Foreign Accent Perception and Processing with EEG

Alexandra Grant[1], Rachael Benons[1], Ashley Johns[1], Melissa Hobson[1], David Nichols[1]
[1]*Roanoke College, Salem VA 24153*

As technology continues to improve communication between cultures, foreign accents are becoming more common in everyday life and, therefore, more important to analyze. The objective of this study was to examine how a range of accents are perceived, and how that may relate to the brain's electrical activity. Fourteen female participants from Roanoke College listened to twelve clips of different accents speaking English while their brain activity was measured using electroencephalography (EEG). There were six speakers with two audio clips each. Four of the six speakers were using English as a native language, while the other two speakers were non-native English speakers. Each participant heard a male and female American, Irish, and Saudi Arabian speaker. After each clip the participants were asked to rate the accent on a Likert scale for understanding, comfortability, trustworthiness, and likability. Electrodes were placed over the frontal lobe for a sufficient understanding of executive reactions to the accents, as well as over the parietal lobe to measure basic audition. Data was then analyzed through Fast Fourier Transformation (FFT) to find the frequency of the brain waves. Significant effects regarding how participants perceived the different accents based on survey data were found. It was found that participants rated females higher and enjoyed listening to the Irish accent most, but understood the American accent best and Saudi Arabian accent least. The results showed no significant findings for the EEG recordings. These results show that further research needs to be done, perhaps restructuring when participants are asked questions about the accent and creating a task during the audio clip to allow the participant to focus more on the actual content of the text.

Abbreviations: EEG – Electroencephalography, FFT– Fast Fourier Transformation
Keywords: FFT; foreign accent; likability; understanding; comfortability; trustworthiness

---

Introduction

An increase in communication between cultures has coincided with a higher prevalence of technology, leading to greater frequency of encountering various accents. For the purpose of this study, accents will be defined as the different ways individuals pronounce words of the same language (English in this study), and dialects in everyday life. Past studies have shown that the way people respond to accents varies considerably and can be influenced by many factors, such as ethnic identity (Bresnahan et al., 2002) and speaking style (Weiss and Burkhardt, 2012). However, with the increase in contact between people with different accents, made possible with new technology, additional research is needed. This topic is important to understand in many areas of our lives. As technology becomes more available, so are foreign ideas, foreign products, and foreign accents. It has previously been shown that foreign accents are less intelligible and differ in how they are processed in the brain than local accents (Goslin et al., 2012). With a shift in prevalence of foreign accents, it is important to understand how these various accents are perceived at an automatic, as well as conscious level. To do this one needs to measure automatic responses in the brain, in addition to asking particular questions about perception. There are many ways of studying the overall perception of a given accent, some factors that can be considered that collectively contribute to an individual's feelings about the accent are:

understanding, comfortability, likability and trustworthiness.

In one study, Bresnahan et al. (2002) found that if a foreign accent was rated as more understandable it was perceived as more attractive by a participant. However, if the accent was unintelligible, it was less attractive and perceived more negatively. This can be explained by Weiss and Burkhardt (2012), who suggest that speech is viewed as more likable when there are fewer hesitations and false starts when speaking, most commonly found with foreign accents. Therefore, Weiss and Burkhardt (2012) found that foreign accents are less likely to be reported as likable. Intelligibility of accents is a large factor in a person's reaction to them. Obleser and Weisz (2012) discovered a linear relationship between increasing alpha suppression activity and intelligibility of words; when people have a harder time understanding a word their alpha wave activity will decrease. Obleser and Weisz (2012) found significant alpha activity on the left of the frontal and parietal central lobe. Alpha activity can be associated with relaxed and peaceful brain processing; therefore we can infer that alpha suppression is associated with more brain processing.

Comfort is also important to assess when looking at accents. Human beings by nature have a desire to feel comfortable, and this also pertains to when people are listening to various accents. Giles (1970) describes the importance of a speaker being able to make the listener feel comfortable in relation to aesthetics of a given accent. While there have been few EEG studies on comfort with various accents, there have been studies on how the brain responds in comfortable situations versus uncomfortable situations. Studies have shown that positive emotions and relaxation, related to comfort, can cause an increase in alpha activity and an increase in alertness, causing an increase in beta activity (Kochupillai, 2015; Eoh et al., 2005). These effects were demonstrated in the prefrontal and occipital regions (Kochupillai, 2015).

Trust is a component that is of high relevance in listening to accents, as people tend to feel less comfortable trusting those who are dissimilar to themselves (Kramer, 1991). This has the potential to tie into speaking in a similar style or accent. In a study by Yagman and Keswell (2015), it was found that when listening to someone with a different accent, the listener is less likely to trust the person. By pairing black males and females to talk with one another, some of whom had foreign accents, it was found that race matters in discrimination with regards to various accents, especially for the Black male subject group. A similar study on how Middle Eastern accents are perceived in America is highly relevant for today's political issues. Although there is little research conducted so far on the relationship between trustworthiness and brain activity, Vecchiato et al. (2015) have found a small relationship to be present with regards to alpha activity and trustworthiness. They assessed EEG activity in subjects' responses to potential political candidates and their ratings of trustworthiness and dominance by finding significant activity in the central scalp sites and parieto-occipital regions related to alpha activity. The study found that less trustworthiness was correlated with decreased alpha activity.

Likability is correlated with each of the components assessed above, and is linked most directly to how attractive a listener views an accent. It can be a difficult aspect of human cognition and processing to understand through EEG. Past research has demonstrated a relationship between feelings of craving to increased beta wave activity (e.g., Knott et al., 2008), implying that there could be a relationship between strong feelings or reactions to a stimulus and beta wave activity by placing electrodes at anterior scalp regions.

In one study on vocal accommodation testing whether individuals change the way they speak to mirror or contrast someone they are speaking to, researchers found that females were more likely to accommodate than males (Namy et al., 2002). Within this study, it was also found that women had a tendency to accommodate more when speaking to men than with women. Studies cited in this article provide enough evidence for researchers to infer that females tend to be more sensitive to social communication than men are. Therefore,

differences in preference for accent type may be easier to discover in females than males.

Current Study

The current study aimed to test whether there is a trend in alpha and beta activity regarding understanding, comfortability, trustworthiness, and trustworthiness with various accents using FFT analysis. For our purposes, we chose Ohio, Irish, and Saudi Arabian accents to use. Each accent was chosen for a different reason. The Ohio accent provided a home accent for the sample. While we conducted the study in Virginia, of the accents we were able to access, the Ohio clips had the most clarity of recordings and most similar prosody of speaking for USA audio clips in comparison to the other two foreign accents. Thus, from this point on we will refer to the Ohio accent as the American accent. The Irish accent provided an example of an accent that was still an Anglophone accent, but sounded dramatically different from the way we speak in America. Additionally, we expected that more of the sample population would be at least slightly familiar with this accent. The Saudi Arabian accent provided an example of a non-Anglophone accent from the Middle East, an accent we expected fewer participants to be familiar with. The purpose of the current study was to estimate differences in subject's reactions to each of these accents and find evidence both objectively with EEG and consciously (subjectively) with questionnaires for these differing views.

It was our prediction that given the current turmoil with the United States and the Middle Eastern countries that the Saudi Arabian accent would be rated lowest on all levels of the questionnaires, and because of this would be related to decreased levels of alpha and beta activity. We hypothesized that the American and Irish accents would have similar reports on both the questionnaire data and the EEG data. There may be a difference in how understandable the two are, but differences shouldn't be too drastic given that the Irish speakers are Anglophones. Perhaps given the subtle differences and the way Irish accents tend to be viewed in American culture, Irish accents would be liked more than American or Saudi Arabian accents.

We also were examining differences between sexes. We predicted that there would be a tendency to have more positive feelings when responding to the opposite sex in a female population. Based on research by Namy and colleagues (2002), we predicted that there would be more activity found for females listening to male speakers. If the questionnaire data showed a trend between sexes, it was anticipated that the EEG data would demonstrate the same trend.

Materials and Methods

Participants

A total of fifteen students from Roanoke College in Salem, VA, were recruited. All participants were female in order to maintain a constant sex relationship to the male and female speakers. Only fourteen of the participants' data is being used since one subject's data was deleted due to a researcher error, i.e., the participant's data was collected incorrectly. Ages of participants ranged from 18-22 years old. Additionally, we controlled for home accents by asking participants to provide information about how familiar they were with certain accents. All participants were somewhat familiar with the Irish accent and not at all with a Saudi Arabian accent.

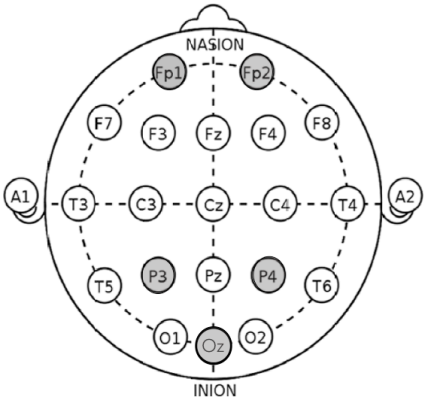

Figure 1. The positions shaded are where each of the electrodes was placed. Channel one included Fp1 and Oz. Channel two included P3 and Oz. Fp2 was used as the ground. Channel one was placed to analyze overall activity, and channel two was used to analyze speech and language processing.

Equipment

EEG signals were recorded using a PowerLab 26T (AD Instruments, Inc., Colorado

Springs, CO), and then amplified and converted to digital output. LabChart 7 software was used to visualize the recording and stimulus time course. A Cedrus StimTracker device sent signals to LabChart 7 specifying the time and label of each stimulus presentation. LabChart 7 then projected the data to the experimenter, but not to the participant, on an external monitor. Stimuli were presented to the participant by using a Dell XPS 15z laptop with SuperLab 4.5. Participants listened to the auditory clips through Coby digital CV-120 over-the-ear headphones at a speaker volume of 30% on the laptop which was measured at an average of 65 dB using Sound Meter SE by LQH Apps.

Stimuli

For this study, stimuli were compiled from the International Dialects of English Archive (1997). Six different clips from their archive based on clarity and strength of the accent were selected for this study: Ireland 7, Ireland 12, Ohio 4, Ohio 8, Saudi Arabia 1, and Saudi Arabia 4. Accents that were perceived as clear and strong were more likely to be chosen for this study. Each accent type include one male and one female, resulting in two control American recordings, as well as four foreign (non-American) recordings. The Ireland group reflected an Anglophone foreign accent and the Saudi Arabia group reflected a non-native, English-speaking foreign accent. The American accent was used as a home accent instead of the Virginia accent, because it included clear sound clips without background noise and did not include any aspects of a southern accent that was found in the Virginian accents. At Roanoke College there is a large number of students who are from the north, so there are less southern accents on the campus than there may be in the state in general. Additionally, the audio clips from American were more similar in prosody to the Irish and Saudi Arabian accents. See Table 1 for more details on the stimuli.

Thirty seconds of each clip were chosen from two different sections of the clip. This length was chosen because it is long enough for a quality FFT analysis, as well as short enough to maintain participant's interest and attention. One section included speakers reading the same story about a young girl on her way to work (McCullough et al., 2000), and the other included the speakers talking about their personal lives in simple, generic ways. The second clip was chosen because we did not want participants to become bored with hearing the same sentence throughout and become desensitized to listening to it. Kongthong et al. (2013) found that when participants are presented the same stimuli, the parieto-occipital region does not respond as strongly as it does upon first exposure. Each participant, therefore, only heard each different voice two times, and the order in which participants heard the stimuli was randomized. Because of this randomization, any types of practice effects that may have biased the results are accounted for.

Procedures

Upon arrival to the study, participants were asked to read and sign an informed consent form. Following completion, participants were asked to remove any facial jewelry and to use abrasive lotion on the forehead in order to remove any dead skin that may affect EEG signals. The five electrodes were placed on the scalp and held in place by use of elastic headbands. The first set of electrodes were placed on the forehead in areas Fp1 and Fp2. Another electrode, measuring the anterior/posterior axis along with FP1, was placed in the Oz location. Based on previous research by Léveque and Schon (2013), we believed that placing an electrode in the parieto-occipital region would be most effective for a study on auditory perception. Therefore, the second set of electrodes were placed on areas P3 and P4. These placements were on the left and right sides of the posterior area of the head. The intent was to place them on the border between the parietal lobe and the occipital lobe. These locations are demonstrated in Figure 1.

Audio clips were presented for a minimum of 29 seconds and were ended at a natural break in speech. The order of the twelve audio clips was randomized separately for each participant. After participants listened to each audio clip, they completed a questionnaire to answer about the audio clip just heard. The four questions were about how much they understood the accent, how comfortable they were with the accent, how trustworthy they felt the speaker

was, and how much they liked the accent. Answers were given on a Likert scale of 1-9, with 1 being not at all and 9 being very much so.

Table 1: Stimulus List

Stimuli	*Length*
Control	
American female	S: *29.82s*
	P: *29.75s*
American male	S: *30.18s*
	P: *30.29s*
Foreign	
Ireland female	S: *31.15s*
	P: *31.54s*
Ireland male	S: *30.13s*
	P: *30.92s*
Saudi Arabia female	S: *29.86s*
	P: *31.25s*
Saudi Arabia male	S: *30.92s*
	P: *31.20s*

***S=story; P=personal life**

Participants took approximately 45 seconds to answer the questions verbally and the researcher entered in their reported scores with a keypad so that participants did not need to remove their eye mask. The entire trial took an average of 15 to 20 minutes per subject. Data was then exported to a MATLAB program for analysis.

Following completion of the EEG data collection, participants were asked to complete a simple demographics form. Included in this form was information about the participant's age, college academic year, and familiarity with Saudi Arabian and Irish accents.

Artifacts were kept to a minimum by allowing participants to rest their heads on a pillow held up by books under the participant's chin. Participants' eyes were closed and under an eye mask in order to minimize blinking artifacts. IRB approval was granted for all procedures in the current study by the Roanoke College board IRB (protocol number:15PS097). All procedures as outlined in the IRB form were followed.

Analysis

Since each participant listened to two clips of the same speaker, EEG and questionnaire data were calculated as an average report across the two clips. Two types of statistical tests were used for analysis. Repeated-measures ANOVA was used to compare means of two or more groups. The null hypothesis would be that none of the means would qualify as significantly different. Paired t-tests were used to analyze two means and assess if they were significantly different.

Results

Survey Results

The first question asked of the participants was how easy the accent was to understand. As seen in Figure 2A, when the country of origin of the speaker increased in distance from the United States, the participants' ratings of understanding decreased (as demonstrated by the brackets). There was a significant difference between the different accents ($F(2,26)=105.4$, $p=.000$), with the largest difference based on the Saudi Arabian accents ($M=4.77$, $SD=1.43$) being rated lower on average than American accents ($M=8.85$, $SD=0.32$; $t(13)=10.56$, $p=0.000$). Females tended to be rated higher than the males for intelligibility ($F(1,13)=13.0$, $p=.003$). There was

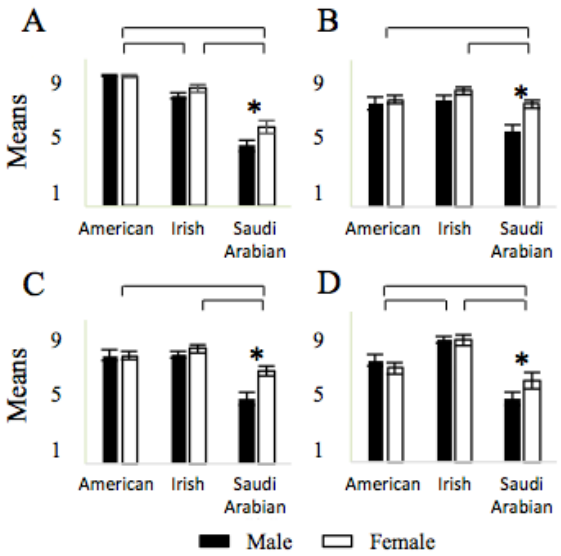

Figure 2. The x-axis refers to type of accent. The y-axis reports the average rating participants gave each accent on a scale from 1 to 9. Asterisks represent significant differences between gender and brackets represent significant differences between accents. The questions referred to understanding (A), Comfortability (B), Trustworthiness (C), and Likability (D).

also a significant interaction effect ($F(2,26)=6.834$, $p=.004$). Results showed that as understanding increased by accent, the difference between sexes of speaker was reduced with only the paired t-test between Saudi Arabian females and males reaching significance ($t(13)=3.526$, $p=.004$).

The second question that was asked of participants was how comfortable participants felt about the speaker (seen in Figure 2B). There was a significant effect for accent ($F(2,26)=23.04$, $p=.000$), where the Irish accents were typically rated higher than the other accents. A significant effect was also found for sex ($F(1,13)=13.11$, $p=.003$), where females tended to be rated higher than males. In addition to these findings, an interaction effect was found ($F(2,26)=7.27$, $p=.001$), as a marginal difference between sex of the speaker was seen in both the foreign accents, however this was largely due to the difference in the Saudi Arabian group (Irish, female: M=7.89, SD=.923; Irish, male: M=7.32, SD=1.067; Irish: $t(13)=2.104$, $p=.055$; Saudi Arabian female: M=7.00, SD=1.019; Saudi Arabian male: SD= 1.422; Saudi Arabian: $t(13)=4.934$, $p=.000$) but not for the American accent (female: M=7.32, SD=1.15; male: M=7.03, SD=1.53; $t(13)=.865$, $p=.40$).

Third, a question on how trustworthy the subject perceived the speaker to be based on just hearing their voice was asked. Similar results were found for this as in the comfortability question. Typically, the female participants felt more trusting of other female speakers ($F(1,13)=30.155$, $p=.000$). There was also a significant effect for accent ($F(2,26)=10.317$, $p=.001$), where Irish speakers were typically rated higher than the other accents. A significant interaction effect ($F(2,26)=5.56$, $p=.010$) was also found, as can be seen in Figure 2C (as demonstrated by the asterisks). These results show that the female vs. male difference was only significant for Saudi Arabian accents ($t(13)=5.014$, $p=.000$).

Lastly, participants were asked how much they liked the particular accent. The primary results were that the Irish accent was rated highest with a significant main effect for accent ($F(2,26)=21.94$, $p=.000$). There was no main effect found for sex for this data ($F(1,13)=.747$, $p=.403$). However a significant interaction effect was found again ($F(2,26)=5.73$, $p=.009$) where the preference for female speakers was only shown in the Saudi Arabian accent ($t(13)=-3.52$, $p=.004$). These results can be seen in Figure 2D.

EEG Results

When looking at the EEG data based on overall alpha and beta waves, we looked for peaks found between 8-13Hz (alpha activity) and between 13-30Hz (beta activity). No significant differences were found across conditions. For instance, using a repeated measures ANOVA for the alpha EEG data with regards to type of accent and sex of speaker (Seen in Figure 3), there was no significant difference for accent ($F(2,26)=.027$, $p=.974$) or sex ($F(1,13)= 1.535$, $p= .237$), nor was there an interaction between sex and accent type ($F(2,26)= .472$, $p= .629$). No significant differences in activity between groups were found with beta activity. Similar results were found with channel two (P3 and P4) alpha activity and beta activity (all p's>.15).

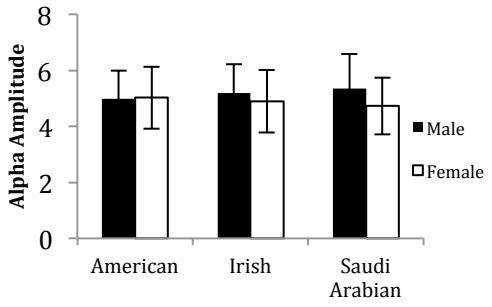

Figure 3. EEG ANOVA: Alpha Activity in Channel 1. The y-axis refers to the mean alpha wave activity. The x-axis separates participants alpha activity by accent type, American being on the far left, followed by the Irish accent and then the Saudi Arabian accent on the far right. The average alpha amplitude across people measured in channel 1 (forehead vs. posterior region of the head) is reported as a function of the location and gender of the speaker.

Discussion

Though the EEG data did not provide any significant findings, the results from the surveys demonstrated clear differences in how various accents were perceived. We found

significant differences between the sex of the speaker and a female listener's reaction, evidence for a potential negative bias for the Saudi Arabian speakers, as well as a relationship between intelligibility and ranking on the other scales.

With regards to gender, it was found that in general female participants enjoyed listening to other female speakers more so than they enjoyed listening to the male speakers. The exception was for the speakers who had an American accent, which they could understand better, in which case a trend for a reverse effect was found with males possibly rated more highly on likability than the females.

It was also evident that, in general, the Saudi Arabian male accent was rated the lowest on every scale. This finding demonstrates either potential discrimination towards this accent or a reflection of intelligibility. The Saudi Arabian accent was the only non-Anglophone, requiring the speakers to communicate in a second language, as opposed to the other speakers communicating in their first language. As past research has indicated a relationship between accent attraction and intelligibility (Bresnahan et al., 2002), this difference between speakers may also have been a reason for these findings. Additionally, as shown in a study by Bradlow and Bent (2007), the more a person hears an accent, the better they are able to understand it. It is more likely that participants have had exposure to people with Irish accents rather than a Saudi Arabian accent, and this may also be a large reason for why these results were found. Additionally, this provides further evidence for the reasoning given above regarding the importance of intelligibility. Another important factor to take into account is that people tend to be drawn to people who are similar to themselves. A subtle effect may have been found due to an ethnicity and race factor (Rubin, 1992). Perhaps participants were more drawn to American and Irish accents over Saudi Arabian accents because they consider themselves more similar to those ethnic groups, as both are Anglophone.

Future studies may focus more on the prosody of the words being spoken by the speakers. The prosody in the Irish speakers may have been happier and more warm-hearted than the Saudi Arabian speakers. This very likely could have had a major effect on the results of this study. Future studies could also look into maintaining more control of the scripts that speakers are talking about. Perhaps each participant could read a set of instructions which would cause very minimal emotional affect, as well as enough variability to ensure participants will not get bored of hearing the same thing repeatedly. Future studies may also use a larger number of speakers. Additionally, future studies could recruit a larger sample size. While fourteen participants is satisfactory for repeated measures EEG data and surveys for large consistent effects, it is minimal when looking for relatively small effects. Lastly, a follow up study may include a group of male listeners to compare with. Gathering enough data to add a second group to compare across genders in sufficient numbers in both sexes would have been too difficult for this study, given the distribution of the population of the psychology department, but would be relevant to assess.

We initially believed that there would be a significant finding for the EEG data, such that when people were reacting to a foreign stimulus in either a positive or negative way, their alpha and beta activity would increase more than it would for normal types of accents that would not elicit an emotional response. Overall, there were no significant findings for the EEG data that was collected. There are multiple reasons for why this may have occurred. One reason may be that asking the questions between each of the audio clips allowed participants to focus only on the accent, not necessarily what the participants were saying. Participants may have been desensitized to the various accents, and, since there was no challenge to the task, they did not pay their full attention to the speaker. Some participants may have been focused on the actual speech and others may have been focused on the accent. This could mean that the alpha and beta activity were not correctly interpreted. Future studies may think of asking the questions at the end of the study instead of in the middle with questions after each speaker about the content of the clip. This task could simply be counting the number of times a speaker said "um" or "that" so that participants were actively engaged. Once

participants know that they will not be asked about the actual content of the words being spoken, they may stop paying attention to the content.

A second possible reason for lack of significance in the EEG data is simply the large amount of individual variability in the data collected. Some participants had on average much higher alpha amplitudes than others. This may be reflecting what other studies have found to be linked to affective reactions to the stimuli. Many studies have given evidence that frontal activity is related to emotion (e.g., Coan and Allen, 2004). Perhaps these individual differences reflect the emotionality of a person rather than a reaction to these accents or to what they are saying individually. The more emotional participants may have reacted overall on a much larger scale than those who were not emotional. Future studies may consider using scripted voice clips with limited variation in what they are speaking about, but enough variation to allow for a simple counting-of-words task to be effective still.

Other current research demonstrates that other brain areas have had significant results when studying accents. Future researchers could consider the centroparietal region. Recent research done by Hatzidaki et al. (2015) found that this region differed in the amplitude of the Late Positive Complex, which is related to emotional language processing. Follow-up studies may consider placing electrodes in this area to find a significant difference between accents. The survey results indicate a clear difference in response to certain accents. Perhaps by measuring alpha and beta activity in the centroparietal region, a more accurate response will be found that aligns more clearly with the survey data.

In conclusion, we have found that there are significant differences in the way participants reacted to Saudi Arabian accents when compared to Irish and American Anglophone accents. We also found that when working with the EEG, it is very important to implement a type of exercise that would ensure that a subject is focusing on the task at hand during the entire study. By simply adding a task as counting the number of times a particular word is said, the participant will need to be more fully engaged in the task. Although no significant results with the EEG were discovered in this study, there are many aspects that may change the outcome as discussed previously. Perhaps by placing electrodes in different places, or by ensuring that participants are focusing on the same thing, may provide researchers with more accurate alpha and beta activity. The evidence that the survey results provided, in conjunction with data from previous studies, allows us to believe that there may be differences in alpha and beta activity present that results do not reflect. Further replication of this study may be helpful to understanding accent processing at an automatic level with a methodology that is more concrete than this study, and keeps the ideas mentioned earlier in the discussion in mind. However, this study is important in understanding people's reactions to various Anglophone accents in comparison to non-Anglophone Middle Eastern accents. Given the current turmoil with the Middle East, this is an important area to study.

Acknowledgements

Thank you to the Psychology Department at Roanoke College for providing the equipment necessary for this study.

Corresponding Author

Alexandra Grant
afgrant@mail.roanoke.edu

References

Bradlow AR, Bent T (2007) Perceptual adaptation to non-native speech. Cognition 106:707-29.

Bresnahan JB, Ohashi R, Nebashi R, Liu WY, Shearman SM (2002) Attitudinal and affective response toward accented English. Lang Commun 22:171-85.

Coan JA, Allen JJ (2004) Frontal EEG asymmetry as a moderator and mediator of emotion. Biol Psychol 67:7-50.

Eoh HJ, Chung MK, Kim SH (2005) Electroencephalographic study of drowsiness in simulated driving with sleep deprivation. Int J Ind Ergonom 35:307-20.

Giles H (1970) Evaluative reactions to accents. Educ Rev 22:211-27.

Goslin J, Duffy H, Floccia C (2012) An ERP investigation of regional and foreign accent processing. Brain Lang 122:92-102.

Hatzidaki A, Baus C, Costa A (2015) The way you say it, the way I feel it: Emotional word processing in accented speech. Front Psyc 6:351-63.

Knott V, Cosgrove M, Villeneuve C, Fisher D, Millar A, McIntosh J (2008) EEG correlates of imagery-induced cigarette craving in male and female smokers. Addict Behav 33:616-21.

Kochupillai V (2015) Quantitative analysis of EEG signal before and after sudharshana kriya yoga. Int J Public Mental Health and Neurosciences 2:19-22

Kongthong N, Minami T, Nakauchi S (2013) Gamma oscillations distinguish mere exposure from other likability effects. Neuropsychologia 54:129-38.

Kramer RM (1991) Intergroup Relations and Organizational Dilemmas: The role of categorization processes. Res Organ Behav 13:191-228.

Léveque Y, Schön D (2013) Listening to the human voice alters sensorimotor brain rhythms. Plos One 8:e80659.

McCullough J, Somerville B, (2000) (Honorof DN, Ed.) Comma gets a cure. International Dialects of English Archive.

Namy LL, Nygaard LC, Sauerteig D (2002) Gender differences in vocal accommodation: The role of perception. J Lang Soc Psychol 21:422-32.

Obleser J, Weisz N (2012) Suppressed alpha oscillations predict intelligibility of speech and its acoustic details. Cereb Cortex 22:2466-77.

Rubin DL (1992) Nonlanguage factors affecting undergraduates' judgments of nonnative English-speaking teaching assistants. Res High Ed 33:511-31.

Vecchiato G, Toppi J, Cincotti F, Astolfi L, Fallani F, Aloise F, Mattia D, Bocale F, Vernucci F, Babiloni F (2010) Neuropolitics: EEG spectral maps related to a political vote based on the first impression of the candidate's face. IEEE EMBS, 2902-05

Weiss B, Burkhardt F (2012) Is 'not bad' good enough? Aspects of unknown voices' likability. INTERSPEECH:510-3.

Yagman E, Keswell M (2015) Accents, race and discrimination: Evidence from a trust game. A Southern Africa Labour and Development Research Unit Working Paper Number 158 Cape Town: SALDRU, University of Cape Town.