

**Investigating the impact of unfamiliar speaker accent on  
auditory comprehension in adults with aphasia.**

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## **Abstract**

*Background:* In an increasingly multi-cultural society, 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 healthcare 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.

*Aims:* To investigate the effect of an unfamiliar accent on the sentence comprehension of individuals with aphasia following stroke.

*Methods & Procedures:* The impact of two different accents (South-East England and Nigerian) on accuracy and response time for 16 individuals with aphasia and 16 healthy control subjects was measured. Participants were presented with a computerised sentence-to-picture matching task, and their accuracy and response times were recorded.

*Outcomes & Results:* 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. Individuals with aphasia were slower overall; however response times did not show significant effects of speaker accent for either group.

*Conclusions & Implications:* The impact of speaker accent should be considered in the rehabilitation of individuals with aphasia following stroke. Clinical implications include the possibility of under-estimating an individual's language abilities on assessment, and the potential errors in comprehension that may occur.

*Keywords:* aphasia, comprehension, speaker accent

### **What this paper adds**

*What is already known on this subject:*

Research on accent variation has demonstrated that listener comprehension can be affected by the familiarity of a speaker's accent, both in accuracy and response time.

The impact of speaker accent on the comprehension skills of adults with aphasia has not been widely investigated.

*What this study adds:*

This study indicates that familiarity of speaker accent can have a significant effect on the accuracy of sentence comprehension in adults with aphasia. In the context of increased immigration and internal migration, and with a highly multi-cultural healthcare workforce, this has significant clinical implications.

### **Introduction**

International and internal immigration are worldwide phenomena. In recent years, this has become an important feature of the global labour market for professionals in healthcare, with English-speaking countries (Australia, Canada, the United Kingdom (UK) and the United States (US)) being the most popular destinations for nurses and physicians (Clark, Stewart & Clark, 2006). Active recruitment strategies introduced by some countries, in particular the UK, have encouraged this process. One consequence of these demographic changes is that individuals are more likely to encounter people

whose culture and accent is different from their own; both the workforce and patients may be non-native English speakers or speak English with an unfamiliar accent. There are benefits in having a diverse workforce in these countries: health workers from other countries or regions can enhance patient care through their language skills and ability to relate to individuals who share their heritage. However, it may also bring problems as research shows that it may be more difficult to understand someone who has a different accent (Anderson-Hsieh & Koehler, 1988; Clarke & Garrett, 2004). This could affect the quality of care, as health advice and instructions given with an unfamiliar accent may be harder to understand. Evidence also suggests that these difficulties may be increased if the person receiving the information has cognitive or communication problems (Mahendra, Bayles & Tomoeda, 1999; Burda, Brace & Hosch, 2007). This study seeks to further our knowledge of how accent affects the comprehension of people with acquired aphasia, a language difficulty arising from focal brain damage.

It is widely acknowledged that accent may have a considerable impact on listeners' perceptions of a speaker's background, character and social status (see Fuertes, Potere & Ramirez, 2002, for a review). This effect on a listener's attitude may have a complex relationship with the impact on listener comprehension. For example, unfamiliar accents may require greater attention leading the listener to conclude the speaker is a poor communicator (Hosoda, Stone-Romero & Walter, 2007). Alternatively, utterances produced by speakers with accents perceived as 'intelligent' may be better recalled (either their perceived intelligence means that listeners pay more attention to them, or that since a listener finds it easier to understand, the speaker is perceived as being more intelligent) (Bottrill & Johnson, 1985a&b). It has also been suggested that

comprehension of an accent involves familiarity, degree of exposure, attitude and stereotyping, so that comprehension may be aided when the listener has no negative attitudes toward that accent (Major, Fitzmaurice, Bunta & Balasubramanian, 2005).

Notwithstanding this relationship, the impact of accent variation on comprehension has been widely investigated with listeners with no reported cognitive or language difficulties. Studies have examined the effect of accent on accuracy of comprehension (e.g. Anderson-Hsieh & Koehler, 1988) and speed of processing (e.g. Floccia, Goslin, Girard & Konopczynski, 2006; Adank & McQueen, 2007). 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 participants had the poorest performance on items produced by the speaker with the heaviest accent. 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 non-native than 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 et al's (2006) study of lexical decision with different 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. A considerable delay in comprehension of words spoken in isolation in an unfamiliar regional accent has also been found (Adank & McQueen, 2007).

Recent research shows that comprehension of accented speech can improve and that this adaptation is associated with a number of factors, including increased exposure to that accent (Clarke & Garrett, 2004; Floccia et al., 2006). Clarke and Garrett (2004), for instance, found that although processing speed was initially slower for the non-native accented speech used in their study, some degree of adaptation occurred after listening to just two to four sentences. However, subsequent studies have produced conflicting evidence, as comprehension of single words has not always been found to benefit from repeated exposure to the same accent (Adank & McQueen, 2007; Floccia, Butler, Goslin & Ellis, 2009). It is possible therefore that successful rapid adaptation depends on hearing words within a sentence context rather than in isolation. Other studies suggest that long-term exposure to a regional accent (e.g., through television) affects the processing of accented speech (Nathan, Wells & Donlan, 1998; Adank, Evans, Stuart-Smith & Scott, 2009). Nathan et al. (1998) found that comprehension of an unfamiliar regional accent improved with age, at least in young children. They suggest that these changes occur not only because of exposure to a wider range of accents, but also because as children become older they are better able to use sentence context to facilitate and support lexical identification. Familiarity with the topic being discussed has also been found to facilitate improved comprehension of accented speech (Gass & Varonis, 1984). Thus, exposure to an accent, prior knowledge and a certain level of linguistic ability on the part of the listener appear to make it easier to understand a speaker.

These studies show that although some adaptation occurs, non-native and unfamiliar regional accents affect the speed and accuracy of comprehension of words and sentences, suggesting that accent influences both word recognition and sentence parsing processes in normal native listeners (Adank & McQueen, 2007). A possible reason for the impaired comprehension of intelligible but accented speech is that it requires increased processing effort on the part of native listeners (Schmid & Yeni-Komshian, 1999). Gill (1994, cited in Fuertes et al., 2002) hypothesises that when additional processing resources are required to attend to a non-standard accent, fewer resources are available for processing information. If this is the case, then it is likely that people with reduced processing resources and compromised language systems will find accented speech even more challenging. It has been suggested that changes in hearing, sensory processing and working memory capacity in older adults compromise their abilities to perceive and process speech (Wingfield, Tun & McCoy, 2005). Several studies show that older adults have greater difficulty understanding individuals with accented speech compared with younger adults (Burda, Scherz, Hageman & Edwards, 2003; Burda, Casey, Foster, Pilkington and Reppe, 2006). Burda et al. (2006), investigating the effects of age and accent on transcription of medically-related information, found that all age groups had more difficulty transcribing the speech of non-native speakers than of native speakers. Although there was no significant interaction between listener age and speaker accent, the older adults made significantly more errors than the younger and middle-aged groups. In a 2005 study Burda and Hageman discovered that residents in assisted-living facilities, aged between 62 and 91, found accented speech harder to understand, with ratings of comprehensibility (defined as

“listeners’ perceptions of difficulty in understanding utterances,” Burda & Hageman, 2005, p.9) highly correlated with ratings of accentedness.

Other studies have examined the effect of speaker accent on a compromised language system. Nathan and Wells (2001) investigated the impact of speaker accent on children with developmental language difficulties by assessing auditory lexical decision and auditory discrimination in speech-disordered and typically-developing children, under familiar and unfamiliar accent conditions. They found that children with speech disorder showed a deficit in the unfamiliar accent condition, concluding that subtle difficulties with the processing of accent variation can block lexical access. They conclude 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.

Only a few studies have involved listeners with acquired neurological disorders. One such study by 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 of words and “non-meaningful phrases” in familiar and unfamiliar accent conditions. Tasks were deliberately chosen to evaluate empirically the effects of an unfamiliar accent by removing semantic context, following their suggestion that “on tasks that have contextual cues to facilitate performance, accent effects are likely to be less dramatic” (p.228). Although Mahendra et al. (1999) did not report a statistically significant interaction between participant group and accent type, they found that both normal elderly and individuals with Alzheimer’s disease scored significantly lower in the unfamiliar accent condition. In addition, the mean scores and

standard deviations indicate that the individuals with Alzheimer's disease had greater difficulty repeating items produced with an unfamiliar accent. More recently, Burda et al. (2007) investigated the ability of individuals with and without aphasia to point to written medical sentences that matched utterances produced in English by native and non-native speakers. Their results indicated that the individuals with aphasia performed worse overall, and that both groups performed less well with the non-native speakers, though no significant interaction was found across group and accent. Although the findings suggest that speaker accent affects the performance of people with aphasia, a number of methodological weaknesses identified by the authors, in particular the fact that participants could correctly identify the target sentence without fully understanding its content, limit their interpretation.

Further research in this area is essential, since difficulties in comprehending speakers with unfamiliar accents may have a significant impact on the ability of individuals with aphasia to participate in life situations in general, and access health services in particular. 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. Through semi-structured interviews with adults with aphasia, Howe, Worrall and Hickson (2008), found that the communication characteristics of other people, such as having a foreign accent, made it more difficult to access the community. Empirical investigation is required to determine whether there is a measurable change in performance that would support this perception of unfamiliar accent as a barrier to community participation.

The study reported here aims to answer the following research 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?

## **Methods**

### *Speakers*

The two speakers (both aged 47) were selected as representative of two accents that adult patients in London are likely to hear: 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 while the Nigerian English accent would be at least *less* familiar.

The accent of the South-East England speaker in this study is characteristic of the middle-class South Eastern Regional Standard described by Wells (1986). She describes her own accent as “a typical South-East of England accent, very non-specific.” The Nigerian speaker 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 (1982) for detailed features of these languages) and of typical West African English. 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.

### *Stimuli*

Stimuli were taken directly from the Comprehensive Aphasia Test (CAT; 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. Sixteen 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, giving a total of 32 items. A range of sentence types was presented: reversible and irreversible active and passives, and sentences with phrasal embedding, e.g. *The nurse chases the butcher; The butcher is chased by the nurse; The shoe under the pencil is red*. Sentences ranged in length from three to seven words. An equal number of each sentence type was presented in each condition.

### *Participants*

Sixteen adults with aphasia (nine male; seven female) and 16 adult control subjects (eight male; eight female) participated in the study. Participants with aphasia were all clients at a London community clinic for acquired communication disorders, whose language difficulties were the result of dominant hemisphere stroke. All were at least six

months post-onset, and presented with a range of communication difficulties and levels of severity, as measured by the Western Aphasia Battery (WAB; Kertesz, 1982). All lived in their own homes. Control subjects were adults with no history of neurological deficit, and no significant medical conditions. None of the participants selected had sustained direct contact with the unfamiliar accent (Nigerian), immediate family members from Nigeria or extended periods spent in Nigeria.

Participants in the two groups were not specifically age-matched, but a similar range of ages was included (36-80 years in the group with aphasia, 35-84 years in the control group) with a mean age of 59 years for both groups (SD=12.2 for participants with aphasia; SD=13.73 for participants without aphasia). Participants with aphasia all had good pre-morbid English, and all had previously chosen to have speech and language therapy in English, although for two subjects English was a second language. All participants underwent a pure tone audiometry hearing screen. Because the sentence comprehension test was carried out in ideal conditions (i.e. quiet room, comfortable volume), 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. When values exceeded 30dBHL, indicating a hearing impairment, participants were advised to get their hearing checked by their GP. Six individuals with aphasia and three control participants did not pass at this level, and this has been considered in the analysis of the results.

Participants also completed a simple computerised auditory discrimination task to determine their ability to discriminate between 18 minimal pairs comprised of

monosyllabic object names presented at the end of a carrier sentence (e.g. *My sister borrowed my key/car; The boy moved the sock/rock*). Stimuli for this task were presented on computer in the familiar accent condition only. Following practice items, participants were asked to select the picture that matched the target word that they heard.

All subjects demonstrated good single word auditory processing and comprehension in this task; any errors were largely in line with noted hearing loss. Full details of participants are included in tables 1 and 2.

**Table 1:** Details of participants with aphasia.

<b>Subject</b>	<b>Age</b>	<b>Gender (M/F)</b>	<b>Years post-onset</b>	<b>First lang English (Y/N)</b>	<b>Hearing at 30dBHL</b>	<b>WAB classification (aphasia quotient; auditory comprehension component score)</b>	<b>Auditory Discrimination (max=18)</b>
1	63	M	15 approx	Y	Pass (one ear)	Conduction (65.6; 8.5)	16
2	75	F	5 approx	Y	Fail	Anomic (98; 10)	18
3	45	F	3;10	Y	Pass	Anomic	18

					(both ears)	(88; 8)	
4	72	M	6;0	Y	Pass (one ear)	Conduction (71.4; 7.7)	14
5	50	M	4;0	Y	Pass (both ears)	Broca's (61.6; 5.7)	17
6	80	F	2;7	Y	Fail	Anomic (90; 10)	16
7	54	M	4;8	Y	Pass (both ears)	Anomic (74.4; 8.3)	15
8	70	F	2;8	Y	Fail	Conduction (56.6; 8.2)	15
9	45	F	6;11	Y	Pass (both ears)	Broca's (36.1; 7.35)	18
10	70	M	4;11	N <sup>1</sup>	Fail	Wernicke's (70.4; 6.9)	17
11	57	M	1;2	Y	Fail	Anomic (71.0; 7.3)	17
12	57	M	9	Y	Pass	Conduction	17

			approx		(both ears)	(49.8; 6.95)	
13	61	F	3;3	Y	Pass (both ears)	Anomic (91.6; 10)	17
14	57	F	0;8	Y	Pass (both ears)	Anomic (77.4; 7.2)	17
15	36	M	2;4	N <sup>1</sup>	Fail	Anomic (76.4; 7.8)	18
16	51	M	2;3	Y	Pass (both ears)	Anomic (84.6; 9.7)	18

<sup>1</sup> 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 2:** Details of control participants.

<b>Subject</b>	<b>Age</b>	<b>Gender (M/F)</b>	<b>First lang English (Y/N)</b>	<b>Hearing at 30dBHL</b>	<b>Auditory Discrimination (max=18)</b>
1	70	M	Y	Pass  (one ear)	18
2	41	F	Y	Pass  (both ears)	18
3	35	M	Y	Pass  (both ears)	18
4	47	F	Y	Pass  (both ears)	18
5	70	M	Y	Pass  (one ear)	18
6	62	F	Y	Pass  (both ears)	18
7	60	M	Y	Pass  (both ears)	18
8	60	F	Y	Pass	18

				(both ears)	
9	84	M	Y	Fail	17
10	60	F	Y	Pass (one ear)	18
11	51	M	Y	Pass (both ears)	18
12	67	F	Y	Pass (both ears)	18
13	38	M	N <sup>2</sup>	Pass (both ears)	18
14	60	M	Y	Pass (one ear)	17
15	68	F	Y	Fail	18
16	75	F	Y	Fail	14

<sup>2</sup> 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.

### *Procedure*

Stimuli were incorporated into an adapted version of Speech by Eye (SP-EYE) (Newton, Chiat & Hald, 2008), a computer-based procedure for recording gaze shift in response to speech input (see figure 1). In this set-up, stimuli are presented on a laptop computer with speakers, in a quiet but not soundproof room, and response time is recorded with a webcam. The use of eye movement response in the assessment of comprehension in patients with neurological impairments has been advocated because it provides a response mode that does not require talking, writing or gesturing (Hallowell, Wertz & Kruse, 2002). This may provide a more sensitive measure of participants' on-line processing and avoids the potential impact of motor deficits that a pointing or button pressing task may involve for this population (see Newton et al., 2008).

Figure 1: **SP-EYE set-up**



A random sequence of all items from both accent conditions was created and presented to all subjects. The set of 32 items (16 in the familiar accent; 16 in the unfamiliar accent) was presented in four blocks, each with eight trials. This gave participants a short break

during testing. To ensure that the participants maintained attention and to encourage them to return their gaze to the centre of the screen between trials, trials were embedded in a developing visual pattern. For 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 the visual pattern 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 whilst their gaze was recorded by webcam. This gave an eight-second video file of response behaviour stored on the computer for each item. Participants were advised that they could also point to their picture of choice if they wished, although this was not required. Following each trial the visual pattern was shown. Four practice trials were presented to all participants prior to testing, to ensure that they understood the task instructions.

Accuracy of response was recorded during administration of the task by the first author, by noting participants' choices. Response time was determined through analysis of individuals' eye movements within the eight-second video files of each participant's response to each item: it was measured from the second time the four pictures were shown until the participant looked at their selected picture, and was measured in milliseconds. Response times were recorded off-line using software that allowed frame-by-frame analysis of the video files (Videolab © University College London). Video files from all participants were analysed by the first author to ensure consistency. Ten percent of the data files were given to the third author for analysis of location and timing of gaze shift. Cohen's Kappa test for categorical judgements was used to calculate inter-

rater reliability for identification of gaze shift location; the Kappa value was  $K=0.91$  ( $p<0.01$ ). For timing of gaze shift, inter-rater reliability was also very high, with Pearson product-moment correlation  $p=0.99$ .

## Results

Results for all participants in both accent conditions are included in table 3. Descriptive statistics of the full data set identified three outliers in the group of participants without aphasia (participants 9, 15 and 16). Data from these individuals was therefore excluded from the analyses described below. However, their performance will be considered in the Discussion.

**Table 3:** Accuracy scores for all participants in familiar and unfamiliar accent conditions.

Participants with aphasia			Participants without aphasia		
Subject	Familiar Score (max=16)	Unfamiliar Score (max=16)	Subject	Familiar Score (max=16)	Unfamiliar Score (max=16)
1	10	7	1	15	15
2	16	11	2	16	16
3	8	6	3	16	16
4	10	5	4	16	16
5	10	11	5	16	14
6	13	7	6	16	16

7	9	9	7	16	16
8	8	4	8	16	16
9	10	10	9	10	7
10	11	6	10	16	16
11	14	7	11	16	15
12	9	6	12	16	15
13	15	12	13	16	15
14	13	13	14	16	16
15	14	14	15	13	7
16	14	13	16	13	7

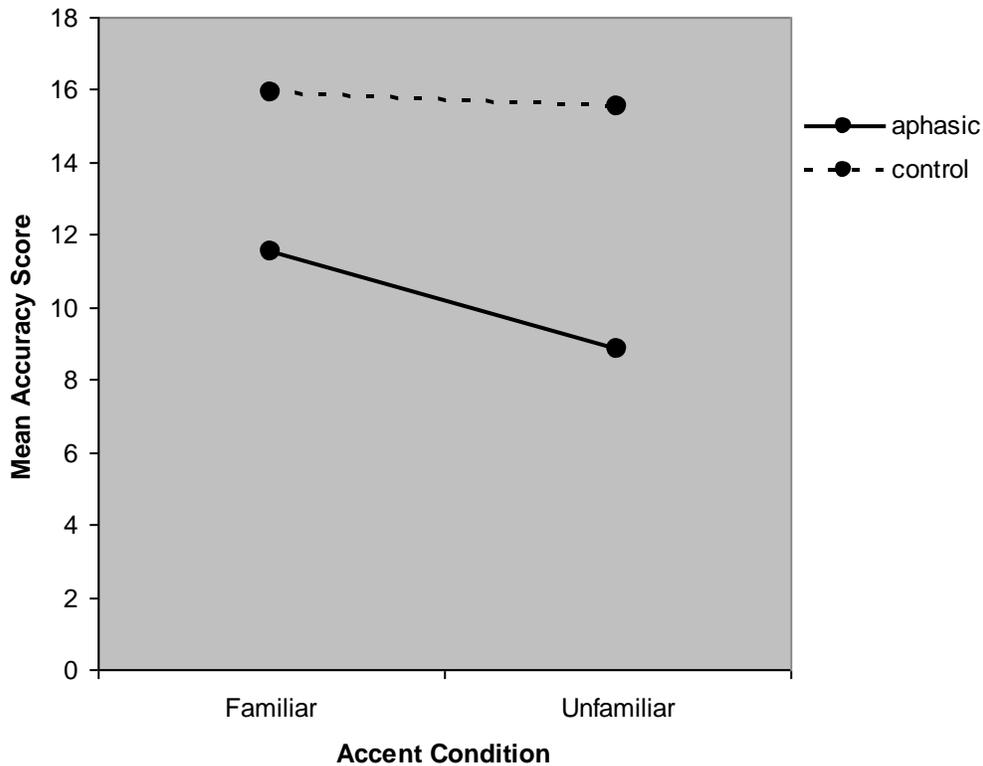
### *Accuracy*

Figure 2 shows mean accuracy scores for both groups of participants in both accent conditions. The mean score for participants with aphasia in the familiar condition was 11.5 (SD=2.61), and in the unfamiliar condition was 8.81 (SD=3.21). For the participants without aphasia, the mean accuracy score in the familiar condition was 15.92 (SD=0.28), and in the unfamiliar condition was 15.54 (SD=0.66).

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 ( $F=18.553$ ,  $df=1,27$ ,  $p<0.001$ ) and group ( $F=56.417$ ,  $df=1,27$ ,  $p<0.001$ ) were found to be highly significant.

There was also a significant interaction between accent condition and group ( $F=10.425$ ,  $df=1,27$ ,  $p<0.005$ ), indicating that the adults with aphasia found it significantly more difficult to comprehend sentences in the unfamiliar accent than the control group (see figure 2).

**Figure 2:** Illustration of accuracy group-by-condition interaction for all participants in familiar and unfamiliar accent conditions.



Accuracy scores of participants with aphasia were 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 ( $t=2.283$ ,  $df=9$ ,

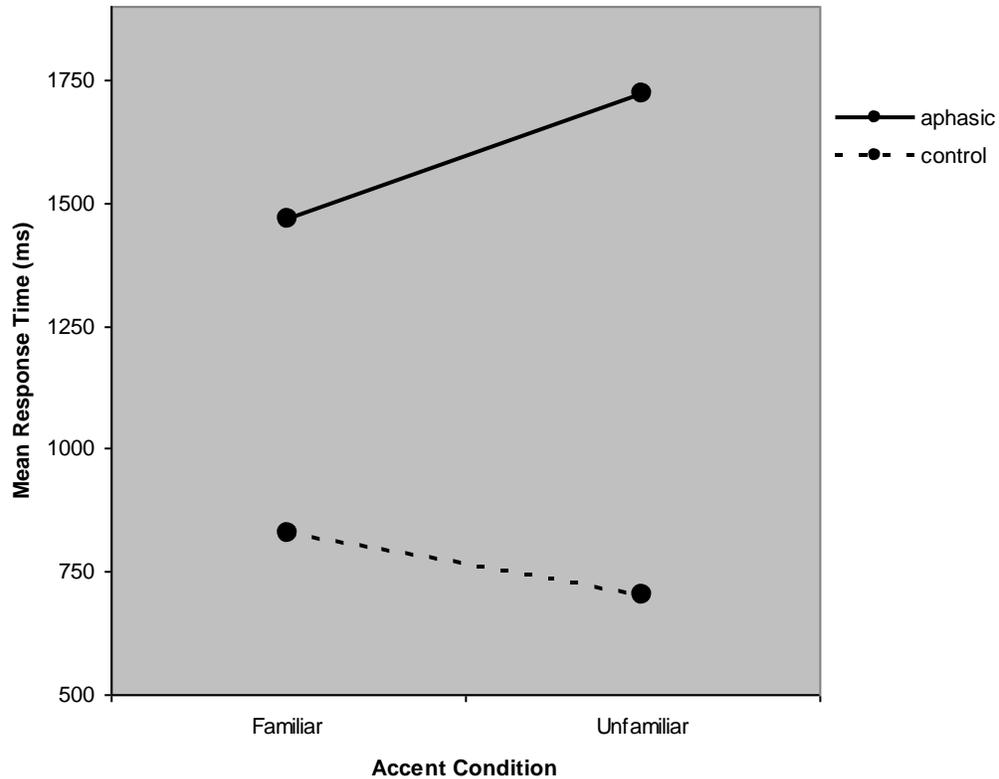
$p=0.048$ ). Both groups reached significance however, suggesting that hearing problems were not the only factor affecting performance. Accuracy scores of participants with aphasia were also analysed in relation to their scores on the auditory comprehension component of the WAB. A significant correlation was found for the familiar accent condition ( $r=0.51$ ), but not for the unfamiliar condition ( $r=0.17$ ).

### *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. Figure 3 shows mean response times for both groups of participants in both accent conditions. The mean response time for participants with aphasia in the familiar condition was 1467.74ms (SD= 503.41), and in the unfamiliar condition was 1720.73ms (SD= 843.68). For the participants without aphasia, the mean response time in the familiar condition was 827.99ms (SD= 410.83), and in the unfamiliar condition was 701.43ms (SD= 413.24).

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 significant main effect of group ( $F=18.124$ ,  $df=1,27$ ,  $p<0.001$ ) was found, but no significant effect of accent condition ( $F=0.402$ ,  $df=1,27$ ,  $p>0.05$ ). The interaction between group and accent condition here did not reach significance ( $F=3.624$ ,  $df=1,27$ ,  $0.1>p>0.05$ ), however inspection of the interaction does suggest that accent condition affects response time quite differently for these two groups (see figure 3).

**Figure 3:** Illustration of response time group-by-condition interaction for all participants in familiar and unfamiliar accent conditions.



## 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. Results showed that the group of 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. Eleven of the 16 participants with aphasia found it harder to understand sentences spoken in an unfamiliar accent, with some of them showing a 50% reduction in the

number of targets correctly identified. Even some of the participants who performed at or close to ceiling in the familiar condition had difficulty when sentences were spoken in an unfamiliar accent. These findings indicate that comprehension difficulties experienced by individuals with an acquired language disorder may be 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 healthcare settings interacting with non-native speakers may be at increased risk of care-giving errors, for example in explanation of medication dosage. The present study indicates that people with aphasia of all ages may have difficulties understanding speech when they are interacting with someone speaking in an unfamiliar accent, although older adults who have aphasia and a decline in cognitive processing and hearing sensitivity are likely to have even greater problems.

In this study, as would be expected, we found a significant positive correlation between auditory comprehension scores on the WAB (Kertesz, 1982) and performance on comprehension of sentences in a familiar accent: individuals who scored highly on the auditory sections of the WAB tended to do better on the sentence comprehension test in the familiar accent. However, no correlation was found between the WAB auditory comprehension scores and comprehension of sentences in an unfamiliar accent. This suggests that other factors such as working memory, in addition to auditory comprehension levels, may contribute to performance of individuals with aphasia when comprehending sentences spoken in an unfamiliar accent.

Previous studies on the effects of accent on comprehension have identified various psychological and demographic variables that are associated with comprehension of unfamiliar accents, including age (Burda et al., 2006) and attitude (Bottriell & Johnson, 1985a&b). The association of age with the effects of accent on the comprehension of people with aphasia is not clear from the findings of the present study, as there were insufficient numbers of younger participants. However, the results show that some participants under 60 years of age made significantly more errors in the unfamiliar accent condition than the familiar condition, which suggests that cognitive and sensory changes associated with ageing are not the only explanation for the current findings. The impact of attitude in this study cannot be commented on, as information about the participants' attitude towards the accents was not collected. In addition to these variables, hearing acuity has also been identified as a factor that may impact on comprehension skills. It has been shown that older adults with hearing loss perform less well on word-list recall tests than older adults with good hearing, even when they have identified the words (Wingfield et al., 2005). These findings have been interpreted as showing that the effort required to perceive the words reduces processing resources available for encoding them in memory. In the present study, although hearing acuity appears to be associated with the comprehension performance of people with aphasia, it is not the only factor that determines scores. Participants with aphasia and good hearing still showed a significant effect of unfamiliar accent on sentence comprehension. However, it is likely that in some cases sensory decline will interact with limited language resources adding to an individual's difficulties. More research is needed which considers these variables and their interactions.

In addition to accuracy scores, response times were collected for both familiar and unfamiliar accent conditions. Results showed that while control participants responded to stimuli more quickly overall than participants with aphasia, 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 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. In the present study, although participants with aphasia were 253ms slower on average to unfamiliar accented stimuli than to familiar accented stimuli, the difference was not significant. It is possible that 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 acuity and severity of aphasia) resulted in a less accurate measure of central tendency than that found by other researchers. Although not significant, the 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 participants without aphasia responded more quickly 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). In the present study, the difference in speaker's rate of speech may be a confounding factor in measurement of response times. In a 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 when stimuli are produced particularly slowly, listeners have already processed substantial parts of the utterance prior to hearing the end of the sentence, thus resulting in shorter recorded response times. Despite being matched for number of words, unfamiliar accented stimuli in the present study were longer (and therefore slower) than familiar accented stimuli (means: unfamiliar = 2.37 seconds, familiar = 1.91 seconds), and so the control group's faster response to the unfamiliar accent may be explained by this additional time for processing. In addition, there may be a 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 [unfamiliar] 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]."

It may therefore be that with the novelty of an unfamiliar accent, heightened attention or enhanced processing facilitates a faster response for some individuals. Interestingly, neither of these factors appears to be used by the participants with aphasia when presented with the unfamiliar accent.

The presence of three outliers in this study's control group is worthy of discussion. 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). 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. It is also 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. In addition, 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 partially attributable to hearing loss. The 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 possible that such individuals may be more likely to be experiencing some type of functional decline and less likely to have the range of conversational partners that may be more typically available to people living independently. Both factors may contribute to performance on tasks such as the one included in this study.

## **Clinical Implications**

The findings of the present study demonstrate that an unfamiliar accent can have a significant impact on the auditory comprehension skills of adults with aphasia following stroke. It is to be expected that individuals with aphasia will have greater communication problems with health professionals than many other service users: they are more likely to be confused by long descriptions, complex instructions and less familiar vocabulary, for example medical terminology. In addition, they may not realise they have not fully understood what has been said nor have the ability to ask questions to clarify information. Results from this investigation suggest that communication difficulties are even more likely to arise when individuals with aphasia are trying to understand someone speaking with an unfamiliar accent. It is important to address this problem, as one of the consequences of changing demographics, particularly in large cities, is that understanding unfamiliar accented speech will be a continuing challenge for people using and delivering healthcare services. The extent of this is evident in the finding that some London healthcare Trusts employ clinical workers of up to 39 different nationalities (Buchan, Jobanputra & Gough, 2004) as well as staff with significant regional accent variation. All healthcare staff need to be aware of the possible impact their accent may have on patients' comprehension, particularly if they have acquired communication difficulties. 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". Accent is one of the factors that healthcare professionals could consider when adapting their communication style to their listener (see, for example, Communication

Accommodation Theory (Giles, Coupland & Coupland, 1991)). However, although some adaptation is possible, it is unlikely that speakers will be able to eradicate their natural accent completely.

Healthcare workers who are responsible for diagnosing, assessing and devising management plans need to be particularly careful about how their accent affects the performance of individuals with aphasia. 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. 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 speech and language therapists regularly adopt such strategies to support clients' communication skills, additional consideration of their importance during assessment should be made in light of the present study's findings.

The aim of speech and language therapy services is to maximise an individual's communicative participation in society and maintain social relationships, and since accent variation is a significant aspect of communication it should be considered. One strategy to facilitate this process may be to help individuals with aphasia to adapt to unfamiliar accents, an idea that has been proposed for students learning a second

language. Major et al. (2005) suggest that since accent variation can affect listening comprehension, ESL teaching should include exposure to a range of accents. Since individuals with aphasia are likely to come into contact with a wide range of regional, international and foreign accents of their native language, it seems sensible to adopt a similar approach for individuals requiring speech and language therapy. For example, therapy materials could be developed that include exposure to a range of recorded speaker accents, since Gass and Varonis (1984) found that familiarity with non-native speech in general facilitated comprehension. Additionally, 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.

## **Summary**

In a multi-cultural society 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. Healthcare services often comprise a highly multi-lingual workforce, and so service providers 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.

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