Accent intelligibility across native and non-native accent pairings: investigating links with electrophysiological measures of word recognition

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Declaration

I, Louise Marie Stringer confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.
Acknowledgements

Firstly, I would like to thank my principal supervisor Paul Iverson. I am very grateful for all his help and support throughout this degree, and for his patience with me while I struggled to get to grips with the many things I had to learn from scratch. I’m also very grateful for his understanding through all my personal problems and helping me to take the best course of action to get through them.

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Abstract

The intelligibility of accented speech in noise depends on the interaction of the accents of the talker and the listener. However, it is not yet clear how this influence arises. Accent familiarity is commonly proposed to be a major contributor to accent intelligibility, but recent evidence suggests that the similarity between talker and listener accents may also be able to account for accent intelligibility across talker-listener pairings. In addition, differences in accent intelligibility are also often only found in the presence of other adverse conditions, so it is not clear if the talker-listener pairing also influences speech processing in quiet conditions.

This research had two main aims; to further investigate the relationship between accent similarity and intelligibility, and to use online EEG methods to explore the possible presence of talker-listener pairing related differences on speech perception in quiet conditions. English and Spanish listeners listened to Standard Southern British English (SSBE), Glaswegian English (GE) and Spanish-accented English (SpE) in a speech-in-noise recognition task, and also completed an event-related potential (ERP) task to elicit the PMN and N400 responses. Accent similarity was measured using the ACCDIST metric.

Results showed the same (or extremely similar) patterns in accent intelligibility and accent similarity for both listener groups, giving further support to the hypothesis that accent similarity can contribute to the level of intelligibility of an accent within a talker-listener pairing. ERP data also suggest that speech processing in quiet is influenced by the talker-listener pairing. The PMN, which relates to phonological processing, seems particularly dependent on a match between talker and listener accent, but the more semantic N400 showed some flexibility in the ability to process accented speech.
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1. Chapter one: Introduction

In everyday life, we commonly encounter speech in a range of accents, including native accents from a variety of countries and regions and also non-native accents of speakers with different native languages (L1s). We are able to understand some of these accents with ease, but others can be much harder to comprehend, particularly if there are other adverse factors present such as background noise or listening to speech in a language other than our L1. However, the intelligibility of an accent does not depend only on the accent of the talker, but also on its pairing with the listener’s accent; one listener may find a talker to be highly intelligible, while another could have great problems understanding the same talker. For example, listeners from the south of England find Glaswegian accents harder to understand than Glaswegian listeners do (Adank, Evans, Stuart-Smith & Scott, 2009; Smith, Holmes-Elliott, Pettinato & Knight, 2014), Chinese listeners can be more accurate at identifying words in Mandarin-accented English than American listeners (Hayes-Harb, Smith, Bent & Bradlow, 2008), and highly proficient French speakers of English may find a standard native English accent to be more intelligible than French-accented English, while less proficient listeners may show the opposite pattern (Pinet, Iverson & Huckvale, 2011).

Although the talker-listener accent pairing seems to be very influential in determining the intelligibility of an accent, it is not clear how this effect arises. One factor which may underlie the intelligibility of an accent for a given pairing is the listeners’ familiarity with the talker’s accent, as listeners tend to find accents they are familiar with to be easier to understand than unfamiliar accents. This could explain some asymmetries in the patterns of accent intelligibility across talker-listener pairings; listeners with a standard accent often find their own accent to be more intelligible than an unfamiliar regional accent, but regional listeners who are familiar with the standard accent through extensive media exposure can find this accent as intelligible as their own regional accent (Adank et al., 2009; Smith et al., 2014; Sumner & Samuel, 2009). It has been proposed that this long-term familiarity allows listeners to form accent-specific phonological representations for their own regional accent and also the standard accent (Sumner & Samuel, 2009), which then facilitates word recognition in both accents.
Another recently explored factor which could influence the intelligibility of an accent in noise is the acoustic-phonetic similarity between talkers’ and listeners’ accents. Subjective judgements of accent similarity suggest that listeners whose accent is closer to that of a talker find that accent easier to understand than listeners whose accent is less similar (Evans & Iverson, 2007), and findings of studies that utilised objective measures of accent similarity suggest that a greater level of similarity between acoustic-phonetic features of talker and listener accents is associated with higher levels of with accent intelligibility. For example, vowels in regional accents whose vowel spaces are closer to the listeners’ own accent are easier to identify than vowels in other regional accents which are more acoustically distant to the listeners’ accent (Oder, Clopper & Ferguson, 2013; Wright & Souza, 2013), and the intelligibility of a range of native and non-native accents in noise shows a positive relationship with the degree of similarity in vowel spectral qualities and duration between talker and listener accents (Pinet et al., 2011). If acoustic-phonetic similarity does contribute to the influence of the talker-listener pairing on accent intelligibility, this would suggest that listeners deal with accented speech in a different way to that which has been suggested based on accent familiarity. Instead of forming new representations to accommodate an accent, listeners may interpret all accents through existing representations formed based on their own accent. More similar accents may then be easier to map onto these representations than accents which are more distant to the listener’s accent.

Regardless of the factors underlying the influence of talker-listener combination on accent intelligibility, differences in the patterns of accent intelligibility across talker-listener pairs are often observed only in the presence of background noise; accents that may show very different levels of intelligibility in noise may be similarly intelligible in quiet conditions (e.g.: Adank et al., 2009, Pinet et al., 2011). This could suggest that processing difficulties affecting accent intelligibility across talker-listener pairings occur specifically as an interaction with background noise, and that listeners are able to successfully accommodate accent-related variability in quiet conditions. However, many behavioural studies measure accent intelligibility based on the outcome of word recognition processes, which raises the possibility that accented speech could cause processing difficulties in quiet conditions, but that these difficulties are not severe enough to prevent successful word recognition and affect the outcome of these tasks. Studies using online measures of word recognition
suggest that this may be the case; eye-tracking studies have shown that segmental (Trude, Tremblay & Brown-Schmidt, 2013) and suprasegmental (Reinsch & Weber, 2012) errors in non-native speech can cause some disruption to word recognition in quiet, even when word recognition accuracy is high. Using electroencephalography (EEG) measures to investigate event-related potentials (ERPs) also suggests there are qualitative differences in the processing of regional and non-native accents in quiet conditions (Brunelière & Soto-Faraco, 2013; Goslin, Duffy & Floccia, 2012; Hanuliková, van Alphen, van Gogh & Weber, 2012; Romero-Rivas, Martin & Costa, in press). If accent-related processing difficulties are present in quiet conditions, as suggested by these online studies, listeners may not be able to fully accommodate the variation occurring in accented speech even in favourable conditions.

The current research aimed to further explore links between accent intelligibility in noise and the acoustic-phonetic similarity of talker-listener accent pairings, and also to use EEG measures to investigate whether any influence of talker-listener pairing on word recognition processes could be observed in quiet conditions. Throughout, we compared responses to a standard native accent, a regional native accent and a non-native accent, (Standard Southern British English (SSBE), Glaswegian English (GE) and Spanish-accented English (SpE), respectively) for native English listeners and non-native Spanish listeners. It was necessary first to develop a suitable set of stimuli to accommodate the different task types and language background of the listeners, which is described in Chapter Two. The first part of the study then established the intelligibility of the three accents for each listener group (Chapter Three), and then went on to investigate links between accent similarity and intelligibility for the talker-listener pairings (Chapter Four). The final aspect of the research, described in Chapter Five, explored ERPs in response to each of the three accents for the two listener groups, in order to investigate whether there is any evidence of the influence of talker-listener accent pairing on online word recognition processes in quiet.
2. Chapter two: Developing new speech recognition materials suitable for non-native speakers of English

2.1. Existing speech recognition materials

Non-native speech perception research has greatly increased in recent years. However, few suitable materials have been developed specifically for this purpose, particularly at the sentence level, so it is common to use materials developed for other listener groups. Such materials can be very useful, but may not be entirely suitable for administration to non-native listeners.

A very commonly used materials set, the Bamford-Kowal-Bench (BKB) sentences (Bench, Kowal & Bamford, 1979), was developed for assessing hearing-impaired children’s speech perception abilities. The BKB sentences consist of 320 simple sentences, each containing three or four key words (e.g.: “The dog played with a stick”). The BKB sentences have been used in many native and non-native speech perception studies, in areas such as accent intelligibility (Bent & Bradlow, 2003; Pinet et al., 2011; Stibbard & Lee, 2006), the influence of various maskers on speech-in-noise perception (Crandell & Smaldino, 1996; Smiljanic & Bradlow, 2011; Van Engen, 2010), and as training materials (Gao, Low, Jin & Sweller, 2013; Shin & Iverson, 2013). Although they are not syntactically complex and most words are familiar to non-native speakers (Bent & Bradlow, 2003), the BKB sentences could be seen as overly-simplistic and fairly childish, so may not be entirely suitable for administration to adults. In addition, there is no opportunity to manipulate the level of semantic context in sentences, which limits their use in EEG experiments focusing on components such as the N400 effect.

Another frequently used materials set is the Speech Perception in Noise (SPIN) sentences (Kalikow, Stevens & Elliott, 1977), which were created for assessing the speech perception abilities of hearing-impaired listeners, but adults in this case rather than children. The SPIN sentences also differ to the BKB sentences in that there are two sentence conditions with different amounts of semantic information provided. In high probability sentences, a strong semantic context means the final word is easy to predict (e.g.: “For your birthday I baked a cake”), while in low probability sentences, no useful semantic information is provided, so the final word is not easily anticipated
(e.g.: “Tom wants to know about the cake”). The SPIN sentences have been used in investigations of both native and non-native listeners’ use of semantic information to support speech perception in adverse conditions (e.g.: Clopper, 2012; Mayo, Florentine & Buus, 1997; Shi, 2012, 2014; Tabri, Abou Chacra & Pring, 2011), and also in EEG studies investigating the N400 effect (e.g.: Connolly & Phillips, 1994). The flexibility offered by having multiple context conditions may mean the SPIN sentences have wider applications than the BKB sentences, but their use is also limited in non-native speech perception studies as they contain some quite advanced vocabulary (e.g.: keywords include ‘brook’, ‘notch’, ‘sap’ and ‘tack’, Kalikow et al., 1977), which may be challenging for non-native speakers, particularly those who are not highly proficient in English.

While both the BKB and SPIN sentences are often used in both native and non-native speech perception studies, there are other material sets which are generally used only for native listeners. One example is the Harvard sentences (IEEE, 1969), which are commonly used in investigations into the perception of noise-vocoded or otherwise spectrally degraded speech (e.g.: Bent, Buchwald & Pisoni, 2009; Stacey & Summerfield, 2007), but are unsuitable for administration to many non-native listeners as the sentences are fairly complex, both in syntax and vocabulary (e.g.: “Trample the spark, else the flames will spread”).

Due to the limitations of administering these material sets in non-native speech perception studies, some materials have been developed specifically for use with non-native listeners. To investigate the use of semantic information to compensate for difficulties in adverse listening conditions, Bradlow and Alexander (2007) developed a set of sentences similar to the SPIN sentences, but with vocabulary that is more familiar to non-native speakers of English. While this set is more useful for non-native listeners, it contains only 120 sentences, which limits its use in studies with multiple within-subject conditions. High and low predictability sentences also differ in length, and low predictability sentences comprise only a small number of very simple sentence structures, meaning the conditions may differ in other features as well as the level of semantic information available. The only large-scale materials set developed specifically for non-native speakers of English is the recent Basic English Lexicon (BEL) sentences (Calandruccio & Smiljanic, 2012), which are based on a lexicon developed from recordings of spontaneous non-native speech. The BEL
sentences have so far been used in both non-native (Rimikis, Smiljanic & Calandruccio, 2013) and native speech perception studies (Smiljanic, Sheft, Chandrasekaran & Shafiro, 2013; van Engen, Chandrasekaran & Smiljanic, 2012). These materials have great potential for use in future research, but the BEL sentences are similar to the BKB sentences in that there is no opportunity to manipulate the level of contextual information present. Sentences are also restricted to a limited number of template forms, meaning some sentence structures become repetitive. In addition, some vocabulary may be unfamiliar to some non-native speakers, particularly those without exposure to American English.

For the present studies, we required sentence materials suitable for fairly advanced, but not proficient non-native listeners. In order to use the sentences in an EEG study in addition to speech-in-noise tasks we needed multiple sentence conditions which varied in the level of contextual information available. The set also needed to be large enough to allow a number of experimental conditions without having to repeat sentences. As none of the existing material sets described above met all these criteria, a new set of materials was developed.

2.2. The new materials set: Non-native speech recognition sentences

The non-native speech recognition (NNSR) sentences developed for the current research contain three related sentence conditions (predictable, neutral and anomalous), which differ based on the level of contextual constraint and/or the congruity of the final keyword. Sentences are organised into 439 related triplets containing one sentence in each of the three conditions to give a total of 1317 individual sentences. Sentences were formed by combining a sentence frame (the main body of a sentence without the final word) and a final keyword. Sentence frames have either a strongly or weakly constrained context, as determined by two or three ‘pointer words’ (content words which generate the context of a sentence, Kalikow et al., 1977). In strongly constrained sentence frames, the pointer words generate a very specific context, while in weakly constrained sentence frames, a more ambiguous context is generated. Final keywords are either congruous or incongruous to the context generated in the sentence frame.

Predictable sentences are formed of strongly constrained sentence frames and congruous final keywords; the specific context generated in the sentence frame can
be completed by very few words, so final keywords in this condition are highly predictable. Neutral sentences contain the same congruous final keywords, but in this case they complete weakly constrained sentence frames. The more ambiguous context generated means that many words could complete the sentence, so final keywords cannot be easily predicted and are now neutral. Anomalous sentences combine strongly constrained sentence frames with incongruous final keywords. As the keyword is not the predictable word that would be expected based on the context, the sentence becomes anomalous. The same sets of sentence frames and keywords appear in more than one condition, so the sentence content overlaps within each triplet; predictable and neutral sentences have different sentence frames, but share the same final keyword, while predictable and anomalous sentences show the opposite relationship (Table 1).

To ensure the NNSR sentences are suitable for lower-proficiency non-native speakers of English, lexical items and syntactic structures used in the sentences were drawn from materials designed for speakers at the B1 level of the Common European Framework of Reference for Languages (CEFR). The B1 level is an 'intermediate level', where speakers can communicate successfully on a range of topics, but still have large gaps in their knowledge (North, Ortega & Sheehan, 2010). All words appearing in the materials were drawn from the Preliminary English Test (PET), whose vocabulary list contains approximately 3300 words (University of Cambridge ESOL Examinations, 2012). This source was chosen as the PET is a commonly administered B1 level examination which is taken by learners of English around the world, meaning that its vocabulary list is not likely to be biased towards speakers of a particular L1. The vocabulary list is also readily available as a study aid, meaning that

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sentence Context</th>
<th>Final Keyword</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictable</td>
<td>Strongly</td>
<td>Congruous</td>
<td>The dolphins are <strong>swimming</strong> in the SEA.</td>
</tr>
<tr>
<td></td>
<td>constrained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>Weakly</td>
<td>Congruous</td>
<td>The children are <strong>playing</strong> in the SEA.</td>
</tr>
<tr>
<td></td>
<td>constrained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anomalous</td>
<td>Strongly</td>
<td>Incongruous</td>
<td>The dolphins are <strong>swimming</strong> in the ROAD.</td>
</tr>
<tr>
<td></td>
<td>constrained</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Content overlapping across sentence types are shown in **bold**, pointer words are **underlined** and **final keywords are capitalised**
this is a good resource of words suitable for the B1 level. Syntactic structures are also limited to those expected to be familiar at the B1 level of the CEFR Core Inventory, which includes the majority of common syntactic structures (North et al., 2010, p10-11). To avoid the repetitive use of a limited number of syntactic structures, sentence structures are not restricted in any other way.

2.3. The development process

The development of the NNSR sentences began with creating predictable sentences, which were then used as the basis of neutral and anomalous sentences. The process of development and validation is described below and summarised in Figure 2.1, and the complete materials set can be found in Appendix 1.

The first stage of development was to select a pool of potential final keywords from the PET vocabulary list (University of Cambridge ESOL Examinations, 2012). As in the SPIN sentences, final keywords were limited to nouns to maintain similarity across sentences (Kalikow et al., 1977). All nouns on the PET vocabulary list were identified, excluding nouns that are also verbs (e.g.: book), multi-word nouns (e.g.: weather forecast, although one-word compounds were retained), acronyms (e.g.: DVD), words with common abbreviations (e.g.: bicycle/bike), occupations with different male/female forms (e.g.: actor/actress), titles (e.g.: Mr., Miss), hyphenated words (e.g.: make-up). These words were excluded in order to minimise possible confusions as to which word should complete a strongly constrained sentence frame. A small number of words were also excluded because they did not appear in word property databases used at later stages in development. This left a pool of 1413 potential final keywords of between one and five syllables and with a frequency of between 0.04 and 5250 occurrences per million words (mean frequency = 61 occurrences/million words, Brysbaert & New, 2009). As the words were all drawn from B1 level materials, even the least frequent words were likely to be familiar to non-native participants (e.g.: notepaper, footballer).

2.3.1. Predictable sentences

Predictable sentences were constructed by creating strongly constrained sentence frames that are congruently completed by one of the potential keywords. Each sentence frame contained two or three related pointer words in order to generate a specific context related to its keyword. In line with existing materials, the length of
Figure 2.1: Development process of the new sentence materials

**Predictable Sentences**
Create contextually constrained sentences ending in potential keywords

- Cloze Test P1
  - adapt
  - Cloze Test P2
  - discard

**Neutral Sentences**
Adapt sentence only

- Cloze test N1
  - adapt
  - Cloze test N2
  - discard

**Anomalous Sentences**
Exchange keyword only

- Select keywords
  - match on lexical properties
  - different initial phonemes

- discard

439 equivalent sentence triplets

**Predictable**  **Neutral**  **Anomalous**

Assign predictable sentences to lists
Check no differences between lists and redistribute if necessary
Assign and check neutral and anomalous lists

check matching on word and sentences properties between sentence conditions

Final set complete
sentence frames was limited to 5-9 words/5-12 syllables (e.g.: Block & Baldwin, 2010; Bradlow & Alexander, 2007; Calandruccio & Smiljanic, 2012), giving complete sentence lengths of 6-10 words and 6-16 syllables. To maximise the size of the final materials set, a highly constrained sentence frame was created for as many of the potential keywords as possible, giving an initial set of 553 predictable sentences.

To ensure these sentences were indeed predictable, the predictability of the final keyword of each sentence was assessed using a series of cloze tests. In a cloze test, participants receive a list of sentences frames and supply a word to complete the sentence (e.g.: “The dolphins are swimming in the __________”). No possible options are provided. A word’s cloze probability is the proportion of participants who choose that word to complete the sentence. For example, if nine out of ten participants chose ‘sea’ to complete the above sentence, it has a cloze probability of 90%. If a sentence has a highly constrained context and a predictable final keyword, the cloze probability of the final keyword should be high (Kutas & Hillyard, 1984). A cloze probability of greater than 65% was set as the threshold for inclusion in the predictable sentences set, which is consistent with thresholds set in other stimuli sets which constrained the predictability of the final word (Block & Baldwin, 2010; Bradlow & Alexander, 2007). Predictability ratings are usually assessed based on native speakers’ responses, but as these materials are intended for use in non-native speech perception research, both native and proficient non-native speakers participated in the cloze tests. In order to ensure the materials set is not biased towards speakers of any particular language, the L1 of non-native participants was not restricted, and speakers of 20 different L1s took part in the various cloze tests (Table 2). Although the current research focuses on native Spanish speakers, this means that the materials could also be administered to a wider population in future work.

Cloze test P1 contained all of the predictable sentences divided randomly into four lists of approximately 140 sentences. Sentence frames appearing in the four surveys did not differ based on syllable, pointer word or total word count. A cloze test was created for each list and completed online by 18 native (13 female) and 26 proficient non-native English speakers (13 female, average age of acquisition (AoA)= 9.45 years, for L1s see Table 2)) with a mean age of 29.75 years. Each participant completed only one survey, was requested to work alone without a dictionary, and was not
Table 2: Native languages of cloze test participants

<table>
<thead>
<tr>
<th>Cloze Test P1</th>
<th>Cloze Test P2</th>
<th>Cloze Test P3</th>
<th>Cloze Test N1</th>
<th>Cloze Test N2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albanian (1)</td>
<td>Dutch (1)</td>
<td>Bosnian (1)</td>
<td>English (9)</td>
<td>Cantonese (1)</td>
</tr>
<tr>
<td>Arabic (2)</td>
<td>English (10)</td>
<td>French (1)</td>
<td>Korean (2)</td>
<td>English (14)</td>
</tr>
<tr>
<td>Cantonese (2)</td>
<td>French (1)</td>
<td>German (1)</td>
<td>Romanian (1)</td>
<td>English (1)</td>
</tr>
<tr>
<td>Dutch (2)</td>
<td>German (2)</td>
<td>Hindi (2)</td>
<td>Mandarin (1)</td>
<td>Romanian (1)</td>
</tr>
<tr>
<td>English (18)</td>
<td>Romanian (1)</td>
<td>Hungarian (5)</td>
<td>Slovak (1)</td>
<td>Slovak (1)</td>
</tr>
<tr>
<td>French (1)</td>
<td>Serbian (1)</td>
<td>Italian (2)</td>
<td>Slovak (1)</td>
<td></td>
</tr>
<tr>
<td>German (7)</td>
<td>Spanish (2)</td>
<td>Korean (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hungarian (3)</td>
<td></td>
<td>Russian (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italian (1)</td>
<td></td>
<td>Spanish (9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korean (1)</td>
<td></td>
<td>Thai (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polish (1)</td>
<td></td>
<td>Vietnamese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romanian (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serbian (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where the number of speakers of each language is given in brackets.

compensated for their time. The average cloze probability for all sentences was 81.8%, showing that overall the final keywords were highly predictable. Based on the cloze probabilities of the keywords, sentences were either retained, adapted or removed from the set of predictable sentences; most sentences with a keyword cloze probability over 65% were retained unmodified (387), but some were adapted slightly based on responses to further strengthen contextual constraint (54), or removed for being too specifically British (7). Sentences whose keyword’s cloze probability was under the 65% threshold were adapted to reduce contextual ambiguity (62) or removed (42). For one sentence with 100% cloze probability, the given response was not the intended keyword. This alternative response also appeared on the potential keywords list, so this response replaced the intended keyword in the retained sentence.

Cloze test P2 was then carried out to ensure the 116 sentences modified after cloze test P1 now passed the 65% cloze probability threshold. A new cloze test was completed online by 10 native (7 female) and 8 proficient non-native English speakers (4 female, average AoA = 9.88 years, for L1s see Table 2) with a mean age of 31.4 years. Again, participants worked alone and did not receive any compensation. Sentences whose keyword’s cloze probability was now over the 65% threshold were retained (88), with one sentence adapted very slightly based on responses to reduce ambiguity. Sentences under the 65% threshold were either removed (23) or adapted.
based on responses if their cloze probability was close to 65% (3). An additional sentence frame was changed back to its original form, as its keyword had a higher cloze probability in test P1 (this sentence had originally been over the 65% threshold, but had been modified slightly based on responses to attempt to further strengthen the context). Along with the 388 sentences included after cloze test P1, this gave a set of 481 highly constrained sentences with a predictable final keyword (average cloze probability = 92.4%). These remaining predictable sentences were used as the basis of the development of the neutral and anomalous sentence conditions.

To ensure the sentences are also suitable for lower-proficiency non-native participants, a third cloze test, P3, was administered to lower level non-native learners of English. The 481 predictable sentences were divided into four lists of approximately 120 sentences, which did not differ based on the number of pointer words, syllables or total word count. A cloze test was compiled for each list, and completed either in pen-and-paper form or online by 36 participants (19 female, mean age = 27.7 years, mean AoA = 7.5 years, for L1s see Table 2). All participants were students enrolled in pre-intermediate (1), intermediate (17) or upper-intermediate level (18) English classes, covering the CEFR levels A2 - B2. Participants completed only one cloze test each, were asked to work alone without a dictionary, and were not compensated for their time. One upper-intermediate level participant’s responses were excluded as they completed only a small part of the test. The average cloze probability of final keywords was 67.9%, showing that the sentences were less predictable for this group than for the native and proficient non-native participants. The cloze probability of most sentences was still over the 65% threshold; 284 sentences had a keyword cloze probability over 65%, along with 7 sentences that also had a cloze probability of over 65%, but where the most common response was related to, but not the intended keyword. Of sentences under the 65% threshold, nine were removed as their keyword had a very low cloze probability or responses suggested participants may not understand the sentence, and five sentences were modified to be easier to understand. For many other sentences with a keyword cloze probability under the 65% threshold, responses were often related to the intended keyword. For example, to complete “The dolphins are swimming in the _______,” words such as ‘river’ or ‘lake’ may be given instead of the more expected ‘ocean’ or ‘sea’. Although sentences are less predictable than for native and proficient non-native speakers, it seems that the relevant context is still activated, and so the
sentences are still suitable for lower proficiency non-native speakers of English. Sentences that were removed or modified from the predictable condition following cloze test P3 were also removed or modified accordingly in the neutral and anomalous conditions during their development.

2.3.2. Neutral sentences

Neutral sentences were created by adapting predictable sentences. The same final keyword was retained in each sentence, but was now paired with a new, weakly constrained sentence frame. These weakly constrained sentence frames were created by substituting pointer words in the strongly constrained sentence frames for others which are less related to the final keyword (e.g.: ‘dolphins’ -> ‘children’, ‘swimming’ -> ‘playing’). This generates a more weakly defined context so final keywords are no longer easily predictable. The number of pointer words was unchanged, but in some cases function or filler words were permitted to be added to or deleted to maintain naturalness. In some cases it was not possible to generate a weakly constrained context only by substituting pointer words, so new frames were constructed with the same number of pointer words. For example, “Meat from a cow is called beef” was difficult to modify by changing only the pointer words, so it became “My favourite meat is beef”. While this meant that some strongly-weakly constrained sentence frame pairs were less similar than other pairs where only the pointer words differ, the structure of the sentence frames was kept as similar as possible across pairs. To ensure these modified sentences with weakly constrained sentence frames were neutral, further cloze tests were carried out. In this case, if a sentence frame has a weakly constrained context and its final keyword is not easy to predict, the cloze probability of the final word should be low. The cloze probability threshold for inclusion in the neutral condition was set at under 40%, and applied to the most common response given instead of just the intended keyword. This threshold was again chosen to be similar to thresholds set in similar stimuli sets (Block & Baldwin, 2010).

Cloze test N1 contained all 481 neutral sentences and was completed online by 9 native (6 female) and 5 proficient non-native (5 female, average AoA = 8.60 years, for L1s see Table 2) English speakers with an average age of 25.78 years. Participants had not completed any of the previous cloze tests, and received course credits for their time. Sentences where the most common response had a cloze probability under
the 40% threshold were retained unmodified (248) or adapted slightly to further weaken contextual constraint (e.g.: “My favourite meat is beef” became “My favourite food is beef”). The nine sentences removed from the predictable condition after cloze test P3 were also removed from the neutral condition at this point, even though they had been under the 40% threshold. Sentences whose most common response had a cloze probability of over 40% were adapted to increase contextual ambiguity (195).

Cloze test N2 contained the 224 modified sentences after cloze test N1, and was completed online by 14 native (12 female) and four proficient non-native (3 female, average AoA = 9.75 years, for L1s see Table 2) English speakers with an average age of 32.61 years. Participants received course credits for their participation, and had not completed any of the previous surveys. Sentences whose most common response now had a cloze probability of under 40% were retained (168 sentences), along with three sentences just over this threshold, but where the most common response was not the intended keyword. Sentences which still had a final word cloze probability above the 40% threshold were either removed (15) or modified based on responses to further weaken contextual constraint and then retained (38). Following these procedures, 457 pairs of predictable and neutral sentences sharing the same final keyword remained.

2.3.3. Anomalous sentences

To form anomalous sentences, the congruous final keywords of the predictable sentences were replaced by alternatives which are incongruous to the strongly constrained sentence frames. These incongruous final keywords were selected from the remaining pool of 932 potential keywords by matching congruous-incongruous keyword pairs as closely as possible on a number of features, including noun type (i.e.: a singular countable noun was substituted by another singular countable noun), syllable count, lexical stress pattern, lexical frequency (Brysbaert & New, 2009), phonological neighbourhood density (Marian, Bartolotti, Chabal & Shook, 2012) and phonological Levenshtein distance (Balota, Yap & Hutchinson, 2007). As far as possible, words were also matched on concreteness ratings (Wilson, 1988), but age of acquisition was not used as a matching criteria as this data was only available for around half of the potential keywords (Wilson, 1988). Keyword pairs were also selected to be immediately acoustically distinguishable, with no initial phonological overlap between the two words; initial consonants (singleton or clusters) differ in
place and/or manner of articulation and voicing (e.g.: /b/ vs. /s/, /sl/ vs. /tr/), and the first vowel also differs in height and/or roundedness (e.g.: /i:/ vs. /æ/). As the pool of potential keywords was limited, it was not possible to find a suitable incongruous keyword to match each congruous keyword, so 18 sets of predictable and neutral sentences were removed at this point, leaving a final set of 439 sentence triplets.

2.4. Ensuring equivalence across sentence conditions

Sentences within each triplet were closely matched on a one-to-one basis during the development process, but to ensure equivalence was maintained across the three sentence conditions the final sets were also compared as a whole. Initial comparisons found that although strongly and weakly constrained sentence frames differ in content and in some cases structure, they two sets of frames as a whole did not differ based on syllable count or pointer word count. However, they did differ on total word count; weakly constrained sentence frames were slightly shorter on average than strongly constrained frames, so approximately 20 of the shortest weakly constrained sentence frames were lengthened by separating contractions, which had been counted as one word (e.g.: don’t -> do not), or adding ‘filler’ words (e.g.: very, really). Following this the two sets did not differ based on syllable count, F=1.167, p=.280, pointer word count, F=0.215, p=.643, or total word count, F=2.271, p=.132. While the total pointer word count did not differ between the two sets of sentence frames, the average frequency of each pointer word across the set was higher for weakly constrained sentence frames (Table 3). This is because the less defined context generated in the weakly constrained sentences requires more general pointer words which may occur frequently compared to the more specific pointer words in the strongly constrained frames. For example, “people” may be used a number of times in weakly constrained frames to substitute more specific, but less frequently used pointer words such as “children”, “students”, “teachers” and “scientists” in strongly constrained frames.

Congruous and incongruous final keywords did not differ based on syllable count, F=0.006, p=.936, lexical frequency, F=0.190, p=.663, phonological neighbourhood density, F=0.002, p=.969, or phonological Levenshtein distance, F=0.523, p=.470. However, due to difficulties matching pairs on all features, the two sets of keywords were found to differ based on concreteness, F=43.691, p<.001, with congruous keywords having more concrete ratings than incongruous keywords (Table 4).
Table 3: Properties of strongly and weakly constrained sentence frame sets

<table>
<thead>
<tr>
<th></th>
<th>Strongly constrained context</th>
<th>Weakly constrained context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllable count</td>
<td>8.40 (1.58)</td>
<td>8.36 (1.32)</td>
</tr>
<tr>
<td>Total word count</td>
<td>6.51 (1.15)</td>
<td>6.40 (1.04)</td>
</tr>
<tr>
<td>Pointer word count</td>
<td>2.50 (0.50)</td>
<td>2.46 (0.49)</td>
</tr>
<tr>
<td>(per sentence)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pointer word count (across whole set) *</td>
<td>1100 (623 unique)</td>
<td>1087 (425 unique)</td>
</tr>
<tr>
<td>Pointer word frequency (across whole set) *</td>
<td>1.79 (1.69)</td>
<td>2.56 (5.57)</td>
</tr>
</tbody>
</table>

Where values are in the form: mean (s.d.), except *

Table 4: Properties of congruous and incongruous final keyword sets

<table>
<thead>
<tr>
<th></th>
<th>Congruous</th>
<th>Incongruous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllable Count</td>
<td>1.792 (0.839)</td>
<td>1.797 (0.840)</td>
</tr>
<tr>
<td>Lexical Frequency (SUBTLEX Lg10)</td>
<td>3.137 (0.597)</td>
<td>3.120 (0.593)</td>
</tr>
<tr>
<td>Phonological Levenshtein Distance (English Lexicon Project)</td>
<td>1.910 (0.871)</td>
<td>1.867 (0.884)</td>
</tr>
<tr>
<td>Concreteness (MRC)</td>
<td>543.947 (84.697)</td>
<td>493.706 (105.775)</td>
</tr>
</tbody>
</table>

Where values are in the form: mean (s.d.)

Table 5. Properties of keywords and sentences used as dependent variables in investigations into the equivalence of complete sentence sets across the three conditions and of smaller experimental lists within each sentence condition

<table>
<thead>
<tr>
<th>Keyword properties</th>
<th>Sentence properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllable count</td>
<td>Sentence frame syllable count</td>
</tr>
<tr>
<td>Lexical frequency</td>
<td>Sentence frame pointer word count</td>
</tr>
<tr>
<td>Phonological neighbourhood density</td>
<td>Sentence frame word count</td>
</tr>
<tr>
<td>Phonological Levenshtein distance</td>
<td>Complete sentence syllable count</td>
</tr>
<tr>
<td>Concreteness</td>
<td>Complete sentence word count</td>
</tr>
</tbody>
</table>
Table 6: Examples of completed sentence triplets

<table>
<thead>
<tr>
<th>Predictable</th>
<th>Neutral</th>
<th>Anomalous</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0106 To EARN MONEY you need a JOB</td>
<td>B0106 To BE HAPPY you need a JOB</td>
<td>C0106 To EARN MONEY you need a TALK</td>
</tr>
<tr>
<td>A0901 RABBITS like EATING fresh ORANGE CARROTS</td>
<td>B0901 Some PETS like EATING fresh TASTY CARROTS</td>
<td>C0901 RABBITS like EATING fresh ORANGE SWIMMERS</td>
</tr>
<tr>
<td>A1822 You WEAR a HAT on your HEAD</td>
<td>B1822 He PUT the BOOK on his HEAD</td>
<td>C1822 You WEAR a HAT on your GIRL</td>
</tr>
</tbody>
</table>

*Pointer words and final keywords are capitalised*

2.5. Forming equivalent lists of sentence triplets

Although the current research used the complete set of NNSR sentences, in the future it may be desired to use only a subset of the materials, depending on experimental design. In this case, it is important that the subset chosen reflects the properties of the materials as a whole, so the 439 sentence triplets were organised into 18 equivalent experimental lists of 24 sentences, with the remaining 7 triplets forming a training list.

The lists were created by first distributing predictable sentences across 18 lists, with a spread of keyword syllable counts, sentence syllable counts, final keyword cloze probabilities and pointer word counts within each list. A MANOVA with list number as a fixed factor and the keyword and sentence frame properties listed in Table 5 as dependent variables showed that these initial experimental lists of predictable sentences differed only on sentence frame pointer word count. Bonferroni-corrected post-hoc comparisons showed that lists 1 and 3 had lower pointer word counts, and lists 10 and 11 had higher pointer word counts than other lists. To correct the balance, a small number of sentences (matched for other properties) were exchanged among these lists. A second MANOVA was conducted and the 18 lists of predictable sentences now did not differ based on any of the sentence frame or keyword properties described in Table 5 (all comparisons $p>.261$). The neutral and anomalous sentences of each triplet were then assigned to the list corresponding to that of the triplet’s predictable sentence (i.e.: if a predictable sentence was assigned to predictable list 3, the neutral and anomalous sentences from its triplet were assigned
to neutral list 3 and anomalous list 3, respectively). This gave 18 corresponding experimental lists for the three sentence conditions. Further MANOVA tests showed that within each sentence condition, the neutral and anomalous lists also did not differ based on the properties listed in Table 5.

The final sentence triplets are identified via a code comprising sentence type (predictable = A, neutral = B, anomalous = C), a list identifier (01-18 plus 00 for the training list) and finally a sentence number identifier (01-24). For example, sentence A0101 is the first predictable sentence in list 1. The same code describes each member of a triplet; sentence A0101 is drawn from the same triplet as B0101 and C0101. Examples of complete sentence triplets are shown in Table 6.
3. Chapter three: Accent intelligibility in noise across different talker-listener pairings

3.1. Introduction
The intelligibility of an accent depends on the particular combination of talker and listener, rather than being purely driven by features of the talker’s speech. In this way, different talker-listener pairings can give rise to many patterns of relative accent intelligibility. A listener’s familiarity with a talker’s accent is often proposed to be a major contributor to accent intelligibility (e.g., Adank et al., 2009), but recently the level of acoustic-phonetic similarity between the talker and listener’s accents has also been suggested to contribute to the intelligibility of accented speech in noise (e.g., Pinet et al., 2011). This chapter begins by reviewing some findings in this field and discussing how they could support either the influence of familiarity or similarity on accent intelligibility. We then move on to examine the intelligibility of accents within the talker-listener pairings in this study. Note that the mechanisms through which accent familiarity and similarity may influence intelligibility, and the implications this may have for word recognition will be discussed in the next chapter.

3.1.1. Accent intelligibility for native listeners
Native listeners who have a standard native accent (e.g., SSBE, General American etc.) generally find this accent to be more intelligible than a regional accent in noise. For example, southern English listeners are less accurate at recognising Northern Irish-accented speech than SSBE (Pinet et al., 2011), and are also slower to identify speech in a Glaswegian accent (Adank et al., 2009) and do so less accurately (Smith et al., 2014). Similar effects are seen in American English; listeners with a General American accent are slower to recognise words in the non-rhotic New York accent than in their own rhotacised accent (Sumner & Samuel, 2009), and are more accurate at transcribing sentences in a General American accent than other more highly marked regional accents (Clopper & Bradlow, 2008). This disadvantage for processing regional accents likely stems from the systematic variations in these accents compared to the relevant standard accent; particular phonemes may be realised phonetically differently in either spectral or durational terms, may occur in different phonotactic environments or may have different lexical distributions, and there may also be differences in suprasegmental features (Wells, 1982a, pp. 72-86).
These variations could impede comprehension as they may not be familiar to standard-accented listeners, who may not commonly encounter speakers of these accents or receive as much exposure to regional accents through the media. It is also possible that regional accents disrupt processing for standard-accented listeners as these variations mean the regional accent is less acoustic-phonetically similar to their own accent.

If the pairing is reversed, native listeners with a regional accent tend to find their own regional accent and the relevant standard accent to be equally intelligible. This has been observed across multiple regional-standard accent pairings, in different countries and languages; word identification in SSBE and Glaswegian accents occurs equally quickly (Adank et al., 2009) and accurately (Smith et al., 2014) for Glaswegians, and is also equally fast in General American and New York accents for New Yorkers (Sumner & Samuel, 2009), and in a local regional accent and standard Parisian French for listeners from the south of France (Floccia, Goslin, Girard & Konopczynski, 2006). Given that the regional accent is both highly familiar to the listeners and also phonetically very similar to their own accent, it may not be surprising that in this case the regional accent is highly intelligible. The standard accent is also likely to be highly familiar to regional listeners through extensive media exposure and to a lesser extent, possibly also through interaction with speakers of the standard accent (Adank et al., 2009, Sumner & Samuel, 2009). This allows listeners to accommodate the differences between the standard accent and their own, and so leads to this accent being more intelligible to regional listeners than in the reverse pairing. However, it is hard to account for this advantage for a standard accent shown by regional listeners based on accent similarity, as the standard accent should be equally distant from the regional accented listeners’ accent than the regional accent is for listeners with a standard accent.

While this asymmetry in accent intelligibility is usually accounted for by assuming that a listener’s own accent is inherently highly intelligible, and that the standard accent also becomes highly intelligible with sufficient exposure, it could be possible that the reverse is true, and standard accents are inherently more intelligible than other accents and regional listeners’ extensive exposure to their own accent and its phonetic similarity to their own speech allows them to process it with ease. Standard accents contain features that could help them to be relatively more intelligible than
other accents; SSBE vowels on average have more central formant placements as compared to other regional English accents, meaning this accent is of a similar acoustic difference to regional accents as diverse as those spoken in Glasgow, East Anglia and Birmingham (Ferragne & Pellegrino, 2010), and so may be comparably intelligible to listeners all around the country. Standard accents may also be more intelligible than other accents as they lack some features of regional accents that could make words harder to distinguish. For example, in many Northern English accents the vowels in words such as could and cud are both realised as /ʊ/, and in a Liverpool accent the vowels in fairy and furry are merged into a single /ɜ/ vowel. In SSBE, both pairs of words are minimal pairs rather than homophones (Wells, 1982b, pp. 356, 361). The Glaswegian accent also adheres to the Scottish Vowel Length Rule, meaning that words such as beat and bead are both realised with a short vowel (Scobie, Hewlett & Turk, 1999). In this accent, the main cues used to distinguish the words appear in the final consonant, while in SSBE vowel duration cues would also be available. In these cases, the standard accent has more cues available to differentiate the words, which may help this accent to be generally more intelligible than regional accents. This could account for the finding in some studies that regional listeners can find the standard accent to be more intelligible than their own accent (Evans & Iverson, 2007; Sumner & Samuel, 2009).

In addition to showing difficulties processing unfamiliar regional accents, native listeners also tend to find a non-native accent to be less intelligible than a standard native accent. English listeners are more accurate at recognising SSBE than French-accented English (Pinet & Iverson, 2010; Pinet et al., 2011), and are faster at recognising their own English accent than a Spanish (Adank et al., 2009) or French accent (Floccia, Butler, Goslin & Ellis, 2009). American listeners find the General American accent more intelligible than Mandarin-accented (Hayes-Harb et al., 2008; Munro & Derwing, 1995), Korean-accented (Bent & Bradlow, 2003) or Spanish-accented English (Imai, Walley & Flege, 2005), and Dutch listeners find a native Dutch accent easier to understand in noise than English-accented Dutch (van Wijngaarden, 2001). These non-native accents may be less intelligible than a native accent as they contain both systematic variations compared to native accents, such as a tendency for French speakers to drop /h/ when speaking in English (Walter, 2001), and also more unsystematic variations due to the high level of variance within non-native talkers’ ability to produce L2 sounds accurately and consistently (e.g., Burgos,
Cucchiarini, van Hout & Strik, 2014; Evanini & Huang, 2012; Flege, Bohn & Jang, 1997). These accent features may be unfamiliar to native listeners as non-native accents are not commonly represented in the media, and listeners may have few encounters with non-native speakers depending on where they live, which could account for the lower intelligibility of these accents. The difficulties posed by non-native accents may also relate to acoustic-phonetic differences to native accents. Non-native speech is influenced by the L1 sound system, and as such, vowels produced by non-native speakers may differ in terms of both spectral properties and duration to vowels produced by native speakers (Flege et al., 1997; Flege, Schirru & McKay, 2003). However, this depends on L2 proficiency levels, and more proficient non-native speakers’ productions tend to be closer to those of native speakers than less proficient speakers’ productions (Burgos et al., 2014; Flege et al., 1997; Pinet et al., 2011). As well as being less similar to native speech, less proficient non-native talkers also tend to be harder to understand than more proficient talkers (Bent & Bradlow, 2003; Stibbard & Lee, 2006), which could suggest a link between the similarity of non-native and native accents and the intelligibility of non-native accents. It should be noted though that this would depend on the specific talker-listener accent pairing, as there is considerable variation between both native and non-native accents.

### 3.1.2. Accent intelligibility for non-native listeners

Considering the intelligibility of accented speech for non-native listeners is more complex than for native listeners. Non-native speakers have an incomplete model of their second language (L2), and the influence of the L1 sound system can cause problems discriminating and identifying L2 sounds, factors which are exacerbated in the presence of conditions which may make speech recognition more difficult (see García Lecumberri, Cooke & Cutler, 2010 for a review). However, there is a great deal of variability in L2 ability and experience among non-native listeners, meaning that while the combination of talker-listener accent remains important for determining accent intelligibility, the L2 proficiency of non-native listeners is also likely to play a role.

One situation where there is a clear relationship between listener proficiency and accent intelligibility is the relative intelligibility of a non-native listener’s own accent and that of a standard native accent. Highly proficient non-native speakers may behave in a similar way to native listeners, in that the standard accent may be more
intelligible than the non-native accent; highly proficient French speakers find SSBE to be more intelligible than French-accented English (Pinet et al., 2011), and a General American accent is more intelligible than the listeners’ own accent for experienced Spanish (Imai et al., 2005), Dutch (van Wijngaarden, Steeneken & Houtgast, 2002) and Chinese listeners (Hayes-Harb et al., 2008). Non-native listeners of slightly less experience may not show this advantage, and instead can find the standard accent equally intelligible to their own non-native accent. This has been found for French-accented English and SSBE for French speakers (Pinet & Iverson, 2010), and for the listeners’ own accent compared to a General American accent for Chinese (Bent & Bradlow, 2003; Xie & Fowler, 2013), Korean (Bent & Bradlow, 2003), Spanish (Imai et al., 2005) and Dutch speakers (van Wijngaarden, 2001). Low proficiency non-native listeners show the opposite pattern to highly proficient listeners, where their own accent is more intelligible than a standard native accent (Pinet & Iverson, 2010; Pinet et al., 2011; Van Wijngaarden et al., 2002; Xie & Fowler, 2013).

This increasing relative intelligibility of a standard native accent as L2 proficiency develops could be accounted for in terms of both familiarity and similarity. More proficient L2 speakers are likely to have had greater exposure to native speech, and so will be more familiar with a standard native accent than less proficient listeners. This means they will have more experience of the L2 sound system, and are more familiar with features which may be more likely to occur in native rather than non-native speech, such as vowel reduction in unstressed syllables in stress-timed languages or a failure to release final stops in continuous speech. A greater awareness of these features could then help listeners to understand standard native accents. Accent similarity could also account for the increasing intelligibility of a standard accent as L2 proficiency develops; speakers tend to become more accurate at producing L2 sounds as their L2 proficiency develops (Burgos et al., 2014) and their accent becomes more similar to that of native speakers (Pinet et al., 2011). As such, it may be easier for listeners to understand the native accent if it more closely matches their own.

When non-native talkers and listeners have different L1s, different patterns of intelligibility may be seen. For fairly proficient listeners, if the speaker’s L1 is similar to their own, this accent can be as intelligible as the listener’s own accent; Chinese
and Korean listeners can find both Chinese and Korean-accented English to be equally intelligible, and at least as intelligible as General American (Bent & Bradlow, 2003). However, if the talker’s L1 is more dissimilar to that of the listener, this accent can be less intelligible, particularly if the talker is of low proficiency; this pattern has been found in English for French speakers listening to Korean and French accents (Pinet et al., 2011), Dutch speakers listening to Dutch and Japanese accents (Weber, Broersma & Aoyagi, 2011), and Korean and Arabic speakers listening to low-proficiency talkers of both accents (Stibbard & Lee, 2006). These differences in accent intelligibility have been proposed to be related to the talkers’ and listeners’ interlanguage, or the knowledge of both the L1 and L2 which speakers apply to the L2. If speakers have the same or similar L1s (e.g.: Chinese and Korean), knowledge relating to the L1 system and its interaction with the L2 system may overlap, meaning that similar features appear in both L2 accents (Bent & Bradlow, 2003). For example, both Chinese and Korean lack the English /æ/ and do not distinguish /ɪ/ and /i:/, which may lead to similar problems in pronouncing these sounds in Chinese- and Korean-accented English (Chang, 2001; Lee, 2001). These variations in the talker’s accent may therefore be familiar to the listener if they also occur in their own accent, and shared features are also likely to mean that the accent of talkers with a similar L1 may be quite acoustically similar to the listener’s accent. If speakers have more dissimilar L1s (e.g.: Arabic and Korean), their interlanguage will overlap to a lesser extent, so different features may occur in the speakers’ L2 accents (Stibbard & Lee, 2006). For example, the vowel inventory of Arabic is much smaller than that of Korean, which can result in very different realisations of English vowels by speakers of these languages (Lee, 2001; Smith, 2001). The accent of a talker with a very different L1 may then be much less familiar, and a lack of shared features could also mean that the accents of the talker and listener may be quite acoustic-phonetically distant.

Regional native accents can also be difficult for non-native listeners to understand; listeners can be less accurate at identifying words in a regional accent than in either a standard native accent or the listeners’ own non-native accent (Northern Irish, SSBE and French-accented English, Pinet et al., 2011; Quebecois French, Standard French and English-accented French, Pinet 2012), and word recognition in an unfamiliar regional accent may be slower than in a standard native accent (Jamaican Mesolect, Cockney English and Standard Australian English, Ying, Shaw & Best, 2013). These
accents may be less intelligible because they are likely to be unfamiliar to non-native listeners as regional accents are less commonly represented in the media and teaching materials. Alternatively, the variation between the accents could also increase the acoustic-phonetic distances between the accents and reduce their intelligibility.

### 3.1.3. Accent intelligibility for talker-listener pairings in the current study

In this study, we presented Standard Southern British English (SSBE), Glaswegian English (GE) and Spanish-accented English (SpE) to groups of English and Spanish listeners. The English listeners also have an SSBE accent, so we could have predicted that they would find the SSBE accent to be more intelligible than the regional GE accent, based on both familiarity and accent similarity. The SpE accent may have been of a similar intelligibility to the GE accent, as found by Adank et al. (2009), or it could have been less intelligible than the other accents; this would likely depend on the accent of these specific Spanish talkers and how close it was to native speech, as listeners were likely to have little familiarity with this accent. It was harder to predict the relative intelligibilities of the accents for the Spanish listeners. They have a high level of proficiency, so it seems unlikely that the SpE accent would have been the most intelligible, but based on comparisons to listener groups in other studies, it was hard to say if the SSBE and SpE accents would be equally intelligible, or if the listeners are of high enough proficiency to show an advantage for the SSBE accent. Although there have been few prior studies investigating the intelligibility of a regional accent for non-native listeners, we could have predicted that the Spanish listeners’ lack of exposure to GE speech may also mean that this accent would be the least intelligible for this group. In addition, while we may have expected these patterns of intelligibility in noise, it is likely that in quiet differences would be much less pronounced, if they are observed at all.

### 3.2. Methods

#### 3.2.1. Listeners

One group of native, monolingual Southern British English listeners, and one group of native Spanish listeners completed the study. All participants were right handed, reported no known hearing, language or learning impairments, and grew up speaking only their native language at home. The 16 English participants (7 female, mean age = 25.25 years, s.d. = 4.20 years, range = 19-32 years) grew up in Southern England and had a Standard Southern British English accent. None had previously lived in
Scotland or Spain. Due to technical problems, one participant’s data were excluded from the analysis. The 16 Spanish participants (12 female, mean age = 19.38 years, s.d. = 2.02 years, range = 18-24 years) were raised in northeast Spain, and none had ever lived in an English-speaking country. All were first or second year students in an English Studies degree at the University of the Basque Country, spoke English at an upper-intermediate or advanced level and had begun learning English between the ages of 5 and 7.

3.2.2. Talkers
The NNSR sentences (Chapter 2) were recorded by 4 talkers (2 male, 2 female) for each of three different accents: Standard Southern British English (SSBE), Glaswegian English (GE), and Spanish-accented English (SpE). SSBE and GE talkers were native, monolingual English speakers, with an accent typical of southeastern England or Glasgow, respectively. SpE talkers were native Spanish speakers from northeastern Spain, and all were in the third year of an English Studies degree at the University of the Basque Country. They spoke English at an upper-intermediate or advanced level, and had begun learning English in primary school between the ages of 5 and 8. Recordings were made digitally in a recording booth at UCL (SSBE talkers and one GE talker), the University of Glasgow (other GE talkers) or the University of the Basque Country (SpE talkers) at a sampling rate of 44100 Hz and with 24 bits per sample. Recordings were normalised to the same mean intensity after completion.

3.2.3. Procedure
Testing took place at UCL (English listeners) or the University of the Basque Country (Spanish listeners). The complete set of 432 neutral NNSR sentences were presented over headphones at a comfortable volume. Sentences were embedded in stationary speech-shaped noise based on the specific talker’s average long-term spectrum at three signal-to-noise ratios (SNRs): +5dB, 0dB and −3dB, and also presented in quiet. Sentences were presented in a random order and were equally distributed across the combinations of talker and noise conditions. For each participant, sentences appeared in only one of these combinations, but between participants sentences were counterbalanced so that each sentence appeared in every accent and at every noise level across the experiment. After each sentence participants repeated the words they understood, and the experimenter recorded the
Table 7: Average sentence and final keyword durations of the neutral sentences presented in each accent in the speech-in-noise recognition task

<table>
<thead>
<tr>
<th>Accent</th>
<th>Sentence duration (s)</th>
<th>Final keyword duration m(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSBE</td>
<td>1.97 (1.15 – 3.27)</td>
<td>0.49 (0.18 – 0.94)</td>
</tr>
<tr>
<td>GE</td>
<td>1.90 (1.00 – 3.83)</td>
<td>0.45 (0.12 – 0.91)</td>
</tr>
<tr>
<td>SpE</td>
<td>2.18 (1.25 – 3.76)</td>
<td>0.47 (0.14 – 0.92)</td>
</tr>
</tbody>
</table>

Where values are in the form: mean (min – max)

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English

number of keywords correctly identified per sentence. Short breaks were given throughout the task. The mean total sentence durations and mean final keyword durations were very similar across the three accents (Table 7).

3.3. Results

The mean proportion of words correctly identified in each accent as a function of noise level is shown in Figure 3.1. Focusing on the accuracy of recognition at the three noise levels suggests that English listeners were more accurate overall than Spanish listeners, and that the intelligibility of the three accents in noise follows different patterns for the two listener groups. Turning to the scores in quiet, as represented by the separate points at the right of the plots, there is less difference in the intelligibility of most of the accents, with average word recognition accuracy over or close to 85%. The exception was the GE accent for Spanish listeners, which had a much lower recognition score of around 60%.

Figure 3.1: Recognition accuracy of SSBE, GE and SpE as a function of noise level for native and non-native listeners

English Listeners

Spanish Listeners

The furthest right data points for each listener group show speech recognition accuracy in quiet.

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
To explore the relationship between accent and recognition accuracy in noise for the English and Spanish listeners, the proportion of words correctly identified in each accent was averaged over the three SNRs for each listener to give average speech-in-noise accuracy levels (Figure 3.2). Sentences presented in quiet were not included in this calculation. Mean accuracy scores for each accent were then entered into a linear mixed-effect model with the fixed effects of accent and listener group (including the interaction term) and by-participant random intercepts. There were significant main effects of accent, $F(2, 62)=161.77$, $p<0.0001$, and listener group, $F(1,31)=100.88$, $p<0.0001$, with the SSBE accent being in general more intelligible than the other accents, and English listeners being more accurate at identifying words than Spanish listeners. There was also a significant interaction between the terms, $F(2, 62)=147.23$, $p<0.0001$. To investigate this interaction further, bonferroni-corrected pairwise contrasts were performed to compare the intelligibility of the three accents for each listener group. These tests confirmed that English listeners were selectively tuned to their own accent; the SSBE accent was more intelligible than the GE accent, and the SpE accent was in turn less intelligible than the GE accent (all three accents were significantly different from each other, $p<0.0001$). For Spanish listeners, the SSBE and SpE accents were equally intelligible in noise ($p=0.671$, n.s.), but both accents were more intelligible than the GE accent ($p<0.0001$).

### 3.4. Discussion

Our findings show a clear effect of talker-listener accent pairing on the intelligibility of an accent in noise. English listeners display a distinct advantage for their own SSBE accent, finding it to be much more intelligible in noise than either of the other accents, even though all three were of a similar intelligibility in quiet. To a lesser extent, this advantage extended to native speech in general, as the GE accent was more intelligible in noise than the SpE accent. This pattern of intelligibility could reflect the listeners’ familiarity with the accents; they will be highly familiar with their own SSBE accent, and less so with the others. However, it is hard to say which of the GE and SpE accents would be most familiar to these listeners. While listeners may have more exposure to GE speech in the media, these listeners reside in London, where there is a large population of Spanish speakers who listeners may interact with. The intelligibility of the accents could also correspond to the level of accent similarity across the talker-listener pairings; the listeners also have an SSBE accent, so this accent will of course be the most similar to their speech, while variations in the
Figure 3.2: Accent intelligibility in noise, with accuracy averaged across SNRs for each listener (excluding quiet)

GE and SpE accents compared to the SSBE accent will make these accents less similar to the listeners’ accent. However, because variations in the GE accent are in general quite systematic and also based on a broadly similar sound system, this accent may be more similar to the listeners’ accent than the SpE accent as this may contain more unsystematic variations and is also influenced by the Spanish sound system. Although there was some overlap in the intelligibility of GE and SpE talkers for these listeners, the intelligibility of individual speakers was not specifically investigated in these analyses, as the current research is focusing more on between, rather than within-accents differences in intelligibility. However, this would be an interesting avenue for further research.

Spanish listeners were less accurate overall at recognising speech in noise than English listeners, which could be expected as they have to cope with the extra demands of listening in an L2, and will also be more adversely affected by the presence of noise than the native listeners (Cooke, García Lecumberri & Barker, 2008). The Spanish group also showed a different pattern of accent intelligibility; these listeners found the SSBE and SpE accents to be equally intelligible, while the GE accent was considerably harder to understand. As they did not show the

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
advantage for a standard native accent which has previously been observed for highly proficient L2 speakers (Imai et al., 2005; Pinet et al., 2011; van Wijngaarden et al., 2002), this suggests that although our listeners are sufficiently proficient to study a degree taught in English, they have not had enough exposure to native English accents in their small Spanish city to allow them to tune to the SSBE accent more selectively. However, as the great majority of English these listeners hear in their daily lives is spoken by other native Spanish speakers, in this case selectively tuning to an SSBE accent may not be necessary and could even be detrimental to the listeners in their more every day interactions.

The difficulty the Spanish listeners faced with the regional GE is consistent with other investigations into regional native accent processing by non-native speakers (Pinet et al., 2011; Pinet, 2012). This accent is unfamiliar to the listeners (none reported any trips to Scotland, or having Scottish friends etc.), which could account for why it was so hard to understand. In addition, the Spanish listener’s interlanguage is likely to contain knowledge relating to a standard English accent, as these accents are commonly represented in the media and in teaching material. As the Scottish sound inventory differs to that of the SSBE accent, and the GE accent also contains features not observed in the SSBE accent (Wells, 1982b), the accents of the Spanish listeners and the GE talkers may be quite acoustically-phonetically dissimilar, which could also contribute to the low intelligibility of this accent.

While the patterns of intelligibility for each of the listener groups are consistent with those found in previous research, it is not clear from these data whether this influence of talker-listener pairing on accent intelligibility stems from differences in the familiarity of the accents to the listeners, or if it can be accounted for by the acoustic-phonetic similarity across the talker-listener combinations. In light of this, the next part of this research went on to further investigate links between accent intelligibility and similarity.
4. Chapter four: The relationship between accent intelligibility and similarity

4.1. Introduction

Listeners’ familiarity with an accent and also the acoustic-phonetic similarity between talkers’ and listeners’ accents seem to be able to account for a range of patterns of accent intelligibility. However, the mechanisms through which accent familiarity and similarity may contribute to the influence of talker-listener pairing on accent intelligibility are likely to differ and may then have different implications for word recognition processes.

Accent familiarity may contribute to the influence of talker-listener pairing on accent intelligibility, by allowing listeners to form multiple exemplars for words in each accent. Although regional listeners may not have much personal interaction with speakers of a standard accent, accents such as SSBE and General American tend to be the media standard in the relevant countries, and as such these listeners may receive high levels of exposure to a standard accent (e.g.: Adank et al., 2009; Clopper & Bradlow, 2008; Sumner & Samuel, 2009). This familiarity may allow listeners to become ‘multi-dialectical’, where they are able to store phonological representations of words in their own accent and also in the standard accent (Sumner & Samuel, 2009). This could account for the asymmetry seen in accent intelligibility across standard-regional accent pairings, as standard listeners will lack regional-accent specific representations, but regional listeners can directly map input onto stored phonological forms that match the features of the relevant accent.

However, even extensive media exposure to a standard accent may not be enough to allow regional listeners to accommodate differences between the standard accent and their own without also having personal contact with speakers of this accent (Evans & Iverson, 2004), and immersion in a regional accent environment also does not seem to be sufficient for standard-accented listeners to form additional long-term representations for the regional accent (Sumner & Samuel, 2009). These findings suggest it is unlikely that regional listeners store multi-accent phonological representations as a matter of course. Accent familiarity also is not able to account for all patterns in accent intelligibility. For example, low-profilency French listeners can
find Korean-accented English to be equally as intelligible as SSBE, where accent familiarity would predict that the SSBE accent would be more intelligible than the unfamiliar Korean accent (Pinet et al., 2011).

Accent similarity may instead influence accent intelligibility through a different mechanism; instead of listeners flexibly processing accents in a multi-dialectal way, listeners may process all accents through their own accent. This may suggest that accents which are more similar to the listener’s own are easier to map to stored phonological representations based on the listener’s accent than accents which are more acoustically-phonetically distant.

Accent similarity is often gauged using subjective perceptual tasks, such as accent free classification, where raters assign speakers to groups based on the similarity of their accents (e.g.: Clopper & Bradlow, 2008, 2009; Clopper & Pisoni, 2007). While this can be useful to explore the factors which influence the perceptual similarity of accents, the classifications can be hard to relate to accent intelligibility as there is a great deal of variability in ratings (Clopper & Bradlow, 2008) and classifications of accent similarity may also be influenced by features which are not directly related to accent, such as a speaker’s gender (Clopper & Pisoni, 2007). Accentedness ratings may also give another subjective measure of accent similarity that is possible to relate to accent intelligibility; listeners from the north of England whose accent was rated as being more similar to a southern accent found SSBE to be more intelligible than listeners who were rated as sounding more northern (Evans & Iverson, 2007). However, perception of accentedness may also be influenced by factors unrelated to accent, such as whether a talker mumbles (Derwing & Munro, 1997), which means such ratings may not be a reliable measure of accent similarity.

Objective measures based on the acoustic-phonetic qualities of speech have recently been used to compare accents, with a number of studies performing formant-based comparisons of vowels in different accents to investigate links between accent similarity and intelligibility. Oder et al., (2013) compared the position of vowels in various American English accents according to their first and second formants (F1 and F2, respectively), and found the Mid-Atlantic accent was more similar to the Midland accent than the Southern accent and also that Mid-Atlantic vowels were more intelligible to Midland listeners than Southern vowels. A similar pattern has
been found for synthesised vowels designed to be equivalent to the F1-F2 positions of vowels in the Pacific Northwest (PNW) accent or to be acoustically close or distant to this accent; PNW listeners found the more distant vowels to be harder to identify than either the close vowels or the PNW vowels (Wright & Souza, 2013). Dutch listeners also had more difficulty understanding German-accented vowels whose F1-F2 position was very different native Dutch vowels than they did when the German-accented vowels had more similar formant frequencies to the native vowel (Witteman, Weber & McQueen, 2013).

Another objective measure of accent similarity is the ACCDIST metric (Huckvale, 2004, 2007), which compares the distance between spectral properties of segments within one speaker’s productions to those of other speakers. Relative, rather than absolute distances are used, so talker-specific features unrelated to accent do not influence the ratings, which avoids some of the issues of subjective measures of accent similarity. ACCDIST can also be applied to a much wider range of speech samples than the isolated vowels in the studies above, so it can be used in studies looking at more global measures of accent intelligibility. Pinet et al. (2011) used ACCDIST to measure the similarity between talker and listener accents in their study of accent intelligibility. For English listeners with an SSBE accent, they found that the similarity of the talkers’ accents to that of the listeners showed a positive relationship with the intelligibility of the accents in noise, with SSBE being both most intelligible and also closest to the listeners’ accent. The non-native accents were least intelligible and also least similar to the listeners’ accent, with the regional Northern-Irish accent intermediate in terms of both intelligibility and accent similarity. A similar pattern was also found for low-proficiency French listeners; French-accented English was most similar to their own accent and most intelligible, Northern Irish English was the most distant and also the least intelligible, and SSBE and Korean-accented English were intermediate both in terms of accent similarity and intelligibility. Higher proficiency French listeners who found the SSBE accent to be more intelligible also showed a higher level of similarity between their own accent and the SSBE accent.

Together, these findings suggest that the intelligibility of accents may be at least in part driven by the similarity of the talker and listener’s accents, although findings are so far limited. To further expand research in this area, this study went on to
investigate the similarity of accents across the talker-listener pairings described in Chapter 3 using the ACCDIST metric, and explored links between these levels of similarity and the patterns of accent intelligibility previously observed.

4.2. Methods
The 16 English and Spanish listeners that participated in the accent intelligibility task (section 3.2.1.) also recorded the first 48 sentences of the predictable NNSR sentences (Appendix 1). These recordings were compared to the same sentences as read by the SSBE, GE and SpE talkers from the accent intelligibility task (section 3.2.2.) using the ACCDIST metric (Huckvale, 2004, 2007) in order to assess the similarity of the talkers' and listeners' accents. In the first stage, an automatic phonetic alignment was performed using the HTK Hidden Markov Modelling Toolkit (1989), whereby hidden Markov models were used to identify the sections of the speech recording that corresponded to each phoneme in a transcription of the sentence. These automatic alignments were then hand checked to ensure phoneme boundaries had been located correctly. In the following analyses, only the segments corresponding to vowels (excluding schwa) were considered.

To measure the similarity of vowel spectra among the talker-listener pairings, the spectral qualities of vowels for each speaker were evaluated by calculating Mel-frequency cepstral coefficients (MFCCs) across the first and second half of each vowel, which are derived using a filter bank approximating the function of the cochlea, giving a more perceptual representation of a signal’s spectral properties (Vergin, O'Shaughnessy & Farhat, 1999). The MFCCs of vowels appearing in repeated tokens of words such as ‘and’ and ‘you’ were averaged across each word, but vowels occurring in different contexts, such as ‘large’ and ‘stars’ were not averaged. An intra-speaker vowel distance table was then computed based on the Euclidian distance between the MFCC vectors of each pair of vowels for each talker and listener. This use of relative rather than absolute distances between vowels normalises speaker-specific differences in production (Huckvale, 2007). The similarity of the accents was then obtained by calculating the correlation between the vowel spectral distance tables of each talker-listener pair. To give a more representative measure of the similarity of a listener’s accent to that of each accent group as a whole rather than to the individual talkers, for each listener the similarity of their vowels to those of the four talkers of each accent were averaged to give the
mean similarity to each of the SSBE, GE and SpE accents.

A measure of accent similarity based on vowel duration was also calculated. For each talker and listener individually, the duration of each vowel token was extracted from the forced alignment data (repeated tokens were not averaged in this case), giving an intra-speaker list of vowel durations. The correlation of these vowel duration lists was then calculated for each talker-listener pair to give a measure of accent similarity. These similarity measures were then averaged across the four talkers of each accent for each listener to give a mean listener-accent similarity in the same way as described above.

4.3. Results

The similarity between the listeners’ accents and the SSBE, GE and SpE accents based on vowel spectral qualities and duration can be seen in Figure 4.1. To confirm which accents were closer to those of the listeners, the level of similarity between each listener-talker accent combination based on both measures of accent similarity were entered into separate linear mixed effects models with talker accent and listener group as fixed effects (also including their interaction term), and by-listener random intercepts.

For talker-listener accent similarity based on vowel spectral qualities, there was a significant effect of listener group, $F(1,32)=29.33$, $p<0.0001$, with the English listeners’ vowels closer in spectral characteristics to the talkers’ accents overall than the Spanish listeners’ vowels (average similarity measures of 34.6% and 26.5% respectively). There was also a significant effect of talker accent, $F(2,64)=88.21$, $p<0.0001$ and a significant interaction between the terms, $F(2,64)=136.46$, $p<0.0001$. Pairwise contrasts (Bonferroni-corrected) showed that the similarity of the three talker accents to the listener accents differed for the two listener groups. English listeners’ vowels were closest to the SSBE accent than the other two accents (both $p<0.0001$), with the GE accent being more similar than the SpE accent ($p=0.0173$). Spanish listeners’ accents were closest to the SpE accent than the other accents (both $p<0.001$), with SSBE more similar than the GE accent ($p=0.0105$). The similarity of talker-listener accent pairings based on vowel duration also showed a significant effect of listener group, $F(1,31)=32.17$, $p<0.0001$, again due to greater similarity between the duration of English listeners’ vowels and those of the talkers than for
Spanish listeners (average similarities of 62.6% and 51.2% respectively). The effect of talker accent was also significant, $F(2,64)=323.85$, $p<0.0001$, along with the interaction between talker accent and listener group, $F(2, 64)=209.76$, $p<0.0001$. Pairwise contrasts (Bonferroni-corrected) again found that the English listeners’ vowel durations were most similar to those in the SSBE accent, then GE and finally SpE (all differences $p<0.0001$). Spanish listeners’ vowels were equally similar in terms of duration to those of the SSBE and SpE accents, and were less similar to the GE vowels ($p<0.001$). In general, listeners’ accents showed a higher level of similarity to the talkers’ accents in terms of vowel duration than vowel spectral similarity.

Comparing accent intelligibility in noise to the similarity between talker and listener accents suggests our data may show a positive correlation between the level of accent similarity across a talker-listener pairing and the intelligibility of an accent for the listener groups (Figure 4.3). To explore this relationship further, word recognition accuracy in noise was entered into a linear mixed effects model, with vowel spectral similarity, vowel duration similarity and listener group as fixed effects and also by-accent and by-listener random intercepts. The two measures of accent similarity were highly correlated, $\rho=0.79$, $p<0.001$, but comparing this full model to reduced models excluding each of the measures in turn showed that vowel spectral similarity, $\chi^2(4)=18.40$, $p=0.0010$, and vowel duration similarity, $\chi^2(4)=25.87$, $p<0.001$, were both able to account for unique variance in speech in noise intelligibility. A three-way interaction between the two accent similarity measures and listener group was also found, $F(1,69)=16.14$, $p=0.001$. Figure 4.3 suggests that this interaction may arise as English listeners seem to show a stronger link between accent intelligibility and similarity than Spanish listeners. To investigate this further, mixed effects models were then constructed for the two groups separately, each containing word recognition accuracy in noise, the fixed effects of vowel spectral and duration similarity and by-accent and by-listener random intercepts. Using a method developed by Nakagawa and Schielzeth (2013), the amount of variance in accent intelligibility accounted for by the fixed effects in each model was then calculated. This showed that for English listeners, accent similarity measures were able to account for around three-quarters of the variation in accent intelligibility, $R^2=0.7408$, compared to only around a third of variance in intelligibility for Spanish listeners, $R^2=0.2948$. 
Figure 4.1: Similarity between listeners’ speech and SSBE, GE and SpE in terms of correlation between relative intra-speaker vowel spectral distances as measured using the ACCDIST metric

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English

Figure 4.2: Similarity between listeners’ speech and SSBE, GE and SpE in terms of correlation in vowel duration

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
Figure 4.3: The relationship between accent intelligibility in noise for SSBE, GE and SpE and the level of acoustic-phonetic similarity between these accents and listeners’ speech in terms of vowel spectral similarity or vowel duration similarity, for both native and non-native listeners.

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
4.4. Discussion

The aim of this study was to explore possible links between the intelligibility of accents in noise across talker-listener pairings and the acoustic-phonetic similarity of speakers’ accents. We found different levels of similarity between the accents of the English and Spanish listeners and the SSBE, GE and SpE talker accents, but evidence of a relationship between accent similarity and intelligibility was seen for both listener groups.

English listeners showed the same pattern of accent similarity in terms of both vowel spectral qualities and duration as observed by Pinet et al. (2011); their accent was most similar to talkers of their own standard native accent, followed by a regional native accent, and was least similar to a non-native accent. This pattern seems to reflect the level of variation between the regional and non-native accents and the listeners’ standard accent; vowels in both accents contain variations compared to the standard accent, but in a regional accent these are based on a broadly similar sound system as the standard accent, and are consistently produced (Wells, 1982a), whereas variations in non-native accents may be more severe as they are based on the interaction of the L1 and L2 sound systems (e.g.: Flege et al., 2003), and can also be rather inconsistent both within and between speakers (Flege et al., 1997; Wade, Jongman, & Sereno, 2007), leading to greater acoustic-phonetic distance to a standard accent.

Spanish listeners showed slightly different patterns of accent similarity across the pairings depending on the measure used. In terms of vowel spectral qualities, the accent of the Spanish listeners was closest to the SpE accent, followed by SSBE and finally the GE accent. As both the Spanish listeners’ and talkers’ representations of the English sound system are influenced the Spanish vowel system, and they also have similar English experiences (they were all studying the same English degree course, in the same Spanish city with little exposure to native English accents), it would be expected that the similarity of this talker-listener pairing would be highest. The similarity between the Spanish listeners’ accent and those of the talkers is in contrast to the pattern shown by the more experienced French listeners in Pinet et al.’s study (2011), whose accent was most similar to that of the SSBE talkers. However, Pinet et al.’s listeners were living in London and so would have had much more experience with the SSBE accent than our Spanish listeners, which may have
helped them develop a more native-like accent. In spite of these differences, in both cases the pattern of similarity across talker-listener pairings was consistent with the intelligibility of the accents for the two listener groups. The similarity of accents based on vowel duration was slightly different, with Spanish listeners’ vowels equally similar in duration to both the SpE and the SSBE accents, and least similar to GE. This finding that the Spanish listeners’ accent was more similar to SSBE in terms of vowel duration than spectral properties may stem from the large spectral differences between the Spanish and English vowel systems; Spanish has only five vowels (Martínez-Celdrán, Fernández-Planas & Carrera-Sabaté, 2003), so usually two or three English vowels can correspond to a single Spanish vowel category, which can cause difficulty distinguishing English vowels (Coe, 2001). In comparison, durational cues may be more salient and so easier for these listeners to acquire.

Although the Spanish listeners have little interaction with native English speakers, most are likely to have learnt English according to an SSBE-based model as teaching materials in Europe are usually based on British English, with mostly SSBE speakers appearing in recordings. This greater familiarity with SSBE may in part account for why it is more similar to the Spanish listeners’ accent than GE. In addition, GE differs to SSBE in terms of both spectral and durational features (Scobbie et al., 1999), so GE may be less intelligible than SSBE if the Spanish listeners’ interlanguage is comprised of features of the Spanish and SSBE vowel systems.

We also found a strong link between accent similarity and intelligibility across the talker-listener pairings, with accents which were more similar to that of the listeners generally being more intelligible than less similar accents; English listeners found their own SSBE accent to be more intelligible than GE, which was more intelligible than SpE. This same SSBE>GE>SpE pattern was also found for the similarity of the accents to the listeners’ own speech, in terms of both vowel spectral properties and duration. Spanish listeners found SpE and SSBE to be equally intelligible and these accents were also equally similar to the listeners’ speech in terms of vowel duration. GE was least intelligible to the Spanish listeners and also the most distant from their speech in terms of both measures of accent similarity. This link between accent similarity and intelligibility may then suggest that listeners process all accents in a fairly inflexible manner, whereby all input is recognised through stored representations related to the listener’s own accent. If an accent matches that of the
listener, or is quite acoustically-phonetically close to it, mapping input to these representations should be easy, and so the accent is more intelligible. For an accent that is more distant to that of the listener, mismatches between the input and the stored representations would make the mapping process more difficult, so word recognition is harder and the accent is less intelligible. Both vowel spectral and durational similarity were able to account for unique variance in accent intelligibility, showing that both cues are important in the mapping process.

Although both listener groups showed a positive relationship between accent similarity and intelligibility, the strength of this relationship was much weaker for the Spanish listeners. This likely reflects the lack of clear distinction between the accents in terms of their similarity to the Spanish listeners’ accent (Figure 4.3). There are also additional difficulties posed by listening in an L2 that may influence the relationship between accent similarity and intelligibility. For example, incomplete knowledge of the L2 sound system and the influence of L1 knowledge can lead to listeners having difficulties discriminating some L2 contrasts. This could then mean that the perceptual similarity of a talker’s accent to a non-native listener’s own accent may also contribute to its intelligibility; phonetic variations in a non-native accent may not impede word recognition by non-native listeners if these variations are perceptually confusable for features of the listeners’ own accent or a native accent (Weber et al., 2011). If input is perceptually similar to a listener’s accent, it may then be easier to map onto stored representations than other variations which are not perceptually confusable but are similarly different in terms of acoustic-phonetic properties. In addition, although listeners tend to become more accurate in both perceiving and producing L2 sounds as their proficiency develops, it seems that gains in perceptual accuracy may often occur before equivalent improvements in production (e.g.: Bradlow, Pisoni, Akahane-Yamada & Tokhura, 1997; Flege et al., 1997). Finally, non-native listeners are also disproportionately affected by the presence of background noise (Cooke et al., 2008). These factors may also contribute to the weaker link between accent intelligibility and similarity seen for non-native listeners.

Overall, accent similarity was able to account for between a third and three-quarters of the variance in accent intelligibility, depending on the listener group. Along with the findings of similar studies (Oder et al., 2013; Pinet et al., 2011; Wright & Souza, 2012), these data provide further support for the hypothesis that talker-listener
accent similarity is an important contributor to accent intelligibility in noise. If this is the case, it may suggest that listeners are rather inflexible and process all accents through stored representations relevant to their own accents. This would be consistent with findings that listeners show rather little change in their vowel best exemplar locations (Evans & Iverson, 2007) and don’t seem to form new representations relating to a regional accent that differs to their own (Sumner & Samuel, 2009) even after extensive exposure to an accent.

However, listeners do show some flexibility in their speech perception, and are able to retune phoneme category boundaries in response to specific variations in speech. For example, when either /l/ or /s/ is replaced with an ambiguous fricative midway between /l/ and /s/, listeners are able to retune the relevant /l/ or /s/ category (depending on which phoneme is replaced) to accommodate this ambiguous phoneme (McQueen, Cutler & Norris, 2006; Norris, McQueen & Cutler, 2003). This category retuning occurs even when the manipulation appears in the context of a global non-native accent (Reinisch & Holt, 2014), and has also been observed in response to systematic variations in vowel height (Maye, Ashlin & Tannenhaus, 2008). Nonetheless, this flexibility in processing is limited; category retuning seems to be largely talker-specific, or at least limited to speakers whose voice is similar to that of the speaker listeners were initially exposed to (Eisner & McQueen, 2005; Maye et al., 2008), and does not occur if the variation is a context-specific dialect feature rather than a context-independent feature of a talker’s speech (Kraljic, Brennan & Samuel, 2008). In light of these findings, this surface flexibility may be a mechanism to allow listeners to cope with idiosyncratic features of individual talkers’ speech, rather than reflecting a more general level of flexibility in accent accommodation. The retuning of categories also generalises to new words where the variation was not previously heard, showing this flexibility is not a result of the formation of new stored representations to accommodate these variations (McQueen et al., 2006). This may also suggest that listeners continue to process the variant forms through their own stored presentations.

Although these findings suggest that listeners may show a long-term inflexibility in their processing of accented speech, in some cases listeners seem able to process multiple accents with ease, at least at a surface level (Adank et al., 2009; Sumner & Samuel, 2009). As such, accent familiarity may contribute to determining accent
intelligibility across talker-listener pairings along with accent similarity. Listeners may process all accents through stored representations relating to their own accent, with the level of similarity between accents giving a ‘baseline’ intelligibility for the talker’s accent based on how difficult input is to map to the listener’s existing stored representations. Familiarity with an accent may then allow listeners to learn how to better perform this mapping process, allowing some perceptual flexibility in processing accented speech. For example, in the lexically guided category retuning studies described above, listeners could use the context that the variant form appeared in to map it to their own stored representations.
5. Chapter five: Electrophysiological responses to accented speech in quiet

5.1. Introduction

The importance of the talker-listener pairing for the intelligibility of an accent in noise is clear. However, when speech is presented in quiet conditions, this relationship often breaks down, and differences that are robust in noise may not be observed. For example, Adank et al. (2009) found that although English listeners found the unfamiliar Glaswegian accent to be less intelligible than their own SSBE accent in noise, the accents were equally intelligible in quiet. Pinet et al.’s (2011) findings also suggest that native English and French-English bilingual listeners find SSBE, Northern-Irish, French and Korean accents all to be highly intelligible in quiet, even though they show distinct tuning to the SSBE accent in noise (but note that accuracy in quiet was not specifically analysed). For less proficient French speakers, it appears that there is some difference in the intelligibility of the accents in quiet, but this is less pronounced than the pattern seen in noise. Some studies have reported significant differences in the intelligibility of accents in quiet, but in each case other adverse conditions which may impede speech processing were also present; for native listeners, non-native accents may be less intelligible than a native accent in quiet for anomalous sentences (Behrman & Akhund, 2015) or isolated words (Hayes-Harb & Watzinger-Tharp, 2012), as contextual information is not available, and also if the talker has low L2 proficiency (Stibbard & Lee, 2006) which further increases the acoustic-phonetic variation present in the speech.

If differences in accent intelligibility across talker-listener combinations arise only in the presence of background noise or other adverse conditions, this may suggest that processing difficulties caused by accented speech arise specifically as an interaction with noise and are not present in quiet. Background noise masks parts of the speech signal, so listeners must use ‘glimpses’ of the signal where the SNR is temporarily favourable enough in order to understand speech (Cooke, 2006). While the segmental and suprasegmental variation in accented speech may not be severe enough to disrupt processing in quiet conditions, when listeners have to rely on these glimpses of the speech signal, they may not be able to compensate for this variation, resulting in differing levels of accent intelligibility in noise. However, accent
intelligibility tends to be measured using tasks such as word recognition accuracy scores, or the response times of lexical decision or other speeded judgement tasks. These tasks give only a measure of the outcome of word recognition processes, so it may be possible that accented speech can disrupt processing in quiet conditions, but that the difficulties caused are not severe enough to prevent successful word recognition. This means differences in accent intelligibility in quiet may not be identified by outcome-based tasks unless other adverse conditions are present which further increase processing difficulties and cause word recognition to begin to break down.

Instead of these outcome-based measures of word recognition, there are also online measures which could be useful to investigate accent-related processing difficulties. Eye-tracking studies that give a measure of ongoing word recognition processes suggest that the talker-listener pairing may be influential even in quiet conditions. For example, listeners do not rule out competitors in French-accented English as quickly as in their own American English accent (Trude et al., 2013), and suprasegmental errors in Hungarian-accented Dutch also cause native listeners to be slower to rule out competitors, even after the target word is identifiable based on its segmental properties (Reinsch & Weber, 2012). Word recognition accuracy in both cases was very high (over 95%), which lends support to the hypothesis that processing difficulties related to talker-listener accent pairing are present even in quiet conditions, but are difficult to observe using common behavioural tasks.

Recently, electrophysiological measures (EEG) of word recognition have also been used to further investigate accent-related processing difficulties in quiet. There are two particular EEG components related to word recognition that may be influenced by global features of accented speech, rather than specific segmental variations; the Phonological Mapping Negativity (PMN) and the N400 effect. The PMN is a relative negativity occurring around 200-350ms after critical word onset, and is caused by input which mismatches phonological expectations about an upcoming word (e.g.: Connolly & Phillips, 1994; Diaz & Swaab, 2007; Newman & Connolly, 2009). The N400 effect is also a relative negativity, but peaks around 400ms after critical word onset, and is elicited by violations of semantic expectations related to upcoming words (Kutas & Hillyard, 1984). For both the PMN and N400, words which cause greater violations of these expectations lead to more negative responses.
Table 8: Situations that may elicit the PMN and N400 effect

<table>
<thead>
<tr>
<th>Key word</th>
<th>Phonological mismatch</th>
<th>Semantic mismatch</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like my coffee</td>
<td>cream</td>
<td></td>
<td>Baseline (fully expected)</td>
</tr>
<tr>
<td>with sugar</td>
<td>crime</td>
<td>x</td>
<td>N400</td>
</tr>
<tr>
<td>and...</td>
<td>milk</td>
<td>x</td>
<td>PMN</td>
</tr>
<tr>
<td></td>
<td>meat</td>
<td>x</td>
<td>PMN &amp; N400</td>
</tr>
</tbody>
</table>

(e.g.: Connolly, Phillips, Stewart & Brake, 1992). Phonological and semantic expectations are created by the context which precedes the critical word, either through priming or more commonly through a highly constrained sentence context that leads listeners to expect a particular word to complete the sentence. Input which does not match this predicted word causes violations of the phonological and semantic expectations created, which gives rises to the PMN and N400 effect (see Table 8 for examples of situations where the PMN and N400 effects may be elicited). These features mean the PMN and N400 are useful components for investigating the presence of accent-related processing difficulties in quiet; if the same sentences are presented in each accent, the extent to which the final key word violates expectations based on the linguistic content of the sentence will be equivalent across accents, so any differences observed in the PMN and N400 effects would then be attributable to features specific to the accent of the talker and would then suggest that the talker-listener accent pairing does influence word recognition in quiet.

Recently, a number of studies have begun to explore the influence of accented speech in quiet on the PMN and N400 effect. In a study focusing on regional accents, Brunelliére and Soto-Faraco (2013) found that native Catalan speakers showed clear a PMN and N400 effect in response to phonological and semantic anomalies in their own Eastern accent, and also in the regional Western accent. The PMN appears to be smaller for the regional accent, but the relative sizes of the responses in the two accents were not specifically compared, so we do not know whether the responses actually differ for the two accents. Other studies do provide some evidence that the talker-listener pairing can influence speech processing in quiet conditions. Native listeners have been found to show a smaller PMN in response to a regional accent.
compared to their own accent, and an even smaller response to a non-native accent. No difference was found in the N400 effects in response to the listeners’ own accent and a regional accent, but responses to a non-native accent were smaller (Goslin et al., 2012). As the non-native accent elicited a smaller PMN and N400, compared to just a smaller PMN for a regional accent, this could suggest that the difficulties caused by a non-native accent are more long-lived and are harder to compensate for. However, it seems that this may not be the case in all situations; Dutch listeners show equivalent N400 effects in response to semantic violations in a native Dutch accent and Turkish-accented Dutch (Hanuliková et al., 2012), and Spanish listeners have exhibited a larger N400 effect in response to violations in a mixed group of non-native accents when compared to a native Spanish accent (Romero-Rivas et al., in press). While inconclusive, these findings do seem to suggest that the talker-listener accent pairing is able to influence the PMN and N400 effects in quiet, and so could reveal differences in accent processing in quiet conditions that are difficult to observe behaviourally.

The aim of this part of the study were to further explore whether talker-listener pairings influences word recognition processes in quiet conditions by investigating the online PMN and N400 responses to different accents. To expand on the limited research conducted so far in this area and explore a wider variety of talker-listener combinations, we presented a standard native (SSBE), regional native (GE) and non-native (SpE) accent to English and Spanish listener groups.

5.2. Methods

5.2.1. Listeners and talkers

The same English and Spanish listeners who participated in the speech in noise task (section 3.2.1.) also completed this EEG task. They also heard the same SSBE, GE and SpE talkers (section 3.2.2.). One English listener’s EEG data were excluded due to technical problems.

5.2.2. Procedure

Testing took place at UCL (English listeners) or the University of the Basque Country (Spanish listeners), between one and four days before the speech in noise recognition task. Listeners were presented with 216 predictable and 216 anomalous sentences from the NNSR sentences (from different sentence triplets) in quiet, with
an equal number occurring in each accent. Sentences were presented in a random order, and conditions were counterbalanced so that each sentence appeared in both sentence conditions and in each accent across the experiment. Mean total sentence durations and final keyword durations of the predictable and anomalous sentences in each accent presented were also fairly similar, except for both sentence conditions the GE sentences and final keywords were slightly shorter in duration (Table 9). The speech in noise task used the neutral sentences, so listeners did not hear repeated sentences across the tasks, although listeners heard two sentences from each triplet in different accents across the tasks (e.g.: A0101 in SSBE in the ERP experiment and B0101 in GE in the speech in noise task).

Stimuli were presented binaurally through shielded insert earphones at the same volume for each subject. Each stimulus consisted of a short beep followed by 1000ms of silence and then a sentence. This was followed by 750ms of silence and then a second, longer beep (Figure 5.1). The next stimulus was presented after a response from the participant (see below). The relevant ERP data was recorded during an 800ms epoch time-locked to the onset of the final word of the sentence, so this second silence ensured that the responses were recorded before the next sentence was presented. Participants were asked to blink when they heard the first beep of the stimulus, and to try not to blink again until the second beep to attempt to minimise artifacts relating to eye movement. To ensure participants attended to the sentences, they were asked to decide if the final word of each sentence matched the context, and pressed a corresponding button (labelled “yes” or “no”) on a keyboard held on their lap after the second beep at the end of each stimulus. The next stimulus was presented after this response. Before starting the main task, a short training task with 4 sentences in each accent was given to familiarise participants with the experimental procedure. These sentences were not repeated in the main task. Short breaks were given after every 50 sentences.

5.2.3. EEG methods

EEG recordings were made from 64 Ag-AgCl active electrodes (BioSemi) arranged according to the 10/20 system, along with electrodes placed above and below the left eye and electrodes adjacent to the external canthus of each eye. Data were collected at a sampling rate of 2048Hz, and online referenced to the left mastoid, filtered with a low-pass cut-off of 100Hz and a high-pass cut-off of 0.16Hz. Unless otherwise
Figure 5.1: Diagram showing the structure of stimuli presented in the ERP task and the EEG recording window of interest

Where blue boxes denote the auditory stimulus components presented to participants and the purple box denotes the time window where the relevant EEG data were recorded. The start of this window was time-locked to the onset of the final word of the sentence, marked by the dashed green line.

Table 9: Average sentence and final keyword durations of the predictable and anomalous sentences for each accent presented in the EEG task

<table>
<thead>
<tr>
<th>Predictable Sentences</th>
<th>Accent</th>
<th>Sentence duration (s)</th>
<th>Final keyword duration m(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSBE</td>
<td>2.09 (1.13 – 3.53)</td>
<td>0.51 (0.22 – 1.00)</td>
<td></td>
</tr>
<tr>
<td>GE</td>
<td>1.90 (1.08 – 3.57)</td>
<td>0.46 (0.18 – 1.00)</td>
<td></td>
</tr>
<tr>
<td>SpE</td>
<td>2.32 (1.20 – 4.19)</td>
<td>0.50 (0.14 – 0.97)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anomalous Sentences</th>
<th>Accent</th>
<th>Sentence duration (s)</th>
<th>Final keyword duration m(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSBE</td>
<td>2.12 (1.23 – 3.60)</td>
<td>0.52 (0.23 – 0.99)</td>
<td></td>
</tr>
<tr>
<td>GE</td>
<td>1.93 (1.20 – 3.36)</td>
<td>0.48 (0.17 – 0.90)</td>
<td></td>
</tr>
<tr>
<td>SpE</td>
<td>2.29 (1.33 – 4.04)</td>
<td>0.51 (0.20 – 1.00)</td>
<td></td>
</tr>
</tbody>
</table>

Where values are in the form: mean (min – max)

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
specified, data were analysed using SPM8 (Litvak et al., 2008). Data were re-referenced offline to an electrode on the tip of the nose, high-pass filtered with a cut-off of 0.5Hz, then low-pass filtered with a cut-off of 30Hz before being downsampled to 512Hz. Artifacts related to eye-movements in continuous data were corrected for using independent component analysis (ICA; EEGLAB, Delorme & Makeig, 2004), and then data relating to each sentence was extracted in 1000ms epochs time-locked to the onset of the final keyword (200ms pre-stimulus baseline, 800ms post-stimulus onset). Any trials that still contained artifacts exceeding a threshold of ±150µV were rejected (an average of 10.87 trials per English listener and 11.31 trials per Spanish listener). Remaining trials were averaged over each combination of accent and sentence condition for each participant. Grand-average difference waveforms were also calculated for each accent by subtracting responses to predictable sentences (averaged over participants) from those to anomalous sentences.

5.3. Results

Scalpmaps showing grand average responses averaged across the time windows corresponding to the PMN (Figure 5.2a) and N400 effect (Figure 5.2b) for the English and Spanish listeners suggest that there may be some differences in the responses to the three accents in quiet conditions. To investigate the distribution of responses across the scalp, a regional analysis was performed. Grand average difference waveforms for each listener group and accent were first averaged across the time windows corresponding to the PMN (200-350ms) and N400 (350-500ms).

As the responses at neighbouring electrodes are not independent of each other, responses were then averaged over electrodes within nine regions of interest (Figure 5.3) to avoid over-inflating any effects. Mean responses at each ROI were entered into ANOVAs for each listener group and time window separately. During the early time window, English listeners showed a significant effect of ROI on PMN amplitude, F(8,16)=3.02, p=0.0284, with the strongest responses concentrated over the midline regions and also less strongly over right fronto-central regions. Spanish listeners however did not show a significant effect of ROI. The usual distribution of the PMN is a frontal-central distribution evenly spread over the left and right hemispheres (e.g.: Newman, Connolly, Service & McIvor, 2003), and as we did not find this distribution for either listener group, this may suggest that a PMN effect was not reliably elicited in this study. Turning to the N400 effect, a significant effect
Figure 5.2a: Scalpmaps showing grand-average differences between responses to anomalous and predictable final words in SSBE, GE and SpE for native and non-native listeners during the PMN time window (200-350ms)
Figure 5.2b: Scalpmaps showing grand-average differences between responses to anomalous and predictable final words in SSBE, GE and SpE for native and non-native listeners during the N400 time window (350-500 ms)
of ROI was seen for both English listeners, $F(8,16)=4.76$, $p=0.0039$, and Spanish listeners, $F(8,16)=3.89$, $p=0.0100$. The strongest effects were exhibited at the midline/central region for English listeners and at the midline/central and midline/parietal regions for Spanish listeners. The N400 is usually concentrated over centro-parietal sites (see Kutas & Federmeier, 2011 for review), so these results suggest the study successfully elicited the N400 effect for both listener groups.

Based on the findings of the regional analyses, further analyses of the PMN and N400 effects in response to the three accents focused on the Cz electrode (Figure 5.4). The PMN effect for each accent was calculated by averaging the amplitude of
responses in each sentence condition across the 200-350ms time window, and then subtracting the mean amplitude for predictable sentences from that of anomalous sentences. The PMN is negative going throughout the response, but during the N400 time window, responses are first negative going, and then begin to return to baseline. Inspection of each participant’s difference waveforms at Cz suggested individual differences in the latency of the negative peak and also in the rate of return to baseline, which could obscure differences in the N400 effect between participants if responses are averaged across the whole time window. To avoid this, the N400 effect was calculated based on each participant’s average latency across all accents. The latency was determined by first constructing a difference wave for each accent across the 350-500ms time window by subtracting responses to predictable sentences from those to anomalous sentences at each sample, and then averaging across the three accents to give a mean N400 response across all accents. The most negative amplitude within the window was identified, and this time point used as that participant’s N400 latency. The N400 effect for each accent was then calculated at this latency by subtracting the amplitude of the response to predictable sentences at that time point from the response to anomalous sentences. PMN and N400 effect amplitudes were then entered into separate linear mixed-effects models containing the fixed effects of accent and listener group (with their interaction term) and by-participant random intercepts.

5.3.1. PMN (200-350ms)

The PMN effect at Cz by accent for each listener group can be seen in Figure 5.5. Significant effects of accent, F(2, 93)=6.04, p=0.0034, and listener group, F(1,93)=4.94, p=0.0286, were found, with larger responses for English listeners than for Spanish listeners. No significant interaction between the terms was found.

Responses seemed rather small (Figure 5.5), so to explore the PMN effect further, average amplitudes in response to the anomalous and predictable sentences over the 200-350ms time window were entered separately into another mixed effects model, with sentence type, listener group and accent as fixed effects and by-participant random intercepts. No significant main effects were found, but significant two-way interactions were seen between sentence type and accent, F(2,155)=6.12, p=0.003, sentence type and listener group, F(1,155)=5.01, p=0.0275, and accent and listener group, F(2,155)=6.47, p=0.0020. Pairwise comparisons (Bonferroni-corrected)
showed that these interactions arise as the only significant difference between responses to anomalous and predictable key words occurred in response to SSBE for English listeners (p=0.0017). This means that a significant PMN effect is seen only for the talker-listener pairing of SSBE accent-English listener, suggesting that there may need to be a match between talker and listener accent to elicit a PMN response. This is consistent with the weak ROI results discussed above.

5.3.2. N400 (350-500ms)

The average latency of the N400 differed between the two groups; 434ms post final word onset for the English listeners, compared to 468ms for the Spanish listeners, t(62) = -5.21, p<0.0001. The N400 effect by accent for each listener group is shown in Figure 5.6. Again, significant effects of accent, F(2, 95)=8.20, p=0.0005, and listener group, F(1, 95)=8.17, p=0.0052, were found, with no significant interaction. Overall, Spanish listeners showed smaller N400 effects compared to the English listeners, but both listener groups show the same general pattern in N400 magnitude; the largest N400 effect was in response to the SSBE accent, followed by the SpE accent and a weaker still N400 for the GE accent. In both cases, the N400 effect response to the SE accent is significantly larger than that for the GE accent (English listeners, p=0.0267; Spanish listeners, p=0.0010). The response to the SpE accent is in between those to the SSBE and GE accents for English listeners, and is not significantly different to either, but for the Spanish listeners it is more similar to the N400 effect for the SSBE accent, and is also significantly larger than the response to the GE accent (p=0.0393).

To explore the N400 effect further, amplitudes for anomalous and predictable sentences at each participants’ N400 latency were entered into another mixed effect model with sentence type, listener group and accent as fixed effects and by-participant random intercepts. A significant main effect of sentence type was found, F(1,155)=62.93, p<0.0001, with more negative responses to anomalous final keywords. Significant two-way interactions were also found between sentence type and accent, F(2,155)=7.57, p=0.0007, and between sentence type and group, F(1,155)=7.54, p=0.0067, with larger differences in responses to predictable and anomalous sentences for English listeners. Bonferroni-corrected pairwise comparisons showed significant differences between responses to anomalous and predictable keywords for all accents for English listeners (all p<0.05), and for SSBE
Figure 5.4: Grand-average waveforms showing differences in responses to anomalous and predictable final words in SSBE, GE and SpE for native and non-native listeners.

**English listeners**

![Waveforms for English listeners](image1)

**Spanish listeners**

![Waveforms for Spanish listeners](image2)

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English  
VEOG = Vertical electrooculogram, HEOG = Horizontal electrooculogram.
Figure 5.5: PMN responses at Cz to SSBE, GE and SpE in quiet for native and non-native listeners

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English

Figure 5.6: N400 responses at Cz to SSBE, GE and SpE in quiet for native and non-native listeners

SSBE = Standard Southern British English, GE = Glaswegian English, SpE = Spanish-accented English
for Spanish listeners (p<0.001). The N400 effect in response to SpE for the Spanish listeners was marginally significant (p=0.0764), but no effect was found in response to GE (p=1.0000, n.s.). As an N400 effect was seen for all talker-listener combinations except for the GE accent-Spanish listener pairing, this suggests that the N400 effect may be more flexibly influenced by the talker-listener accent combination than the PMN. The N400 effect for Spanish listeners in response to SpE was weak, but this may reflect the slightly small sample size in this study and may have been more robust if more participants had been tested.

5.3.3. The relationship between the N400 and accent intelligibility

To further investigate the relationship between EEG responses and accent intelligibility, average word recognition scores in quiet and in noise were entered into separate linear mixed effects models with the fixed effect of N400 response amplitude and by-listener group random intercepts. PMN amplitude was not entered into these models as we did not find a reliable PMN for most talker-listener pairings.

N400 amplitude showed a significant relationship with accent intelligibility in quiet, $F(1, 88)=5.49$, $p=0.0214$ and also accent intelligibility in noise, $F(1, 75)=6.92$, $p=0.0103$. However, N400 effect size was able to account for more variance in intelligibility when speech was presented in quiet, $R^2=0.091$, than in noise, $R^2=0.039$. In both cases, the amount of variance in intelligibility accounted for by N400 amplitudes was very small, suggesting the N400 reflects only some of the processes which contribute to accent intelligibility.

5.4. Discussion

The aim of this study was to investigate whether an influence of talker-listener pairing could be observed in quiet conditions. To do this, we compared English and Spanish listeners’ EEG responses to SSBE, GE and SpE accents during time windows corresponding to the PMN and N400 effect. These responses are elicited by phonological and semantic anomalies, respectively (e.g.: Connolly & Philips, 1994), but as the same linguistic content was presented in each accent, any resulting differences in the PMN and N400 for the listener groups could then be attributed to properties of the speech, rather than to sentence content. We found overall effects of listener background and talker accent on the presence and amplitude of the PMN and N400 effect, with smaller overall responses by Spanish listeners and to the GE
and SpE accents.

The PMN seems to be particularly dependent on a match in the talker-listener combination, even in quiet conditions. We found a reliable PMN response only for the SSBE accent-English listener pairing, suggesting that even if accented speech is highly intelligible in quiet, earlier phonological processing stages can be severely affected by mismatches between the talker’s accent and that of the listener. However, there seem to be some situations where a mismatching accent can elicit a PMN, as Brunelliére and Soto-Faraco (2013) found a clear PMN response for the listeners’ own accent and also a regional accent. The distinction between these accents seems to be based on quite minor differences in the application of vowel reduction, so in this case the regional accent may be similar enough to the listeners’ own accent to be processed in a similar way and also elicit a PMN response. This study did find some evidence that listeners do not form fine phonological expectations in the regional accent though, as a PMN was not elicited when the accent changed from the regional to the listeners’ own accent on the final word of the sentence, but was elicited with the reverse manipulation. Goslin et al. (2012) also reported differences in responses during the time window corresponding to the PMN for regional and non-native accents compared to the listeners’ accent. However, the methodology used differs to that of the current study and other ERP studies mentioned; this study measured absolute responses to fairly neutral sentences rather than using the more standard methodology which is to calculate the relative differences between responses to anomalous and predictable words. This makes it difficult to compare the findings of the current study to Goslin et al.’s (2012) findings.

During the later time window, we found that Spanish listeners showed a longer latency of the N400 effect than English listeners. This is consistent with the findings of a number of other studies, and may reflect the greater difficulty of speech processing for non-native listeners (e.g.: Hahne, 2001; Newman, Tremblay, Nichols, Neville & Ullman, 2012; Weber-Fox & Neville, 1996). Spanish listeners also showed smaller N400 effects overall than the English listeners, a pattern which again has also been found previously (auditory N400: Hahne, 2001; Hanhe & Friederici, 2001; visual N400: Martin et al., 2013; Newman et al., 2012). Despite these group differences, we found very similar patterns of responses for both listener groups, with the largest N400 effects overall in response to the SSBE accent, followed by SpE and
finally the GE accent. That the Spanish listeners also showed this pattern is interesting, as it may suggest that listeners form expectations based on SSBE, rather than their own SpE accent. This in turn could suggest that the listeners are beginning to tune their English word representations to a native accent, even though they are not able to produce a native-like accent. The N400 effect also seems to be more robust to accented speech than the PMN, with responses observed for all pairings except the GE accent for Spanish listeners. The greater flexibility of N400 effect responses across the talker-listener pairings than seen for the PMN may suggest that lexical integration processes are better able to accommodate differences among accents than phonological processes. N400 amplitudes also showed closer links to accent intelligibility in quiet than in noise. Together, these findings provide further support that the talker-listener accent pairing influences word recognition processes in quiet, even though this is hard to observe using behavioural methods. It should be noted that our findings differ to those of some previous studies; Goslin et al. (2012) found equivalent responses to the listeners’ own accent and a regional accent, with smaller responses to a non-native accent (using the same methodology as described for the PMN), but Romero-Rivas et al. (in press) found larger responses to non-native accents than the listeners’ own accent and Hanulíková et al. (2012) did not find any differences in N400 effect size in response to a native or a non-native accent. These inconsistencies could result from the specific talker-listener pairings in the studies, or perhaps from differences in methodology such as differences in the number of talkers appearing in the studies or differences in methods of calculating the N400 effect. However, even with the different patterns of results across the studies, findings do seem to suggest that there are differences in accent processing in quiet conditions.

In general, PMN and N400 effects are elicited in response to input which conflicts with expected phonological or semantic forms, respectively. The conflicting input may be harder to map onto activated lexical candidates than the expected form, meaning lexical integration is more effortful and resulting in larger responses (Brown & Hagoort, 1993). Applying this to the current study, acoustic-phonetic variation in accented speech could be expected to mean that anomalous words cause greater conflict with expected forms than in a standard accent, causing further lexical integration difficulties and increasing PMN and N400 effects. However, the opposite pattern was observed in this study, and PMN and N400 effects for accented speech
were smaller than responses to a standard accent, and in some cases were not observed at all. This could instead suggest that listeners form weaker expectations in response to accented speech, meaning that predictable words are less expected and anomalous words are less unexpected than in a standard accent, leading to smaller PMN and N400 effects. Spanish listeners’ responses were also smaller than those of English listeners, suggesting that their expectations may also be weakened as a result of listening in an L2. Non-native listeners are less able to use contextual information to recognise words than native listeners (Bradlow & Alexander, 2007; Mayo et al., 1997; Shi, 2014), and also experience more diffuse activation of lexical competitors during word recognition (e.g.: Broersma, 2012; Broersma & Cutler, 2011; Weber & Cutler, 2004), in addition to having incomplete language knowledge of the L2. All these factors may mean that non-native listeners are less able to form fine phonological and semantic expectations about upcoming words than native listeners.

Weaker expectations may be formed about upcoming words in accented speech because the acoustic-phonetic variations in regional and non-native accents compared to a standard accent can cause difficulties identifying words and also lead to lexical uncertainty (see Mattys, Davis, Bradlow & Scott, 2012 for a review). Artificially degraded speech that causes similar processing difficulties elicits reduced N400 effects compared to clear speech, with less intelligible speech generally leading to smaller responses (Aydellott, Dick & Mills, 2006; Boulenger, Hoen, Jacquier & Meunier, 2011; Obleser & Kotz, 2011; Strauß, Kotz & Obleser, 2013). The reduced intelligibility of degraded speech may limit listeners’ access to the semantic information in a sentence, meaning the context is less clearly defined. Listeners’ semantic expectations about upcoming words will then be weaker, resulting in smaller N400 effects (Aydellott et al., 2006). Phonological expectations may be affected in the same way, as the only study to report findings during the PMN time window found a PMN effect for clear, but not degraded speech (Strauß et al., 2013). Our results generally follow this pattern, with smaller N400 responses to the less intelligible GE and SpE accents than for the SSBE accent, and a reliable PMN seen only for the most intelligible accent, which could suggest expectations are weakened by accented speech in a similar way. However, the accents presented in this study were generally highly intelligible in quiet, and we also found little link between N400 amplitude and accent intelligibility, so it seems unlikely that this is the only mechanism through which accents influence the PMN and N400. However, the GE
accent was difficult for the Spanish listeners to understand even in quiet, so
difficulties accessing the content of the sentences could contribute to the lack of
PMN and N400 effects seen for this talker-listener pairing.

Listeners’ expectations about upcoming words may also be influenced by global
knowledge based on a talker’s accent. Previous knowledge of a talker’s accent can
affect listeners’ speech perception, with just the suggestion that a speaker has a
particular native accent (Hay, Nolan & Drager, 2006; Niedzielski, 1999) or is a non-
native speaker (Hu & Lindemann 2009; Rubin, 1992) influencing listeners’
judgements, even if the same talker is heard in all “accents”. Listeners also seem to
expect non-native speech to contain more variation or a greater number of errors
compared to a standard native accent; listeners are more tolerant of phonological
errors in non-native speech than in native speech (Schmid & Yeni-Komshian, 1999)
and process it in less detail (Lev-Ari & Keysar, 2012), and syntactic errors elicit a
P600 effect in native speech, but not in non-native speech where they may be less
unexpected (Hanulíková et al., 2012). Expectations formed about upcoming words
are also influenced by listeners’ prior knowledge or biases about a talker; a mismatch
between input and expectations based on a speaker’s age, gender or social class can
elicit N400 effects without a semantic anomaly (e.g.: if a child says “I should stop
smoking”, Van Berkum, van den Brink, Tesink, Kos & Hagoort, 2008), and smaller
N400 effects occur if semantic anomalies are congruent with prior knowledge of a
character (e.g.: “The Hulk picked up the lorry”, Filik & Leuthold, 2013). It could
then be expected that listeners are also influenced by their prior knowledge and
biases when forming expectations about accented speech. If listeners expect more
variation, they may form less defined expectations about upcoming words in order to
accommodate this increased level of ambiguity in accented speech. This would mean
that predictable words conform less to expectations and anomalous words violate
expectations less, leading to smaller PMN and N400 effects.

Whether weaker expectations arise because of difficulties accessing the context of
sentences or due to the influence of listeners’ prior experiences of accented speech,
our findings suggest that phonological and semantic expectations may also depend on
the talker-listener pairing, even in quiet conditions. Phonological expectations were
severely affected by accented speech; English listeners showed a clear PMN only for
their own SSBE accent and Spanish listeners showed no PMN at all. This could
suggest that listeners may be too uncertain about the phonological variation in unfamiliar regional and non-native accents to be able to form detailed phonological expectations about accents that are different to their own. This requirement that accents either match or be very similar to the listener’s own in order to elicit a PMN response (Brunelliére & Soto-Faraco, 2013) may also provide further support for the hypothesis that accent similarity is important in determining accent intelligibility. Semantic expectations seem to be more robust across talker-listener pairings, as more flexibility was seen in N400 effects across talker-listener combinations. This may be because semantic forms are less specific to accent than phonological forms, and so may be less affected by mismatches between talker and listener accent.

Forming weaker expectations in relation to accented speech could also be a compensatory mechanism to accommodate the ambiguity associated with accented speech, possibly by limiting the occurrence of costly repair processes. Minor variation or errors in accented speech may not inhibit successful communication, and as these errors may not necessarily require repair, weaker expectations could allow them to be overlooked (Hanulíková et al., 2012) in order to maintain efficiency in processing. Less clearly defined expectations could also allow more severe variations in speech to occur without triggering repair processes. For example, if a speaker uses “glass” when “cup” would be correct, repair may not be necessary if a listener expects “something to drink from” rather than something more specific to the features of a cup, as the input can still be mapped to this less constrained representation (Lev-Ari & Keysar, 2012). Listeners have also been found to show slight delays in word recognition processes if a signal is unreliable, because confidence in having correctly identified the input is weaker (McQueen & Huetting, 2012; Trude et al., 2013). This delay may allow listeners to avoid prematurely identifying words and then needing to apply repair processes if later input contradicts this judgement. Forming weaker expectations may be analogous to this process, allowing listeners to avoid incorrectly identifying words. While forming weaker expectations about upcoming words may protect listeners from unnecessary repair processes or premature word recognition, this mechanism may still introduce some processing inefficiency. More predictable words are more intelligible than neutral or anomalous words (e.g.: Bradlow & Alexander, 2007; Clopper, 2012; Kalikow et al., 1977), possibly as having strong expectations about upcoming words facilitates the activation of relevant lexical candidates and means input is more easily mapped to representations of the
predictable word (Aydelott & Bates, 2004). Weaker expectations may mean that anomalous input is less disruptive to lexical integration, but would also mean that congruent input does not benefit from this support given by stronger expectations, and word recognition may be comparatively slower and more effortful.

To return to our aim of investigating whether the influence of talker-listener pairing is also important in quiet conditions, the reduced PMN and N400 effects we observed for accented speech in quiet (along with the weaker expectations we hypothesise are associated with them) suggest that this is the case. Phonological processes reflected in the PMN seem to be reliant on a talker and listener sharing the same L1 accent, but lexical integration processes, reflected in the N400, show a similar pattern to the intelligibility of accents across the talker-listener pairings in quiet, with smaller responses (and more difficulties) for less intelligible accents. These difficulties may relate to a reduced efficiency of word recognition processes, and so do not necessarily prevent word recognition if there are no further adverse listening conditions present. This could explain why we could observe accent related difficulties with the online EEG measures, but accent intelligibility in quiet remained high.
6. Chapter six: General discussion

The findings of this research have added to our understanding of the mechanisms of how talkers’ and listeners’ backgrounds interact to influence accent intelligibility. Findings provide further evidence to support the contribution of accent similarity across talker-listener combinations to accent intelligibility in noise, with accent similarity in terms of vowel spectral qualities and duration able to account for variance in accent intelligibility. This relationship was observed for native and non-native listeners, but was weaker for non-native listeners, suggesting other factors may also contribute to accent intelligibility for this group. Online EEG measures of word recognition processes also showed that the influence of talker-listener pairing was present in quiet conditions and so did not arise specifically as an interaction with difficulties caused by background noise. Listeners' ability to form phonological expectations about upcoming words was severely affected by mismatches in talker-listener accent, with a PMN response elicited only by the English listeners' own SSBE accent. Semantic expectations were less severely affected by a mismatching accent, but difficulties seemed to remain with weaker responses to regional and non-native accents.

Previous research has proposed that different patterns of intelligibility across talker-listener pairings reflect listeners' differing levels of familiarity with the talkers' accents (e.g., Adank et al., 2009). As listeners become more familiar with a media-standard accent, they may be able to develop multiple stored phonological representations relating to their own accent and also this standard accent (Sumner & Samuel, 2009). This would be consistent with exemplar-based models of word recognition such as MINERVA (Hintzman, 1986) or the exemplar-resonance model (Johnson, 2006) where multiple exemplars of each word are stored in order to account for the high level of variability in speech. Input is then compared to these exemplars, with matching exemplars activated in order to retrieve the relevant conceptual representation. As the level of activation depends on the level of similarity between the input and stored exemplars (Hintzman, 1986; Johnson, 2006), if familiarity with an accent allows listeners to form accent-specific representations, there will be a better match between input in that accent and stored exemplars, leading to stronger activation and thus easier word recognition.
However, listeners do not always have sufficient flexibility to form multi-accent stored representations; Sumner and Samuel (2009) found that while speakers with a typical New York accent store representations in both the standard rhotic form and the regional non-rhotic form, New Yorkers who produce the more standard rhotic forms store representations only of this rhotic form, even though they are highly familiar with the regional non-rhotic form. This suggests that forming accent-specific representations may be very difficult for listeners to achieve, even with extensive exposure. Sumner and Samuel (2009) suggest that listeners may need this extensive exposure to an accent in early childhood; the typical New Yorkers would have received exposure to non-rhotic forms at home, along with rhotic forms through the media, but rhotic New Yorkers would have received much less exposure to non-rhotic forms as they heard rhotic forms at home, and non-rhotic forms are less represented in the media. If this very early exposure is required to form multi-accent representations, most listeners would never be able to form multiple representations, suggesting that familiarity with an accent may not influence accent intelligibility by allowing new exemplars to be formed.

Instead of accent familiarity being the main determiner of accent intelligibility, the similarity of accents across talker-listener pairings also seems to be influential (e.g., Pinet et al., 2011). In this study, we observed the same patterns of accent intelligibility and similarity across our talker-listener pairings, which could support this hypothesis. A greater role of accent similarity would suggest listeners are more inflexible and process accents by mapping multiple variations onto a single abstract representation based on the listener’s own accent (Sumner & Samuel, 2009). The general premise of abstract models of word recognition such as TRACE (McClelland & Elman, 1986), Shortlist (Norris, 1994) and Merge (Norris, McQueen & Cutler, 2000) is similar to that of the exemplar based models described above; input is compared to stored representations, and units that match the input are activated. Competition between activated units leads to eventual lexical retrieval. The difference between the models is the nature of the stored forms - instead of multiple episodic memory traces for each unit, in the abstract models representations have been stripped of surface variation and are stored as an abstract representation. The similarity of a talker’s accent to that of the listener could then influence intelligibility based on the ease of mapping the accented input onto the listener’s stored phonological representations. Input in a similar accent is easier to recognise as
corresponding to a particular stored unit, be that feature-based representations, as in TRACE (McClelland & Elman, 1986) or phonemes, as in Shortlist (Norris, 1994) or Merge (Norris et al., 2000) than input which is more acoustically-phonetically distant, which may not be recognised, or may be misidentified. This more efficient mapping to stored representations would then make word recognition easier in more similar accents.

ERP findings in this study may also suggest that listeners only store representations relating to their own accent. The only reliable PMN effect found was in response to SSBE for English listeners, suggesting that listeners are only able to form fine-grained phonological expectations in their own accent. This inflexibility may reflect the underlying nature of their stored phonological representations, as multiple representations could be expected to allow listeners to adapt their expectations based on accent. Brunelliére & Soto-Faraco (2013) found that if a regional accent is similar enough to that of the listeners, they may be able to form phonological expectations, leading to a PMN in response to mismatching input. However, no PMN was elicited in another part of the study where the final word of the sentence changed from the regional accent into the listeners’ own accent, but a clear PMN was seen in the reverse situation. This asymmetry may suggest that the expectations formed about upcoming words in the regional accent are still based on stored representations specific to their own accent.

While these findings show that the level of similarity between a talker and listener’s accent can influence the accent intelligibility, the contribution of accent familiarity cannot be completely discounted as listeners are able to use knowledge of particular accent features to aid speech perception (e.g., Dahan, Drucker & Scarborough, 2008; Oder et al., 2013) and can quickly adapt to unfamiliar accents (e.g., Bradlow & Bent, 2008; Clarke & Garrett, 2004). This could provide support for a hybrid model of word recognition, incorporating elements of both abstract and exemplar-based models. Goldinger (2007) has proposed a hybrid ‘complementary learning system’ containing a stable cortical network of abstract representations along with a fast-learning hippocampal network that is able to quickly form episodic memories in order to accommodate idiosyncratic variation. When listeners encounter a new accent, they can use the hippocampal network to form short-lived traces to aid word recognition, which could account for listeners’ ability to rapidly adapt to a previously
unfamiliar accent. Dahan et al. (2008) proposed that listeners adapt to a specific accent feature by altering their stored representations to incorporate this variation, but this could also have occurred by recruiting this fast-learning hippocampal network. If a listener has more long-term exposure to an accent, traces in the hippocampal network can interact with the cortical network to affect the listeners’ abstract representations. This could possibly allow representations to encompass multiple accented forms, rather than forming separate accent-specific representations, and may account for Sumner and Samuel’s (2009) finding that New Yorkers with a standard rhotic accent are also able to easily process the non-rhotic forms that they have extensive exposure to even though they retain only rhotic stored representations.

A further possibility may be that the acoustic-phonetic similarity between accents determines the 'baseline' intelligibility of an accent for a listener. Familiarity with an accent may then allow listeners to build on this baseline level of intelligibility. This could be consistent with a recently proposed model of word recognition that takes a rather different approach than the activation-based models described above. Instead of matching input to stored abstract representations based on the sequences of phonemes contained in the input, in Shortlist B (Norris & McQueen, 2008) the input is phoneme probabilities. This replaces the interaction-activation process in other models with Bayesian judgements of likelihood in order to recognise words, and listeners identify speech based on phoneme likelihoods - their prior knowledge of the likelihood of a phoneme occurring given the specific input. These probabilities of a phoneme’s occurrence are then used to estimate the likelihood of a particular word occurring. Phoneme likelihood functions are based on listeners’ knowledge of the probability of certain acoustic input being associated with different phonemic categories. For example, input A may be more likely to be interpreted as /s/ than input B, and so the phoneme likelihood for /s/ will be higher for input A. If a talker’s accent is very similar to a listener’s own accent, the listener’s knowledge of phoneme likelihoods may apply well to the talker’s accent. However, if the accent is more acoustically-phonetically distant, the phoneme likelihoods may not fit well, making word recognition more difficult. Familiarity with an accent may contribute to accent intelligibility by allowing listeners to update their knowledge of phoneme likelihoods to incorporate regular variation that they encounter in accented forms. This could account for the ability of listeners to learn to interpret an ambiguous segment as
either /l/ or /s/ depending on its lexical context (McQueen et al., 2006; Norris et al., 2003). Listeners may have updated their likelihood functions of the relevant phoneme to have greater density corresponding to the ambiguous input. In this way, listeners may not modify their original representations in response to accented speech, but exposure may allow them to become more skilled at mapping from the accented input to their own representations.

There remain a number of questions this study did not explore which may be interesting avenues for future research. One option would be to investigate the relationship between accent similarity and intelligibility in a more fine-grained manner, as there is generally a lot of variation in talker intelligibility within accent groups as well as between accents. Reanalysing the current data to compare listeners’ responses to the four individual talkers of each accent, rather than looking at their responses to the accents in general would allow this to be explored further. If listeners do process all speech through their own representations, links between similarity and intelligibility may be observed even within one accent group. To further investigate the possibility of forming accent-specific phonological representations, it would be interesting to extend this research to a group with long-term exposure to another accent, as listeners in this study were largely unfamiliar with the accents that did not match their own. One such group are Glaswegian listeners, as this group will obviously be highly familiar with GE, but will also have received extensive exposure to SSBE through the media. If Sumner and Samuel’s (2009) proposal is correct, these listeners may have had sufficient early exposure to both accents to form multi-accent long-term representations. If this is the case, a weaker relationship between accent similarity and intelligibility could be expected. In terms of ERP data, if listeners have stored representations corresponding to both SSBE and GE, they may be able to form expectations about upcoming words in both accents. This would mean that input in both accents would mismatch less with expectations, leading to less distinction between differences in the PMN and N400 responses to SSBE and GE. However, if listeners continue to interpret both accents through GE-based representations, a PMN may only be observed in response to the GE accent, and the N400 effect may be strongest for GE and the other accents. It may also be interesting to include a group of Spanish listeners who have lived in London for an extended period to see whether they become more tuned to SSBE than SpE, and if this also manifests in EEG responses.
7. References


McQueen, J. M., & Huetting, F. (2012). Changing only the probability that spoken words will be distorted changes how they are recognized. The *Journal of the Acoustical Society of America, 131*(1), 509–17. doi:10.1121/1.3664087


# Appendix 1: Sentence Recognition Materials

<table>
<thead>
<tr>
<th>Predictable Sentences</th>
<th>Neutral Sentences</th>
<th>Anomalous Sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0101 Warm sweaters are made from wool from a sheep</td>
<td>B0101 Farms have lots of animals like sheep</td>
<td>C0101 Warm sweaters are made from wool from a cruise</td>
</tr>
<tr>
<td>A0102 The chef used a lot of salt and pepper</td>
<td>B0102 The chef cooked using a lot of pepper</td>
<td>C0102 The chef used a lot of salt and novels</td>
</tr>
<tr>
<td>A0103 A large church is called a cathedral</td>
<td>B0103 The large building over there is a cathedral</td>
<td>C0103 A large church is called a diploma</td>
</tr>
<tr>
<td>A0104 For breakfast children eat toast or cereal</td>
<td>B0104 For dinner students sometimes eat cereal</td>
<td>C0104 For breakfast children eat toast or literature</td>
</tr>
<tr>
<td>A0105 Last night we saw the stars and the moon</td>
<td>B0105 Some people want to go to the moon</td>
<td>C0105 Last night we saw the stars and the hole</td>
</tr>
<tr>
<td>A0106 To earn money you need a job</td>
<td>B0106 To be happy you need a job</td>
<td>C0106 To earn money you need a talk</td>
</tr>
<tr>
<td>A0107 My children enjoy singing simple songs</td>
<td>B0107 The students enjoy hearing simple songs</td>
<td>C0107 My children enjoy singing simple books</td>
</tr>
<tr>
<td>A0108 Beef and chicken are types of meat</td>
<td>B0108 The man is choosing some nice meat</td>
<td>C0108 Beef and chicken are types of crew</td>
</tr>
<tr>
<td>A0109 The clothes are cheap because they are on sale</td>
<td>B0109 Students get most of their clothes in the sale</td>
<td>C0109 The clothes are cheap because they are on dirt</td>
</tr>
<tr>
<td>A0110 Camels usually live in the desert</td>
<td>B0110 People don’t often live in the desert</td>
<td>C0110 Camels usually live in the project</td>
</tr>
<tr>
<td>A0111 The light hangs from the ceiling</td>
<td>B0111 The fly is walking on the ceiling</td>
<td>C0111 The light hangs from the ladder</td>
</tr>
<tr>
<td>A0112 Remote controls can change the TV channel</td>
<td>B0112 The children want to watch their favourite channel</td>
<td>C0112 Remote controls can change the TV quarter</td>
</tr>
<tr>
<td>A0113 Keep your drink cold with some ice</td>
<td>B0113 Please can you give me some ice</td>
<td>C0113 Keep your drink cold with some age</td>
</tr>
<tr>
<td>A0114 Beef and milk come from cows</td>
<td>B0114 The man draws pictures of cows</td>
<td>C0114 Beef and milk come from bays</td>
</tr>
<tr>
<td>A0115 He parks his cars in his garage</td>
<td>B0115 He keeps his stuff in the garage</td>
<td>C0115 He parks his cars in his member</td>
</tr>
<tr>
<td>A0116 She usually wakes up early in the morning</td>
<td>B0116 He usually does his homework in the morning</td>
<td>C0116 She usually wakes up early in the lady</td>
</tr>
<tr>
<td>A0117 Cars and factories can cause air pollution</td>
<td>B0117 In some cities there is lots of pollution</td>
<td>C0117 Cars and factories can cause air gymnastics</td>
</tr>
<tr>
<td>A0118 Your aunt and uncle’s children are your cousins</td>
<td>B0118 My children like to play with their cousins</td>
<td>C0118 Your aunt and uncle’s children are your programs</td>
</tr>
<tr>
<td>A0119 The shop assistant served all the customers</td>
<td>B0119 The angry man talked to the customers</td>
<td>C0119 The shop assistant served all the benefits</td>
</tr>
<tr>
<td>A0120 The north is colder than the south</td>
<td>B0120 The food is better in the south</td>
<td>C0120 The north is colder than the pants</td>
</tr>
<tr>
<td>A0121 The passengers thanked the bus driver</td>
<td>B0121 The visitors thanked the kind driver</td>
<td>C0121 The passengers thanked the bus soldier</td>
</tr>
<tr>
<td>A0122 My hair was too long so I got a haircut</td>
<td>B0122 I don’t like going to get a haircut</td>
<td>C0122 My hair was too long so I got a technique</td>
</tr>
</tbody>
</table>
A0125 I went to the post office to buy a stamp
A0124 After dinner we asked the waiter for the bill
A0201 You can see lions and monkeys at the zoo
A0202 Flats don’t have gardens but they have balconies
A0205 The sheep had two cute little lambs
A0204 Football and running are types of sport
A0205 The sun can burn your skin
A0206 There are three pictures hanging on the wall
A0207 The opposite of midday is midnight
A0208 Sick people should see a doctor
A0209 You should put your rubbish in the bin
A0210 A T-Rex was a big dinosaur
A0211 The chef cooks in the hot kitchen
A0212 When there is snow in the mountains we go skiing
A0213 Spring and summer are two of the four seasons
A0214 He opened the lock with a key
A0215 Zebras have many black and white stripes
A0216 Eat breakfast in the morning and dinner in the evening
A0217 The day after today is called tomorrow
A0218 She packed her holiday clothes in the suitcase
A0219 We crossed the river by walking over the bridge
A0220 I always look up new words in a dictionary
A0221 We went to visit our grandfather and grandmother
A0222 Children like pasta with tomato sauce
A0223 He rides through the desert on a camel

B0123 I went to the supermarket to buy a stamp
B0124 After we finished we waited for the bill
B0201 You can have lots of fun at the zoo
B0202 People sometimes buy flats with big balconies
B0203 The cutest baby animals are lambs
B0204 On Sundays I often do some sport
B0205 Put the cream on your skin
B0206 There are many dirty marks on the wall
B0207 The quietest time of day is midnight
B0208 Some students will become a doctor
B0209 You should put your tickets in the bin
B0210 That animal was a big dinosaur
B0211 The boy plays in the big kitchen
B0212 When it is cold in the winter we like skiing
B0213 In some countries there are only two seasons
B0214 He could not find the correct key
B0215 Some animals have big black stripes
B0216 Some employees have to work in the evening
B0217 We are going to the dentist tomorrow
B0218 She put all her winter clothes in the suitcase
B0219 We discussed the modern and expensive bridge
B0220 I always correct mistakes with a dictionary
B0221 Every week the girl visits her lonely grandmother
B0222 Children like burgers with delicious sauce
B0223 He often goes to the market to buy a camel

C0123 I went to the post office to buy a quiz
C0124 After dinner we asked the waiter for the cold
C0201 You can see lions and monkeys at the tap
C0202 Flats don’t have gardens but they have lotteries
C0203 The sheep had two cute little pills
C0204 Football and running are types of range
C0205 The sun can burn your paint
C0206 There are three pictures hanging on the pain
C0207 The opposite of midday is knowledge
C0208 Sick people should see a business
C0209 You should put your rubbish in the rail
C0210 A T-Rex was a big coconut
C0211 The chef cooks in the hot station
C0212 When there is snow in the mountains we go banking
C0213 Spring and summer are two of the four warnings
C0214 He opened the lock with a pop
C0215 Zebras have many black and white flutes
C0216 Eat breakfast in the morning and dinner in the figure
C0217 The day after today is called professor
C0218 She packed her holiday clothes in the peanut
C0219 We crossed the river by walking over the throat
C0220 I always look up new words in a babysitter
C0221 We went to visit our grandfather and property
C0222 Children like pasta with tomato noon
A0224 Turn it on using the remote control | B0224 You must press the button on the control | C0224 Turn it on using the remote report
A0301 In tennis you hit the ball with a racket | B0301 In some games you play using a racket | C0301 In tennis you hit the ball with a puzzle
A0502 A shape with no corners is called a circle | B0502 That special thing is called a circle | C0502 A shape with no corners is called a taxi
A0303 Every country is run by the government | B0303 That country will soon have a new government | C0303 Every country is run by the memory
A0504 When it is raining you should carry your umbrella | B0504 When you have time you should buy a better umbrella | C0504 When it is raining you should carry your accountant
A0305 We knocked on the front door | B0305 We often stopped at the big door | C0305 We knocked on the front check
A0306 There are sixty seconds in a minute | B0306 He went into the house for a minute | C0306 There are sixty seconds in a human
A0307 In the day we get light from the sun | B0307 Every day we can see the sun | C0307 In the day we get light from the fair
A0308 Bosses should be kind to their employees | B0308 The old manager has lots of employees | C0308 Bosses should be kind to their adventures
A0309 February is always the shortest month | B0309 This is always the shortest month | C0309 February is always the shortest gift
A0310 Giraffes have spots and a long neck | B0310 That manager has a long neck | C0310 Giraffes have spots and a long form
A0311 The mother and father have four children | B0311 The nurse doesn't want to have any children | C0311 The mother and father have four pieces
A0312 After his shower he got dried with a towel | B0312 Before he went he looked for his towel | C0312 After his shower he got dried with a chat
A0313 Every day I write my thoughts in my diary | B0313 Sometimes I put my ideas in my diary | C0313 Every day I write my thoughts in my relative
A0314 Tourists read about the sights in their guidebook | B0314 People read about the town in their guidebook | C0314 Tourists read about the sights in their snowboard
A0315 The footballer kicked the round ball | B0315 The athlete held the really heavy ball | C0315 The footballer kicked the round shop
A0316 Trousers and skirts are types of clothes | B0316 Some people do not have nice clothes | C0316 Trousers and skirts are types of steps
A0317 Eggs come from a duck or a chicken | B0317 Her family like meat from a chicken | C0317 Eggs come from a duck or a boyfriend
A0318 Doctors try to cure dangerous diseases | B0318 Scientists try hard to stop different diseases | C0318 Doctors try to cure dangerous pianos
A0319 There was lots of rain and lightning during the storm | B0319 In the summer we had a very big storm | C0319 There was lots of rain and lightning during the cliff
A0320 The bride is wearing a white dress | B0320 That teacher is wearing a nice dress | C0320 The bride is wearing a white club
A0321 My shoes are made of brown leather | B0321 My coat is made of nice leather | C0321 My shoes are made of brown hockey
A0322 Athletes get instructions from their coach | B0322 The athlete needs a new coach | C0322 Athletes get instructions from their block
A0323 Friday is my favourite day of the week | B0323 I want to visit them for a week | C0323 Friday is my favourite day of the guess
A0324 Eating quickly will give you a stomach ache | B0324 Playing the guitar can make my hand ache | C0324 Eating quickly will give you a stomach oil
A0401 The car has space for a driver and three passengers | B0401 The train carriage has space for all the passengers | C0401 The car has space for a driver and three signatures
<p>| A0402 | I get my hair cut by my favourite hairdresser. | B0402 | The teenager admires her favourite hairdresser. | C0402 | I get my hair cut by my favourite pineapple. |
| A0403 | In winter there can be very cold weather. | B0403 | In my city we have very good weather. | C0403 | In winter there can be very cold candy. |
| A0404 | I keep my wallet in my trouser pocket. | B0404 | I put the pencil in my little pocket. | C0404 | I keep my wallet in my trouser lesson. |
| A0405 | She smelled the flowers using her nose. | B0405 | The woman has a really interesting nose. | C0405 | She smelled the flowers using her cash. |
| A0406 | Your sister's son is your nephew. | B0406 | Please promise to help your nephew. | C0406 | Your sister's son is your blanket. |
| A0407 | Your brother's daughter is your niece. | B0407 | My kids are playing with my niece. | C0407 | Your brother's daughter is your coin. |
| A0408 | The boss of a ship is called the captain. | B0408 | The man in the corner is the captain. | C0408 | The boss of a ship is called the office. |
| A0409 | You wear shoes on your feet. | B0409 | You have dirt on your feet. | C0409 | You wear shoes on your trucks. |
| A0410 | The athlete is a very fast runner. | B0410 | The teacher is a very fast runner. | C0410 | The athlete is a very fast spelling. |
| A0411 | A book about someone's life is called a biography. | B0411 | The story of his life would be a biography. | C0411 | A book about someone's life is called a curriculum. |
| A0412 | Apples and bananas are types of fruit. | B0412 | Every day I have a piece of fruit. | C0412 | Apples and bananas are types of yard. |
| A0413 | The popular girl has lots of friends. | B0413 | The quiet woman has a lot of friends. | C0413 | The popular girl has lots of thoughts. |
| A0414 | They went to watch a play at the theatre. | B0414 | They went to meet a friend at the theatre. | C0414 | They went to watch a play at the document. |
| A0415 | He drove too fast and had an accident. | B0415 | He knew the woman had an accident. | C0415 | He drove too fast and had an officer. |
| A0416 | A black and white horse is a zebra. | B0416 | The zoo the boy saw a zebra. | C0416 | A black and white horse is a handbag. |
| A0417 | We work during the week and relax at the weekend. | B0417 | We work hard sometimes and relax at the weekend. | C0417 | We work during the week and relax at the magic. |
| A0418 | They gave a prize to the competition winner. | B0418 | They gave a gift to the very lucky winner. | C0418 | They gave a prize to the competition model. |
| A0419 | There are eleven players on a football team. | B0419 | There are interesting people on the famous team. | C0419 | There are eleven players on a football fire. |
| A0420 | The baseball player hit the ball with his bat. | B0420 | The lazy player forgot to bring his bat. | C0420 | The baseball player hit the ball with his row. |
| A0421 | Magicians know a lot of card tricks. | B0421 | Children know a lot of clever tricks. | C0421 | Magicians know a lot of card scenes. |
| A0422 | Everest is the world's highest mountain. | B0422 | My country only has one mountain. | C0422 | Everest is the world's highest jacket. |
| A0423 | There are hundreds of countries in the world. | B0423 | There are lots of people in the world. | C0423 | There are hundreds of countries in the jacket. |
| A0424 | The queen is married to the king. | B0424 | The man is related to the king. | C0424 | The queen is married to the news. |
| A0501 | My phone doesn't work because it's run out of battery. | B0501 | My laptop doesn't work because it's run out of battery. | C0501 | My phone doesn't work because it's run out of comedy. |
| A0502 | These clothes were made by the designer. | B0502 | All of my clothes were made by the same designer. | C0502 | These clothes were made by the fashion relation. |</p>
<table>
<thead>
<tr>
<th>A0503</th>
<th>The border guard put a stamp in my passport</th>
<th>B0503</th>
<th>My friend often forgets to bring his passport</th>
<th>C0503</th>
<th>The border guard put a stamp in my software</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0504</td>
<td>Grandfather has a moustache and a long beard</td>
<td>B0504</td>
<td>My uncle has green eyes and a big beard</td>
<td>C0504</td>
<td>Grandfather has a moustache and a long sheet</td>
</tr>
<tr>
<td>A0505</td>
<td>The customers queued in a straight line</td>
<td>B0505</td>
<td>The schoolchildren stood in a messy line</td>
<td>C0505</td>
<td>The customers queued in a straight cut</td>
</tr>
<tr>
<td>A0506</td>
<td>Villages are smaller than cities and towns</td>
<td>B0506</td>
<td>These days more and more people live in towns</td>
<td>C0506</td>
<td>Villages are smaller than cities and drinks</td>
</tr>
<tr>
<td>A0507</td>
<td>A big sea is called an ocean</td>
<td>B0507</td>
<td>This place is far from the ocean</td>
<td>C0507</td>
<td>A big sea is called an apple</td>
</tr>
<tr>
<td>A0508</td>
<td>Rain falls from big black clouds</td>
<td>B0508</td>
<td>He sees some very big black clouds</td>
<td>C0508</td>
<td>Rain falls from big black snacks</td>
</tr>
<tr>
<td>A0509</td>
<td>Famous people are also called stars or celebrities</td>
<td>B0509</td>
<td>The people were excited to meet the celebrities</td>
<td>C0509</td>
<td>Famous people are also called stars or varieties</td>
</tr>
<tr>
<td>A0510</td>
<td>Every morning he washes in the sink in the bathroom</td>
<td>B0510</td>
<td>Every evening he changes his clothes in the bathroom</td>
<td>C0510</td>
<td>Every morning he washes in the sink in the final</td>
</tr>
<tr>
<td>A0511</td>
<td>People sleep with their head on a pillow</td>
<td>B0511</td>
<td>People like having a comfortable pillow</td>
<td>C0511</td>
<td>People sleep with their head on a farmer</td>
</tr>
<tr>
<td>A0512</td>
<td>Please don’t tell anyone my secret</td>
<td>B0512</td>
<td>Please don’t talk about my secret</td>
<td>C0512</td>
<td>Please don’t tell anyone my college</td>
</tr>
<tr>
<td>A0513</td>
<td>The south is warmer than the north</td>
<td>B0513</td>
<td>People are friendlier in the north</td>
<td>C0513</td>
<td>The south is warmer than the choice</td>
</tr>
<tr>
<td>A0514</td>
<td>They are drinking coffee in the café</td>
<td>B0514</td>
<td>They are sitting together at the café</td>
<td>C0514</td>
<td>They are drinking coffee in the ferry</td>
</tr>
<tr>
<td>A0515</td>
<td>In some zoos animals live in small cages</td>
<td>B0515</td>
<td>In some places pets live in little cages</td>
<td>C0515</td>
<td>In some zoos animals live in small purses</td>
</tr>
<tr>
<td>A0516</td>
<td>One hundred years is called a century</td>
<td>B0516</td>
<td>A really long time is called a century</td>
<td>C0516</td>
<td>One hundred years is called a basketball</td>
</tr>
<tr>
<td>A0517</td>
<td>Before you use it you should read the instructions</td>
<td>B0517</td>
<td>Before you start you must find the instructions</td>
<td>C0517</td>
<td>Before you use it you should read the arguments</td>
</tr>
<tr>
<td>A0518</td>
<td>The student makes a lot of spelling mistakes</td>
<td>B0518</td>
<td>The student hates all the annoying mistakes</td>
<td>C0518</td>
<td>The student makes a lot of spelling partners</td>
</tr>
<tr>
<td>A0519</td>
<td>She made a special cake for her son’s birthday</td>
<td>B0519</td>
<td>We had a lovely chat about his birthday</td>
<td>C0519</td>
<td>She made a special cake for her son’s message</td>
</tr>
<tr>
<td>A0520</td>
<td>Someone who owns a meat shop is called a butcher</td>
<td>B0520</td>
<td>The woman who lives nearby works as a butcher</td>
<td>C0520</td>
<td>Someone who owns a meat shop is called a necklace</td>
</tr>
<tr>
<td>A0521</td>
<td>Honest people always tell the truth</td>
<td>B0521</td>
<td>It can be hard to find out the truth</td>
<td>C0521</td>
<td>Honest people always tell the luck</td>
</tr>
<tr>
<td>A0522</td>
<td>On her birthday she ate chocolate cake</td>
<td>B0522</td>
<td>On the weekend she ate creamy cake</td>
<td>C0522</td>
<td>On her birthday she ate chocolate bells</td>
</tr>
<tr>
<td>A0523</td>
<td>The girl likes toast with strawberry jam</td>
<td>B0523</td>
<td>The girls like eating delicious jam</td>
<td>C0523</td>
<td>The girl likes toast with strawberry corn</td>
</tr>
<tr>
<td>A0524</td>
<td>My favourite flowers are red roses</td>
<td>B0524</td>
<td>I often give my friend some roses</td>
<td>C0524</td>
<td>My favourite flowers are red gases</td>
</tr>
<tr>
<td>A0601</td>
<td>In rush hour there is a lot of traffic</td>
<td>B0601</td>
<td>In the city there is lots of traffic</td>
<td>C0601</td>
<td>In rush hour there is a lot of winter</td>
</tr>
<tr>
<td>A0602</td>
<td>Trees grow lots of green leaves</td>
<td>B0602</td>
<td>We saw a lot of brown leaves</td>
<td>C0602</td>
<td>Trees grow lots of green gaps</td>
</tr>
<tr>
<td>A0603</td>
<td>Footballers are happy when they score a goal</td>
<td>B0603</td>
<td>People are happy when they see a goal</td>
<td>C0603</td>
<td>Footballers are happy when they score a tune</td>
</tr>
</tbody>
</table>
A0604  I can't read your terrible handwriting
A0605  He keeps money in a leather wallet
A0606  The policeman shot the thief with his gun
A0607  The opposite of war is peace
A0608  The two boys are identical twins
A0609  Someone who makes bread is called a baker
A0610  He cuts vegetables with a sharp knife
A0611  I chose a recipe and bought all the ingredients
A0612  The photographer took pictures with a camera
A0613  Your mum and dad are your parents
A0614  Chairs and tables are types of furniture
A0615  Students have to write a lot of long essays
A0616  I protect my eyes from the sun with sunglasses
A0617  The people who live near you are your neighbours
A0618  There are three children and two parents in the family
A0619  The carpet is covering the floor
A0620  We planned our journey using a map
A0621  The mess is cleaned up by the cleaner
A0622  The actors performed on the theatre's stage
A0623  I cut up lettuce and tomato for the salad
A0624  For dinner we often eat fish and chips
A0625  This beach has soft white sand
A0701  French fries and chips are made from potato
A0702  Tonight we are going to a restaurant for dinner
A0703  Children usually write with a pen or pencil
B0604  I really can't stand your terrible handwriting
B0605  He keeps important things in his wallet
B0606  The policeman hit his friend with his gun
B0607  The president wants to have peace
B0608  Those nice boys are obviously twins
B0609  The man quit his job and became a baker
B0610  He prepares breakfast with an old knife
B0611  The delicious biscuits have a lot of ingredients
B0612  The engineer borrowed an expensive camera
B0613  On Fridays I sometimes meet my parents
B0614  My house has lots of lovely furniture
B0615  Sometimes we have to read a lot of essays
B0616  I keep myself safe outside with my sunglasses
B0617  The people who make lots of noise are my neighbours
B0618  There are lots of children in the big family
B0619  The girl is sitting on the floor
B0620  Before our trip we bought a map
B0621  This place is looked after by the cleaner
B0622  The schoolchildren played on the enormous stage
B0623  I prepared everything for the simple salad
B0624  For dinner we often eat eggs and chips
B0625  She likes to relax on the nice sand
B0626  The famous dish is made from potato
B0627  Tomorrow I will be too busy for dinner
B0628  Children usually have a favourite pencil
C0604  I can't read your terrible handwriting
C0605  He keeps money in a leather wallet
C0606  The policeman shot the thief with his gun
C0607  The opposite of war is peace
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C0623  I cut up lettuce and tomato for the salad
C0624  For dinner we often eat fish and chips
C0701  This beach has soft white sand
C0702  French fries and chips are made from potato
C0703  Tonight we are going to a restaurant for dinner
C0704  Children usually write with a pen or pencil
After school children must do their homework.
The dining table has six matching chairs.
Clean your teeth with toothpaste and a toothbrush.
The husband bought flowers for his wife.
Dollars and pounds are different types of currency.
Pork and bacon come from a pig.
The class went on a history trip to the museum.
Put the letter inside the white envelope.
Every night I read my children a story.
We went sailing on the lake in our new boat.
He typed using the computer's keyboard.
I write my homework sitting at my desk.
There are many trees in the forest.
Scientists do experiments in a laboratory.
My bag was stolen by a thief.
We waited an hour in the long queue.
Boys quickly grow up and become men.
The orchestra played some classical music.
Doctors take care of their patients.
In China the most famous drink is green tea.
When we go camping we sleep in a tent.
The plane was flown by the pilot.
Circles and squares are different shapes.
Patients are cared for by doctors and nurses.
Many people died in the Second World War.

On Friday I sometimes do my homework.
The living room has two nice modern chairs.
Make sure your child uses the right toothbrush.
The lawyer had dinner with his wife.
Those two countries have different types of currency.
Her favourite animal is a pig.
The family went on a group tour of the museum.
Put the form under the orange envelope.
Every night she wants a different story.
We went there to look at the fantastic boat.
The computer has a tiny keyboard.
I often eat my dinner at my desk.
Many animals live in the forest.
Engineers sometimes work in a laboratory.
My dog was taken by a thief.
We talked for an hour in the queue.
Boys often admire those famous men.
The architects know some interesting music.
Those very sad people are her patients.
In my country a popular drink is tea.
When we go walking we take a tent.
The house was bought by the pilot.
Children learn the names of the shapes.
Sometimes children are looked after by nurses.
Many people cried during the awful War.

After school children must do their plastic.
The dining table has six matching notes.
Clean your teeth with toothpaste and a nightclub.
The husband bought flowers for his stuff.
Dollars and pounds are different types of scenery.
Pork and bacon come from a fan.
The class went on a history trip to the solution.
Put the letter inside the white industry.
Every night I read my children a couple.
We went sailing on the lake in our new mess.
He typed using the computer's brochure.
I write my homework sitting at my crowd.
There are many trees in the rabbit.
Scientists do experiments in a certificate.
My bag was stolen by a trunk.
We waited an hour in the long blog.
Boys quickly grow up and become ways.
The orchestra played some classical service.
Doctors take care of their credits.
In China the most famous drink is green soul.
When we go camping we sleep in a gum.
The plane was flown by the shadow.
Circles and squares are different flats.
Patients are cared for by doctors and crosses.
Many people died in the Second World top.
The little girl loves her teddy bear.

People who design buildings are called architects.

Your heart's job is to move your blood.

The sports team built a big new stadium.

Land with water all around is called an island.

Famous chefs usually work at expensive restaurants.

When he moved house he told me his new address.

The new chemical was discovered by a scientist.

When you travel by train you should buy a ticket.

The nasty cat caught the little mouse.

Clothes for sleeping in are called pyjamas.

I passed my test and got my driving licence.

Footballers wear a t-shirt and shorts.

Girls quickly grow up and become women.

Hair above your lip is called a moustache.

The little girl made a new dress for her doll.

I eat soup in a white bowl.

Take aspirin if you have a headache.

Rabbits like eating fresh orange carrots.

People usually sleep in a bed.

I prefer pens with blue ink.

A sandwich has two pieces of bread.

Cyclists protect their head with a helmet.

We checked in at the hotel reception.

The little boy saw the really angry bear.

Some people who work in this building are architects.

The new film has a lot of blood.

Concerts sometimes happen at the stadium.

We travelled to the very beautiful island.

Famous actors often go to popular restaurants.

The stuff is on a white plate.

When he got here he told me his new address.

The new machine was invented by that scientist.

When you visit it you must have a ticket.

The lion caught the unlucky mouse.

I like to buy some interesting pyjamas.

I failed my test and didn't get my licence.

Little boys often like wearing shorts.

They are talking to the friendly women.

The pilot has a big orange moustache.

The father made his daughter a doll.

I put the milk in a white bowl.

Buy this if you have a headache.

Some pets like eating fresh tasty carrots.

People usually like their own bed.

I prefer ones with nice blue ink.

For lunch I have three pieces of bread.

People protect themselves with a helmet.

My son works at the hotel reception.

The little girl loves her teddy sea.

People who design buildings are called inventions.

Your heart's job is to move your street.

The sports team built a big new granddaughter.

Land with water all around is called an author.

Famous chefs usually work at expensive battles.

The food is on a white spy.

When he moved house he told me his new regret.

The new chemical was discovered by a capital.

When you travel by train you should buy a shower.

The nasty cat caught the little jet.

Clothes for sleeping in are called recycling.

I passed my test and got my driving discount.

Footballers wear a t-shirt and beans.

Girls quickly grow up and become today.

Hair above your lip is called a cabbage.

The little girl made a new dress for her meal.

I eat soup in a white shore.

Take aspirin if you have a product.

Rabbits like eating fresh orange swimmers.

People usually sleep in a rock.

I prefer pens with blue herbs.

A sandwich has two pieces of snake.

Cyclists protect their head with a picnic.

We checked in at the hotel conclusion.
A0909 The prince's parents are the king and queen.

A0910 Cook the chicken at a high temperature.

A0911 A zebra is similar to a horse.

A0912 The busiest part of the city is the centre.

A0913 Police work hard to catch criminals.

A0914 The king lives in an old stone castle.

A0915 Make sure you wash your hands with soap.

A0916 Get out of the ocean if you see a shark.

A0917 Poor people don't have a lot of money.

A0918 I keep my money in an account at the bank.

A0919 Someone who writes for a newspaper is a journalist.

A0920 Boxes are made of strong paper called cardboard.

A0921 Painters and musicians are different types of artist.

A0922 Cows eat a lot of green grass.

A0923 A big boat is called a ship.

A0924 You wash your hair using shampoo.

A1001 There are twenty-six letters in the English alphabet.

A1002 Tomorrow there will be rain with lightning and thunder.

A1003 The walkers followed the forest path.

A1004 He often buys his wife a bunch of flowers.

A1005 A male cow is called a bull.

A1006 Leaves fall off trees in the autumn.

A1007 Workers get instructions from their boss.

B0907 I eat delicious dinners in the garden.

B0908 It isn't nice to have the flu.

B0909 The old woman is a powerful queen.

B0910 Make sure it is at the right temperature.

B0911 An elephant is bigger than a horse.

B0912 I don't like needing to go into the centre.

B0913 Some children grow up and become criminals.

B0914 The nice tourists enjoyed the castle.

B0915 Make sure you always use the soap.

B0916 Most people are scared if they see a shark.

B0917 Some people don't need a lot of money.

B0918 I keep my things in a box in the bank.

B0919 The woman who lives across the road is a journalist.

B0920 The artist made a sculpture using cardboard.

B0921 That interesting woman is a famous artist.

B0922 Animals eat a lot of fresh grass.

B0923 I really like to travel by ship.

B0924 My dad forgot to buy shampoo.

B1001 Some countries use different types of alphabet.

B1002 Tomorrow there will be heavy rain and lightning.

B1003 The children walked along the dark path.

B1004 He often gives his friend some lovely flowers.

B1005 They are very scared of the big bull.

B1006 It is very nice here in the autumn.

B1007 People get annoyed by their boss.

C0907 I grow beautiful flowers in my painting.

C0908 A very bad cold is called the flu.

C0909 The prince's parents are the king and queen.

C0910 Cook the chicken at a high temperature.

C0911 A zebra is similar to a horse.

C0912 The busiest part of the city is the centre.

C0913 Police work hard to catch criminals.

C0914 The king lives in an old stone castle.

C0915 Make sure you wash your hands with soap.

C0916 Get out of the ocean if you see a shark.

C0917 Poor people don't have a lot of money.

C0918 I keep my money in an account at the bank.

C0919 Someone who writes for a newspaper is a journalist.

C0920 Boxes are made of strong paper called cardboard.

C0921 Painters and musicians are different types of artist.

C0922 Cows eat a lot of green grass.

C0923 A big boat is called a ship.

C0924 You wash your hair using shampoo.

C1001 There are twenty-six letters in the English alphabet.

C1002 Tomorrow there will be rain with lightning and thunder.

C1003 The walkers followed the forest path.

C1004 He often buys his wife a bunch of flowers.

C1005 A male cow is called a bull.

C1006 Leaves fall off trees in the autumn.

C1007 Workers get instructions from their boss.

C1008 A very bad cold is called the flu.

C1009 The prince's parents are the king and queen.

C1010 Cook the chicken at a high temperature.

C1011 A zebra is similar to a horse.

C1012 The busiest part of the city is the centre.

C1013 Police work hard to catch criminals.

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C1032 A very bad cold is called the flu.

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C1035 A zebra is similar to a horse.

C1036 The busiest part of the city is the centre.

C1037 Police work hard to catch criminals.

C1038 The king lives in an old stone castle.

C1039 Make sure you wash your hands with soap.

C1040 Get out of the ocean if you see a shark.

C1041 Poor people don't have a lot of money.

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C1046 Cows eat a lot of green grass.

C1047 A big boat is called a ship.

C1048 You wash your hair using shampoo.

C1049 There are twenty-six letters in the English alphabet.

C1050 Tomorrow there will be rain with lightning and thunder.

C1051 The walkers followed the forest path.

C1052 He often buys his wife a bunch of flowers.

C1053 A male cow is called a bull.

C1054 Leaves fall off trees in the autumn.

C1055 Workers get instructions from their boss.
A1008  I made a cake by following the recipe
A1009  We study lots of vocabulary and grammar
A1010  The bored children aren’t paying attention
A1011  Sick animals are cared for by a vet
A1012  You have eight fingers and two thumbs
A1013  Paintings and music are types of art
A1014  Jungles have a hot and wet climate
A1015  Students go to university to get a degree
A1016  Our house has two bathrooms and three bedrooms
A1017  The day is light but the night is dark
A1018  We heard rain falling on the house’s roof
A1019  The pilot got the plane ready for the flight
A1020  Women sometimes wear nice smelling perfume
A1021  He went to hospital in the ambulance
A1022  She loves swimming and sunbathing on the beach
A1023  On each foot you have five toes
A1024  Letters are delivered by the postman
A1011  After the main course we ordered dessert
A1012  We got on the plane at the airport
A1015  The wife cooked dinner for her husband
A1014  Birds fly by using their wings
A1015  History is lots of students’ favourite subject
A1016  Buses and trains are types of public transport
A1017  I’ll call you if you give me your telephone number
A1018  Go to the dentist if you have toothache

B1008  I followed the long and complicated recipe
B1009  We practice lots of complicated new grammar
B1010  The bored children gave me their attention
B1011  The little child wants to become a vet
B1012  Most animals do not have thumbs
B1013  The teacher is interested in art
B1014  Some countries have a pleasant climate
B1015  Architects and engineers need to have a degree
B1016  The couple’s children have cozy bedrooms
B1017  My grandfather’s house is very dark
B1018  We saw people fixing the building’s roof
B1019  The family arrived early for their flight
B1020  Women sometimes buy nice special perfume
B1021  He drove there very fast in the ambulance
B1022  She loves reading and relaxing at the beach
B1023  Some people have very strange toes
B1024  My gift was taken by the postman
B1011  Children usually love to have dessert
B1012  We saw people arriving at the airport
B1015  The woman baked bread for her husband
B1014  Some insects have got big wings
B1015  This is lots of children’s favourite subject
B1016  Some cities have extremely crowded transport
B1017  I’ll remind you if you give me the correct number
B1018  Don’t complain loudly if you have toothache

C1008  I made a cake by following the cabinet
C1009  We study lots of vocabulary and logos
C1010  The bored children aren’t paying history
C1011  Sick animals are cared for by a disk
C1012  You have eight fingers and two links
C1013  Paintings and music are types of shame
C1014  Jungles have a hot and wet backpack
C1015  Students go to university to get a poem
C1016  Our house has two bathrooms and three contracts
C1017  The day is light but the night is group
C1018  We heard rain falling on the house’s trade
C1019  The pilot got the plane ready for the next track
C1020  Women sometimes wear nice smelling sunshine
C1021  He went to hospital in the underwear
C1022  She loves swimming and sunbathing on the lock
C1023  On each foot you have five pans
C1024  Letters are delivered by the spinach
C1101  After the main course we ordered repairs
C1102  We got on the plane at the object
C1103  The wife cooked dinner for her problem
C1104  Birds fly by using their caps
C1105  History is lots of students’ favourite purpose
C1106  Buses and trains are types of public luggage
C1107  I’ll call you if you give me your person
C1108  Go to the dentist if you have surnames
A very small town is called a village.
The couple have two girls and a boy.
The thick book had five hundred pages.
The big university has thousands of students.
The baby has big blue eyes.
There are billions of websites on the internet.
The alphabet has five vowels and twenty-one consonants.
The model wore a top and a short skirt.
A baby cow is called a calf.
Your mother's sister is your aunt.
She ate her food with a knife and fork.
Zoos have a lot of dangerous animals.
He holds up his trousers with a belt.
I can't see because the TV has a small screen.
Monkeys like to eat yellow bananas.
The competition winner received a prize.
Stealing and killing people are crimes.
Biology and chemistry are types of science.
I keep my pictures in a photo album.
Astronauts use rockets to go to space.
Most governments have a prime minister or a president.
Penguins and ducks are types of birds.
Cats and dogs are popular pets.
The journalist wrote a long article.
New shoes usually come in a cardboard box.

I grew up in a boring village.
The couple would like another boy.
The old book had a lot of pages.
The famous professor has a lot of interesting students.
The lovely baby has two nice eyes.
There is lots of information on the internet.
The interesting language doesn't have many consonants.
The student had a fashionable new skirt.
The children looked at the little calf.
That nice woman is helping your aunt.
My mother has an old silver fork.
Cities don't have a lot of big animals.
He always wears a brown belt.
I'll buy this one because it has a good screen.
Some children's favourite food is bananas.
The badminton player was given a prize.
In this neighbourhood there isn't much crime.
Those schoolchildren enjoy learning about science.
I put her drawings in a pretty album.
Yesterday we watched a film about space.
Many countries have an interesting president.
That country has many types of bird.
Father talked about our nice pets.
The grandmother saw the long article.
The vegetables are under the wooden box.

A very small town is called a planet.
The couple have two girls and a fine.
The thick book had five hundred glasses.
The big university has thousands of bottoms.
The baby has big blue acts.
There are billions of websites on the embassy.
The alphabet has five vowels and twenty-one motorways.
The model wore a top and a short breeze.
A baby cow is called a jug.
Your mother's sister is your engine.
She ate her food with a knife and cheek.
Zoos have a lot of dangerous enemies.
He holds up his trousers with a tongue.
I can't see because the TV has a small brush.
Monkeys like to eat yellow policemen.
The competition winner received a chain.
Stealing and killing people are types of spot.
Biology and chemistry are types of career.
I keep my pictures in a photo oven.
Astronauts use rockets to go to heat.
Most governments have a prime minister or a company.
Penguins and ducks are types of van.
Cats and dogs are popular miles.
The journalist wrote a long universe.
New shoes usually come in a cardboard land.
We showed our passports when we crossed the border.

A baby cat is called a kitten.

In the morning she drinks orange juice.

Draw a straight line using the ruler.

A1210 The children are playing a fun game.
A1211 Carrots and potatoes are types of vegetable.
A1212 Smoking is a very bad habit.
A1213 In the morning we drink tea or coffee.
A1214 She has a gold ring on her finger.
A1215 Football teams always have eleven players.
A1216 If you are lost, ask someone for directions.
A1217 Next month the pregnant lady will have her baby.
A1218 Children should never talk to strangers.
A1219 The girl brushed her long blonde hair.
A1220 Every day the chicken lays an egg.
A1221 The desk has four wooden legs.
A1222 People eat soup or cereal using a spoon.
A1223 The singer has a beautiful voice.
A1224 An architect’s job is to design buildings.
A1501 For lunch I usually eat a cheese sandwich.
A1502 Asia is not a country, it’s a continent.
A1503 In the morning people eat toast for breakfast.
A1504 Children ask their teachers lots of questions.
A1505 Money you pay to the government is called tax.
A1506 The happy president won the election.
A1507 Really scary dreams are called nightmares.
A1508 We showed our passports when we crossed the border.
A1509 A baby cat is called a kitten.
A1510 In the morning she drinks orange juice.
A1511 Draw a straight line using the ruler.

B1210 The girls are talking about the new game.
B1211 The tasty curry has two types of vegetable.
B1212 This man has a very bad habit.
B1213 At lunchtime I usually drink coffee.
B1214 She has a small cut on her finger.
B1215 The team manager wants other players.
B1216 If you are there, get some useful directions.
B1217 Next month the busy woman will have a baby.
B1218 Those weird people over there are strangers.
B1219 The man loved his soft black hair.
B1220 Every day those people eat one egg.
B1221 That man has very nice legs.
B1222 In some countries people never use a spoon.
B1223 The lawyer has a powerful voice.
B1224 Those people’s jobs is to tidy up buildings.
B1501 On Monday I often have a sandwich.
B1502 This lovely place is my favourite continent.
B1503 In some countries people don’t often have breakfast.
B1504 Sometimes children have a lot of questions.
B1505 Most people enjoy complaining about their tax.
B1506 The excited people watched the election.
B1507 Children have a lot of scary nightmares.
B1508 We showed our tickets when we reached the border.
B1509 I used to have a little kitten.
B1510 In the morning she drinks tasty juice.
B1511 The designer bought a new ruler.

C1210 The children are playing a fun ride.
C1211 Carrots and potatoes are types of lemonade.
C1212 Smoking is a very bad review.
C1213 In the morning we drink tea or presents.
C1214 She has a gold ring on her market.
C1215 Football teams always have eleven turnings.
C1216 If you are lost, ask someone for reporters.
C1217 Next month the pregnant lady will have her million.
C1218 Children should never talk to toilets.
C1219 The girl brushed her long blonde bar.
C1220 Every day the chicken lays an inch.
C1221 The desk has four wooden bands.
C1222 People eat soup or cereal using a film.
C1223 The singer has a beautiful list.
C1224 An architect’s job is to design girlfriends.
C1501 For lunch I usually eat a cheese jungle.
C1502 Asia is not a country, it’s a pharmacy.
C1503 In the morning people eat toast for marriage.
C1504 Children ask their teachers lots of brothers.
C1505 Money you pay to the government is called rap.
C1506 The happy president won the arrangement.
C1507 Really scary dreams are called baseballs.
C1508 We showed our passports when we crossed the fever.
C1509 A baby cat is called a poster.
C1510 In the morning she drinks orange coast.
C1511 Draw a straight line using the parrot.
A1512  Lots of teachers work in that school
A1513  Children love playing with noisy toys
A1514  Tablets and pills are types of medicine
A1515  A jacket isn't as warm as a long coat
A1516  The bride and groom had a traditional wedding
A1517  Your eyes and mouth are part of your face
A1518  He loves driving fast in his car
A1519  In Asia people eat a lot of rice
A1520  You can get fit by working out at the gym
A1521  The largest animal in Africa is the elephant
A1522  The tourists are visiting the capital city
A1523  Keep your neck warm with a long scarf
A1524  Sweet honey is made by bees
A1525  Some children go to school on a yellow bus
A1526  The musician plays the piano and other instruments
A1527  Please put the flowers in a vase
A1528  A kitten is a baby cat
A1529  The painting is in a wooden frame
A1530  Cars and buses are types of vehicle
A1531  I take sandwiches to work to eat for lunch
B1512  Lots of people work in that school
B1513  People like shopping for lovely toys
B1514  The man takes many types of medicine
B1515  This thing isn't as useful as a nice coat
B1516  The man and woman went to a horrible wedding
B1517  These important things are part of your face
B1518  She loves eating chips in her car
B1519  In that country they eat a lot of rice
B1520  You can have fun by going to the gym
B1521  My favourite animal in Africa is the elephant
B1522  The people are visiting the famous city
B1523  Keep yourself warm with a long scarf
B1524  Some children are really scared of bees
B1525  People sometimes send their friends a postcard
B1526  In some places people wear a uniform
B1527  I asked the man about his other account
B1528  My father doesn't usually leave a tip
B1529  Children enjoy having fun at the circus
B1530  Some people go to work on the crowded bus
B1531  Some people have a lot of different instruments
B1532  Please be careful with that old vase
B1533  The old lady has a very cute cat
B1534  The nice present is a beautiful frame
B1535  The man will have three types of vehicle
B1536  Every day I drink chocolate milk with my lunch
C1512  Lots of teachers work in that chance
C1513  Children love playing with noisy ports
C1514  Tablets and pills are types of video
C1515  A jacket isn't as warm as a long lake
C1516  The bride and groom had a traditional army
C1517  Your eyes and mouth are part of your dad
C1518  He loves driving fast in his sir
C1519  In Asia people eat a lot of caves
C1520  You can get fit by working out at the flag
C1521  The largest animal in Africa is the orange
C1522  The tourists are visiting the capital power
C1523  Keep your neck warm with a long bulb
C1524  Sweet honey is made by huts
C1525  Tours often send their friends a classroom
C1526  In some countries schoolchildren wear a location
C1527  I paid the money into his bank extra
C1528  After dinner we left the waiter a small bone
C1529  Children enjoy seeing clowns at the district
C1530  Some children go to school on a yellow clock
C1531  The musician plays the piano and other announcements
C1532  Please put the flowers in a grill
C1533  A kitten is a baby board
C1534  The painting is in a wooden tube
C1535  Cars and buses are types of prisoner
C1536  I take sandwiches to work to eat for front
<p>| A1413 | Use the lift or walk up the stairs |
| A1414 | People you work with are your colleagues |
| A1415 | A baby dog is called a puppy |
| A1416 | Those bees make delicious sweet honey |
| A1417 | When you eat, food goes down into your stomach |
| A1418 | The Italian restaurant sells slices of pizza |
| A1419 | Your hand is connected to your arms |
| A1420 | The tourists are staying in an expensive hotel |
| A1421 | I drink coffee with sugar and milk |
| A1422 | I often borrow books from the library |
| A1423 | You can’t control the beating of your heart |
| A1424 | Meat from a cow is called beef |
| A1501 | Managers often earn a high salary |
| A1502 | In the past teachers wrote on the blackboard |
| A1503 | People with toothache should visit the dentist |
| A1504 | There are sixty minutes in an hour |
| A1505 | The rock musician plays the guitar |
| A1506 | Carrying a heavy bag can hurt your back |
| A1507 | To visit some countries you need a visa |
| A1508 | I prefer typing to writing with a pen |
| A1509 | He’s drinking water out of the tall glass |
| A1510 | After lunch I work all afternoon |
| A1511 | My dentist looks after my teeth |
| A1512 | A puppy is a baby dog |
| A1513 | The traditional furniture is made of wood |
| A1514 | Mice love to eat smelly cheese |
| B1413 | Turn right and then walk up the stairs |
| B1414 | I often have meetings with my colleagues |
| B1415 | The children love their cute puppy |
| B1416 | The children eat tasty sweet honey |
| B1417 | When you eat too much you get a fat stomach |
| B1418 | The expensive restaurant sells pieces of pizza |
| B1419 | Your ears aren’t connected to your arms |
| B1420 | The receptionist works at a famous hotel |
| B1421 | Kids sometimes drink a lot of milk |
| B1422 | I don’t read newspapers at the library |
| B1423 | You can’t change the action of your heart |
| B1424 | My favourite food is called beef |
| B1501 | He doesn’t have a very good salary |
| B1502 | In the past people used a blackboard |
| B1503 | Every six months I visit my dentist |
| B1504 | We are going home in one hour |
| B1505 | The old scientist plays the guitar |
| B1506 | The man fell and really hurt his back |
| B1507 | Before his holiday he got a visa |
| B1508 | At work I often have to find a pen |
| B1509 | He’s pouring water into the small glass |
| B1510 | I only work here in the afternoon |
| B1511 | I always look after my teeth |
| B1512 | The children have a nice little dog |
| B1513 | The very pretty jewellery is made of wood |
| B1514 | I really like sandwiches that have cheese |
| C1413 | Use the lift or walk up the term |
| C1414 | People you work with are your painters |
| C1415 | A baby dog is called a sweater |
| C1416 | Those bees make delicious sweet matter |
| C1417 | When you eat, food goes down into your machine |
| C1418 | The Italian restaurant sells slices of football |
| C1419 | Your hand is connected to your east |
| C1420 | The tourists are staying in an expensive system |
| C1421 | I drink coffee with sugar and staff |
| C1422 | I often borrow books from the chocolate side |
| C1423 | You can’t control the beating of your arm |
| C1424 | Meat from a cow is called zone |
| C1501 | Managers often earn a high festival salary |
| C1502 | In the past teachers wrote on the checkout blackboard |
| C1503 | People with toothache should visit the sunset dentist |
| C1504 | There are sixty minutes in an air hour |
| C1505 | The rock musician plays the reward guitar |
| C1506 | Carrying a heavy bag can hurt your set |
| C1507 | To visit some countries you need a topic visa |
| C1508 | I prefer typing to writing with a duck pen |
| C1509 | He’s drinking water out of the tall breath glass |
| C1510 | After lunch I work all engineer afternoon |
| C1511 | My dentist looks after my lamps teeth |
| C1512 | A puppy is a baby fact dog |
| C1513 | The traditional furniture is made of golf wood |
| C1514 | Mice love to eat smelly views cheese |</p>
<table>
<thead>
<tr>
<th>A1515</th>
<th>Eggs taste better with a little</th>
<th>salt</th>
<th>B1515</th>
<th>It is better with a little</th>
<th>salt</th>
<th>C1515</th>
<th>Eggs taste better with a little</th>
<th>league</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1516</td>
<td>The tour guide is talking to a group of</td>
<td>tourists</td>
<td>B1516</td>
<td>The woman is talking to a group of</td>
<td>tourists</td>
<td>C1516</td>
<td>The tour guide is talking to a group of</td>
<td>biscuits</td>
</tr>
<tr>
<td>A1517</td>
<td>We used the bridge to cross the river</td>
<td>A1518</td>
<td>A holiday after your wedding is called a</td>
<td>A1519</td>
<td>She's making some trousers using scissors</td>
<td>C1519</td>
<td>She's cutting the paper using sharp scissors</td>
<td>pirates</td>
</tr>
<tr>
<td>A1519</td>
<td>She's cutting the paper using sharp scissors</td>
<td>A1521</td>
<td>People in England and China speak different languages</td>
<td>B1519</td>
<td>She's making some trousers using scissors</td>
<td>C1520</td>
<td>Keep your feet warm with wool</td>
<td>tins</td>
</tr>
<tr>
<td>A1520</td>
<td>Keep your feet warm with wool</td>
<td>A1521</td>
<td>People in England and China speak different</td>
<td>A1520</td>
<td>Keep your hands off my new socks</td>
<td>C1521</td>
<td>People in England and China speak different</td>
<td>characters</td>
</tr>
<tr>
<td>A1521</td>
<td>People in England and China speak different</td>
<td>A1522</td>
<td>In the morning father always reads the newspaper</td>
<td>B1522</td>
<td>In the evening I usually buy a newspaper</td>
<td>C1522</td>
<td>In the morning father always reads the newspaper</td>
<td>studio</td>
</tr>
<tr>
<td>A1522</td>
<td>In the morning father always reads the newspaper</td>
<td>A1523</td>
<td>A pilot's job is to fly a plane</td>
<td>B1523</td>
<td>Their job is to fix the plane</td>
<td>C1523</td>
<td>A pilot's job is to fly a plane</td>
<td>fool</td>
</tr>
<tr>
<td>A1523</td>
<td>A pilot's job is to fly a plane</td>
<td>A1524</td>
<td>The child loves his mother and father</td>
<td>B1524</td>
<td>On Mondays the child helps his father</td>
<td>C1524</td>
<td>The child loves his mother and father</td>
<td>running</td>
</tr>
<tr>
<td>A1524</td>
<td>The child loves his mother and father</td>
<td>A1525</td>
<td>The mother loves her son and daughter</td>
<td>B1525</td>
<td>The nurse plays with her little daughter</td>
<td>C1525</td>
<td>The child loves his mother and father</td>
<td>running</td>
</tr>
<tr>
<td>A1525</td>
<td>The mother loves her son and daughter</td>
<td>A1526</td>
<td>Her wedding ring is made of gold</td>
<td>B1526</td>
<td>The small statue is made of gold</td>
<td>C1526</td>
<td>The mother loves her son and daughter</td>
<td>surprise</td>
</tr>
<tr>
<td>A1526</td>
<td>Her wedding ring is made of gold</td>
<td>A1527</td>
<td>The funniest people at the circus are the clowns</td>
<td>B1527</td>
<td>The saddest people at the theatre were some clowns</td>
<td>C1527</td>
<td>The funniest people at the circus are the clowns</td>
<td>dust</td>
</tr>
<tr>
<td>A1527</td>
<td>The funniest people at the circus are the clowns</td>
<td>A1528</td>
<td>Forests have many tall green trees</td>
<td>B1528</td>
<td>People like to walk near nice trees</td>
<td>C1528</td>
<td>Forests have many tall green trees</td>
<td>kicks</td>
</tr>
<tr>
<td>A1528</td>
<td>Forests have many tall green trees</td>
<td>A1529</td>
<td>The teacher helps the children in her class</td>
<td>B1529</td>
<td>The man talked to the children in the class</td>
<td>C1529</td>
<td>The teacher helps the children in her class</td>
<td>fault</td>
</tr>
<tr>
<td>A1529</td>
<td>The teacher helps the children in her class</td>
<td>A1530</td>
<td>We hear sound using our ears</td>
<td>B1530</td>
<td>Some kids have very big ears</td>
<td>C1530</td>
<td>We hear sound using our ears</td>
<td>halls</td>
</tr>
<tr>
<td>A1530</td>
<td>We hear sound using our ears</td>
<td>A1531</td>
<td>Children between thirteen and nineteen are teenagers</td>
<td>B1531</td>
<td>The kittens are playing with the group of teenagers</td>
<td>C1531</td>
<td>Children between thirteen and nineteen are</td>
<td>calendars</td>
</tr>
<tr>
<td>A1531</td>
<td>Children between thirteen and nineteen are</td>
<td>A1532</td>
<td>Some women wear very high-heeled shoes</td>
<td>B1532</td>
<td>Some men like very expensive shoes</td>
<td>C1532</td>
<td>Some women wear very high-heeled shoes</td>
<td>pies</td>
</tr>
<tr>
<td>A1532</td>
<td>Some women wear very high-heeled shoes</td>
<td>A1533</td>
<td>He called the restaurant to book a table</td>
<td>B1533</td>
<td>He asked the waiter about the table</td>
<td>C1533</td>
<td>He called the restaurant to book a table</td>
<td>middle</td>
</tr>
<tr>
<td>A1533</td>
<td>He called the restaurant to book a table</td>
<td>A1534</td>
<td>The doctor told me to quit smoking</td>
<td>B1534</td>
<td>My mother told me to stop smoking</td>
<td>C1534</td>
<td>The doctor told me to quit smoking</td>
<td>drama</td>
</tr>
<tr>
<td>A1534</td>
<td>The doctor told me to quit smoking</td>
<td>A1535</td>
<td>My favourite fish is grilled pink salmon</td>
<td>B1535</td>
<td>My favourite food is nice fresh salmon</td>
<td>C1535</td>
<td>My favourite fish is grilled pink salmon</td>
<td>cola</td>
</tr>
<tr>
<td>A1535</td>
<td>My favourite fish is grilled pink salmon</td>
<td>A1536</td>
<td>In the summer we go to the swimming pool</td>
<td>B1536</td>
<td>At the weekend we often go to the pool</td>
<td>C1536</td>
<td>In the summer we go to the swimming pool</td>
<td>cream</td>
</tr>
<tr>
<td>A1536</td>
<td>In the summer we go to the swimming pool</td>
<td>A1537</td>
<td>At the gym I put my things in the locker</td>
<td>B1537</td>
<td>At work I put my things in my locker</td>
<td>C1537</td>
<td>At the gym I put my things in the locker</td>
<td>tiger</td>
</tr>
<tr>
<td>A1537</td>
<td>At the gym I put my things in the locker</td>
<td>A1538</td>
<td>I buy all my food at the big supermarket</td>
<td>B1538</td>
<td>I saw all this stuff at the new supermarket</td>
<td>C1538</td>
<td>I buy all my food at the big supermarket</td>
<td>graduation</td>
</tr>
<tr>
<td>A1538</td>
<td>I buy all my food at the big supermarket</td>
<td>A1539</td>
<td>Cars and buses have four wheels</td>
<td>B1539</td>
<td>Trains and buses have big wheels</td>
<td>C1539</td>
<td>Cars and buses have four wheels</td>
<td>pots</td>
</tr>
</tbody>
</table>
A1616 Please help me to open the jam jar
A1617 The sports centre has a new basketball court
A1618 When it is hot you should drink lots of water
A1619 Before we ordered we looked at the menu
A1620 The model looked at herself in the mirror
A1621 My car was fixed by a mechanic
A1622 She called the doctor to make an important appointment
A1623 The postman delivered the letter
A1624 The student studied and got good grades
A1701 Penguins eat a lot of fish
A1702 On sunny days there are no clouds in the sky
A1703 Silver, gold and iron are different types of metal
A1704 Wine is usually made from grapes
A1705 The tea is in a small white cup
A1706 Cars are made in a factory
A1707 History is learning about what happened in the past
A1708 If you are hot you can open the window
A1709 He is driving faster than the speed limit
A1710 Your father's brother is your uncle
A1711 I called the hotel to book a room
A1712 Sweets and biscuits have a lot of sugar
A1713 Keep your head warm by wearing a hat
A1714 Login using your username and password
A1715 I like driving instead of walking
A1716 Children are punished for their bad behaviour

B1616 Please help me with this big jar
B1617 The sports team is playing on the new court
B1618 When you get home you should have some water
B1619 Before we decided we looked at the long menu
B1620 The designer bought an expensive mirror
B1621 My son was helped by a mechanic
B1622 She asked the woman to change the appointment
B1623 The scientist opened the important letter
B1624 The professor rarely gives good grades
B1701 Those people like to eat lots of fish
B1702 On winter days there are some birds in the sky
B1703 This company uses different types of metal
B1704 Dishes are sometimes made with grapes
B1705 The stuff is in a small clean cup
B1706 Those men work in a factory
B1707 Students like this subject because they learn about the past
B1708 If you are bored you can clean the window
B1709 The driver is going over the limit
B1710 My father often meets my uncle
B1711 I called the place to ask about a room
B1712 He enjoys food with a lot of sugar
B1713 You can look nice by wearing a hat
B1714 It's hard for me to remember my password
B1715 I like football, swimming and walking
B1716 Children are admired for their good behaviour

C1616 Please help me to open the jam phrase
C1617 The sports centre has a new basketball date
C1618 When it is hot you should drink lots of trouble
C1619 Before we ordered we looked at the restaurant bucket
C1620 The model looked at herself in the section
C1621 My car was fixed by a translation
C1622 She called the doctor to make an example
C1623 The postman delivered the kisses
C1624 The student studied and got good shocks
C1701 Penguins eat a lot of guards
C1702 On sunny days there are no clouds in the firm
C1703 Silver, gold and iron are different cable
C1704 Wine is usually made from wool
C1705 The tea is in a small white roll
C1706 Cars are made in a performance
C1707 History is learning about what break
C1708 If you are hot you can open the future
C1709 He is driving faster than the speed pattern
C1710 Your father's brother is your picture
C1711 I called the hotel to book a case
C1712 Sweets and biscuits have a lot of monkeys
C1713 Keep your head warm by wearing a park
C1714 Login using your username and bracelet
C1715 I like driving instead of duty
C1716 Children are punished for their bad departure
A1717  Most vegetables are grown on a farm
A1718  The area close to your house is your neighbourhood
A1719  People enjoy reading their birthday cards
A1720  Chefs are very good at cooking
A1721  Reading and photography are common hobbies
A1722  He carefully filled out the job application
A1723  Russia is the world's largest country
A1724  Clothes fit best if they are the right size
A1801  Some people wear blue trousers called jeans
A1802  Housewives carry food in a plastic bag
A1803  I like jewellery made of gold more than silver
A1804  Doctors and nurses work in a hospital
A1805  The criminal was caught by the police
A1806  Kind people give money to charity
A1807  Children's films made of drawings are called cartoons
A1808  There are books and CDs on the shelf
A1809  Your heart moves blood around your body
A1810  Children quickly grow up and become adults
A1811  Babies drink from a plastic bottle
A1812  Schoolchildren wear trousers and a white shirt
A1813  He called the restaurant to make a reservation
A1814  Eating fruit and exercising are good for your health
A1815  In summer we always go abroad on holiday
A1816  In India we eat rice and chicken curry

B1717  Most weekends I work on a farm
B1718  My house is in a very quiet neighbourhood
B1719  People enjoy receiving a lot of cards
B1720  His father is really good at cooking
B1721  People often have a lot of different hobbies
B1722  He quickly finished the very boring application
B1723  Tourists like going to that small country
B1724  Make sure that you get the correct size
B1801  Some people enjoy wearing clothes called jeans
B1802  The housewife couldn't find her favourite bag
B1803  I like sculptures made of wood more than silver
B1804  The cleaners work in the big hospital
B1805  The man was interviewed by the police
B1806  The people talked about the charity
B1807  Some popular films are amazing cartoons
B1808  There are lots of things on the shelf
B1809  Some people do not like their body
B1810  Children often do not want to become adults
B1811  He threw away the old bottle
B1812  Office workers usually wear a shirt
B1813  She told her husband to make a reservation
B1814  Teenagers don't know how to look after their health
B1815  In summer we always have a relaxed holiday
B1816  At the weekend I like to eat chicken curry

C1717  Most vegetables are grown on a speech
C1718  The area close to your house is your butterfly
C1719  People enjoy reading their birthday brains
C1720  Chefs are very good at dollars
C1721  Reading and photography are common candles
C1722  He carefully filled out the job entertainment
C1723  Russia is the world's largest moment
C1724  Clothes fit best if they are the right fear
C1801  Some people wear blue trousers called grooms
C1802  Housewives carry food in a plastic seat
C1803  I like jewellery made of gold more than talent
C1804  Doctors and nurses work in a detective
C1805  The criminal was caught by the watches
C1806  Kind people give money to happiness
C1807  Children's films made of drawings are called trumpets
C1808  There are books and CDs on the drum
C1809  Your heart moves blood around your reason
C1810  Children quickly grow up and become options
C1811  Babies drink from a plastic level
C1812  Schoolchildren wear trousers and a white bunch
C1813  He called the restaurant to make a generation
C1814  Eating fruit and exercising are good for your price
C1815  In summer we always go abroad on gallery
C1816  In India we eat rice and chicken leisure
A1817  The restaurant has a famous chef
A1818  She invited all her friends to her party birthday
A1819  She speaks with a strong Scottish accent
A1820  The class listened to their teacher
A1821  The nervous fans watched the football match
A1822  You wear a hat on your head
A1823  A small mountain is called a hill
A1824  The mother made her sick child some chicken soup

B1817  The woman knows a very famous chef
B1818  She arrived with her friends at the fantastic party
B1819  She likes his lovely pleasant accent
B1820  The students always listen to their teacher
B1821  The children watched the important match
B1822  He put the book on his head
B1823  My town is close to a big hill
B1824  The mother made her child some delicious soup

C1817  The restaurant has a famous plug
C1818  She invited all her friends to her birthday sister
C1819  She speaks with a strong Scottish entry
C1820  The class listened to their danger
C1821  The nervous fans watched the football file
C1822  You wear a hat on your girl
C1823  A small mountain is called a mate
C1824  The mother made her sick child some chicken tear

A0001  Doctors choose medicine and then write a prescription
A0002  In maths class we do sums using a calculator
A0003  Call the police or an ambulance in an emergency
A0004  She wants to get a degree from a famous university
A0005  Studying animals and plants is called biology
A0006  The scientist is in the lab doing the experiment
A0007  Someone who doesn’t eat meat is called a vegetarian

B0001  After our discussion he gave me a prescription
B0002  In some classes we need to use a calculator
B0003  Call this number if you have an emergency
B0004  She will get a certificate from the old university
B0005  The scientist studies a lot of biology
B0006  The engineer is in the room doing the experiment
B0007  I don’t want those things because I’m a vegetarian

C0001  Doctors choose medicine and then write a tomato
C0002  In maths class we do sums using a millimetre
C0003  Call the police or an ambulance in an operation
C0004  She wants to get a degree from a famous possibility
C0005  Studying animals and plants is called facilities
C0006  The scientist is in the lab doing the ability
C0007  Someone who doesn’t eat meat is called a documentary