**Psychophysiological investigation of cognitive load and resulting attitudes when listening to non-native accents**

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Contents

Declaration

'I declare that this thesis that I have submitted to Dublin Business School for the award of BA (Hons) Psychology is the result of my own investigations, except where otherwise stated, where it is clearly acknowledged by references. Furthermore, this work has not been submitted for any other degree.'

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Date: 22/03/2019

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Abstract

The current study investigated differences in psychophysiological measurements when listening to accents (native and non-native), evaluated different attitudes across accent type, and whether psychophysiological responses would predict a measure of attitudes when listening to native and non-native accents. Using a quasi-experimental design, 30 participants rated six speakers (Irish, Brazilian and Polish) on the Social Perceptions Scale. Simultaneously, EEG and GSR measurements were collected to establish if there was a difference in psychophysiological response for the different accents. Results supported the hypothesis that attitudes are influenced by accent, with native accent being rated highest, followed by Polish, then Brazilian. A psychophysiological effect on attitudes was found in the case of Brazilian male speaker only. No significant results for psychophysiological measures and attitudes were found. Previous studies have supported attitudes affected by accent type and psychophysiological reasons for attitudes based on accent. Therefore the current study's strengths and limitations are discussed.

Introduction

Ireland has become an increasingly diverse country with the Central Statistics Office (2016), reporting over 53,000 non-nationals coming to live in Ireland in the year prior to April 2016. With the changing dynamics the country is experiencing, and the diversity within the population in mind (CSO, 2016) it is important to understand the factors at play that can potentially impede or encourage integration of differing cultures. The purpose of this study is to investigate the relationship between the attitude of Irish nationals towards accented English speakers through the use of a questionnaire and simultaneous collection of psychophysiological measures. By using electroencephalography (EEG) and Galvanic Skin Response (GSR) to record the cognitive demands made on the listener across the different accents, the aim is to gain greater insight into why similar accents can potentially be rated as more favourable than those that are outside the listener's accent range (Dragojevic & Giles, 2014; Pietraszewski & Schwartz, 2014). The study will test a range of positive (e.g. trustworthy, attractive) and negative (e.g. intimidating, annoying) attitudes (Turcotte, Wilson, Harris, Seikaly & Rieger, 2009) as well as collecting additional demographic information which may help shape intervention techniques for education programmes in relation to immigration in Ireland. It is important to note when embarking on these investigations that Timberlake, Schaal & Steinmetz (2005) highlighted the best practice of treating behaviourist theory and neurobiology separately whilst also working towards an eventual interwoven explanation for different behaviours.

The current study proposes that there will be a significant difference in psychophysiological measurements when listening to non-native accents when compared to native accent and that there will be a significant relationship between attitudes and accent

type. It is further hypothesised that psychophysiological measures will be a predictor for attitudes in relation to accented English.

*Attitudes towards immigrants*

Ingroups and outgroups have been a subject of interest in Psychology for decades. Tajfel & Turner, (1986) developed Social Identity theory proposing that individuals will differentiate themselves from others based on their group identity. This in-group categorisation helps to provide a knowledge of self and place in a group, while at the same time categorising those that are outside the established in-group. According to an ERSI report (2018) on immigrant integration, Polish nationals are the number one nationality choosing to become Irish citizens year on year. Despite this number dropping in recent years (ERSI, 2018) this trend shows that Irish people are more likely to interact with Polish nationals on a regular basis. A second report from the ERSI (2018) on attitudes towards immigrants, shows that Brazil represents one of twelve countries with more than 10,000 people currently living in Ireland. Based on this, Brazilian and Polish accents could be considered a fair representation of the non-native population of Ireland and have been selected for the current study.

A study carried out by Dragojevic & Giles (2014) working with Californian college students, investigated attitudes towards the phenomenon of ingroup and outgroup effect in relation to accented English when participants are given a 'reference frame' of interregional (other US state) and international (Punjabi) to compare with a native Californian accent. They found that when the Californian accent was paired with Southern US accent the participants identified more strongly on sense of connection, solidarity and status with the Californian accent. When the pairing was Punjabi and Southern US accents the same scales were more strongly related to the Southern accent. Based on their findings Dragojevic & Giles (2014)

proposed language attitudes dynamically shift depending on the social context, and the occurrence of dual identity can occur when extending the ingroup to those generally in one's outgroup, in this case to those with a Southern US accent. Pietraszewski & Schwartz (2014) paired photos of people and audio clips of spoken statements to test this idea of social categorisation further. They proposed that individuals have an underlying cognitive process that works to categorise the world around them and so will process differences such as accent to create generalisations about the speaker. The experiment involved participants viewing photos of faces while listening to a statement that this person made. The statements were all neutral to ensure no bias recorded could be attributed to the statement. This allowed the participants to form an impression of the person after which they were asked to complete a short task to act as a distractor from the first exposure. When the participants were asked to recall speakers by photo following this task, participant's incorrect choices showed a significant selection by accent category, which supports the notion that this grouping process by accent happens unconsciously. Weiss & Burkhardt (2012) carried out a study investigating the components of likeable versus dislikeable voices. They found that detectable accents and mispronunciation played a significant role in negative ratings for speakers. McAleer, Todorov & Belin (2014) investigated the development of first impressions and personality ratings that listeners based solely on hearing only the word 'hello'. They found consistency across the ratings for each vocal recording on traits such as aggressiveness and likeability. Belin, Boeheme & McAleer (2017) carried out a similar study focussing this time on rating trustworthiness of a voice based on hearing one word and found that the acoustic nature of the voice affected the rating strength. They found that high intonation at the beginning of the word, then lower in the middle and ending higher significantly related to higher trustworthiness scores showing how quickly an assessment of accent and speech can be. A study by Souza, Pereira, Camino, de Lima & Torres (2016) looking at the role accents play in

discrimination, tested whether recruitment of job candidates would be influenced by whether they had a native or non-native accent. They found that only those that displayed prejudice in their questionnaire responses were more likely to discriminate against a candidate with a non-native accent. Their results supported their hypothesis that those with existing attitudes will use the quality of the non-native accent to validate their choice for the other candidate. It is important to note that Souza et al., (2016) only measured how the accent influenced prejudiced individuals and they did not include reasons for the prejudice itself, investigating reasons for the incidence of ingroup and outgroup. In a theoretical review carried out by Crisp & Turner (2011) found that the more challenges to stereotype norms, the more likely the individual will have to adapt their views and that multiculturism can lead to more positive changes in intergroup attitudes. They highlighted the important role that minority exposure can play in increasing diverse thinking, forcing the individual to evaluate and consider the opinions of others, and make new decisions. Paquette-Smith, Buckler, White, Choi & Johnson (2019) conducted a study in Toronto looked at attitudes of children aged five and six when they are exposed to different accents (Canadian, British and Korean) and found that children rated those with an accent similar to their own preferable to those that were outside their own group, rating Canadian accent more favourably when paired with the British accent, and in turn choosing the British accent above the Korean accent when paired. The authors note that Toronto is an extremely diverse population so many of the children would be exposed to different accents on a regular basis yet still showed preferences for their own in-groups over others. Pietraszewski & Schwartz (2014) note that categorisation in relation to accent may be established by puberty so perhaps the age group of the children in Paquette-Smith et al., (2019) study were tested at too young an age.

In order to measure the attitudes of the participants, this study will use the Social Perception Scale devised by Turcotte et al., (2009) which measures positive attitudes such as

'trustworthy' and negative attitudes such as 'boring' on a Likert scale. Turcotte et al., (2009) used this measure in their study to determine listener's perception of different speakers who had some form of procedure on their larynx along which affected their voice in some way and a control group that had no procedure. The 40 participants were asked to rate the speakers on the different scales to assess how their perceptions of the speaker changed based on the sound of their voices.

*Psychophysiological Measurements of Cognitive Load*

Research into psychophysiology, utilising the tools of biofeedback has been an area of increased attention over the last number of years (Dickter & Kieffaber, 2014). EEG and GSR techniques have been used in a variety of investigations of behaviour including Attention Deficit Hyperactivity Disorder (ADHD), reaction time, and stress (Andreassi, 2007). By recording brain activity reacting to a stimulus, referred to as an event-related potential (ERP), EEG methods can record the psychophysiological impact on the individual during a specific task (Dickter & Kieffaber, 2014). Kemmerer (2015) explains that ERPs are measured across four different factors: latency, amplitude, polarity and topography. Latency relates to the points in a reading immediately after presentation of a stimulus or at the peak of the reaction, amplitude records the power of the stimulus in terms of voltage, polarity is output from two related electrodes and whether the activity is positive or negative and topography involves the area in which electrodes are focused on the scalp and signals retrieved (Kemmerer, 2015). As outlined by Dickter & Kieffaber (2014) the agreed upon frequencies for alpha waves are 8-12 Hz and 12-30Hz for beta waves. Pinel & Barnes (2018) explain that utilising the occurrences of these waves across the cortex to interpret reactions to sensory stimulus is often used in psychophysiological investigations. By averaging out the different outputs from the various points of recording on the scalp one can interpret the cognitive demands of the specific task.

Pinel & Barnes (2018) explain that increases in conducting electricity through the skin increases during times of increased stimulation. GSR methods are used to measure the Skin Conductance Level (SCL) often referred to as tonic waves and seen at times of rest or when a person is relaxed. Phasic waves, also called Skin Conductance Response (SCR), are a good indication of a change in the skin surface and is seen when a person is performing a task or observing a stimulus (Pinel & Barnes, 2018; Westland, 2011). Isaichev, Chernorizov, Adamovich & Isaichev, (2018) explain how these measures can prove useful for understanding the mental activity involved in a task. Dufour, Brunellière & Nguyen (2013) used EEG to evaluate ERPs when participants were tasked with picking out the differences in native and non-native vowel sound pairs. When participants were observed using EEG, they found that mixed pairs (native and non-native) sounds took longer to differentiate compared to native pairs. This supports the idea that there is a greater level of processing involved when tasked with listening to different accents. Barry (2004) used GSR to identify physiological responses when participants were asked to count experimental stimuli which were then compared with the control group (no counting) and found that a phasic response was recorded at times when the listener was exposed to non-native accent compared to native pairings. This again would indicate that there is a greater demand physiologically when one encounters accents that are outside the norm for the listener.

*Psychophysiological Measurements and Accent Processing*

A number of studies have used EEG to evaluate the neural demands involved in language and accent processing (Obleser & Weisz, 2012; Shahin & Pitt, 2012; Capps et al., 2016; Grant, Benons, Johns, Hobson & Nichols, 2016) and found that when participants were tasked with understanding words or accents, alpha waves in the brain decreased while beta activity increased, lending support to the idea that the demands on the individual are

heightened in these scenarios. An EEG study by Shahin & Pitt (2012) found that alpha waves in the brain decreased when a participant was tasked with understanding words, whereas beta activity increased, showing the cognitive demand is greater on the individual. Grant et al., (2016) addressed perception of foreign accents and how they were processed using EEG investigation. Using a small female sample, they tested the hypothesis that US English speakers would identify more readily with their own or Irish accents compared to Saudi Arabian accents in relation to likeability, understanding, comfort and trustworthiness. Furthermore, they measured neural activity while listening to the speakers to measure changes in neural processing of the listener depending on the different accents. While they found that participants scored the Irish accent higher on all measures compared to the Saudi accent as well as scoring more favourably than US accents in most cases, they did not find the differences in alpha wave activity that they would have expected, finding no significant differences across any of the recordings. While findings were not significant in this study, interestingly, they did find that the Saudi male voice scored poorly across all the ratings, demonstrating how unfavourable the accent was in comparison to the others presented to participants. Bradlow & Bent (2007) proposed that this maybe based on the level of exposure the listener has had previously to different accents and therefore, the ability to understand it more readily. Those encountered more often are often classed more favourably. Grant et al., (2016), when looking at gender, found that their participants (all female) rated the other female voices more favourably than the male with the exception of the US male accent.

In their study testing implicit and explicit attitudes and responses to questionnaires relating to ethnicity Isaichev et al., (2018) used EEG and GSR to assess participants' neural responses when asked to complete an attitudes questionnaire in relation to ethnicity and religious beliefs. They found that when participants were answering questions in relation to their beliefs their beta (EEG) and phasic (GSR) waves increased showing a higher cognitive

stress for the individual. Isaichev et al., (2018) proposed this change in EEG waves could be explained by the 'Index of Fatigue', whereby the increase in cognitive stress is due to the participant being required evaluate the content of the question and then respond. Their study supports the idea that using psychophysiological indicators for testing sociopsychological issues may aid in the successful application of questionnaires around attitudes. The study of twelve US college students from Capps et al., (2016) found that the more novel the accent to their participants the more difficult to understand and the decrease in alpha waves, however they did not record significant alterations in beta waves as compared to other studies. In agreement with previous research they did find increased brain activity is required for listening to foreign accents.

For the purpose of this study, EEG and GSR will be measured simultaneously to assess the psychophysiological demand on participants when they are listening to different accents. Biofeedback information will be recorded for each participant whilst listening to six recordings of accented English. Dickter & Kieffaber (2014) explain that the use of neuroscientific techniques such as EEG can help to collect data that demonstrates a more authentic report of participants thoughts and attitudes than self-report methods alone. Kemmerer (2015) explains that Brocas's area and Wernicke's area, both located in the left hemisphere of the cortex, are widely understood to be involved in language production and comprehension. Investigations into these two locations in the cortex have continued with the understanding now that they are central processing hubs for all activity across the cortex involved in language (Kemmerer, 2015). When working with psychophysiological measures it is important to understand some of the inhibitors to precise data collection. A recent review of MEG and EEG technologies from Puce & Hämäläinen (2017) pointed out some potential issues that can arise in the use of EEG as an investigative tool. These included interference with the signal from other electrical devices in the lab setting, movements of the individual

during recording, and the inability to definitively track the recorded electrical activity to a specific stimulus. In many cases, studies with a combination of scanning options are used, such as MEG, fMRI and EEG (Puce & Hämäläinen, 2017) which result in more accurate data collection.

*Aim of the current study*

A 2018 ERSI report outlined the changing attitudes of Irish nationals towards immigrants in Ireland from 2002 – 2014 and stated that positive sentiment towards people of other cultures has diminished amongst the Irish population in recent years. This change in society highlights the importance in understanding the effect this can have in the existing population. Isaichev et al., (2018) noted that similar recent changes in the Russian population has led to the emergence of prejudicial and nationalistic behaviours. The purpose of this study is to investigate the attitudes of Irish nationals towards non-native English speakers specifically, which is a population not previously investigated. Using EEG and GSR alongside Social Perceptions Scale (Turcotte, et al., 2009) the cognitive demand required of native Irish people, to listen to non-native accented English and the corresponding attitudes will be recorded. Based on the 2016 Census, the number of Polish and Brazilian immigrants in Ireland is currently over ten thousand each (ERSI, 2018) and as such are representative of a large portion of the immigrant population. Therefore, for the purpose of investigation in relation to Irish society, speakers with Brazilian and Polish accents will be used to compare with the Irish accent for this study.

Timberlake et al., (2005) warns off hastily linking behaviour and neurobiological measures to one another which shows the equal importance of continuing to investigate these potential links to provide definitive evidence of their potential relationships. Their review underlines the importance of continuing research in both areas in the hopes of creating more

robust theories and explanations of behaviour. Using our questionnaire and simultaneous recording of psychophysiological responses, it is hoped that this study will establish the level of cognitive load involved for the participants to listen to a foreign accent and give us the opportunity to establish a correlation between this cognitive demand and the resulting attitudes. Based on the research the potential would be to build strategies aimed at diminishing the creation of ingroups and outgroups based on accent. Capps et al., (2016) reported that subjects with a history of exposure to speakers of a foreign language were less likely to experience increased beta activity, therefore implying that less effort was required and exerted in order to understand different accents to their own. Similarly, Crisp & Turner (2011) proposed that challenges to existing stereotypes through repeated exposure can result in these being required to shift and adapt.

With this information in mind, our study will aim to address the possible reasons for ingroup and outgroup identities from a neurological basis. Based on the findings, this can then inform interventions that could be implemented to potentially reduce separation between groups by using repeated education on and exposure to other cultures, accents and languages. By understanding the underlying motivations for ingroup and outgroup identities hopefully their effects can be diminished. As Ireland becomes a more diverse society with greater global representation in the local population, studies such as this one could aid in the successful integration of different cultures.

*Hypotheses*

For the purpose of this study three hypotheses will be tested, looking at attitudinal responses on the Social Perception Scale and also Psychophysiological responses.

**H1** – There will be a significant difference in psychophysiological measurements when listening to non-native accents when compared to native accent.

**H2** - There will be a significant relationship between Social Perception scale and accent type.

**H3** – Psychophysiological responses will predict measure of attitudes when listening to non-native accented English.

Methodology

*Participants*

Based on Cohen's (1992) in order to achieve statistical power, thirty participants (Female=21, Male=8, Other=1) who were Irish nationals (Urban=66.7%, Rural=33.3%) were recruited, using convenience sampling from DBS Part Time Psychology students. Two DBS lecturers shared the study recruitment message (Appendix A) with their classes specifying that participants must be native Irish. A brief presentation was also made to second year part time students to encourage participation. In addition, snowball sampling was used, recruiting further participants through connections to the students. 70% of participants were between the ages of 25 and 44 and all were right handed with the exception of one. Participants were advised not to disclose the nature of the study to anyone on completion of the experiment to ensure that all remained naïve to its nature.

*Design*

For the purpose of this study, a quasi-experimental design within-subjects was used (Salkind, 2017, p194). All participants were selected based on their nationality and exposed to the same experimental conditions.

*Hypothesis 1:* IV: Accent Type. DV: Psychophysiological Measures (EEG and GSR results)

*Hypothesis 2:* IV: Accent Type DV: Questionnaire Responses

*Hypothesis 3:* Criterion: Attitudes and Accent Predictor: Psychophysiological responses

*Equipment*

The experiment was built, and results interpreted using Superlab stimulus presentation software version 4.5. Psychophysiological (EEG and GSR) data was collected using Labchart

v8.1.8 and Powerlab 26T. An EEG cap was connected to electrodes FP1, FP2, T3 and T5 as well as an earthed cable attached to the participants ear. Once the participants were wearing the EEG cap, electrogel was administered to the relevant electrodes with a gel syringe. Each participant listened to six audio clips through Trust PC speakers on Dell Desktop PC in the lab quiet room. Responses to the questionnaire was recorded on paper and later entered it into SPSS data file. A fabric eye mask was used to cover participants eyes during the experiment.

*Stimuli*

Six audio clips each with either a male and female speaker across three accents (Irish, Brazilian and Polish) were retrieved from the International Dialects of English Archive (2000) and played in randomised order for each participant. The chosen files were: Poland 8 Female, Poland 5 Male, Brazil 4 Male, Brazil 8 Female, Ireland 5 Male and Ireland 7 Female. This allowed for participants to be exposed to their native accent as well as two others for comparison. The recordings were of each speaker reciting the same story to ensure it was a neutral stimulus with no possible cues for social categorisation (Appendix B). Each clip was approximately 30 seconds and stopped at a natural break in speech.

*Questionnaires*

The Social Perception Scale (Turcotte et al., 2009) was used to measure participant's attitudes to each accent they heard (Appendix C). This scale was used in the previous study to measure listener's perception of a speaker's voice (Turcotte et al.,2009). The participants were asked to rate the clarity of each clip and the scale which consists of four positive adjectives: trustworthy, attractive, clever, sophisticated and four negative adjectives: boring, scary, intimidating, annoying. Participants scored each on a seven-point Likert scale, 1 representing 'not at all' and 7 representing 'very much'. The negative responses were reverse coded prior to analysis. This was not done in the original administration of the scale but for

comparative reasons was done in this case. Demographic information was also collected for each participant: age, gender, handedness, the area type they are from (i.e. Urban/Rural).

*Cronbach's Alpha:* Reliability was not reported in the original use of the Social Perception scale. In the current study Cronbach's was run for the data following reverse coding and was found to be high ($\alpha$=.89).

*Experiment Setup*

*Lab Procedure - Steps for lab and software set up*

1. Turn on Stimtracker & Powerlab in quiet room

2. On Quiet Room PC

   - Open Superlab > File > Open > Desktop > Fiona Accent

   - Superlab experiment was coded to track the start and end points of each audio clip and label with the matching speaker name (e.g. Brazil male) for post-experiment analysis.

3. EEG Cap - electrodes connection

   - CH1

     - Positive: Red Clip – Brown Wire (FP1)

     - Negative: White Clip – Brown Wire (FP2)

   - CH2

     - Positive: white clip – violet wire (T3)

     - Negative: white clip – grey wire (T5)

4. On room PC

   - Open Labchart – Lab Chart> File > Open > Desktop > Fiona Accent

     - Filename – Fiona EEG GSR

   - Setup > Channel Settings > GSR Amp

- Open Circuit Zero

5. Quiet Room

    - Connect Participant to GSR – strap two electrodes to middle fingers

    - Place blindfold over eyes and ask participant to relax

    - Place EEG cap on head with label to the back

    - Inject gel into four points

    - Connect ear clip to ear (earth connection)

6. On Room PC (Labchart)

    - Click Subject Zero for Baseline reading

    - Monitor GSR output until signal plateaus

    - Hit OK > OK

    - Press Start

7. Quiet room

    - Close door

    - Walk participant through the steps in the experiment

    - Click Green Start Button on Superlab

8. Run experiment

9. On Room PC

    - Stop tracker on Labchart

10. Disconnect Participant

*Experimental Procedure*

All experiments took place in the DBS Psychology Lab, Castle House, room 3.8. Each participant was allocated an appointment time to take part in the experiment. This was to ensure that the lab is free from outside distractions and prevent participants from discussing the nature of the experiment with each other. Prior to commencing the experiment

each participant read the information sheet and consent form (see Appendix D and E). By reading the consent form they agreed to their participation.

Participants took a seat in the lab's quiet room and were asked to place the eye mask over their eyes to control for eye blinks interfering with EEG recording. The GSR plates were connected to the two middle fingers, the EEG cap was placed on the participant's head and participants were instructed to make themselves comfortable. The electrodes identified for use during the experiment were FP1 and FP2 which relate to frontal lobe activity, such as executive function and comprehension (Capps et al, 2016), and T3 and T5 were used in order to record activity from the temporal lobe and more specifically from Wernicke's area, agreed to be the area of the cortex involved in the processing of language and speech (Kemmerer, 2015, p25). An earthed ear clip was attached to the participant's ear lobe in order to reduce external signal interference. Gel was applied to the relevant electrode reference sites.

The researcher remained in the room for the duration of the experiment. A test audio clip was played to ensure the volume and audio quality was sufficient. Demographic information was collected before the audio clips commenced and were recorded along with the questionnaire responses on paper (Appendix C). In order to maintain their attention, they were asked to count the number of mistakes (Grant et al., 2016) made by the speaker. Once the test audio clip was played the participant was informed that the experiment had started. The audio clips were randomised for gender and accent type as per Grant et al., (2016) to ensure that the responses could not be affected by practice effect. There was a pause after each speaker so the researcher could collect the questionnaire responses. They were reminded of the scale throughout to ensure correct scoring was collected. Their responses were recorded on the questionnaire to be transcribed into SPSS and saved by participant number for analysis. On completion of the experiment participants were provided with a debrief sheet

(see Appendix F) and thanked for their participation. The entire experiment including set up took no more than 20 minutes per participant.

*EEG and GSR Software Setup and Analysis*

For each participant, data was collected and interpreted using Labchart software. Each participant file was saved under participant number and then analysed. As part of the initial experiment setup the software was coded to add markers to the start and end point of each audio clip and label accordingly so that they were identifiable during analysis. On completion of the experiment, the data file was analysed by applying filters to the frontal and temporal readings to capture the alpha and beta activity for each channel (8-12Hz for alpha and 12-30Hz for beta) in the chart tab. This was done for each of the six stimuli and the information was added to data pad along with GSR data. This was then added to SPSS for further analysis.

*Artefacts:*

Dickter & Kieffaber (2014) explain that while artefacts cannot be removed from EEG data altogether there are methods available that can reduce them. In the current study this was addressed with the eye mask that participants were instructed to wear.

*Ethical Approval*

The research proposal for the current study was submitted to and approved by the DBS Ethics Committee.

Results

Data was inputted and analysed using SPSS v. 25 for the three hypotheses stated. A repeated measures ANOVA was conducted for hypotheses one and two, and a multiple regression was completed for hypothesis three. Further analysis was also carried out on the social perception scale for the individual variables, accent clarity and accent by country.

*H1 – There will be a significant difference in psychophysiological measurements when listening to non-native accents when compared to native accent*

For psychophysiological investigations alpha activity (8-12 hz) and beta activity (12-30 Hz) were isolated for analysis along with the GSR readings. A One Way Repeated Measures Anova, using the Greenhouse-Geisser correction, found no significant results for psychophysiological measures, GSR $(F_{(4,105)}=.26)$, p=.888) or EEG $(F_{(4,106)}=1.56$, p=.196). However, although not significant, there was a sharp drop in alpha wave activity in the temporal area (T3 and T5) in comparison to beta waves when listening to Brazilian Male voice (see *Figure 1* below).
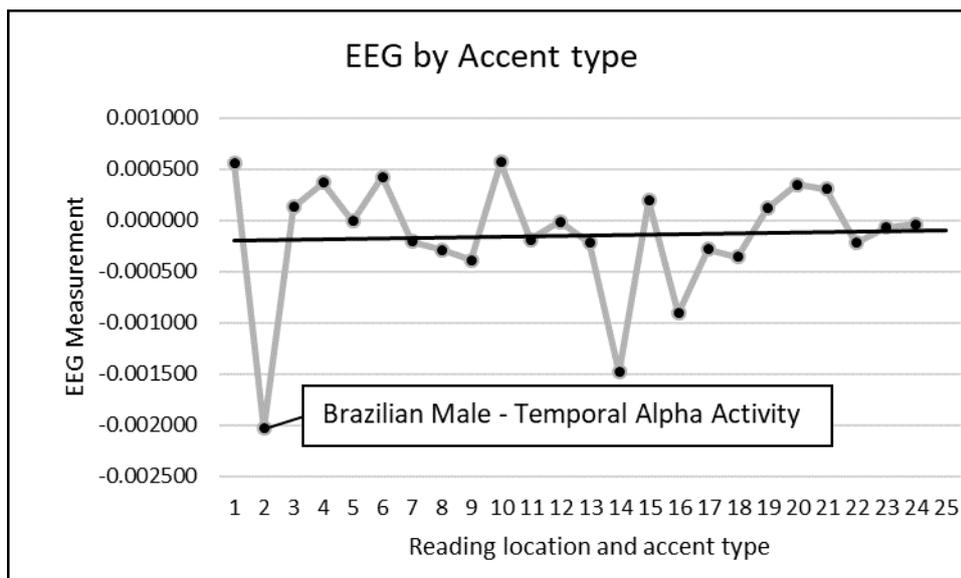


Figure 1: *EEG activity by accent type*

*H2 - There will be a significant relationship between Social Perception scale and accent type.*

A One Way Repeated Measures Anova, using the Greenhouse-Geisser correction, showed that attitudes for accented English differed significantly across the speaker audio clips ($F(3,97)=21.18$, $p<.001$) with an effect size of .42 (See Figure 2). As a result, 42% variation in attitude scores can be explained by the different accent types. More specifically, pairwise comparisons showed that the Irish male was rated higher than Polish Male (Mean difference =5.93, CI 95% =.6 79-11.19, p=.017) and Brazilian male (Mean Difference=9.80, CI 95% = 4.11-15.49, p<.001). Similarly, the Irish female speaker was rated higher than Polish male (Mean difference = 7.83, CI 95% = 3.68-12.00, p<.001) and Brazilian male (Mean difference = 11.70, CI 95%=6.35-17.05, p<.001) on the attitudes scales. Brazilian male was the lowest rated accent across all speakers, although not significantly in the case of Polish male comparison. See Table 1 below for full details.
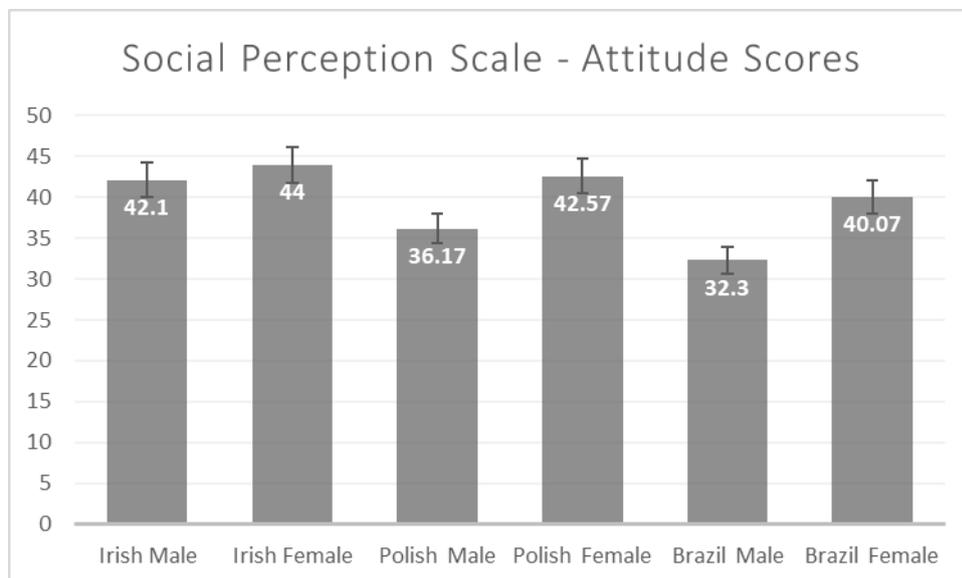


Figure 2: *Social Perception Scale – Attitude Scores by Accent and Gender of Speaker*

Table 1: *Social Perception Scale Pairwise Comparisons by Accent and Gender of Speaker*

| Groups | | Mean Diff | *p* | CI 95% Lower | Upper |
|---|---|---|---|---|---|
| Irish Male | Polish Male | 5.93 | .017 | .679 | 11.19 |
| Irish Male | Brazilian Male | 9.80 | <.001 | 4.11 | 15.49 |
| Irish Female | Polish Male | 7.83 | <.001 | 3.68 | 12.00 |
| Irish Female | Brazilian Male | 11.70 | <.001 | 6.35 | 17.05 |
| Polish Female | Polish Male | 6.40 | <.001 | 3.00 | 9.80 |
| Polish Female | Brazilian Male | 10.27 | <.001 | 5.72 | 14.82 |
| Brazilian Female | Brazilian Male | 7.77 | <.001 | 4.33 | 11.21 |
| Polish Male | Brazilian Male | 3.87 | .128 | -.52 | 8.25 |

*H3 – Psychophysiological responses will predict measure of attitudes when listening to non-native accented English.*

Multiple regression was used to test whether the psychophysiological measures of EEG and GSR were predictors of attitudes towards accented English. The results of the regression indicated that three predictors explained 20% of the variance ($R^2$=.23, $F(3,26)$=3.93, *p*=.02) for the Brazilian Male accent only. It was found that GSR significantly predicted attitudes towards Brazilian Male speakers (β=-.36, p=.051, 95% CI =1192.86 – 2.27) as did alpha wave activity (β=-.44, p=.017, 95% CI= -7790.54- -.842.08). Results for all other accent/gender combinations were not significant.

Additional Analysis

*Social Perception Scale – Individual Variables*

A One Way Repeated Measures Anova, using the Greenhouse-Geisser correction, showed that attitudes for accented English differed significantly across the individual variables in the Social Perception Scale. In particular, all the positive attributes, trustworthy $(F(4,106)=9.58)$, $p<.001$), attractive $(F(4,125)=14.80)$, $p<.001$), sophisticated $(F(4,122)=19.59, p<.001)$ and clever $(F(4,106)=10.37, p<.001)$ were highly significant in relation to attitudes towards the different accents. Similarly, in the case of the negative descriptors, intimidating $(F(3,102)=6.04)$, $p<.001$), scary $(F(3,93)=11.07)$, $p<.001$), boring $(F(4,106)=4.46)$, $p=.003$) and annoying $(F(4,113)= 4.47)$, $p=.002$) were also found to have highly significant differences across the sample.

More specifically, pairwise comparisons showed that there was a significant difference for the Irish female speaker compared to all other accents for '*attractiveness*' (see table 2 below). Similarly, the Irish male speaker rating differed significantly against all other accents for '*sophisticated*'.  Brazilian male significantly higher scores for scary compared to Irish male (mean difference=1.20, CI 95% =.14-2.26, p=.016)  and Irish (Mean difference =1.43, CI 95% = .48-2.39, p=.001), Polish (Mean Difference=1.20, CI 95% = .35-2.04, p=.001) and Brazilian (Mean Difference=1.33, CI 95% = .41-2.26, p=.001) female.

Table 2: *SPS Pairwise Comparisons by Accent and Gender of Speaker for Scale Variables*

| Variable | Groups | | Mean Diff | *p* | CI 95% Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Trustworthy | Irish Male | Brazilian Male | 1.23 | .028 | .08 | 2.39 |
| | Irish Female | Polish Male | 1.33 | .005 | .24 | 2.02 |
| | Irish Female | Brazilian Male | 1.53 | <.001 | .60 | 2.46 |
| | Polish Female | Polish Male | .90 | .007 | .17 | 1.62 |
| | Polish Female | Brazilian Male | 1.30 | .001 | .40 | 2.20 |
| | Brazilian Female | Brazilian Male | .77 | .008 | .14 | 1.39 |
| Attractive | Irish Female | Irish Male | 1.20 | .006 | .24 | 2.16 |
| | Irish Female | Polish Male | 2.17 | <.001 | 1.16 | 3.17 |
| | Irish Female | Polish Female | .97 | .027 | .07 | 1.87 |
| | Irish Female | Brazilian Male | 2.03 | <.001 | .99 | 3.08 |
| | Irish Female | Brazilian Female | .87 | .013 | .12 | 1.61 |
| | Polish Female | Polish Male | 1.20 | .002 | .33 | 2.07 |
| | Polish Female | Brazilian Male | 1.07 | .006 | .21 | 1.92 |
| | Brazilian Female | Polish Male | 1.30 | .011 | .20 | 2.40 |
| | Brazilian Female | Brazilian Male | 1.17 | .002 | .326 | 2.008 |
| Clever | Irish Male | Brazilian Male | 1.67 | <.001 | .70 | 2.63 |
| | Irish Male | Brazilian Female | 1.13 | .021 | .11 | 2.16 |
| | Irish Female | Brazilian Male | 1.30 | .004 | .30 | 2.30 |
| | Polish Female | Brazilian Male | 1.17 | <.001 | .48 | 1.85 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sophisticated | Irish Male | Irish Female | .83 | .014 | .11 | 1.55 |
| | Irish Male | Polish Male | 1.67 | <.001 | .67 | 2.66 |
| | Irish Male | Polish Female | 1.10 | .001 | .37 | 1.82 |
| | Irish Male | Brazilian Male | 2.50 | <.001 | 1.66 | 3.35 |
| | Irish Male | Brazilian Female | 1.63 | <.001 | .65 | 2.62 |
| | Irish Female | Brazilian Male | 1.67 | <.001 | .75 | 2.58 |
| | Polish Female | Brazilian Male | 1.40 | <.001 | .61 | 2.19 |
| | Brazilian Female | Brazilian Male | .87 | .013 | .12 | 1.61 |
| Boring | Polish Female | Brazilian Male | 1.77 | .002 | .50 | 3.04 |
| Scary | Irish Male | Brazilian Male | 1.20 | .016 | .14 | 2.26 |
| | Irish Female | Polish Male | 1.00 | .010 | .16 | 1.84 |
| | Irish Female | Brazilian Male | 1.43 | .001 | .48 | 2.39 |
| | Polish Female | Brazilian Male | 1.20 | .001 | .35 | 2.04 |
| | Brazilian Female | Brazilian Male | 1.33 | .001 | .41 | 2.26 |
| Intimidating | Irish Female | Brazilian Male | .97 | .024 | .08 | 1.85 |
| | Polish Female | Brazilian Male | 1.13 | .001 | .37 | 1.90 |
| | Brazilian Female | Brazilian Male | 1.23 | <.001 | .471 | 1.99 |
| Annoying | Polish Female | Polish Male | 1.00 | .008 | .17 | 1.83 |
| | Polish Female | Brazilian Male | 1.23 | .007 | .23 | 2.23 |

*Accent Clarity*

A One Way Repeated Measures Anova, using the Greenhouse-Geisser correction, showed that ratings of accent clarity for all speakers were significant across the different accents ($F_{(4,106)}=58.88$, $p<.001$) with an effect size of .67. As a result, 67% variation in clarity scores can be explained by the different accent types. More specifically, pairwise comparisons (as seen in Table 3 below) showed that Irish accents were rated more positively than Polish and Brazilian overall and that the Polish accent was rated higher than the Brazilian.

Table 3: *Pairwise Comparisons by Accent and Gender for Accent Clarity*

| Groups | | Mean Diff | *p* | CI 95% Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| Irish Male | Polish Male | 2.53 | <.001 | 1.73 | 3.34 |
| Irish Male | Polish Female | 1.87 | <.001 | 1.07 | 2.66 |
| Irish Male | Brazilian Male | 3.33 | <.001 | 2.43 | 4.23 |
| Irish Male | Brazilian Female | 3.13 | <.001 | 2.45 | 3.81 |
| Irish Female | Polish Male | 2.27 | <.001 | 1.26 | 3.27 |
| Irish Female | Polish Female | 1.60 | <.001 | .65 | 2.55 |
| Irish Female | Brazilian Male | 3.07 | <.001 | 2.16 | 3.97 |
| Irish Female | Brazilian Female | 2.87 | <.001 | 2.06 | 3.67 |
| Polish Male | Brazilian Male | .80 | .014 | .11 | 1.49 |
| Polish Female | Brazilian Male | 1.47 | .001 | .50 | 2.43 |
| Polish Female | Brazilian Female | 1.27 | .002 | .35 | 2.19 |

*Accents by country*

Furthermore, a repeated measures ANOVA, showed that there was a significant difference for overall attitudes to Irish accent compared to the other accent types $(F(2,50)=16.41, p=.001)$ with an effect size of .36. More specifically, pairwise comparison showed that Irish accent (M=86.1, SD=9.44) was higher than Polish (M=78.73, SD12.87) or Brazilian (M=72.37, SD=12.76) accents.
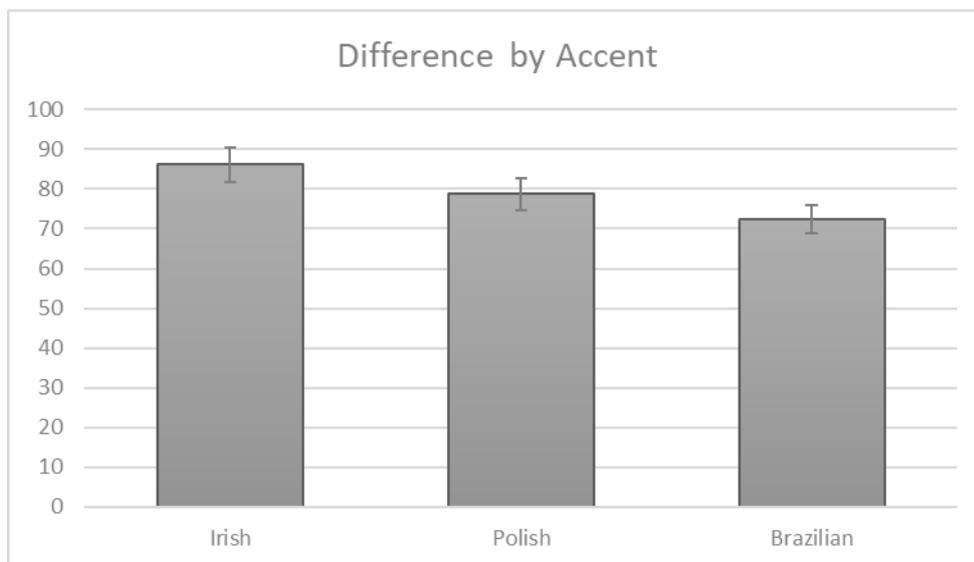


Figure 3: *Social Perception Scale – Attitude Scores by Country*

Discussion

Research into the underlying psychophysiological demands on the individual when listening to non-native accents has become a topic of interest to Psychologists in recent years, particularly with the improvements in scanning and neurological assessment technology. The current study focussed specifically on Irish natives as a study population, which was a cohort that had not been previously explored. The research was approached by combining the collection of underlying psychophysiological responses in the format of EEG and GSR along with the gathering of information in relation to attitudes of Irish people towards speakers of English, with native Irish accents, as well as two non-native accents that are representative of the Irish immigrant population, Brazilian and Polish (ERSI, 2018). Overall, using the Social Perception Scale, it was found that there were significant differences across all accents, with Irish accents rated more favourably than Polish and Brazilian, and Polish more positively than Brazilian. The Brazilian male speaker was scored as the least favourable accent across all other speakers to significant levels except for comparisons to Polish male, where it was still lower but not significantly. For accent clarity, again Irish accents achieved higher scores compared to Polish and Brazilian. There were significant differences in the ratings for Polish female speaker compared to both Brazilian male and female, and Polish male compared to Brazilian male. The Irish male voice was scored significantly higher overall for the descriptor 'sophisticated' and Irish female for attractiveness. Female speakers scored higher than male on attractiveness and Brazilian male accent significantly higher scores for the descriptor of scary compared to Irish male and Irish, Polish and Brazilian female accents.

There were no significant results found in relation to the psychophysiological measurements and accent type, however, there was a larger, non-significant, decrease in alpha waves when participants listened to the Brazilian male speaker. In the case of psychophysiological outcomes being a predictor for attitude scores for accented English, it

was found that in the case of Brazilian male only, alpha wave and GSR activity were predictors for related Social Perception Scale scores. Findings are discussed further in relation to each hypothesis below.

*H1 – There will be a significant difference in psychophysiological measurements when listening to non-native accents when compared to native accent.*

Grant et al (2016) in their study of EEG processing of accents did not ask questions after each speaker as part of their procedure, which was part of the procedure in the current study. This was done to ensure the responses reflected the participants immediate recall of the person speaking. As suggested, the participants were given the task of counting mistakes in order to keep their attention and maintain the corresponding alpha and beta wave activity. Capps et al., (2016) found that alpha wave activity dropped significantly based on how different the accent was to the participants own. Similarly to the current study, Grant et al., (2016) did not find the expected changes in alpha and beta activity however, it was found that there was a noted drop in alpha activity when listening to the Brazilian male speaker in comparison to the other speakers which indicates that there was some level of additional cognitive strain on the listener in this case. Dufour, Brunellière & Nguyen (2013) also found support for changes in reaction times using EEG when processing and differentiating between native and non-native the vowel sounds. While adjacent electrodes T3 and T5 were selected for the current study, Capps et al., (2016) selected T3 and T4 to offer signals recorded across the cortex which could account for the difference in findings. Isaichev et al., (2018) combined model of psychophysiological factors, which included GSR and EEG as well as ECG and EMG, found support for using this method in relation to testing attitudes and physiological responses. The additional measures gave Isaichev et al., (2016) a stronger indication of the stress that their participants encountered.

*H2 - There will be a significant relationship between Social Perception scale and accent type.*

Pietraszewski & Schwartz (2014) found evidence to support the idea that there are implicit cognitive processes at play when listening to accents and that this is established from a relatively young age. Grant et al., (2016) had similar findings to the current study in relation to one male speaker being the lowest rating overall. Brazilian male was repeatedly rated more poorly than the other speakers across all descriptors. As our study population were not evenly split for gender, it was not possible to reliably test for differences in relation to attitudes based on participant gender. However, the analysis across the study group showed female speakers were scored higher than Brazilian and Polish males. Weiss & Burkhardt (2012) noted that articulation and pronunciation as well as accent itself can negatively influence attitude scores. The speakers were scored for accent clarity, with Irish again ranking higher than Polish or Brazilian and Brazilian male ranked at the bottom. The analysis of all accents collectively showed that the Irish accent was ranked the highest overall, followed by Polish and then Brazilian. Dragojevic & Giles (2014) looked at varying attitudes based on the reference frame associated with the accents and found that individuals will use this to group those normally an out-group member as part of their in-group when compared to individuals who are further outside their group (US versus Punjabi). The ERSI (2018) reported that Polish represents one of the most established migrant populations in Ireland so in relation to our study, the participants may have a greater sense of connection with the Polish accent as it would be one they are more familiar with.

*H3 – Psychophysiological responses will predict measure of attitudes when listening to non-native accented English.*

Isaichev et al., (2018) supported the procedure of using psychophysiological indicators for testing sociopsychological issues, stating that it may aid in the application of

questionnaires around attitudes in the future. The results of the current study showed significant results in relation to EEG readings for Brazilian male only which is positive but underlines the need for further research into the area with a larger sample. Isaichev et al., 2018 also note that the time involved in recording the measures of psychophysiological methods and then analysing it was longer than expected, which in the current study was supported, more so in relation to the analysis of outputs than the recording of them. Capps et al (2016) found that based on different existing accent exposure (in their case Spanish) the introduction of an additional comparable accent could be of benefit which was also used in the current study. They also found that the greater the exposure, the less cognitive effort required to listen to differing accents. In the case of the current study, previous exposure to accents was not researched, therefore, the current study cannot speak to the levels of pre-existing experience each participant had to foreign accents in general and more specifically, , to Brazilian and Polish accents. Puce & Hämäläinen (2017) reviewed the use of EEG and MEG as two methods to explain behaviours and investigate activity in the cortex. They highlighted that EEG records all electrical activity across different electrodes as required without the ability to pinpoint the exact stimulus for same. Therefore, they advise that it is not enough on its own to confirm stimulus-response scenarios.

*Implications & Applications*

Based on findings in relation to attitudes towards non-native accents, it was found that participants rated their own accent more favourably than out-group accents. This could have implications for integration policies and education for citizens in relation to non-native populations. As was seen from Smith et al., (2019) this categorisation is present in five and six year olds so targeting educational policies from school going age could be of real benefit on a longitudinal basis. Perhaps, as supported by Souza et al., (2016) greater exposure to different cultures can diminish the out-group effect in relation to accents. However, the

hypotheses that this is caused by greater cognitive and physical demand on the listener when encountering different accents were not supported. Therefore, while this study shows that the difference in ratings exist for non-native accents, it is not possible to provide an underlying psychophysiological explanation for this from the current research. In order to understand the implications of the research, this should be investigated further, perhaps using additional technology, such as in the case of Isaichev et al., (2018) or expanding the questionnaire data regarding the participants previous experience of different accents (Capps et al., 2016).

*Limitations*

*Ecological Validity*

Although, based on Cohen (1992) the current study had statistical power, with a participant number of 30 this cannot be generalised to the Irish population. Additionally, due to the nature and location of the study the majority of the participants were recruited from Psychology student population at DBS and the experiment was carried out in a controlled lab setting. In order for the study to be ecological valid the participant number and type would need to be larger and the more varied in their backgrounds while being observed in a natural setting.

*Influence of Scale*

The repetition and clear distinction between positive and negative adjectives may have produced some practice effects in the participants scale responses. To control for this, McAleer, Torodov & Belin (2014) only asked participants to rate each speaker on one trait. Dragojevic & Giles (2014) used a scale that used only positive adjectives, asking the participants to rate them on a Likert scale, which may be a better scale rather than the Social Perception Scale which had a distinctive positive/negative split. The use of a qualitative

element could have provided more insight into where the attitudes originated from, perhaps from previous experience rather than a psychophysiological demand.

### *Hawthorne Effect*

The recording of alpha wave activity required the participant to wear an eye mask which resulted in the need for the researcher to be in the room during the experiment in order to collect the questionnaire data directly after each audio clip. While participants were assured that data would be collected anonymously, this set up may have had an unintentional impact on the answers provided by the participants as seen in the Hawthorne effect (Salkind, 2017, p.255). In an effort to keep favour and not be judged by the researcher participants may have been less inclined to rate the accents in a truthful way.

### *Reliability of Measures*

As outlined by Puce & Hämäläinen (2017) EEG alone may not be a sufficient tool for inferring links such as was the aim in this study. In order to reliably assess the relationship between attitudes and psychophysiological demands, the option to use scanning processes such as fMRI could be of real benefit in pinpointing the underlying activations and processing involved in a more definitive manner.

### *Implications and Future Research*

Pietraszewski & Schwartz (2014) in their investigation into categorisation by accent, used a memory confusion paradigm method to ensure that no practice effect would take place before participants were given their categorisation tasks. This should be considered as a possible procedural step in future iterations of the current study. Beline, Boeheme & McAleer (2017) found that trustworthiness ratings, using just one word as the stimulus, were affected by intonation within the word. This could be a potential addition to the current research, investigating whether ratings of single words stimuli matched those of a longer duration.

In terms of scales used to measure attitudes, Souza et al (2016) used the Blatant and Subtle Prejudice scale to measure the pre-existing level of prejudice of each participant toward their non-native population. The addition of this scale as a pre-test measure so as to record any underlying and prevailing attitudes that could be at play in accent ratings before the population is exposed to the test levels. A further consideration for future research could be the addition of a question around the level of previous exposure participants may have had to foreign accents in general or more specifically in relation to the specific accents used during the experiment. Capps et al (2016) found that the greater one's exposure to foreign accents the less effort required and exerted from a psychophysiological perspective in order to understand different accents to their own. Smith et al., (2019) looking at social categorisation in children, found that increased exposure to accents did not reduce social categorisation by accent. This is, therefore, as a combined area that would be a valuable area for additional research.

*Conclusion*

Overall, the attitudes of Irish natives towards their own accent in comparison to Polish and Brazilian accents in the current study, shows the possible effects of in-group and out-group dynamics as explained by Social Identity Theory (Tajfel & Turner, 1986). These findings could prove important interventions based around increased social acceptance of non-native populations in Ireland. The aim to establish an implicit and underlying psychophysiological reason for this was not supported by the data. However, the previous research does lend support to the idea that physical and cognitive demand can influence attitudes (Isaichev et al., 2018, Grant et al., 2016; Capps et al., 2016;). Therefore, it is important to consider the possibility that future research with the suggested changes outlined above could provide a better framework for investigation.

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Appendices

**Appendix A: Recruitment Email**

Hi all,

I'm reaching out for participants for my thesis study. I need people who were born in Ireland to complete an experiment in the Psychology lab. The experiment takes about 20 mins.

It involves EEG so you will have a small amount of gel applied to your scalp.

Please contact me directly and I can book a slot for you.

Thanks Fiona

**Appendix B: Audio clip for audio stimuli**

Well, here's a story for you: Sarah Perry was a veterinary nurse who had been working daily at an old zoo in a deserted district of the territory, so she was very happy to start a new job at a superb private practice in North Square near the Duke Street Tower. That area was much nearer for her and more to her liking. Even so, on her first morning, she felt stressed. She ate a bowl of porridge, checked herself in the mirror and washed her face in a hurry. Then she put on a plain yellow dress and a fleece jacket, picked up her kit and headed for work.

When she got there, there was a woman with a goose waiting for her.

**Appendix C: Experimental Questionnaire**

Participant Number:

Demographic Information: Please circle the appropriate answer.

Age:

18-24

25-34

35-44

45+

Gender: Male / Female

Handedness: Left / Right

Which of the following best describes the area you live in?:  Urban / Rural

**Social Perception Scale**

**Rate your feeling for each of the following audio clips from 1- *not at all* to 7 - *very much* for each adjective**

|                    | Audio 1 | Audio 2 | Audio 3 | Audio 4 | Audio 5 | Audio 6 |
|--------------------|---------|---------|---------|---------|---------|---------|
| **Clarity of speech** |         |         |         |         |         |         |
| **Trustworthy**    |         |         |         |         |         |         |
| **Attractive**     |         |         |         |         |         |         |
| **Clever**         |         |         |         |         |         |         |
| **Sophisticated**  |         |         |         |         |         |         |
| **Boring**         |         |         |         |         |         |         |
| **Scary**          |         |         |         |         |         |         |
| **Intimidating**   |         |         |         |         |         |         |
| **Annoying**       |         |         |         |         |         |         |

**Appendix D: Information sheet for study using mild deception**

**Information Sheet for study on cognitive processes during a listening exercise**

You are invited to participate in a research study that will form the basis for an undergraduate thesis. Please read the following information before deciding whether or not to participate.

**What are the objectives of the study?** The nature of this study requires participants to be naive to the exact research question, as information about the research may influence your behaviour and responses. For this reason, we can only inform you that we are conducting research on the cognitive processes underlying a listening exercise. A complete debriefing will be offered after participation, where any questions will be answered.

**Why have I been asked to participate?** I would like to collect information from different people. The research requires each participant meet the following criteria:

- be a native Irish national

- Have no hearing problems

- Not have any issues with eyes being covered

**What does participation involve?** Each participant will have EEG and Galvanic Skin Response recordings collected using a Powerlab Biofeedback unit while listening to 6 recordings. This is a non-invasive procedure that will be carried out in the DBS Psychology lab. As part of the research, each participant will also be required to provide ratings on a scale during the experiment which will be provided and recorded by the researcher.

**Please note, when recording EEG, gel to be applied to the scalp and a skull cap placed over your head. Your eyes will be covered for the duration of the experiment.**

**Right to withdraw** Participants have the right to withdraw from the research at any time before commencement of the experiment. As all participant information will be anonymous, once the experiment begins and data is collected we will be unable to extract from the final results.

**Are there any benefits from my participation?** While there will be no direct benefit from participation studies like this can make an important contribution to our understanding of cognitive processes at play in the task of listening. As such, the findings from this study may be presented at national and international conferences and will be submitted for publication in peer-reviewed journals. Interim and final reports will be prepared. However, no individual participant will be identified in any publication or presentation and the pictures used will not be presented. Individuals will not be offered any monetary or other rewards for their participation.

**Are there any risks involved in participation?** There are no risks associated with participation. Any inconvenience involved in taking part will be limited.

**Confidentiality** All individual information collected as part of the study will be anonymous and used solely for experimental purposes. They will be stored safely using non-related participant numbers to identify the results.

**Contact Details**

If you have any further questions about the research you can contact:

Researcher:

Supervisor:

**Appendix E: Consent Form**

**A study on cognitive load in a listening exercise**

I have read and understood the attached Information Leaflet regarding this study. I have had the opportunity to ask questions and discuss the study with the researcher and I have received satisfactory answers to all my questions

I am free to withdraw from the study prior to commencement of the experiment without giving a reason.

**I understand that by agreeing to participate in the experiment and completing the questionnaire I am providing my consent.**

**Appendix F: Debrief sheet**

**Study: Psychophysiological investigation of cognitive load when listening to non-native accents and resulting attitudes**

Thank you for taking the time to be involved in this study.

The overall research question in this study concerns the cognitive processes involved in listening to accented English speakers and the effort required. As a result of this requirement we wanted to assess if this affected people's perception of the speaker. The study is an adaptation of the studies from Isaichev, Chernorizov, Adamovich & Isaichev (2018) and Grant, Benons, Johns, Hobson & Nichols (2016) looking at the affect physiological demands may have in the formation of attitudes.

In order to have participants give accurate answers when completing the questionnaire, you were not informed that we were measuring attitudes.

The responses to the survey will be compared to the EEG and GSR recordings that were collected at the same time to assess what physical demand you were under at the same time. The use of the Dictaphone to record responses was as a secondary back up to the responses taken during the survey. Your responses are identified by participant number only so as to make them unidentifiable.

If you would like to be informed of the findings of the study please contact the research team by email (below) and this will be shared with you.

If you have any concerns or have been impacted in any way due to your participation in this study please contact the researcher by email (below). Alternatively, you can consult one of the below information services.

**Nasc:** www.nascireland.org

**European Website for Integration:** Migrant Integration Information and good practices

https://ec.europa.eu/migrant-integration/home

**Samaritans:** Call Freephone: 116 123 Text: 087 2 60 90 90  Email: jo@samaritans.ie

**Citizens Advice:** http://www.citizensinformation.ie/en/

**Researcher:** Fiona Breheny –