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INVESTIGATING THE IMPACT OF UNFAMILIAR SPEAKER ACCENT ON AUDITORY COMPREHENSION IN ADULTS WITH APHASIA.

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1. ABSTRACT

The UK is a highly multi-cultural society, where all individuals are likely to come into contact with speakers with unfamiliar accents. Recent figures suggest that such accent variation may be particularly apparent within the National Health Service (NHS) workforce. Research on accent variation has demonstrated that an unfamiliar speaker accent can affect listener comprehension, but the impact of speaker accent on the comprehension skills of listeners with neurological impairment has not been widely explored.

This study investigated the effect of an unfamiliar accent on the sentence comprehension of individuals with aphasia following stroke. It measured the impact of two different accents (South-East England and Nigerian) on accuracy and response time for 16 individuals with aphasia and 16 control subjects. Participants were presented with a computer-based sentence comprehension task using stimuli from the Comprehensive Aphasia Test (Swinburn, Porter & Howard, 2004), and their accuracy and response times were recorded. Results showed that individuals with aphasia made significantly more errors in comprehension of sentences spoken in an unfamiliar accent than in a familiar accent, a finding that was not demonstrated by the control group when outliers were excluded. Response times did not show significant effects of speaker accent for either group.

The findings of this study indicate that the impact of speaker accent should be considered in the rehabilitation of individuals with aphasia following stroke, and a number of possible clinical implications are discussed.

2. INTRODUCTION

The current UK climate of increased immigration and internal migration, coupled with recent active international recruitment to the National Health Service (NHS) (Buchan, Jobanputra, Gough & Hutt, 2005) indicates that the potential for patients to come into contact with speakers with unfamiliar accents is high. The present study aimed to identify the implications of this for patients for an acquired language disorder, specifically those patients with aphasia following stroke.

2.1 The healthcare environment

2.1.1 International healthcare recruitment

Recruitment of health workers from abroad became a key feature of NHS recruitment policy in the late 1990s, initially as a reactive 'quick fix' to help meet staffing targets (Buchan, Jobanputra & Gough, 2004). Following concern over the resulting skills shortages in developing countries, the Department of Health Code of Practice of International Recruitment for NHS Employers (DoH, 2001) was introduced, preventing active recruitment in a foreign country unless specific government-to-government agreements are in place. Despite this, however, there have been significant increases in recent years in new registrations of both doctors and nurses from abroad (Buchan et al, 2004), as the Code does not prevent health professionals proactively seeking employment in the UK (Buchan et al, 2005). Between 2001-2004 overseas countries contributed an average of around 45% of the annual number of new registrations to the Nursing and Midwifery Council (NMC figures). The Code also does not cover the private sector, and a recent study found that many international nurses had completed their required period of adaptation in private sector nursing homes (Buchan et al, 2005), subsequently moving into NHS employment.

Foreign health workers in the UK originate from a wide range of countries, thereby contributing to a diverse range of accents that patients may come into contact with. Figures in 2004 indicated that the majority of international nurses in London were from the Philippines, South Africa, Australasia, Ghana and Nigeria (Buchan et al, 2004).

2.1.2 Accent variation within the healthcare workforce

A number of researchers have identified the potential relevance of variation in speaker accent for individuals accessing health and social care services. Reynolds (1992, cited in

Mahendra, Bayles & Tomoeda, 1999) commented that care providers and nursing staff often have accents that are difficult for nursing home residents to understand, while Santo Pietro and Ostuni (2003) found that around 30-40% of direct care staff in American healthcare facilities were non-native speakers of English.

In the UK, variation in speaker accent may be particularly significant in London, as the capital's overall population is subject to significant regional and international immigration. In 2004, London received 218,000 international migrants and 155,000 new residents from the rest of the UK (ONS, 2007), thereby increasing the diversity of accents of English that can be expected in all industries, not only in healthcare. However, one London NHS Trust in a recent study employed nurses of 39 different nationalities (Buchan et al, 2004), and the overall London NHS workforce has a higher proportion of minority ethnic groups than the London population as a whole (Hutt & Buchan, 2005).

Regional accent variation may also have more impact in London, as health professionals from the rest of the UK are drawn to the capital. Workers may be attracted by an increased London salary weighting following Agenda for Change (Hutt & Buchan, 2005); higher staff vacancy rates than in the rest of the UK (Buchan et al 2004); and the range of career and educational opportunities on offer (Buchan et al, 2004).

The present study investigated the impact of variation in the familiarity of speaker accent on the comprehension skills of individuals with and without acquired language disorders, in the context of this environment.

2.2 Environmental factors in language impairment

Within the social approach to disability (e.g. see Parr, Byng, Gilpin & Ireland, 1997) focus shifts away from the individual and towards the capacity and willingness of society to make sufficient adaptations to disability. The WHO International Classification of Functioning, Disability, and Health (ICF) (WHO, 2001) explicitly includes contextual factors (both personal and environmental) within its bio-psychosocial approach to health conditions. Negative environmental factors (barriers) hinder an individual's participation in life situations, while positive environmental factors (facilitators) support participation.

Brown, McGahan, Alkhaledi, Seah, Howe and Worrall (2006) state that within the field of aphasiology the importance of identifying environmental barriers and facilitators has been

recognised, though the need for further research in this area is highlighted as the majority of studies have focused on individuals with physical disabilities. Lack of communicative access in the community has been shown to impact on the emotional health and quality of life for people with aphasia (Cruice, Worrall, Hickson & Murison, 2003), and it is likely that speaker behaviours and characteristics affect this access. However, in a review of aphasiology articles considering environmental factors, Howe, Worrall and Hickson (2004) found that authors have generally not conceptualised the communication of other people within this domain of the ICF, although it is recognised as an important influence on the communication of people with aphasia.

In an attempt to identify environmental factors that influence the community participation of adults with aphasia, Howe, Worrall and Hickson (submitted) carried out a qualitative study of 25 people with post-stroke aphasia, investigating their perceptions of the accessibility of the community. Semi-structured interviews with participants aged 34 to 85 years revealed a range of environmental factors falling into a number of broad categories: barriers related to other people, physical barriers, societal barriers, facilitators related to other people, physical facilitators and societal facilitators. The perception of some subjects was that the communication characteristics of other people such as having a foreign accent made it more difficult to access the community. However, this reported experience requires empirical investigation to determine whether the perception of foreign accent as a barrier to community participation is supported by a measurable change in performance.

2.3 The importance of accent

2.3.1 Accent as a form of variation

In the literature on sociolinguistics, differences between 'varieties' of a language may involve differences in syntax, morphology, lexicon and pronunciation (Wells, 1982a). Chambers and Trudgill (1980, p.5) state that 'accent' "refers to the way in which a speaker pronounces, and therefore refers to a variety which is phonetically and/or phonologically different from other varieties." A speaker's accent can be a strong indicator of that individual's geographical identity, though accent may also be affected by the speaker's socio-economic class, age, gender and ethnicity (Wells, 1982a). However, some accents do not have such geographical markers, and are regarded as a 'standard'. In the UK, Southern Standard English is considered the general standard according to Wells' (1982a, p.34) definition:

"A standard accent is the one which, at a given time and place, is generally considered correct: it is held up as a model of how one ought to speak, it is encouraged in the classroom, it is widely regarded as the most desirable accent for a person in a high-status profession to have."

Wells (1982a) makes the distinction between native accents of English (the pattern of pronunciation used by a native English speaker) and foreign accents of English (pronunciation patterns that reflect phonological and phonetic characteristics of another native language). As outlined in section 2.1, it is likely that individuals in the UK, and perhaps in London particularly, will come into contact with regional, international and foreign accents of English, and all of these are highly represented within the healthcare workforce. The familiarity of these accents to an individual listener may have a significant impact on the success of communication.

2.3.2 The impact of accent

Speaker accent has been identified as a significant factor in listener perceptions of speech by a range of authors. It is perhaps reasonable to expect that strongly or unfamiliarly accented speech should take longer to process than speech produced in a familiar accent. According to Munro and Derwing (1995), for example, the time required for recognition of individual segments may be greater if they differ from stored exemplars, or the miscomprehension of specific lexical items may require top-down processing within the sentence context.

Accent variation may have wide-reaching consequences. The impact of speaker accent on listener perceptions of the background, character and social status of the speaker has been widely investigated (see Fuertes, Potere & Ramirez, 2002, for a review). Bresnahan, Ohashi, Nebashi, Ying Liu and Shearman (2002) found that an intelligible foreign accent resulted in a more positive attitude and affective response by listeners when compared with an unintelligible foreign accent, and some studies have suggested that speakers with a standard accent tend to be rated more favourably than speakers with foreign, non-standard or regional accents (Fuertes et al, 2002). In their comparison of standard American-accented listeners' reactions to standard American-accented and Asian-accented English speakers, Hosoda, Stone-Romero and Walter (2007) found that Asian-accented speakers were perceived as poorer communicators who were less potent, less threatening, and more concerned about others. The Asian-accented

speakers also evoked more negative affect and required more attention from listeners. The relationship between such perceptions and the impact on listener comprehension, however, is rarely clearly delineated by researchers. For example, Hosoda et al (2007, p.321) conclude that foreign-accented speech requires more attention from listeners, "probably because foreign-accented speech is more difficult to comprehend". Bottriell and Johnson (1985a&b) suggested two possible explanations for their findings that information spoken in Received Pronunciation (RP) was recalled more successfully than information in a regional accent: either RP speakers are perceived as more intelligent than regional speakers and so listeners pay more attention to them, or that since a listener finds it easier to understand RP speech more of the content is recalled and the speaker is therefore perceived as being more intelligent. Major, Fitzmaurice, Bunta and Balasubramanian (2005) claim that comprehension of an accent involves familiarity, degree of exposure, attitude and stereotyping, and that "listening comprehension is aided when the listener is familiar with a particular accent and has no negative attitudes toward that accent" (p.45). Thus the relationship between comprehension and affective response appears to be important, if somewhat unclear.

Impact on comprehension of normal native listeners

The present study sought to directly assess the impact of accent variation on comprehension skills, and this has been widely investigated with normal native listeners. Nathan, Wells and Donlan (1998) investigated children's comprehension of an unfamiliar regional accent (Glaswegian) in comparison with their own accent (London). They predicted that with increased age and increased exposure to speech, the resulting exposure to a wider range of accents would benefit the older children in their study. They found that comprehension of unfamiliar accents did improve with age, at least in young children, but emphasised the importance of sentence context to support lexical identification in an unfamiliar accent.

In an investigation of the effects of various types of familiarity on native speaker comprehension of non-native speech, Gass and Varonis (1984) found that familiarity with topic had the greatest impact. However, they also concluded that a general familiarity with non-native speech facilitates comprehension, as does familiarity with a particular non-native accent when listening to another speaker of that language background. It is reasonable to suppose, then, that individuals who have experience of listening to a range

of accents may have less difficulty with comprehension of non-native accents than those with limited experience.

Gill (1994, cited in Fuertes et al, 2002) found that standard American accented listeners understood more information when delivered by standard accented teachers than teachers with foreign accents, and argued that this may be due to differential allocation of cognitive resources. Gill suggests that when additional processing resources are required to attend to a non-standard accent, fewer resources are available for processing information. The argument that listening to and comprehending intelligible but accented speech requires increased processing effort on the part of native listeners has been supported by further research (e.g. Schmid & Yeni-Komshian, 1999). However, Clarke and Garrett (2004) found that although processing speed is initially slower for accented speech than for native speech, this deficit diminishes within one minute of exposure. They also found that some degree of adaptation to the non-native accent could occur within just two to four sentences.

In their study of the effect of foreign accent and speaking rate on native speaker comprehension, Anderson-Hsieh and Koehler (1988) tested subjects' comprehension of short passages read by native and non-native speakers at three different rates. Listeners' comprehension scores were higher for native speakers than for non-native speakers, and scores for each speaker corresponded to their degree of accentedness. While scores for all speakers were significantly lower at a fast rate than at a regular rate, the biggest difference was found for the speaker with the heaviest accent. This interaction between rate and degree of accent may be meaningful within the context of healthcare services, where staff shortages and heavy workload can lead to a reduction in patient contact time and perhaps an increased rate of speech. In such a context, listener response time may also become a factor in the success of communication and interaction. Munro and Derwing (1995) found that response times for comprehension of single sentences by native English listeners were, on average, 30 milliseconds (ms) slower for a foreign accent than for a native English accent. Clarke and Garrett (2004) found that English listeners took an average of 100-150ms longer to identify target words in a sentence when produced in a Spanish accent than in a native English accent. Floccia, Goslin, Girard and Konopczynski's (2006) study of the lexical decision processing of regional French accents found a significant increase in reaction time associated with processing

unfamiliar accents, and demonstrated that the latency effect was due to familiarity rather than to the specific features of any one accent.

Not all studies have found that accented speech results in impaired comprehensibility however. Munro and Derwing (1999) found that non-native stimuli were highly intelligible to native English-speaking listeners, and argued that "the presence of a strong foreign accent does not necessarily result in reduced intelligibility or comprehensibility," (p.303). However, response time was not recorded in their study, and they concede that discrepancies between listeners' perception of comprehensibility and their actual accuracy may be related to increased processing time. For any investigation of the impact of speaker variation on listener comprehension, then, response time may be a crucial factor.

Impact on comprehension of second language listeners

The comprehensibility of accented speech for learners of English as a second language (ESL) has also been investigated, and it has been suggested that familiarity with a specific variety of English may be a more significant factor in comprehension than actually sharing the same accent or native language (Major et al, 2005, Tauroza & Luk, 1996). Wilcox (1978) assessed 320 Chinese-educated students of English in their comprehension of American English, RP, Australian English and Singaporean-Malaysian English. Subjects' comprehension of the Singaporean-Malaysian accent was strongest, followed by RP, suggesting an effect of familiarity rather than the specific features of a particular accent.

Major, Fitzmaurice, Bunta and Balasubramanian's (2002) study of non-native accents found that both native and non-native listeners scored significantly lower on listening comprehension tests when they listened to non-native speakers of English. In their further study, Major et al (2005) gave a multiple choice comprehension test to 180 ESL learners and 60 native English speakers following short lectures by speakers with standard, regional, ethnic and international accents of English. They found that speaker dialect had a significant effect for all listeners, but there was no significant interaction between speaker dialect and listener status. In a multi-cultural society where both listeners and speakers are likely to have a range of native and non-native accents of a language, a standard or at least more familiar accent appears to be more easily comprehended by all listeners.

Impact on comprehension of at-risk populations

Older adults may be more susceptible to the effects of accent, as changes in hearing, sensory processing and working memory capacity may compromise older adults' abilities to perceive and process speech (Burda & Hageman, 2005). As the risk of stroke increases with age (National Service Framework for Older People, DoH, 2001) this may be an additional factor in the comprehension skills of individuals with aphasia following stroke.

Burda and Hageman (2005) measured how intelligible accented speech was to residents in assisted-living facilities in America. Twenty native English speakers aged between 62 and 91, with no history of neurological deficit, listened to and transcribed words and sentences produced by English, Taiwanese and Spanish speakers, and then rated comprehensibility and accentedness on a seven-point scale. While their data suggest that listening to accented speech may be difficult for native English speaking residents in assisted-living facilities, with ratings of comprehensibility highly correlated with ratings of accentedness, the lack of control data makes conclusions about the significance for this particular population problematic. Similarly, in an investigation of the effects of age and accent on transcription of medically-related information, Burda, Casey, Foster, Pilkington and Potter (2005) found that all age groups had more difficulty transcribing the speech of non-native speakers than of native speakers, and that older adults had more difficulty overall. However, since no significant interaction between listener age and speaker accent was found, their claim that "persons, particularly those aged 65+, may have difficulty understanding medically-related utterances" (p.2) cannot be extended to include the effects of speaker accent. Further, subjects in these studies were required to provide an accurate transcription to demonstrate understanding, and so the real impact on comprehension of the stimuli can only be estimated. Comparison of all studies investigating the impact of accent on comprehension is in fact restricted by the variety of tasks used. Techniques as diverse as the identification of mispronunciations (Schmid & Yeni-Komshian, 1999), reaction time to visual probe words following auditory sentences (Clarke & Garrett, 2004), lexical decision (Floccia et al, 2006) and sentence verification (Munro & Derwing, 1995) have been employed, making direct comparison and clinical application problematic. A more robust assessment of comprehension skills may be required in order to determine the clinical relevance of accent variation in individuals with communication difficulties. Burda and Hageman (2005) recognise that a task requiring subjects to listen to the stimuli and then point to a correct answer may have yielded

different results, and so a picture-pointing paradigm might be appropriate in this type of investigation.

Impact on comprehension of individuals with language impairment

The research discussed above has demonstrated that speaker accent can influence comprehension, processing time and affective response in a number of groups, but little research has examined the effect of speaker accent on a compromised language system.

Nathan and Wells (2001) assessed auditory lexical decision and auditory discrimination in speech disordered and control children, under familiar and unfamiliar accent conditions. They found that children with speech disorder showed a specific deficit in the unfamiliar accent condition, concluding that subtle difficulties with the processing of accent variation can block lexical access. They state, therefore, that speaker accent is an important variable to consider in both assessment of speech and language skills and in the design and implementation of therapy tasks.

While Nathan and Wells (2001) discuss this issue in developmental terms, the impact of accent variation on listeners with an acquired communication disorder has received limited attention. In an apparently unique study into the effects of speaker accent on adult listeners with neurological deficit, Mahendra et al (1999) investigated the performance of a small sample of normal elderly and individuals with Alzheimer's Disease on tests of speech discrimination and phrase repetition in familiar and unfamiliar accent conditions. Tasks were deliberately chosen to empirically evaluate the effects of an unfamiliar accent by removing semantic context, following their claim that "on tasks that have contextual cues to facilitate performance, accent effects are likely to be less dramatic" (p.228). However, this potential lack of clinical validity and practical application can be seen as a distinct disadvantage, where conclusions about the realistic implications of speaker accent variation for listeners with neurological deficit cannot be drawn. Moreover, although Mahendra et al (1999) did find that both normal elderly and individuals with Alzheimer's Disease scored significantly lower in the unfamiliar accent condition, the relative performance of the two groups was not fully investigated. While they claim that their findings have "serious implications for the testing of cognitively impaired individuals" (p.227), their evidence does not clearly demonstrate that individuals with cognitive impairment are more at risk of miscomprehension of unfamiliar accents than normal elderly.

In their study of the effects of age and accent on the comprehension of medically-related information, Burda et al (2005) recognise the role of speech and language therapists in providing the knowledge and skills to facilitate successful communicative interactions between native and non-native speakers. They call for investigation of the effects of speaker accent on participants who are not neurologically intact, a call echoed by Burda and Hageman (2005) who highlight the need for research on the perception of accented speech with subjects with acquired speech and language disorders. The present study aimed to begin to address this need.

2.4 Aim of present study

Since the literature on accent variation indicates that less familiar or non-native accents of English affect comprehension and speech processing in many groups, the present study aimed to investigate this within the context of healthcare services for individuals with aphasia following stroke. The study addressed the following questions:

1. Does the familiarity of speaker accent affect accuracy of sentence comprehension in individuals with aphasia following stroke?
2. Does the familiarity of speaker accent affect response time for sentence comprehension in individuals with aphasia following stroke?

3. METHOD

3.1 Design

All participants were tested on an auditory sentence comprehension task, using stimuli from the Comprehensive Aphasia Test (Swinburn, Porter & Howard, 2004), a recognised tool for the assessment of language skills. The spoken sentence comprehension and written sentence comprehension items were used as stimuli for this spoken test, employing the sentence-picture matching paradigm common in research with aphasic patients (Berndt, Mitchum & Haendiges, 1996). Two types of responses were recorded: the accuracy of response and the reaction time. Stimuli were presented in two conditions: a familiar accent condition (South-East England) and an unfamiliar accent condition (Nigerian). Participants were either people with aphasia following stroke, or adults with no history of neurological deficit. There was therefore one within-subjects factor (accent condition) and one between subjects-factor (language status group) constituting a mixed experimental design.

3.2 Speakers

In order to control for cross-speaker variation due to age or sex differences rather than accent differences, both speakers selected for this study are female and the same age (47), and both live in the Greater London area. Given the current healthcare workforce environment (see section 2.1), they were selected as representative of two accents that adult patients in London are likely to come into contact with: a standard South-East England accent, and a Nigerian English accent. Although both of these accents are present in the London community, it was thought that the South-East England accent, approximating Southern Standard English, would be very familiar to British listeners (Wells, 1986) while the Nigerian English accent would be at least *less* familiar.

The South-East England speaker in this study grew up in the South-East and has spent the majority of her life in the area. Her accent is characteristic of the middle-class South Eastern Regional Standard described by Wells (1986), which can be considered as being on a continuum from Cockney to RP. For example, she demonstrates greater allophonic variation between 'two' and 'tool' than RP, less smoothing in words such as 'fire' and 'power', and the use of /i/ rather than /ɪ/ in final position in words such as 'happy'. She describes her own accent as "a typical South-East of England accent, very non-specific."

The Nigerian speaker in this study is a fluent English speaker, having learnt English from primary school age. Although her first language is Igbo, one of the many native Nigerian languages, which she spoke as a child, her accent exhibits more features of Yoruba, the language she spoke as a teenager (see Wells (1982b) and Trudgill & Hannah (2002) for detailed features of these languages) and of typical West African English. For example, the distinction between /i/ and /ɪ/ is typically not clear in her speech, and although she does produce both of these vowel sounds (a feature of Igbo and not of most other Nigerian languages) she does not adhere to the Igbo rule of vowel harmony that would preclude the inclusion of both these vowels in the same word (Wells, 1982b). The speaker moved to London at the age of 29, and at the time of recording had lived in London for 18 years. She describes her own accent as a mixture of Southern and Western Nigerian, reflecting her background, and states that her accent has changed slightly since moving to England. She speaks English at work and at home with her husband and children. Sample phonetic differences between the two speakers' accents are presented in Table 3.1.

Table 3.1: Differences in phonetic realisation between speaker accents in this study.

Target	South-East realisation	Nigerian realisation
butcher	[ˈbʊtʃə]	[ˈbutʃa]
is	[ɪz]	[ɪs:]
carpet	[ˈkɑ:pɪt]	[ˈkapet]
green	[gɹi:n]	[gɹɪn]
nurse	[nɜ:s]	[nes:]
dancer	[ˈdɑ:nsə]	[ˈdansa]
the	[θi:]	[d̪ɪ]

3.3 Stimuli

Stimuli were taken directly from the CAT written and spoken sentence comprehension tests. 16 test items, each consisting of a sentence and four picture-match options, were presented in the familiar accent condition and 16 items in the unfamiliar accent condition. A range of sentence forms was presented but by taking items from the CAT, sentence types were matched across the two conditions.

Sentences were recorded by the two speakers using a recordable mini-disk player, in a quiet but not soundproof room. Throughout the experiment, environmental conditions were controlled to reflect a normal speaking environment where consideration has been given to the reduction of background noise, to contribute to the clinical value of the test. A random sequence of all items from both accent conditions was created and presented to all subjects (see Appendix 1 for full stimuli list).

3.4 Participants

A total of 16 adults with aphasia and 16 adult control subjects participated in this investigation. Participants with aphasia were all clients at a clinic for acquired communication disorders, whose language difficulties were the result of dominant hemisphere stroke. All participants with aphasia were at least six months post-onset, and presented with a range of specific communication difficulties and levels of severity, as measured by the Western Aphasia Battery (Kertesz, 1982). Control subjects were adults with no history of neurological deficit, and no significant medical conditions. The researcher ascertained that all participants selected had no sustained direct contact with the unfamiliar accent (Nigerian), no immediate family members from Nigeria and no extended periods spent in Nigeria.

Of the 16 adults with aphasia, nine were male and seven were female. Ages ranged from 36 to 80 years old, with a mean age of 59 years. All participants had a good pre-morbid level of English, and all had previously chosen to have speech and language therapy in English, although for two subjects English was a second language. Full details of participants with aphasia are included in Table 3.2.

Of the 16 control subjects eight were male and eight were female. Subjects in the two test groups were not specifically age-matched, but a similar range of ages was included. Ages in the control group ranged from 35 to 84 years old, with a mean age of 59 years. Full details of control subjects are included in Table 3.3.

All subjects underwent a pure tone audiometry hearing screen using an audiometer, in a quiet but not soundproof room. As free-field testing was used, participants who passed at 30dBHL at all frequencies tested (500Hz, 1KHz, 2KHz, 4KHz) in at least one ear were considered to have passed the screen. A number of participants did not pass, and consideration has been made of this in analysis of the results. Subjects also completed a

simple auditory discrimination task to determine their ability to discriminate between minimal pairs within a carrier sentence. Stimuli for this task were presented in the familiar accent condition only (see Appendix 2 for full stimuli list). All subjects demonstrated good single word comprehension in this task; any errors were largely in line with noted hearing loss.

Table 3.2: Details of participants with aphasia.

Subject	Age	M/ F	Years post-onset	First language English?	Hearing at 30dBHL	WAB classification	Auditory Discrimination (max=18)
1	63	M	15 approx	Y	Pass	Conduction	16
2	75	F	5 approx	Y	Fail	Anomic	18
3	45	F	3;10	Y	Pass	Anomic	18
4	72	M	6;0	Y	Pass	Conduction	14
5	50	M	4;0	Y	Pass	Broca's	17
6	80	F	2;7	Y	Fail	Anomic	16
7	54	M	4;8	Y	Pass	Anomic	15
8	70	F	2;8	Y	Fail	Conduction	15
9	45	F	6;11	Y	Pass	Broca's	18
10	70	M	4;11	N[1]	Fail	Wernicke's	17
11	57	M	1;2	Y	Fail	Anomic	17
12	57	M	9 approx	Y	Pass	Conduction	17
13	61	F	3;3	Y	Pass	Anomic	17
14	57	F	0;8	Y	Pass	Anomic	17
15	36	M	2;4	N[1]	Fail	Anomic	18
16	51	M	2;3	Y	Pass	Anomic	18

[1] Subject 10 identified his first language as Patois, with English as his third language. Subject 15's first language is Dutch, with English as his third language. However both subjects stated that their post-onset language use was predominantly English.

Table 3.3: Details of control participants.

Subject	Age	M/F	First language English?	Hearing at 30dBHL	Auditory Discrimination (max=18)
1	70	M	Y	Pass	18
2	41	F	Y	Pass	18
3	35	M	Y	Pass	18
4	47	F	Y	Pass	18
5	70	M	Y	Pass	18
6	62	F	Y	Pass	18
7	60	M	Y	Pass	18
8	60	F	Y	Pass	18
9	84	M	Y	Fail	17
10	60	F	Y	Pass	18
11	51	M	Y	Pass	18
12	67	F	Y	Pass	18
13	38	M	N[2]	Pass	18
14	60	M	Y	Pass	17
15	68	F	Y	Fail	18
16	75	F	Y	Fail	14

3.5 Procedure

Stimuli were presented on a laptop computer with speakers, in a quiet but not soundproof room, and response time was recorded with a webcam. Stimuli were incorporated into an adapted version of Speech by Eye (SP-EYE) (Newton, Chiat & Hald, submitted), a procedure for recording gaze shift in response to speech input (see Appendix 3 for set-up). The use of eye movement response in the assessment of comprehension in patients with neurological impairments has been advocated as providing a response mode that does not require talking, writing or gesturing (Hallowell, Wertz & Kruse, 2002), and also

[2] Control subject 13's first language as a child was a dialect of Urdu, but he has spoken English exclusively since the age of 10.

avoids the potential impact of motor deficits within this population that a pointing or button pressing task may involve.

The set of 32 items was presented in four blocks, each with 8 trials. The trials were embedded in a gradually building-up jigsaw puzzle, to maintain attention and to encourage participants to return their gaze to the centre of the screen between trials. Two practice items were presented initially to accustom participants to the task. Within each trial, a set of four images was displayed on the computer screen for five seconds to allow time for scanning and initial processing of the pictures. The images then disappeared, and were replaced by a jigsaw puzzle piece while the target sentence was played through the speakers. The stimulus images then returned to the screen for eight seconds, and participants were asked to look at their picture of choice and point if they were able whilst their gaze was recorded by webcam. This gave an eight-second video file of response behaviour stored on the computer for each item. Following each trial the partially completed jigsaw puzzle was shown.

On completion of the test, subjects were asked to describe any particular difficulties they had experienced with the task, and were specifically asked whether they felt there had been any difference in their responses to the two accent conditions. These informal comments are considered in discussion of the results.

3.5.1 Scoring procedure

Accuracy of response was recorded during administration of the task by the researcher, by noting participants' choices. Response time was determined through analysis of the eight-second video files of each participant's response to each item. Response times were recorded off-line using software that allowed frame-by-frame analysis of the video files (Videolab © Department of Human Communication Science, University College London). Video files from all participants were analysed by the researcher to ensure consistency. The response time was considered to be the duration from the end of the spoken sentence up to the participant's final shift of gaze to their chosen picture, and was measured in milliseconds.

4. RESULTS

A number of participants commented that the unfamiliar accented speaker spoke more slowly than the familiar accented speaker. To determine whether this was a perceptual effect or a genuine difference between speakers, utterance durations were analysed. A paired-samples t-test indicated that the Nigerian speaker (mean = 2.372 seconds) did produce slower stimuli than the South-East England speaker (mean = 1.914 seconds) ($t = -5.415$, $df=15$, $p<0.001$). To determine whether this was representative of their normal speaking rates, a sample of conversational speech was taken from each speaker, and an average rate of words per second was calculated and compared with average rate of words per second from the recorded stimuli. This indicated that in normal speech the unfamiliar accented speaker does speak more slowly (familiar speaker = 2.65 words per second; unfamiliar speaker = 2.28 words per second), and so the difference in speaking rates between the two speakers is at least somewhat representative of normal conditions.

Statistical analysis of the test data was carried out using accuracy and reaction time as dependent variables.

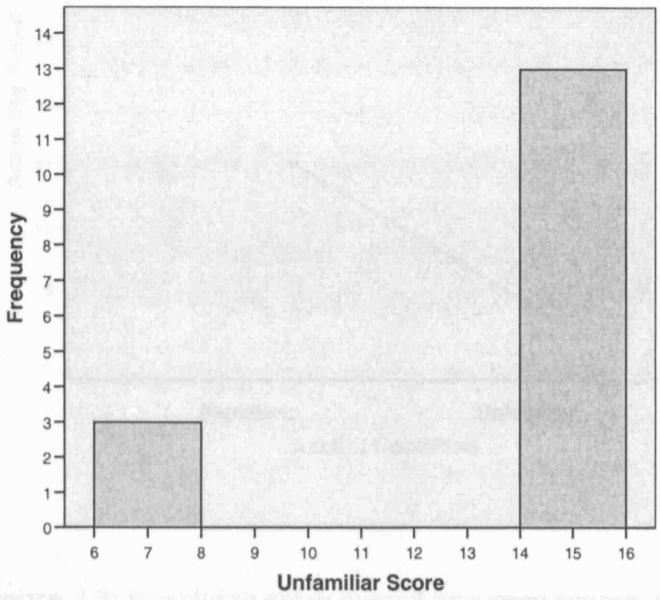
4.1 Accuracy

A repeated-measures ANOVA was carried out with accent condition (two levels: familiar and unfamiliar) as the within-subjects factor and group (two levels: aphasic and control) as the between-subjects factor. Main effects of accent condition ($F = 23.785$, $df=1,30$, $p<0.001$) and group ($F=22.977$, $df=1,30$, $p<0.001$) were found to be significant. The interaction between accent condition and group was less clear, reaching only marginal significance ($F=3.170$, $df=1,30$, $0.1>p>0.05$). This indicates that individuals with aphasia find the comprehension of an unfamiliar accent relatively more difficult than controls.

Descriptive statistics of the full data set revealed that control participants seemed to represent two distinct populations (see Figure 4.1). The three participants (con09, con15, con16) identified as potential outliers were all residents in sheltered accommodation (unlike other control subjects who all live independently), living in the same warden-controlled housing unit. Although no health problems were reported by these three participants, their performance suggests that they may have been drawn from a distinct population or that environmental factors may be indicated. The analysis was repeated excluding data from these participants to determine whether any difference in results

would be seen. Main effects of accent condition ($F=18.553$, $df=1,27$, $p<0.001$) and group ($F=56.417$, $df=1,27$, $p<0.001$) were again found to be highly significant. There was also a significant interaction between accent condition and group ($F=10.425$, $df=1,27$, $p<0.005$).

Figure 4.1: Histogram showing control subjects' accuracy scores in unfamiliar accent condition, with two distinct populations.



Inspection of this interaction (Figure 4.2) indicates that the aphasic group had greater difficulty with the unfamiliar accent condition than the control group. This was investigated further with Bonferroni-corrected t-tests. Comparison of the means for accent condition by paired-sample t-test indicated that the aphasic group had significantly more difficulty with the unfamiliar accent (mean = 8.813) than the familiar accent (mean = 11.5) ($t=4.307$, $df=15$, $p=0.001$), whereas the control group did not differ significantly in accuracy between the two conditions (familiar mean = 15.923, unfamiliar mean = 15.538) ($t= 2.132$, $df=12$, $p>0.05$). Independent-samples t-tests indicated that the control group had higher accuracy than the aphasic group in both the familiar accent condition ($t=-6.738$, $df=15.417$, $p<0.001$) and the unfamiliar accent condition ($t=-8.174$, $df=16.548$, $p<0.001$). Scores for control subjects are subject to a ceiling effect (see Figure 4.3), and so may not reflect a true distribution of scores for adults with no neurological deficit. However, any effect of this would only underestimate the difference between groups.

Figure 4.2: Illustration of accuracy group-by-condition interaction (with control outliers excluded).

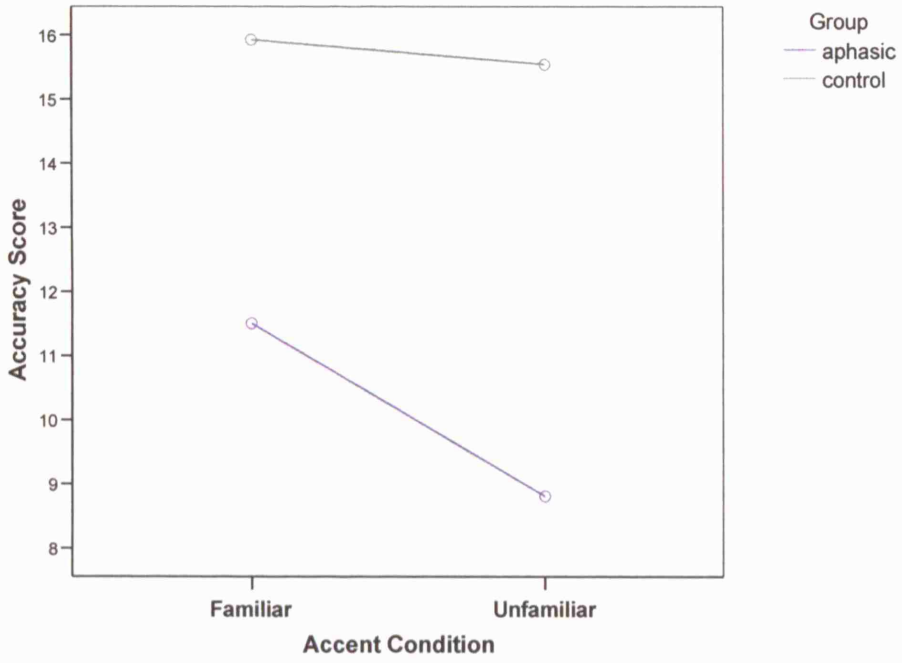
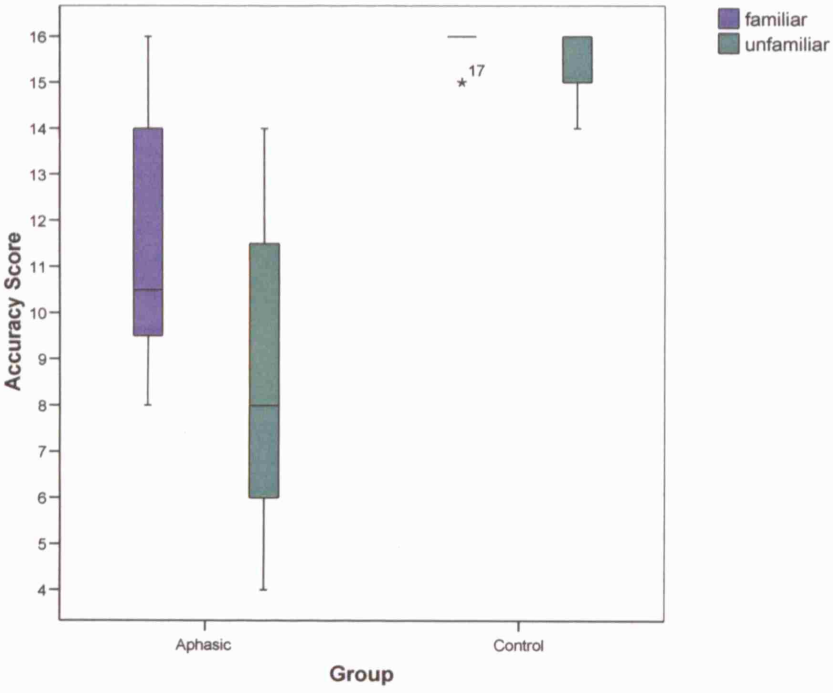


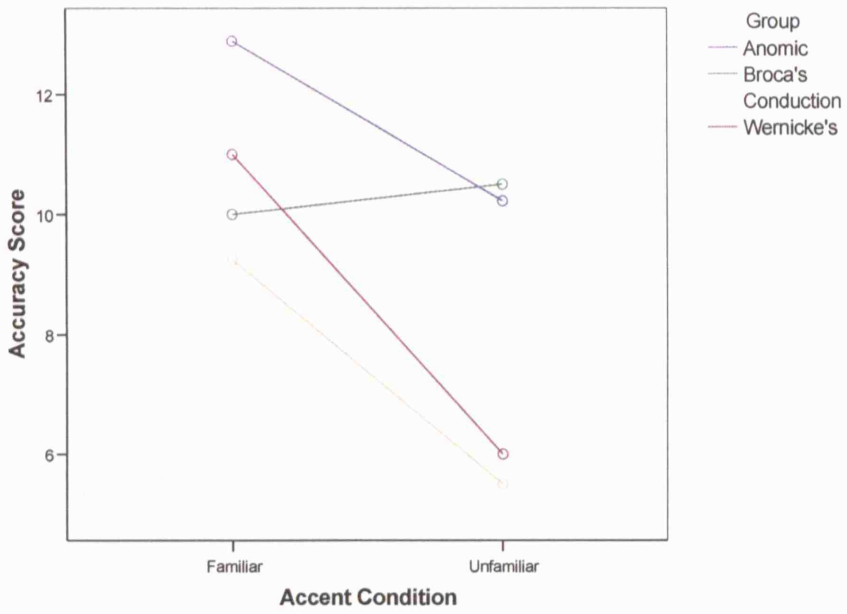
Figure 4.3: Boxplot to show overall accuracy scores, indicating ceiling effect for control group in both conditions (with control outliers excluded).



These findings indicate that the adults with aphasia found it significantly more difficult to accurately comprehend sentences in the unfamiliar accent than the control group, when outliers in the control group were excluded.

Participants with aphasia were classified according to aphasia type with the Western Aphasia Battery (Kertesz, 1982) (see Table 3.2). Detailed analysis of the impact of aphasia classification in this investigation was not possible given the small sample size and unequal groups (Anomic = 9, Conduction = 4, Broca's = 2, Wernicke's = 1). However, a repeated measures ANOVA illustrates a potentially interesting relationship between type of aphasia and accuracy in this experiment (see Figure 4.4). Participants classified with Broca's aphasia seem to demonstrate a stronger performance in the unfamiliar accent condition, while all other groups show greater accuracy in the familiar condition. This pattern warrants further investigation with a larger sample.

Figure 4.4: Illustration of aphasia type-by-condition interaction.

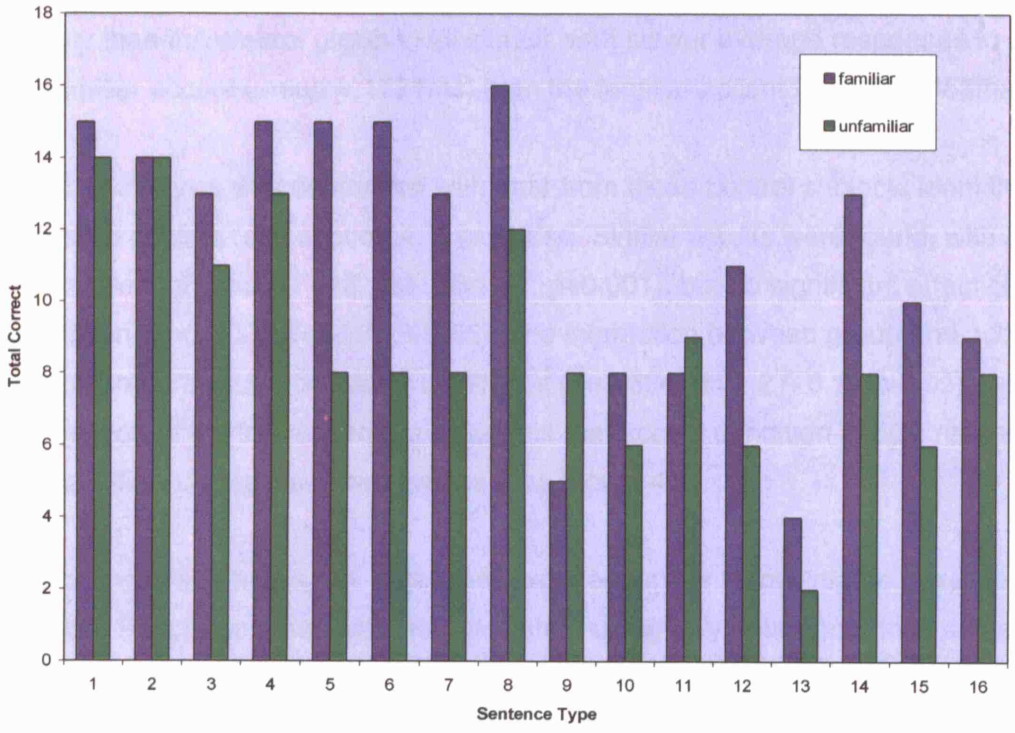


Accuracy scores of participants with aphasia were also analysed in relation to hearing status. Paired-samples t-tests indicated that participants who had failed the hearing test performed more poorly in the unfamiliar accent condition at a higher level of significance ($t=12.649$, $df=5$, $p<0.001$) than those who passed the hearing test ($t=2.283$, $df=9$,

p=0.048). Both groups reached significance, but it is possible that poor hearing may further exacerbate difficulties with comprehending an unfamiliar accent.

Overall total accuracy on individual sentence types was analysed for participants with aphasia, to indicate whether particular sentence types were more likely to result in errors. Stimulus sentences were considered to increase in complexity in accordance with the CAT order of presentation (see Appendix 4 for full list of paired sentences). Total correct scores for the group in the familiar and unfamiliar accent conditions were inspected (see Figure 4.5). This revealed that certain sentence types resulted in more errors in both conditions (e.g. type 13: The shoe under the pencil is blue; The shoe under the pencil is red), and overall performance appears to reduce slightly for the more complex sentences. Only two sentence types had higher total correct scores in the unfamiliar accent condition than the familiar condition (type 9: The singer hits the soldier; The soldier hits the singer, and type 11: The butcher is chased by the nurse; The nurse is chased by the butcher). This may be explained by the order of presentation, as picture sets for the sentence types were repeated in the unfamiliar accent condition and may have been remembered by participants.

Figure 4.5: Total correct scores for participants with aphasia, according to sentence type.



4.2 Response Time

An average response time for all participants in each accent condition was calculated by taking the mean response time for all correct responses in each condition. Response times for incorrect items were not included, following Munro and Derwing's (1995) procedure for analysing response time, as data from incorrectly answered items would be difficult to interpret. However, for this analysis all correct response times were included; Munro and Derwing (1995) excluded values falling outside the range of +/- 2 standard deviations from the mean to minimise the effect of outliers. Since a range of sentence types were used here, though, rather than the single form used in Munro and Derwing's study, a wider range of response times was to be expected and so potential outliers were not excluded.

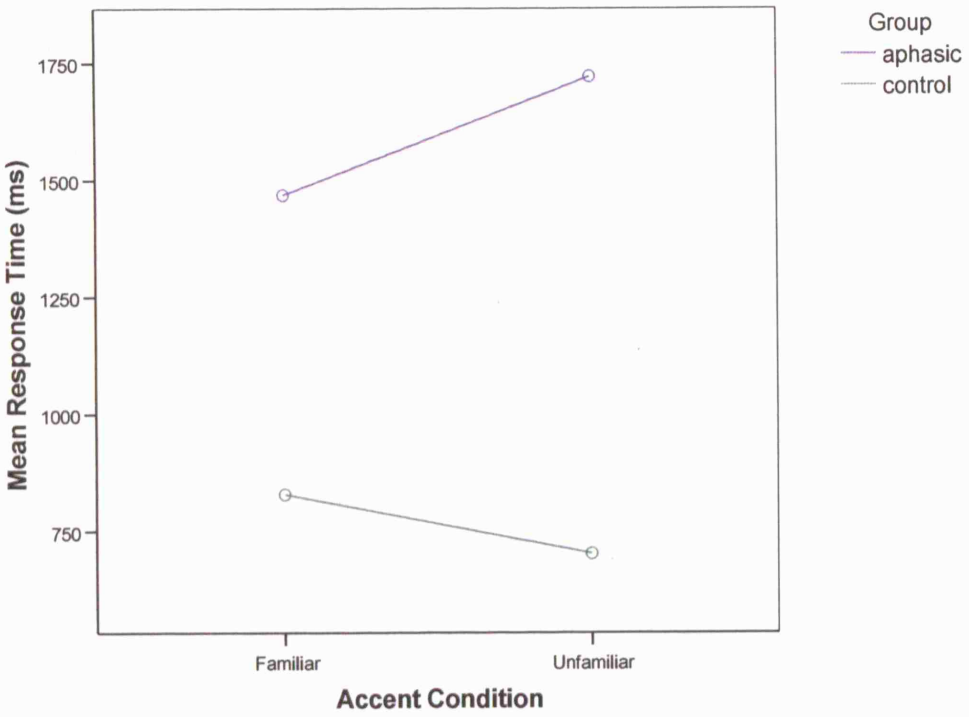
A repeated-measures ANOVA was again carried out with accent condition (two levels: familiar and unfamiliar) as the within-subjects factor and group (two levels: aphasic and control) as the between-subjects factor. A main effect of group ($F=12.076$, $df=1,30$, $p=0.002$) was found to be significant, but there were no significant effects of accent condition ($F=0.793$, $df=1,30$, $p>0.05$) or of interaction ($F=3.089$, $df=1,30$, $p>0.05$). Inspection of the means indicates that the control group actually responded more quickly on average to the unfamiliar accented stimuli (mean = 833ms) than the familiar accented stimuli (mean = 916ms), which was not expected. The aphasic group responded more slowly than the control group to all stimuli, with slower average responses to the unfamiliar accent (mean = 1721ms) than the familiar accent (mean = 1468ms).

Further analysis was conducted with data from those control subjects identified as possible outliers (see section 4.1) excluded. Similar results were found, with a significant main effect of group ($F=18.124$, $df=1,27$, $p<0.001$), but no significant effect of accent condition ($F=0.402$, $df=1,27$, $p>0.05$). The interaction between group and accent condition here was moderately significant ($F=3.624$, $df=1,27$, $0.1>p>0.05$), though. Inspection of the interaction does suggest that accent condition affects response time quite differently for these two groups (see Figure 4.6).

Following this analysis, the data were explored further to investigate possible hidden effects. Response times were re-calculated, using only data from those sentence forms that a participant answered correctly in both accent conditions. This adjustment aimed to isolate only those sentence forms that a participant was able to comprehend reliably, so

that a more direct comparison of performance in the two accent conditions could be made.

Figure 4.6: Illustration of response time group-by-condition interaction (with control outliers excluded).



A further repeated-measures ANOVA was carried out on this data with accent condition (two levels: familiar and unfamiliar) as the within-subjects factor and group (two levels: aphasic and control) as the between-subjects factor. Again, main effect of group was found to be significant (though at a lower level of significance, $F=7.088$, $df=1,30$, $p=0.012$), while accent condition ($F=0.063$, $df=1,30$, $p>0.1$) and interaction ($F=0.003$, $df=1,30$, $p>0.1$) did not show significant effects. Here, examination of mean response times indicated that both groups took longer to respond to unfamiliar accented stimuli (means: aphasic = 1421 ms, control = 855ms) than familiar (means: aphasic = 1386ms, control = 833ms). However, when data from the three potential control subject outliers (see section 4.1) was excluded from the analysis, although the same results were found in terms of main effects the remaining control subjects responded more quickly on average to the unfamiliar accent (mean = 702ms) than the familiar (mean = 818ms).

5. DISCUSSION

The aim of this study was to investigate the impact of familiarity of speaker accent on auditory sentence comprehension in adults with aphasia following stroke. The impact of familiarity of speaker accent on accuracy and response time was measured for individuals with aphasia and for a control group, and a number of significant findings are reported. These will be discussed in the context of healthcare delivery in a multi-cultural and multi-accented society, and with consideration of speaker accent as a potential barrier to community participation for individuals with aphasia.

5.1 Accuracy

Results of this study showed that individuals with aphasia make significantly more errors in comprehension of sentences spoken in an unfamiliar accent than in a familiar accent, a finding that was not demonstrated by the control group when outliers were excluded. Analysis of total scores from the group of participants with aphasia (Figure 4.5) illustrates that although some simple sentence types resulted in similar accuracy in both conditions, others showed a clear difference between conditions. For example, two-part sentences presented as type 2 (The man is walking; The woman is walking) resulted in equal overall accuracy for the group of participants with aphasia in the two accent conditions. Two-part sentences in type 5 (The woman is painting a wall; The man is painting a picture) gave very different overall accuracy scores (familiar: 15 correct out of 16 participants; unfamiliar: 8 correct out of 16 participants), indicating that speaker accent can influence accuracy. This answers the first research question: Does the familiarity of speaker accent affect accuracy of sentence comprehension in individuals with aphasia following stroke? This finding indicates that comprehension difficulties experienced by individuals with an acquired language disorder are exacerbated by an unfamiliar speaker accent, which could have serious implications for the delivery of healthcare services to this client group. Burda and Hageman (2005) claim that older adults in health care settings interacting with non-native speakers may be at increased risk of care-giving errors, for example in explanation of medication dosage. In the light of the present study, it is possible that older adults with aphasia following stroke are at even greater risk of such errors as a result of unfamiliar speaker accent. With some London healthcare Trusts employing clinical workers of up to 39 different nationalities (Buchan et al, 2004), all staff should be aware of the possible impact their accent may have on patients' comprehension. Indeed, Mahendra et al (1999, p.228) highlight the importance of speaker behaviour in removing

this potential barrier, stating that "to facilitate successful communicative interaction, caregivers with unfamiliar accents may have to modify their communicative style to be better understood by individuals with cognitive impairments".

Differences in performance between the two accent conditions may have been intensified by increased exposure to the familiar accented speaker's voice. The auditory discrimination task featured the South-East England speaker only, and as this task was presented prior to the sentence comprehension task some accommodation to the speaker may have occurred. By using a third speaker, or by presenting this task last, the possible effects of this accommodation could have been avoided. It should be remembered, though, that both test groups had this opportunity for accommodation, and so any benefit might have been demonstrated by control participants as well as by participants with aphasia. However, the ceiling effect shown by control participants in both conditions prevents identification of any impact of accommodation on comprehension accuracy, and illustrates that this task was not sufficiently sensitive to demonstrate an effect of comprehension accuracy for control subjects.

The presence of three apparent outliers in the control group is worthy of discussion. These participants were all residents at the same warden-controlled sheltered housing unit for older people, while all other control participants were living independently and across a wide geographical area. These three participants achieved lower accuracy scores than other members of the group in both accent conditions, but performed particularly poorly in the unfamiliar condition (all three scored 7/16 in the unfamiliar condition, though correct responses were not made to the same items). It is of note that all three reported they were not widely travelled (indeed control participant 16 has never left the UK), but this was not exclusive to this group. It is possible that educational level may have some influence, as all other control participants and all aphasic participants were known to have a fairly high level of education and such information was not obtained from the three apparent outliers. Conclusions about the impact of educational level cannot be drawn, however, as participant information on this was not routinely collected. The close habitual proximity of the three apparent outliers does perhaps suggest the possibility of an environmental factor affecting their performance, and their data might be helpfully considered in the context of Burda and Hageman's (2005) study of the perception of accented speech by residents in assisted-living facilities in America. It is important to note, however, that these three participants were the only members of the

control group to fail the hearing screen, and so the difference in their performance may be attributable to hearing loss. Whatever the reason, these findings indicate that some individuals with no history of neurological deficit may have increased difficulty in comprehending an unfamiliar accent, and that the CAT sentence comprehension test norms may be misleading for some populations.

5.2 Response Time

Results showed that while control subjects responded to stimuli more quickly overall than aphasic subjects, speaker accent had no significant effect on response times for either group. This finding appears to contradict evidence from a number of studies that an unfamiliar or non-native speaker accent results in increased response time for listeners (e.g. Munro & Derwing, 1995; Schmid & Yeni-Komshian, 1999; Clarke & Garrett, 2004; Floccia et al, 2006). However, it is possible that this difference in findings is accounted for in part by differences in research design. Clarke and Garrett (2004) stated that an average difference of 100-150ms in reaction time to native and non-native accents was worthy of attention. In Munro and Derwing's (1995) study, a difference in response time of 30ms between native and non-native accents was found to be significant, with a similar increase in lexical decision reaction time found by Floccia et al (2006) in processing an unfamiliar regional accent. In the present study, participants with aphasia responded 253ms slower on average to unfamiliar accented stimuli than to familiar accented stimuli. The amount of variance recorded for each participant (due to the range of sentence types included in the test) and across participants (likely to be influenced by a range of factors including age, hearing level and severity of aphasia) may result in a less accurate measure of central tendency than that found by other researchers, so the findings of the present study do not reach significance. Still, this average difference in response time indicates that individuals with aphasia do require additional processing time for sentences in an unfamiliar accent.

Perhaps more problematic is the finding that the control group in this study responded on average 83ms faster to the unfamiliar accented stimuli than to the familiar accented stimuli, in direct opposition to a number of published studies (e.g. Munro & Derwing, 1995; Schmid & Yeni-Komshian, 1999; Clarke & Garrett, 2004; Floccia et al, 2006). Since participants had increased exposure to the familiar accent (due to the prior administration of the auditory discrimination task, see section 5.1), this finding is particularly surprising. Three possible explanations are proposed for this finding. First, it is possible that the

difference in speaker's rate of speech is a confounding factor in measurement of response times. In their study of the effects of speaking rate and foreign accent on native speaker comprehension, Anderson-Hsieh and Koehler (1988) found that comprehension scores for all speakers were significantly lower for a faster rate than a regular rate. Similarly, Munro and Derwing (1995) found that faster stimuli utterances resulted in longer response times regardless of accent. They suggest that with stimuli produced particularly slowly, listeners may have already processed substantial parts of the utterance prior to hearing the end of the sentence, thus resulting in shorter recorded response times. Unfamiliar accented stimuli in the present study were longer (and therefore slower) than familiar accented stimuli (means: unfamiliar = 2.372 seconds, familiar = 1.914 seconds), and so the control group's faster response to the unfamiliar accent may be explained by this additional time for processing. A second possible explanation for this finding lies in the order of presentation of stimuli and repetition of picture options. A random order was created (see Appendix 1), in which the majority of the familiar accented stimuli appeared in the first half of the test. Since picture stimuli are repeated in the test (e.g. items 1 and 5 contain the same picture options) participants were introduced to a number of the picture selections in the familiar accent condition and so perhaps required less processing time when pictures were repeated in the unfamiliar accent condition. A third explanation is the possibility of differential allocation of processing resources in the two accent conditions by control subjects. Several participants in the control group reported that they had to attend more to the unfamiliar accented stimuli than to the familiar accented stimuli, for example:

"I had to think harder about the West Indian accent, and even more with longer sentences."
"With the non-standard accent I had to listen a bit more carefully."
"The London accent is easier – you don't have to concentrate so much on listening to it."
"You try and concentrate a bit more [in the unfamiliar condition]."

One participant commented, "I think you adapt your cognitive skills to the accent you're expecting. Once one started, I knew what to expect. Once you realise what the accent is you expect different vowel sounds," and it may therefore be that when the unfamiliar accent was heard participants attended more closely to the task.

5.3 Limitations and future research

While the present study demonstrates an effect of speaker accent on accuracy of sentence comprehension in individuals with aphasia following stroke, it does not explain which specific language processes may be implicated. The small sample size included prevented detailed analysis of the impact of aphasia type or severity, and since information on lesion site was not collected it is not possible to consider localisation of accent processing. However, Munro and Derwing (1999) suggest that perception of foreign-accented speech may require special top-down processing if an initially unintelligible word or phrase becomes clear within the context of a whole utterance. It may be that this special top-down processing capacity is affected in individuals with aphasia, making sentence comprehension of unfamiliar accented output particularly difficult. Findings from Caplan, Waters and Hildebrandt's (1997) study of sentence processing in patients with aphasia were consistent with the view that, "an important determinant of patients' syntactic comprehension is a reduction in the availability of processing resources that can be devoted to this task," (p.552) and the allocation of processing resources to the interpretation of an unfamiliar accent may exacerbate this.

The degree of participants' familiarity with the two accents used in this study has not been fully explored. Although participants made informal comments about the familiarity of the accents, and all participants stated that the South-East England accent was more familiar to them than the Nigerian accent, a more formal record of this would have been useful. For example, by asking participants to specifically rate their familiarity with each accent on a Likert-type scale, the correlation between comprehension and perception of familiarity could have been discussed. Such an analysis might be valid in the context of research considering affective response to accent variation (see section 2.3.2), and in the light of Hosoda et al's (2007, p.309) claim that, "When an individual speaks with a foreign accent, a listener is likely to categorize the speaker on the basis of his accent, and the stereotype associated with the accent will be activated and a set of beliefs about him will be generated that is based on the stereotype."

Although detailed analysis of the performance of participants with different types of aphasia is restricted by the small sample size in the present study, individual results suggests that further investigation of this area may be valid. Indeed, analysis of sentence comprehension with variation in speaker accent alongside neuro-imaging studies may be warranted to investigate the possibility of localisation of accent processing.

5.4 Clinical implications

Mahendra et al (1999) argue that the effects of an unfamiliar accent on the testing of cognitively impaired individuals may confound assessment, may affect care planning, and may make patients seem less appropriate for rehabilitation. In their developmental study, Nathan and Wells (2001) stated that speaker accent should be considered in both assessment of speech and language skills and in the design and implementation of therapy tasks. The findings of the present study support these claims, and demonstrate that accent variation can have a significant impact on the auditory comprehension skills of adults with aphasia following stroke. Clinicians must be aware of the possible impact their own accent may have on the performance of clients and make appropriate adjustments to assessment and management. For example, spoken instructions may need to be supplemented with written instructions or pictures, or desired responses may need to be modelled and demonstrated before tests are administered. While such strategies are regularly adopted by speech and language therapists to support clients' communication skills, additional consideration of their importance should be made in light of the present study's findings. Additional research is required to determine whether a period of familiarisation to the unfamiliar accent would help to overcome some of these issues.

Major et al (2005) suggest that since accent variation can affect listening comprehension, ESL teaching should include exposure to a range of accents. When individuals in the UK are likely to come into contact with a wide range of regional, international and foreign accents of English, perhaps particularly when accessing healthcare services, it seems sensible to adopt a similar approach to the delivery of speech and language therapy services for adults with aphasia. The aim of such services is to maximise an individual's communicative participation in society and maintain social relationships (RCSLT, 2006), and since accent variation is a significant aspect of communication it should be accounted for. Therapy materials could be developed that include exposure to a range of recorded speaker accents, for example, following Gass and Varonis's (1984) finding that familiarity with non-native speech in general facilitates comprehension. Alternatively in an inpatient or residential setting, members of the MDT working with an individual could be encouraged to contribute to speech and language therapy sessions to help support generalisation of skills. A range of approaches could be developed to manage the effects of accent variation in communication, complementing and enhancing existing therapies.

6. CONCLUSION

Within the UK all individuals are likely to come into contact with speakers with unfamiliar accents. While previous research on accent variation has demonstrated that this may impact on comprehension for all listeners, the present study indicated that implications may be particularly significant for individuals with aphasia following stroke. The NHS represents a highly multi-cultural workforce, and so providers of healthcare services should be aware of the possible effects of speaker accent on listener comprehension. Particularly for those professionals involved in stroke care and rehabilitation, consideration should be given to how possible difficulties due to accent variation can be overcome. Individuals with aphasia should be supported to accurately demonstrate their level of competence in assessment, and to develop effective communication skills that will enhance their quality of life.

Word count: 9,455

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8. APPENDICES

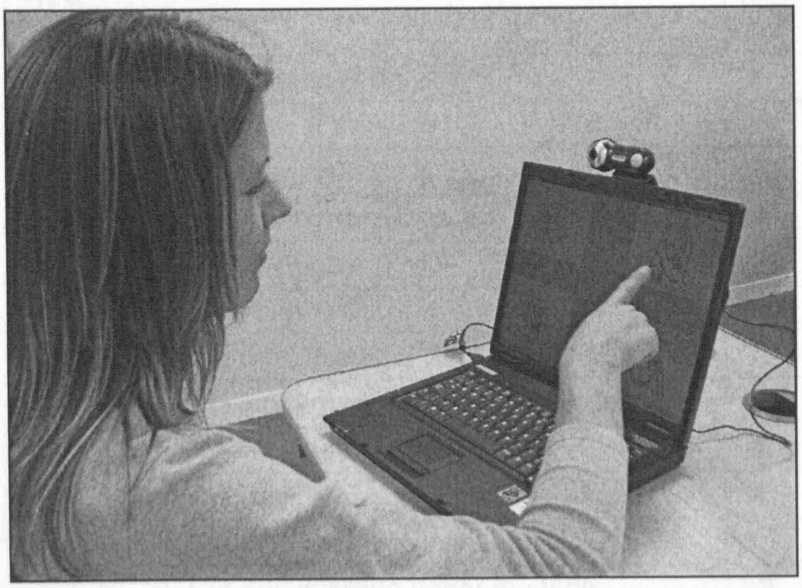
Appendix 1: Sentence comprehension stimuli list

Item No.	Stimulus sentence	Accent (Familiar/ Unfamiliar)
1	The dancer paints the policeman	F
2	The flower in the cup is blue	F
3	The man is eating the apple	F
4	The butcher is chased by the nurse	F
5	The policeman paints the dancer	U
6	She is laughing	F
7	The blue shoe is under the pencil	U
8	The dog is sitting on the table	F
9	The policeman is painted by the dancer	F
10	The woman is eating an ice-cream	U
11	The red pencil is under the shoe	F
12	The nurse is chased by the butcher	U
13	The apple is under the shoe	F
14	The woman is walking	U
15	The carpet the cat is on is red	F
16	The man is painting a picture	U
17	The pen is under the paper	U
18	The shoe under the pencil is red	U
19	The man is walking	F
20	The woman is painting a wall	F
21	The butcher shoots the nurse	U
22	The dancer is painted by the policeman	U
23	The boy is sitting under the table	U
24	The shoe under the pencil is blue	F
25	The man is drinking	U
26	The flower under the cup is red	U
27	The nurse shoots the butcher	F
28	The singer hits the soldier	F
29	The carpet the cat is on is green	U
30	The woman is drinking	F
31	He is crying	U
32	The soldier hits the singer	U

Appendix 2: Auditory discrimination stimuli list

Item No.	Stimulus sentence	Target	Distractor
1	My sister borrowed my car	car	key
2	The man threw the key	key	pea
3	The woman wanted the rice	rice	dice
4	The man bought a new cup	cup	cap
5	The artist painted a mouse	mouse	house
6	The man found the socks	socks	fox
7	The man moved the chip	chip	ship
8	The girl picked up a ball	ball	bell
9	The man hid the boot	boot	bat
10	The girl trod on the cat	cat	mat
11	The robber stole a coat	coat	goat
12	My friend borrowed my van	van	fan
13	The woman ironed the shirt	shirt	sheet
14	The boy mended the cap	cap	tap
15	The man photographed a sheep	sheep	ship
16	The man drew a bear	bear	pear
17	The boy bought a new mat	mat	bat
18	The woman liked the ring	ring	king

Appendix 3: SP-EYE set-up



Appendix 4: Sentence comprehension stimuli, in CAT order of complexity

Sentence type	Stimulus sentence	Test item no.	Accent (Familiar/ Unfamiliar)
1	The woman is drinking	30	F
	The man is drinking	25	U
2	The man is walking	19	F
	The woman is walking	14	U
3	She is laughing	6	F
	He is crying	31	U
4	The man is eating the apple	3	F
	The woman is eating an ice-cream	10	U
5	The woman is painting a wall	20	F
	The man is painting a picture	16	U
6	The dog is sitting on the table	8	F
	The boy is sitting under the table	23	U
7	The apple is under the shoe	13	F
	The pen is under the paper	17	U
8	The nurse shoots the butcher	27	F
	The butcher shoots the nurse	21	U
9	The singer hits the soldier	28	F
	The soldier hits the singer	32	U
10	The policeman is painted by the dancer	9	F
	The dancer is painted by the policeman	22	U
11	The butcher is chased by the nurse	4	F
	The nurse is chased by the butcher	12	U
12	The dancer paints the policeman	1	F
	The policeman paints the dancer	5	U
13	The shoe under the pencil is blue	24	F
	The shoe under the pencil is red	18	U
14	The carpet the cat is on is red	15	F
	The carpet the cat is on is green	29	U
15	The red pencil is under the shoe	11	F
	The blue shoe is under the pencil	7	U
16	The flower in the cup is blue	2	F
	The flower under the cup is red	26	U