

Acoustic, perceptual and social analyses of speech convergence of black and white people in Nigeria

Joy Oluchi Uguru  & Nkechi Mgbodichinma Ukaegbu* 

Department of Linguistics, Igbo and other Nigerian Languages, University of Nigeria, Nsukka, Nigeria

*Correspondence: nkechi.ukaegbu@unn.edu.ng

This study assesses speech convergence between white American English (AE) speakers and black Nigerian English (NE) speakers. Most studies base convergence on speech shadowing, but this study investigates convergence in real-life conversations. Eighty utterances were analysed with PRAAT. The utterances were selected from interactions between two AE speakers and two NE speakers, and from separate interactions between the two Americans and between the two Nigerians respectively. Their fundamental frequency (F0) and duration values were subjected to a *t*-test. Results showed that the F0 of utterances made by the two blacks while they interacted with the whites were significantly different ($p < 0.05$) from the F0 of their speech with each other. Conversely, there was no significant difference between the F0 of the speech the whites made during their interaction with the blacks and the F0 of their speech with each other. Furthermore, fifteen NE speakers were used to assess the extent of convergence in whites; more of them understood the utterances of the white person that has socialised longer with Nigerians; the F0 of his speech also had higher probability. The study concludes that socialisation aids speech convergence, while F0 is a cue for predicting interlocutors' degree of socialisation.

Keywords: speech convergence; speech accommodation; interlocutors; speech perception; speech comprehension; socialization

Introduction

It is natural to assume that white English speakers, having colonised Nigeria, may not converge their speech during interaction with black Nigerians. This study therefore seeks to discover the direction of speech convergence in real-life conversations between whites (American English speakers) and blacks (Nigerian English speakers).

Auditory perception involves the ability to engage in human communication, with fellow interlocutor(s) receiving and interpreting the information given by the speaker (Dobie & Van Hemel, 2004). To ensure smooth communication, interlocutors need to perceive and comprehend each other. Therefore, when interlocutors are native speakers of different languages, the participants need to diverge from the phonetic features of their language and converge on those of the other interlocutor(s) (Atamturk et al., 2017; Ghanem, 2017; Jiang & Kennison, 2022). This is necessary if the interlocutors' individual languages are related, as seen in the case of black-white interactions involving American English native speakers and Nigerian English speakers which have different phonetic features. This becomes necessary if the interlocutors' language is unrelated, as seen in the case of the black-white interactions examined in this study. This applies to the way Nigerian English (NE) differs from American and British English. Nigeria has a colonial history with Britain and technological interaction with America, yet speakers of NE have variable pronunciations of English words from British English (BE) and American English (AE) speakers. This is largely because of interference from the local

languages. The diverging variations provide insights into the unique phonological features of NE (Oladipupo & Akinola, 2022). This study investigates phonetic convergence in a real-life conversational context. This is unlike most previous studies which usually base convergence studies on speech shadowing (Marslen-Wilson, 1985; Gessinger et al., 2021).

In Nigeria, English is the official language; however, the variety of English spoken in the country is very different from Standard British English due to language interference. The Nigerian English pronunciation is closer to the indigenous Nigerian languages than to Received Pronunciation. Hence, when a Nigerian interacts with a white person, particularly a native English speaker, understanding may be hindered since either the Nigerian or the white person may not fully understand the other (Adedeji, 2022). We have decided to use the terms black and white because this hitch in communication is not only limited to English speakers, but also to other white people, probably because their native languages are intonation languages while Nigerian languages are tonal, and therefore NE is mostly tonal (Sunday & Oyemade, 2021). However, it appears that most Nigerians tend to make some effort to improve their pronunciation when they are speaking with white people and the white people, in turn, also try to speak in a way that the blacks can understand. This study sets out to analyse speech convergence in a real-life black-white conversation, using acoustic cues, fundamental frequency (F0) and duration.

F0 is shown to be important in phonetic convergence. Babel and Bulatov (2012) reveal from acoustic analyses

that the utterances that had their F0 filtered out could not be imitated as well as those with their F0 intact. Gregory et al. (2001) developed the Vocal Channel Social Status Model (VOCSTAT), which posits that the vocal channel, specifically fundamental frequency (F0), is important for conveying the social information to which interlocutors converge. This model forms the base of this study which sets out to analyse how F0 influences speech convergence in a social interaction between blacks and whites. Showing that acoustic measures are used to evaluate phonetic convergence, Pardo (2013) defines phonetic convergence as an increase in the similarity of acoustic-phonetic features between speakers. The acoustic features, F0 and duration, are used to account for phonetic convergence in this article. Also, the degree of socialisation of some study participants and its effect on phonetic convergence and speech perception are accounted for. Thus, the study adopts both acoustic and perceptual analyses similar to Pardo (2013).

Ruch et al. (2018) opine that linguistic accommodation can occur in two different directions (convergence and divergence). While divergence involves an emphasis on the linguistic differences of the interlocutors, convergence involves the interlocutors converting their speech to be more similar to each other's. This study is concerned with convergence. Vocal accommodation is a natural reaction that interlocutors make in the process of oral speech communication. Speech is a kind of social behaviour and participants may exhibit some similarities and dissimilarities in their speech forms, hence they tend to make some adjustments to facilitate smooth communication. This happens across dialects, languages, ethnic groups and races and is observable in communication between black African and white Western people. This is because their native languages are usually very different from each other, belonging to different language families. Following the views of Giles (1973) it could be thought that it is the blacks (ex-colonised) who make efforts to converge to the white man's language, while the whites may not do so. Such conclusions appear to authenticate the views of Giles (1973) that an interlocutor in a less dominant role tends to converge towards the speaking style of a more dominant interlocutor. Following colonialism and the adoption of some European languages as official languages in African nations like Nigeria, this view has continued to affect the harmonious relationship between whites and blacks generally and more specifically, the ex-colonialists and ex-colonialised. Hence, it is pertinent to undertake a study of this kind to reveal the nature and degree of convergence and the hindrances to speech convergence in black-white spoken communication. This study does this by examining the F0 of the utterances of black-white interlocutors and assessing the effect of socialisation on phonetic convergence.

According to the findings of Babel (2010) and Yu et al. (2013), phonetic accommodation is influenced by certain social factors. For example, the degree of convergence towards a model talker is motivated by listeners' social bias and positive attitude towards the narrator. Also, increased exposure to the model can be a factor. This is somehow implicated in this study as the white person who is more exposed to black people converged more to black speech. This is evidenced by the fact that the listeners understood his speech more than that of the other person who had less exposure to black people. In a nutshell,

accommodative communication refers to a situation where the speaker has adequately adjusted their speech to meet the listener's communication needs (Gasiorek, 2015). Speech perception is the process where the sounds of a language are heard, interpreted and understood, which makes the hearing organ important. When perception is referred to in this work, it pertains to the latter, that is, the interpretation of sounds by the brain. For instance, the study subjects who listened to the white people in this research were meant to report whether they could make meaning out of what they heard them say. In this study, the test carried out on the fifteen young listeners was based on their accuracy of perception, which involves the brain's interpretation of what is perceived. This interpretation also depends on the brain's familiarity with such pronunciations. According to the University of Maryland (2018), when we hear someone talking in a familiar language, our brain quickly shifts to pay attention, process the speech sounds by turning them into words, and understand what is being said. Thus psycho-acoustics, which deals with the sensitivity and accuracy of hearing, is an important area of study.

According to Nardy et al. (2013), linguistic usage is associated with social relationships and interactions between persons. They show that people who interact more frequently adopt the use of similar sociolinguistic variables and that these variables converge after one year of regular contact. The communicative act theory (Giles et al., 1991; Shepard et al., 2001) addresses these kinds of relationships between language, social interactions and social evaluation, and helps us to understand what speech adjustment (accommodation) is all about. Speakers converge towards their interlocutors for social closeness (Kim, 2012; Lewandowski & Jilka, 2019). In the absence of convergence, comprehension is hampered because the message does not match the listener's speech style (Gasiorek, 2016). This is typical of what is usually experienced in black-white oral interaction in the Nigerian setting. This study aims to unravel why this is so.

Speech accommodation is a natural social behaviour, and there is no correlation between speech accommodation and status (Danescu-Niculescu-Mizil et al., 2011). Babel (2009) and Zajac (2013) assert that individuals passively acquire the acoustic characteristics of vowels in the utterances of their fellow interlocutors, imitating the length of vowels in their speech due to linguistic and social factors. These findings appear to negate the conclusion of Giles (1973) that people of lower status accommodate those of higher status. However, the view of Giles is usually carried by people in real-world situations, particularly in black-white communication; this is a fallout from colonialism. The present study is geared towards providing further insights into these arguments. In summary, the study is geared towards establishing – by using real-life conversations – if and how speech converges during communication between the NE and native English speakers. It seeks to specifically discover the direction of convergence. Real-life conversations recorded during communication between two Nigerian English and two American English speakers were analysed in the study.

Methodology

Participants

This study was carried out on the Nsukka campus of the University of Nigeria. A purposive sampling technique

was used to select two white AE speakers, and two NE speakers. The method of data collection was that of semi-structured observation where the speakers could naturally discuss any topic. They were aware that their interactions was being recorded, though they did not know what was being tested. The participants were oblivious to the fact that they were being studied for convergence to make the findings of the study authentic.

Data

Ten utterances were selected from each interlocutor as the NE and AE speakers interacted. Subsequently, another set of ten sentences was selected from each interlocutor in different contexts of interaction. First, the NE speakers spoke with each other, and later the AE speakers spoke with each other. Finally, a total of eighty utterances from the different contexts of the NE and AE speakers' interactions were digitised in *PRAAT* at 4.1 kHz (see Appendix A). Then the F0 and duration of the speech of each English speaker were analysed using the *PRAAT* software. It is worth noting here that one of the AE speakers has interacted (socialised) with NE speakers for ten years, while the other has done so for one and a half years. This aspect of socialisation is the basis for the social analysis aspect of the study.

Analytical procedure

Tokens from the elicited data were first segmented and annotated in the *PRAAT* software (version 5.3.35; Boersma & Weenink, 2017). Next, a descriptive statistical analysis (using Microsoft Excel) was used to calculate the mean values of the duration and the fundamental frequencies elicited from the participants' speech. The mean values of these acoustic cues are used to analyse and compare the interlocutors' speech.

A (confirmatory) experiment was conducted to reveal the effect of socialisation on phonetic convergence and speech perception and comprehension. In doing so, the two AE speakers had a discussion of twenty utterances (ten utterances per speaker) with each other in front of a group of fifteen NE speakers, who were mostly undergraduates. The degree to which the NE speakers understood the white men's speech was evaluated by what the NE speakers wrote down based on what they heard. Findings from these were then qualitatively analysed (see Appendix B). For the quantitative analysis, a *t*-test was carried out to ascertain the relationship between the NE and AE speakers in the different contexts of their interaction to ascertain the degree of convergence.

Results and discussion

This section presents the analysis of the data from the instrumental analysis and the perception and comprehension experiments. The utterances analysed can be seen in Appendix A along with the visual displays of some of the spectrograms.

The results of the experiments are shown in the various tables and charts. In Tables 1a and 1b, the values of F0 and the duration of the first white man's utterances are displayed. He made these utterances as he interacted with the two black men and the second white man. Alongside these values are also the F0 and duration values of the speech he made during his interaction with

only the second white man. Fwb1 refers to the former (first white with black 1) while Fww1 refers to the latter (first white with white 1). As seen from the tables, there is not much difference between the F0 and duration values of his utterances with the black people and those with his fellow white person only. The same is the case with the F0 and the duration values of the second white man's utterances with the blacks and those with his fellow white man as seen in Tables 2a and 2b. The results from both white men show that there is no significant difference ($p > 0.05$) between the F0 and duration values of their speech with the blacks on one hand, and their speech with each other on the other, with a *t*-value of 1.37 and a probability of 0.18 (as seen in the analysis of the first white man's speech), and a *t* value of -1.016 and a probability value of 0.323 (as seen in the analysis of the second white man's speech).

First white man (AE speaker)

Table 1a: F0 values in hertz (Hz) of the first white man's speech with the black and white interlocutors

Fwb1	Fww1
74.98	75
75.90	75
75.02	75
75.01	75
71.96	75
70.86	75
75.31	75
74.88	75
75.02	75
74.07	75

Table 1b: Duration values of the first white man's speech with the black and white interlocutors (in milliseconds, m/sec)

Dwb1	Dww1
3.85	3.2
2.33	3.6
5.04	4.5
3.06	2.7
2.70	5.5
2.31	3.6
3.14	3.6
2.89	5.5
4.10	8.7
4.45	4.5

The results of the *t*-test analyses of the F0 and duration of utterances produced by the first white man are shown below:

F0 results

$t = -1.37$

Probability = 0.18

Not significant ($p > 0.05$).

Duration results
 $t = 0.225$
 Probability = 0.824
 Not significant ($p > 0.05$)

It can be seen from the results of the t -test analyses that there is no significant difference between the F0 and duration values of the first white man's speech with the blacks and the values of the same acoustic features in his speech with a fellow white man. This implies that the man did not make any adjustment to his speech patterns when he conversed with the blacks.

Second white man

Table 2a: F0 values of the second white man's speech with blacks and with a fellow white

Fwb2	Fww2
81.95	75
82.53	75
90.82	75
88.48	75
82.07	107
79.14	115
86.60	75
86.74	75
79.17	75
75.90	75

Table 2b: Duration values of the second white man's speech with blacks on one hand and with a fellow white on the other hand

Dwb2	Dww2
3.88	6.8
1.54	2.7
1.46	2.2
1.78	1.8
3.86	4.1
1.76	2.2
1.67	2.7
2.29	3.6
4.32	2.7
2.03	1.8

The results of the t -test analyses are as follows:

F0
 $t = -1.85$
 probability = 0.08
 Not significant ($p > 0.05$).

Duration
 $t = -1.016$
 probability = 0.323
 Not significant ($p > 0.05$)

Just as in the case of the first white man, the t -test analyses and results in Tables 3a and 3b show that there is no significant difference between the F0 and duration values of the second white man's speech with the blacks, and the F0 and duration values of his speech with the fellow white person. However, judging from the probability value of his F0 analysis, which is 0.08, one may conclude that it is nearly significant since it is close to 0.05, the level of significance.

First black man

Table 3a: F0 values of first black man's speech with whites on one hand and with a fellow black on the other

Fbw1	Fbb1
86.25	78.20
85.26	76.44
99.32	82.20
87.97	83.65
84.83	85.02
88.14	85.49
85.70	85.57
82.64	84.85
85.60	79.37
82.30	78.54

Table 3b: Duration values of first black man's speech with whites on one hand and with a fellow black on the other

Dbw1	Dbb1
2.76	3.25
4.88	3.08
1.03	5.25
1.94	3.05
3.61	3.05
3.61	1.85
3.96	2.83
2.81	2.42
2.19	2.56
4.46	5.12

Summary of t -test analyses for the first black man:

F0
 $t = 2.59$
 Probability = 0.018
 Significant ($p < 0.05$).

The results of the t -test analyses reveal that there is a significant difference between the F0 values of the speech of the first black man with the white people and that of his speech with his fellow black man. This implies speech or phonetic convergence; apparently the speaker adjusted his speech to approximate the speech of the white people.

Duration
 $t = -0.235$
 Probability = 0.817
 Not significant ($p > 0.05$)

On the contrary, the results of the t -test analyses show that there is no significant difference between the duration values of the first black man's speech with the whites and those of his speech with his fellow black man. Thus, there was no adjustment in terms of the time taken to pronounce words.

Second black man

Table 4a: F0 values of the second black man's speech with whites on one hand and with a fellow black on the other hand

Fbw2	Fbb2
127.06	91.40
105.88	107.43
109.70	102.59
101.55	105.29
102.00	98.67
111.76	86.98
113.40	88.53
116.87	89.19
102.72	95.85
103.65	111.46

Table 4b: Duration values of the second black man's speech with whites on one hand and with a fellow black on the other hand

Dbw2	Dbb2
2.32	6.49
2.40	6.49
6.17	5.83
7.76	4.61
4.58	3.95
5.15	2.08
2.51	2.48
1.73	3.89
3.99	7.77
4.16	3.32

The results of the t -test analyses are as follows:

F0
 $t = 3.11$
 Probability = 0.006
 Significant ($p < 0.05$).

The results of the t -test analyses reveal that there is a significant difference between the F0 values of the speech of the second black man with the white men and

those of his speech with his fellow black man. This can also be observed from Tables 4a and 4b. Hence, both black men adjusted their speech while speaking with the whites. This is speech convergence. Both black men had significant differences in their F0, while the whites did not. This confirms the observation of Giles (1973) and Turner and West (2010) that it is usual for a person being dominated to converge on the speech patterns of the one who is dominating. The post-colonial effect could be a factor influencing convergence in the blacks. And the fact that English is the native language of the whites and the national language of the blacks could have made the whites maintain the same speech pattern in both settings. On the contrary, the blacks (NE speakers), who usually speak the Nigerian variety of English (to one another) under normal circumstances, must have modified their speech patterns while speaking with the whites, probably in a bid to approximate to the whites' variety of English. However, one may wonder why the whites should not at least adjust their speech to enable their black co-interlocutors to understand them better. This is possible since the subjects used for the study have spent some time in black society; that is, they have some degree of socialisation; which will be discussed later.

Duration
 $t = -0.721$
 Probability = 0.480
 Not significant ($p > 0.05$)

However, the results of the t -test analyses show that there is no significant difference between the duration values of the second black man's speech with the whites and those of his speech with his fellow black man.

In summary, a significant difference ($p < 0.05$) is only seen between the F0 values of the utterances of the black men with the whites and the F0 values of their speech with themselves (blacks). No significant difference is seen for other analyses.

Result and discussion and the effect of socialisation on convergence

To further test the white men's degree of speech convergence and the extent to which their utterances can be perceived or comprehended, fifteen people (mostly undergraduate students in the University of Nigeria, Nsukka) listened to twenty utterances from the black-whites' interactions. The subjects listened and wrote down the utterances they perceived while the two whites talked. The result of their responses are shown below (Table 5).

Table 5: Range of subjects' perception of the white men's utterances by fifteen respondents

	11–15 utterances	16–20 utterances
Respondents for short socialisation	6	9
Respondents for long socialisation	1	14

The range of perception scores are seen in Table 5 with a corresponding chart in Figure 1.

Perception of the twenty utterances reflected two ranges: 11–15 and 16–20. From Table 5, it can be seen that for the white man with a short socialisation, six people's perception fell in the range 11–15, while nine people's perception fell in the range 16–20. On the contrary, for the man with a long socialisation, only one person's perception fell into the 11 to 15 range; the perception of

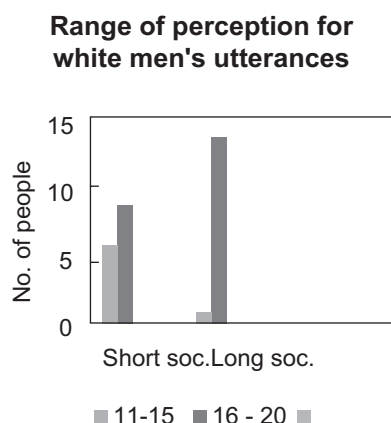


Figure 1: Fifteen respondents' range of perception of the two white men's speech based on degree of socialisation (Short soc. – short socialisation; Long soc. – long socialisation)

the remaining fourteen people fell into the 16 to 20 range. The chart in Figure 1 clarifies this.

From these results, it can be deduced that socialisation has a positive effect on speech convergence. Hence, it should be given a primary place in the analysis or evaluation of speech convergence. These findings authenticate the views of Nardy et al. (2013) that linguistic usage is associated with social relationships and interactions between persons. However, the findings that people who interact frequently adopt similar variables which converge after one year is not shown in the second white man used for this study because he did not converge in his speech though he had spent one and a half years in that society.

Conclusion

In this study, speech convergence in black and white people's (Nigerians and Americans) interactions was assessed. Two white men (American English speakers) and two black men (Nigerian English speakers) were involved in the interactions, and eighty utterances were analysed acoustically. Forty of the utterances were produced while both white men and black men interacted, while the other forty were produced during white-on-white and black-on-black discussions. The F0 and duration of all the utterances were analysed with *PRAAT* software. There was no significant difference between the F0 of the utterances of white people while conversing with the black people and the F0 of their utterances while conversing with each other (the two American English speakers) ($t > 0.05$). On the contrary, there was significant difference between the F0 of the blacks' utterances made during their interactions

with the white people and the F0 of those they made during the interactions with each other ($t < 0.05$). As for duration, there was no significant difference between the utterances that the interlocutors made during interactions between black and white people and those made in white-white and black-black discussions.

The results of the confirmatory experiment on the effect of socialisation on speech convergence, which involved fifteen people listening to the white people talking to each other, showed that more people understood the utterances of the white man with longer socialisation than those of the one with shorter socialisation. The respondents' perception of the 20 utterances reflected two ranges: 11 to 15 and 16 to 20. For the white person with shorter socialisation, out of the fifteen respondents, six people's perceptions fell within the range of 11 to 15, while nine people's perceptions fell in the range of 16 to 20. On the other hand, for the perception of the utterances of the man with longer socialisation, fourteen people's perception fell in the 16 to 20 range, while only one person fell within the 11 to 15 range.

In their interaction with the black people, the white person with longer socialisation produced utterances that had F0 with a probability (0.08) that is very close to 0.05, in contrast to the F0 probability of 0.18 of the utterances of the white person with a shorter socialisation period with black people. Apparently, therefore, socialisation aids speech convergence and acoustic measures. This is what Ruch et al. (2018) refer to as long-term accommodation between people who interact frequently over a longer time. In addition, in line with the findings of Lewandowski and Nygaard (2018), we conclude from our results that F0 can be used to predict the degree of phonetic or speech convergence in an interaction.

Abbreviations glossary

- Fwb1 – (F0 of utterances of first white person with black people)
- Fww1 – (F0 of utterances of first white person with only fellow white person)
- Dwb1 – (duration of utterances of first white person with blacks)
- Dww1 – (duration of utterances of first white person with only fellow white person)
- Fwb2 – (F0 of utterances of second white person with black people)
- Fww2 – (F0 of utterances of second white person with fellow white person)
- Dwb2 – (duration of utterances of second white person with black people)
- Dww2 – (duration of utterances of second white person with fellow white person)
- Fbw1 – (F0 of utterances of first black man with white people)
- Fbb1 – (F0 of utterances of first black man with a fellow black person)
- Dbw1 – (duration of utterances of first black person with white people)
- Dbb1 – (duration of utterances of first black person with a fellow black person)

Fbw2 – (F0 of utterances of second black person with white people)
 Fbb2 – (F0 of utterances of second black person with fellow black person)
 Dbw2 – (duration of utterances of second Black person with White people)
 Dbb2 – (duration of utterances of second black person with fellow black person)

ORCID

Joy Oluchi Uguru – <https://orcid.org/0000-0002-0416-6169>
 Nkechi Mgbodichinma Ukaegbu – <https://orcid.org/0000-0002-8703-4101>

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