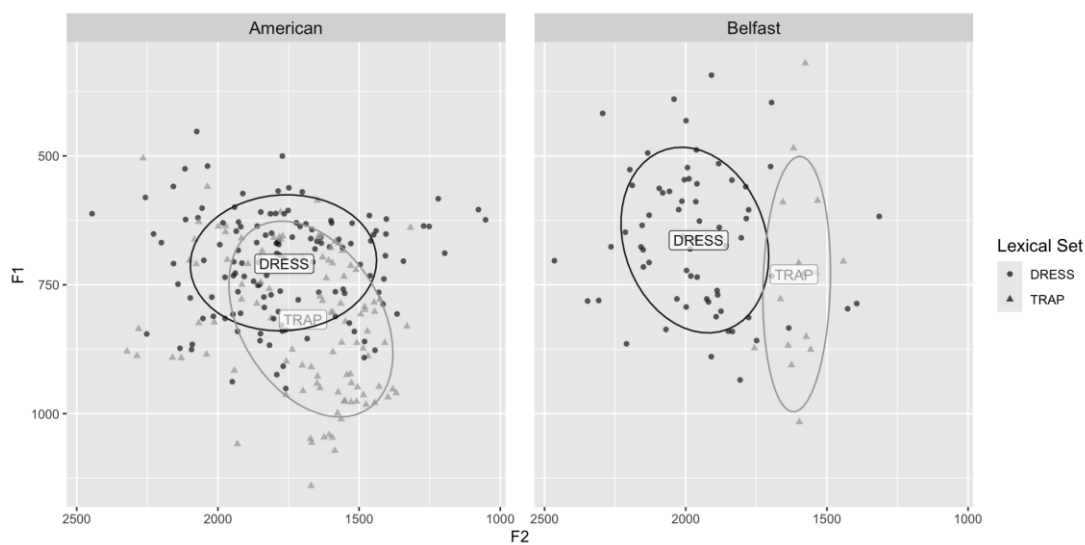
The DRESS vowel was incorrectly identified twice: in ‘men’ (28.9% accuracy) and in ‘ready’ (41.1% accuracy). Most participants (55%) incorrectly transcribed the word ‘men’ as ‘man’, indicating that listeners misinterpreted the DRESS vowel as a TRAP vowel (‘So his men searched...’). Meanwhile, the word ‘ready’ was incorrectly transcribed as containing the word

‘out’ (65% of incorrect transcriptions), which instead contains the MOUTH diphthong. This common mistranscription is interesting, as it cannot be entirely explained by the surrounding linguistic context (‘She had to help her sisters get ready’). Regardless, both interpretations of the DRESS vowel contain an open near-front vowel (/a/ or /æ/), indicating a more open vowel than GenAm’s /ɛ/.

Considering the TRAP interpretation first, it’s worth noting that the DRESS and TRAP vowels do *not* significantly overlap in Belfast English. Indeed, considering Figure 5, the GenAm speakers’ pronunciation of DRESS and TRAP (which listeners did not struggle with) contained much more overlap in production.

FIGURE 5

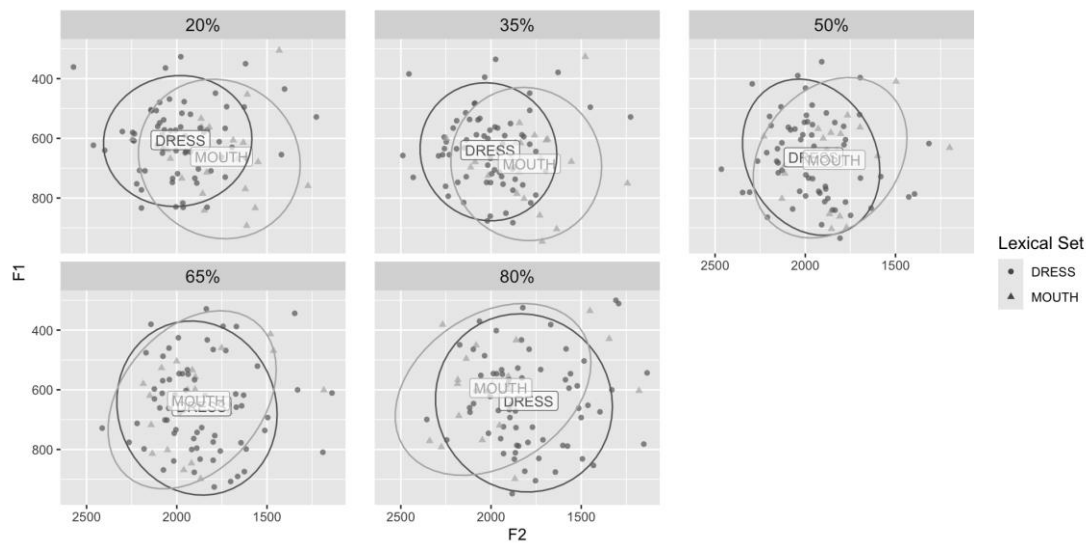
Midpoint formant values of DRESS and TRAP vowels in GenAm vs. Belfast English



The transcription of DRESS words as instead containing a MOUTH vowel, on the other hand, has much more acoustic evidence to back it up.

FIGURE 6

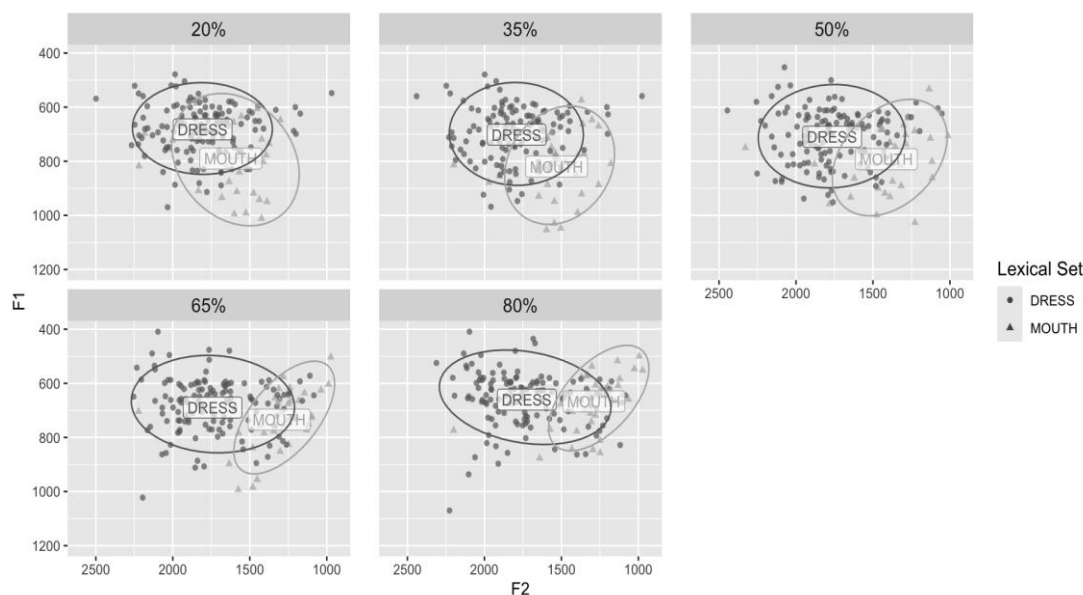
Movement of DRESS and MOUTH diphthongs in Belfast English



Considering Figure 6, the Belfast production of DRESS has a similar height (F1 value) to the MOUTH vowel. DRESS is slightly further fronted (higher F2) until the tail end of production (80%), when MOUTH moves forward and DRESS moves backward. This indicates that DRESS is pronounced as a *centering* diphthong in Belfast English, which may confuse listeners given their heightened exposure to GenAm. GenAm DRESS remains monophthongal and is distinct from the MOUTH vowel, as displayed in Figure 7.

FIGURE 7

Movement of DRESS and MOUTH diphthongs in GenAm



4.4. SQUARE vowel and final /z/: ‘stairs’

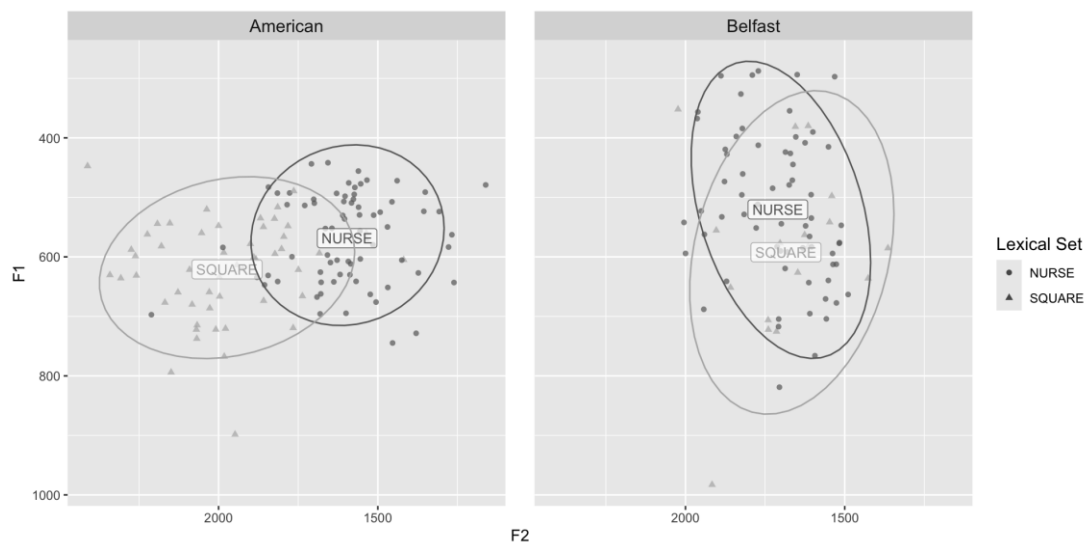
Over 75% of participants did not correctly transcribe the word ‘stairs’ (24.4% accuracy). 44.4% omitted the word entirely, while 31.2% replaced it with another word. Many of these incorrect transcriptions bear resemblance to one another. For example, many of them include post-alveolar fricatives /ʃ/ or /ʒ/ at the end (71.4% of incorrect transcriptions). This may mean that the plural –s sound, or final /z/, is somewhat further back in Belfast English. This instance occurs phrase-finally (‘... down the stairs’), so this may be context-dependent. 50% of the incorrect transcriptions replace the SQUARE vowel with the NURSE vowel, such as in the transcriptions ‘church’, ‘search(ed)’, and ‘surge’. This indicates that the pronunciation of the SQUARE vowel may be centralized such that it sounds like a NURSE vowel instead.

Vowel analysis reveals a considerable overlap between the NURSE and SQUARE vowels in Belfast English which is not present in the GenAm productions (see Figure 8). This

‘merger’ of the two vowels in the Belfast accent is one of two potential causes of lowered intelligibility for the word ‘stairs’.

FIGURE 8

Midpoint formant values of SQUARE and NURSE vowels in GenAm vs. Belfast English



The second possible explanation for listeners’ responses is rooted in the fact that most incorrect transcriptions for ‘stairs’ also contain a post-alveolar /ʃ/ or /ʒ/ in the place of the /z/ coda. The F1 and F2 of all instances of coda /z/ are presented in Figure 9. While there is some overlap between the GenAm and Belfast English productions, most of the Belfast productions have higher F1 and F2 values compared with the GenAm productions. This effect is even more prominent when the final /z/ segment is preceded by an /r/, as in Figure 10 where there is no overlap between the 90% confidence intervals. Similar results are found when the final /z/ is preceded by a vowel or when it occurs phrase-finally. This co-occurrence of two features within one word may also explain why the word ‘stairs’ was one of the most difficult words for listeners of Belfast English.

FIGURE 9

Mean formant values of final /z/ in GenAm vs. Belfast English

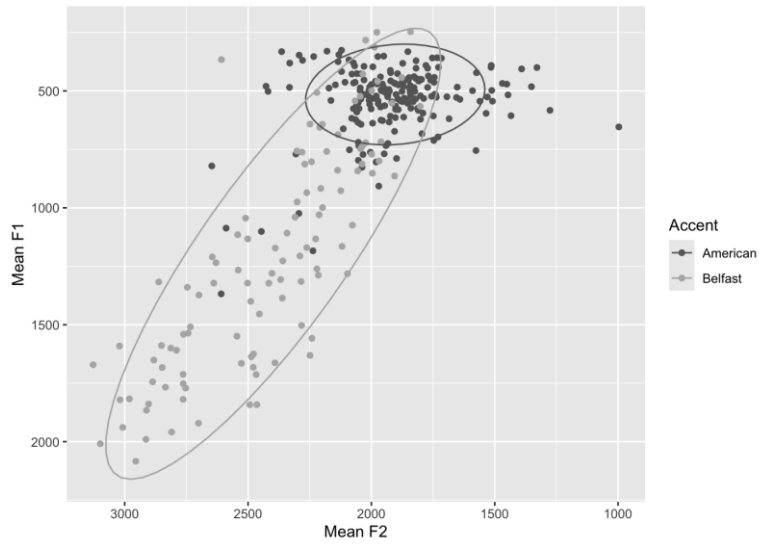
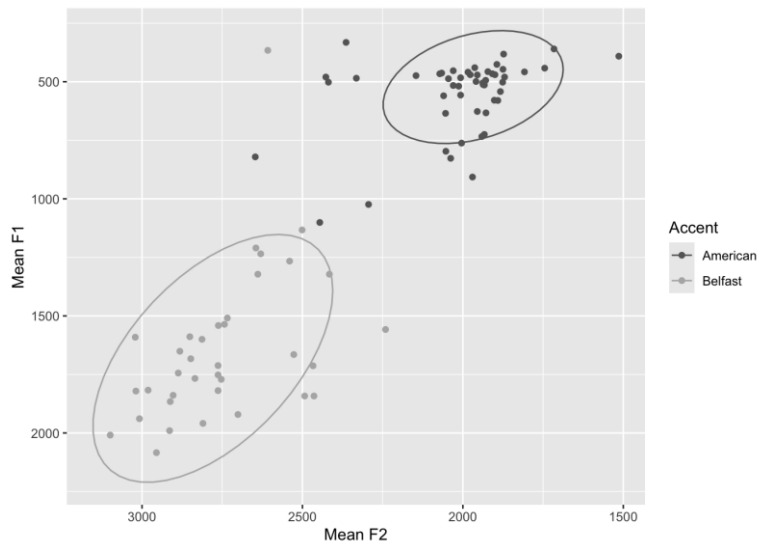


FIGURE 10

Mean formant values of final /z/ following /r/ in GenAm vs. Belfast English

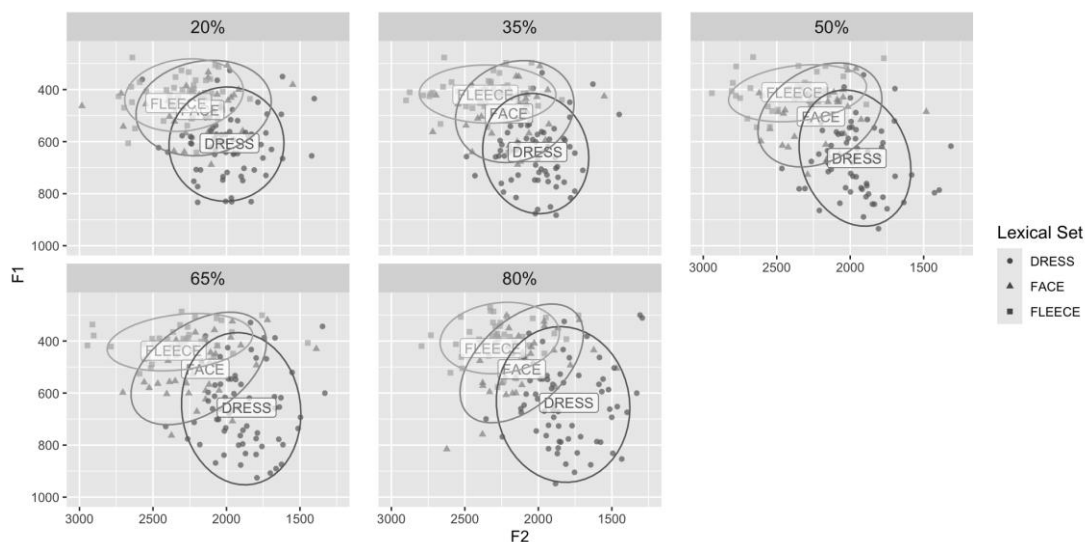


4.5. FACE vowel: ‘dainty’

67.7% of the participants who incorrectly transcribed ‘dainty’ (34.4% accuracy) omitted it entirely rather than attempting to describe what they heard (‘The slipper was so small and dainty’). However, the available transcriptions are surprisingly informative. The most common erroneous transcription was ‘empty’ (31.6% of incorrect transcriptions), but several listeners also transcribed nonce words that resembled what they heard: ‘denty’, ‘dicty’, ‘diente’, ‘dienty’, and ‘dintu’. These errors represent all three listening groups, indicating that this is not an issue with L2 proficiency or word familiarity. While the incorrect word ‘empty’ indicates that listeners heard the DRESS vowel instead of the FACE vowel, the nonce words ‘diente’ and ‘dienty’ seem to imply that listeners heard an unidentifiable diphthong. This may explain why so many listeners omitted the word from their transcriptions.

FIGURE 11

Movement of FLEECE, FACE, and DRESS vowels in Belfast English



The Belfast productions of FLEECE, FACE, and DRESS are shown in Figure 11. The FACE vowel appears to begin in a space close to the FLEECE vowel and then moves to a more central location

over time. This is the behavior of another *centering* diphthong, which might be produced similarly to /iə/.

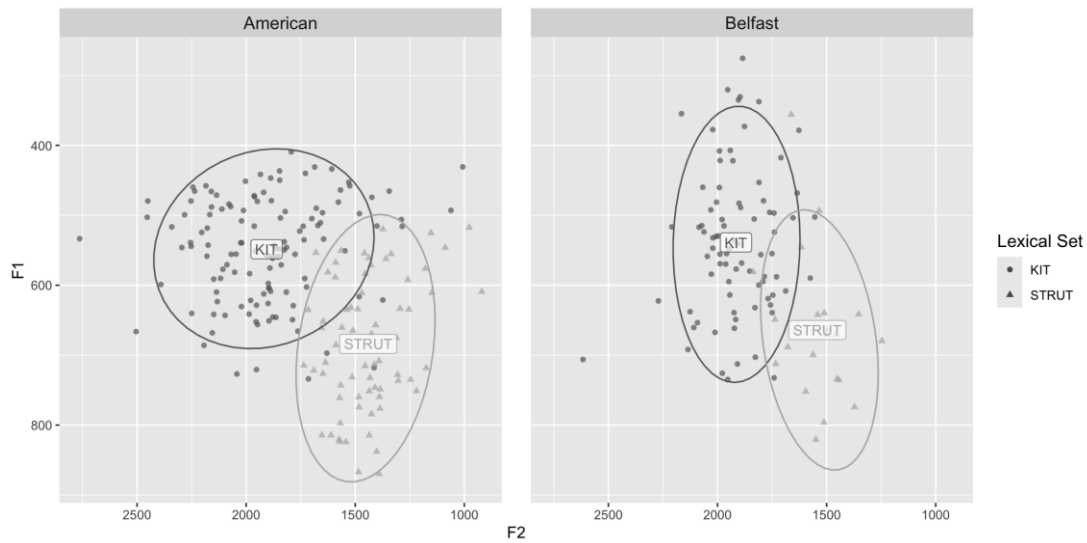
4.6. KIT vowel: ‘slipper’

Finally, the word ‘slipper’ (34.4% accuracy), procured an almost equal proportion of omissions (49.2% of errors) and incorrect replacements (50.8% of errors). The most common incorrect transcription was ‘supper’ (53.3% of incorrect transcriptions), indicating that the listeners mistook the KIT vowel for a STRUT one. This cannot be fully explained by the surrounding conversational context (‘The slipper was so small and dainty’). Given the omission of the preceding /l/ in the transcriptions, it’s possible that this consonant affected the production or perception of the KIT vowel. Considering the relative positioning of these vowels in GenAm, the KIT vowel in ‘slipper’ may have been further back and/or more open than listeners anticipated.

Interestingly, however, there is no evidence that the formant values of KIT and STRUT in Belfast English are close together or, indeed, that Belfast KIT somehow overlaps with the GenAm production of STRUT (see Figure 12). This remains true even in exclusively post-/l/ contexts. Therefore, there must be something beyond spectral cues that incites confusion for listeners.

FIGURE 12

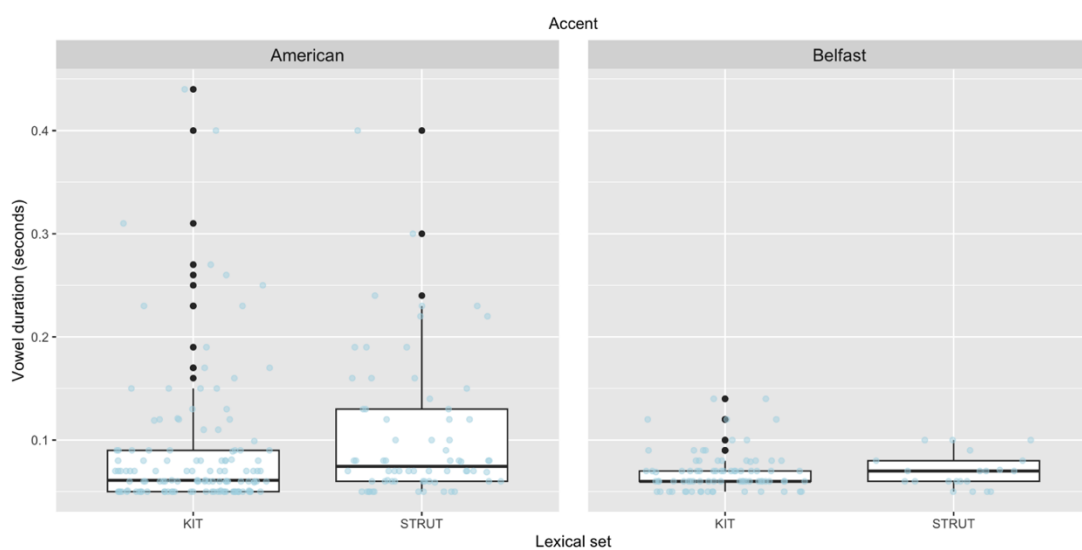
Midpoint formant values of KIT and STRUT vowels in GenAm vs. Belfast English



It seems more likely that the *duration* of these vowels causes them to sound more similar in Belfast English than they do in GenAm (see Figure 13).

FIGURE 13

Duration of KIT and STRUT vowels in GenAm vs. Belfast English



The mean duration of KIT vowels by GenAm speakers is 0.088 seconds, while the mean duration of STRUT vowels is 0.104 seconds. This leaves the STRUT vowel with a higher average duration in GenAm, exceeding KIT by 16 milliseconds. Meanwhile, Belfast speakers' mean KIT vowel duration is 0.069 compared to the mean duration of STRUT vowels at 0.070— only a one millisecond difference. Not only are the Belfast vowel durations lower than the GenAm ones, but they are also more similar in duration. This reduction of the durational difference between these two vowels may be the cause of listeners' confusion, as they may expect a larger difference based on their previous exposure to GenAm.

5. Discussion

The following discussion first relates how the above results pertain to researchers' current descriptions of Belfast English. Next, it explores the potential impact of *functional load* on the intelligibility of the identified features, considering that some of these contrasts are uncommon in the English lexicon. Finally, the current study is placed into the context of previous and future research on the phonetic features which most impact the intelligibility of accented Englishes.

5.1. How Perceptual Data Informs Our Understanding of Belfast English

The analysis identified two perceptual mergers that are consistent with the available literature. The first is the MOUTH vowel, which Amador-Moreno (2010, p. 83) claimed may sound like PRICE to unfamiliar listeners. The PRICE and MOUTH vowels were found to significantly overlap, especially toward the tail end of production (cf. Figure 2), and listeners' transcriptions show that they struggle with interpreting the MOUTH vowel as a result. The second is the SQUARE-NURSE merger, which proved to be difficult for listeners to untangle. An acoustic analysis found that the pronunciation of these two vowels overlaps significantly (cf. Figure 9), providing

further evidence for the existence of this merger. Also consistent with the previous literature was the identification of FACE as [iə], which was identified as one possible variant for this lexical set.

Although acoustic analysis did support the existing hypothesis that GOOSE and FOOT are (somewhat) merged, listener transcriptions indicated that they perceived the GOOSE vowel (in ‘two’) as a FLEECE vowel instead. This was unexpected, as Maguire (2020, p. 110) attests that the GOOSE vowel is never pronounced as far forward as FLEECE. However, an acoustic analysis demonstrates that the pronunciation of GOOSE is positioned such that it overlaps with both the furthest back FLEECE and the most fronted FOOT productions (cf. Figure 4). It’s possible that listeners perceive the GOOSE vowel differently based on the available linguistic context. For example, the word ‘fool’ might be misinterpreted as ‘full’ or ‘feel’ depending upon the specific articulatory behavior of the speaker and the semantic context. Given that minimal pairs between GOOSE and FOOT are few and far between, confusion between GOOSE and FLEECE may be more likely.

The DRESS vowel also subverted expectations, as the available literature suggested a merger with TRAP. The current acoustic analysis provides no evidence for a merger between DRESS and TRAP. Instead, the DRESS vowel was found to be a diphthong, starting close to an [a] sound but ending in a central position. The pronunciation of DRESS as a diphthong has not been attested to in the previous literature, so it would be worth analyzing more (and more recent) data to investigate these findings further.

Although the literature suggests that KIT may be perceived instead as a DRESS vowel due to centralization, it was instead perceived by participants in the current study as a STRUT vowel. An initial analysis came up with no evidence of any overlap in fundamental frequency between these vowels. Instead, the current study found that the durations of KIT and STRUT

vowels in Belfast English are much shorter than in GenAm, and their average durations are much closer together. This aligns with the established vowel length rules of Belfast English, which indicate that KIT and STRUT vowels are always short in duration (Milroy, 1981; Maguire, 2020). This is the first study, however, to suggest that this similarity in *duration* may lead to comprehension issues for unfamiliar listeners, so it would be worthwhile to investigate this phenomenon further.

Finally, one aspect of the analysis identified a completely new feature altogether: the pronunciation of coda /z/ as a post-alveolar fricative /ʒ/. This feature co-occurred with the SQUARE-NURSE merger (in ‘stairs’), and over half of incorrect transcriptions included post-alveolar fricatives (/ʒ/ or /ʒ/) in the coda position instead of /z/. An acoustic analysis unveiled that the Belfast English coda /z/ has a higher F1 and F2 than the GenAm coda /z/. This effect is exacerbated when /z/ is preceded by an /r/ sound. Unlike with vowels, fricatives which are produced with higher F2 values are typically produced further back in the mouth and higher F1 values indicate a voiceless consonant. This indicates that the Belfast English coda /z/ is likely pronounced closer to a /ʒ/, which aligns with the transcriptions provided by listeners. While it appears that this feature is not included in previous descriptions of Belfast English, it is highly prominent in the available recordings. Further analysis would be worthwhile to investigate whether this extends to a larger group of speakers.

5.2. The Importance of Functional Load

With several features identified as lowering the intelligibility of Belfast English, one important aspect of intelligibility that has yet to be considered is *functional load* (Munro & Derwing, 2006). Relative functional load, as established by Catford (1987), provides a scale of the number of words that serve to keep a minimal pair distinct. For example, the minimal pair with the *highest* functional load in English is /ɪ/-/æ/ because this is the vowel pair that distinguishes

the greatest number of words (e.g., pit-pat, bit-bat, sit-sat), giving it a relative functional load of 100%. On the other end of the scale, the contrast between /æ/-/ɑ/ is among the vowel pairs with the lowest functional load (4%) as it does not often distinguish words (e.g., cam-calm) and therefore only contributes 4% of the number of pairs that /ɪ/-/æ/ does. Considering functional load can allow a greater understanding of how the above features might contribute to the *overall* intelligibility of Belfast English.

According to Catford (1987), the majority of the above contrasts—including MOUTH-PRICE and SQUARE-NURSE—have a low functional load (50% or lower), which aligns with his claim that “native varieties of English can tolerate the loss of one or two oppositions with a functional load of about 30% or less” with minimal issue (p. 91). Only KIT-STRUT has a high relative functional load (85%). Based on functional load alone, most of the identified features may not contribute much toward the intelligibility of Belfast English in real-world contexts.

However, even lower functional load pairs can lead to listener incomprehension, as was attested to in this study. For example, despite MOUTH-PRICE obtaining a low relative functional load of 30%, it was this pair that contributed the highest number of high-error words to this analysis. None of the resulting erroneous transcriptions constitute a traditional minimal pair (e.g., ‘announcement’-‘a knightsman’), yet listeners still struggled with comprehending the unfamiliar pronunciation. Therefore, the results above are still useful to raise awareness regarding challenging contrasts in Belfast English.

5.3. Implications for Overall Intelligibility Research

Based on his understanding of functional load, Catford (1987) posited that accurate consonant pronunciation is more critical to intelligibility than vowel pronunciation. This is confirmed in empirical research that identified consonants (Barrass et al., 2020) and suprasegmental aspects

of speech (Kang et al., 2018) as the most significant factors contributing toward intelligibility. The current results, however, suggest that listeners most struggled to accurately perceive *vowel* pronunciations. While this study was unable to consider suprasegmental features, only one consonantal feature was identified as a cause of lowered intelligibility in the Belfast accent—final /z/.

One potential reason for this is that Belfast English simply does not contain many consonantal divergences that could cause issues for listeners. For example, while the fronting of /θ, ð/ to /f, v/ is increasingly common in younger speakers in Northern Ireland (Corrigan, 2010), the resulting mergers are quite low in functional load (11-15%). Other interesting consonant features in Belfast English (e.g., dropping of intervocalic /ð/) result only in allophones which could not be easily confused with other phonemes (Corrigan, 2010). Therefore, it's possible that the only features of Belfast English that *do* create phonemic confusion are vowels.

Another potential explanation is that the current investigation is limited to the words that most listeners found difficult to understand. If it was possible to instead code every listener error with its likely cause and extrapolate the most frequent causes, then consonant features might emerge. However, with the current data set, this type of analysis is impossible. In future research, it would be favorable to design an experiment which controls for the potential causes of intelligibility errors so that such extrapolations would be possible, following Barrass et al. (2020) and Kang et al. (2018). In such a purpose-built experiment, it would be wise to also include intonational features of Belfast English to better understand their impact on its intelligibility.

6. Conclusion

The current study aimed to uncover the phonetic causes of reduced intelligibility in Belfast English to unfamiliar listeners. This was possible through a focused error analysis on previously collected data involving listeners from Belgium, the United States, and the Republic of Ireland.

A series of features emerged as being particularly prominent in high-error words. This included some features which had been previously identified in the literature, such as the perceptual merger between MOUTH and PRICE and the SQUARE-NURSE merger. Other features, such as the palatalization of final /z/ and listeners' misidentification of KIT as a STRUT vowel, were only able to be uncovered through this perceptual research and may inform future descriptions of Belfast English. While some of these features may not have a high functional load, they would still be well-suited for inclusion in an EFL curriculum for newcomers to Northern Ireland.

Additionally, this study contributes to intelligibility research in its discovery of a wealth of *vowel* sounds which lowered intelligibility, as most previous works prioritized consonantal deviations. While some studies have been conducted to understand which consonants are most challenging for listeners (Bent et al., 2007; Munro & Derwing, 2006), equivalent studies for *vowel* sounds would be beneficial and would provide further support to EFL curriculums.

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