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Greenslade, Daniel John

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An Evoked Potential Study of the Cross-Race Effect of Facial Recognition in the South African Context

Daniel John Greenslade

Declaration

"A research project submitted in partial fulfilment of the requirements for the degree of Master of Arts in Research Psychology, for the Faculty of Humanities, University of the Witwatersrand, Johannesburg, December 2011".

"I declare that this research entitled "An Evoked Potential Study of the Cross-Race Effect of Facial Recognition in the South African Context" is my own, unaided work. It has not been submitted before for any other degree or examination at this or any other university".

Signed: _____ 15 December 2011

Daniel John Greenslade

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Abstract

This research aimed to explore and contextualise research on the electrophysiological potentials evoked in response to human face recognition within the South African context. Previous research provides evidence that there is a measurable difference in the electrophysiological response to faces of people of other racial groups when compared to the response to one's own race group. The difference is seen in greater peak amplitudes in response to one's own-race (indicating greater attention being granted) in comparison to the other-race. This has been labelled the Cross-Race Effect. This research also attempted to expand on previous research in the use of a mixed-race sample and realistic colour images, in contrast to previously used greyscale images. A purposive sample of 40 students at the University of the Witwatersrand was split equally between gender and race (Black and White) with an Indian control group. The electrical potentials elicited by the facial stimuli were extracted from the ongoing electroencephalograms. The results obtained displayed inverse results to those found internationally, with Black participants eliciting no differences between racial groups, and White participants eliciting a greater peak amplitude to Black (other-race) faces. A gender effect was also seen, with White participants eliciting greater peak amplitudes towards female faces, while Black participant again showed no differences between male and female faces. Trends displayed in the results, and the significance thereof, are discussed, and the importance of the effect of society of developmental neurology is highlighted, with the rephrasing of cultural neuroscience to Socio-Cultural Neuroscience. The results ultimately suggest that the internationally seen cross-race effect is absent in a young South African population (with the principle of increased exposure leading to increased attention still in effect), indicating that South Africa is beginning to move away from racial discrimination, and moving towards a future of true integration and equality.

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Research Aims

The aims of this research was to explore and contextualise research on the electrophysiological potentials evoked in response to human face recognition. Previous research provides evidence that there is a measurable difference in the peak amplitudes between recognition of faces of people of another race group and recognition of faces of one's own race group, called the Cross-Race Effect (Ito, Thompson & Cacioppo, 2004). This research performed an evoked potential study on the cross-race effect on South African University students, thereby contextualising it within the South African climate. The implications of those results within that context were explored.

Chapter 1: Literature Review

Rationale

"Faces are of essential importance for human social life. They provide valuable information about the identity, expression, gaze, health, and age of a person." (Grüter, Grüter & Carbon, 2008, p. 79).

There exists a well documented phenomenon called the 'Cross-Race Effect' (also known as Cross-Race Bias and Other-Race bias) (Ito et al, 2004). This phenomenon is responsible for the creation of the stereotype that states that people of other races all look alike (for example: 'All *X* people look the same'). However, this stereotype has an actual basis in science, from social, cognitive and neurological paradigms (Ito et al, 2004; Herrmann et al, 2007; Anthony, Copper & Mullen, 1992).

South Africa has an infamous history of legalised racial segregation and discrimination favouring the white race, called Apartheid. Apartheid, which lasted 46 years from 1948 to 1994, was unique not only in the manner in which is was a legalised discrimination, but also because the dominant race was a minority race (Whites) whilst the races discriminated against constituted the majority (Wilson, 2001). This has, since 1994, changed, and now South Africa is enjoying equality for all. Despite this history, and to some extent possibly as a reaction to this, in the "New South Africa" the younger generation have developed in an environment that propagates equality, and from this equality an integrated "Rainbow Nation". The implication is thus that a generation of young South Africans have had the opportunity to develop in a country where different racial groups have equality, which has therefore lead to integration. This integration has naturally has created the by-product of increased cross-societal exposure, albeit currently would only be completely reflective in an urban and suburban environment of South Africa, rather than in township and more rural areas (Christopher, 2005). The sample chosen for this study reflected this, and was drawn from sub/urban upbringings. The

international research has generally been in societies where the "White" racial group is dominant both socially and relative to numbers (Caldara et al, 2004; Ito et al, 2004; Kubota & Ito, 2007; Miyoshi, Katayama & Morotomi, 2004; Shriver, Young, Hugenberg, Bernstein & Lanter, 2008). The integration of our new generation of young South African adults facilitates a multi-directional investigation of the phenomenon, and hence the design of the present study including the two dominant racial groupings (Black and White) and the control (Indian). This is not representative of the current South Africa as a whole, as research based on the South African census illustrates a slow residential reintegration (Christopher, 2005), but rather a representative of what could eventually become a nationwide reality rather than an ideal in generations to come.

Much of the research on the cross-race effect of facial recognition has been performed by social and cognitive researchers. As can be seen in the work of Wright, Boyd and Tredoux (2001, 2003) as well as Hugenberg, Miller and Claypool (2007), this has generally taken the form of line-up identification procedures. This type of research, however, depends on conscious decision making. One must question whether there is a pre- or unconscious aspect to this. This would best be addressed through an exploration of the neurological basis for the cross-race effect. Despite the vast amount of social and cognitive research on facial recognition and own-race bias, electro-physiological correlates do not appear to have enjoyed the same degree of attention, as literature survey produced no published literature on evoked potential studies of the cross-race effect of facial recognition within the New South African context. Electrophysiological research enjoys much attention in the developed world, however comparative studies emanating from a different socio-cultural setting are limited, and the understanding with regard to the specific gaps in the literature could possibly addressed through this focus. This research therefore conducted neuropsychological exploration of the cross-race effect of facial recognition within the South Africa context in an attempt to add to literature and research.

Cross-racial adoption studies, taken from a social-cognitive perspective, have shown that the cross-race effect is the most plastic during childhood (Sangrigoli, Pallier, Argenti,

Ventureyra, & de Schonen, 2005). The results of their studies established that children who were adopted cross-racially (Korean children to White families in this case) displayed an inverse cross-race effect, favouring their adopted other-race rather than their own biological race. Their research demonstrated that the cross-race effect can be changed or completely removed, depending on social circumstances, during this childhood period.

Changes brought about and upheld by specific post-apartheid legislation have created cross-racial integration. Specifically the South African Schools Act of 1996 (RSA, 1996) which made interracial schooling a legal right. This integration for any person under the age of 24 has occurred during the cross-race effect's period of highest plasticity (pre-primary age). One must thereby question whether this integration has affected the standard cross-race effect for this integrated generation, and, if there has been an effect, one must question whether it is a positive effect, being the integration has caused increased exposure, and thereby decreased the cross-race effect (Sangrigoli et al, 2005); or negative effect, being the sudden increase in exposure has increased the them-us rift and therefore increased the cross-race effect. South Africa has a unique exposure set with which to challenge the previously published findings, and lend empirical support, or not, to what they concluded. These results would be important in the exploration of ways in which South Africa can move forward from its history.

The constant neurological electrochemical activity underlies, and is indicative of, the constant workings of the brain (nervous system) (Jasper & Carmichael, 1935). This activity can be measured through an electroencephalogram (EEG), which records the ongoing neuroelectric activity within the brain though the scalp via attached surface electrodes (Morgan, Hansen & Hillyard, 1996. Evoked Potentials (also known as Evoked Response or Evoked Response Potentials [ERPs]) are the electrical potentials recorded from the brain of humans in response to a stimulus, and are specifically time-locked to that stimulus. It does this by extracting and averaging the time-locked stimulus potentials from the ongoing EEG). Neuroelectric studies have shown that it takes 300ms for a reaction to a stimulus to become conscious (Lamme, 2003). With regards to the evoked

potential of the cross-race effect on facial recognition, previous research has shown that the cross-race effect occurs earlier than 300 milliseconds, with significant peaks at 170 milliseconds as well as 250 milliseconds (Caldara, Rossion, Bovet & Hauert, 2004; Ito et al, 2004), which indicates that the significant aspects of facial recognition are at a preconscious stage. This distinction has important implications. The results of previous social-cognitive research are based on conscious decision making, due to the non-neuroanalytic methods used, and therefore do not take the preconscious differentiation into account. The temporal accuracy of the evoked potential will allow preconscious measurements which will therefore accurately measure this effect. Therefore ERPs were employed for this research as the exceptionally accurate temporal measurements of the differences between recognition of in-group and out-group faces, will displayed differences between races.

This research is interesting in that as an individual in South Africa one has the opportunity to enjoy the benefit of a broader multicultural and multiracial society, and one must therefore be able to live, adapt and integrate on into the society. The cross-race effect existing in this context would make this decidedly more difficult, as it would highlight (if only on an unconscious level) that there is a difference between oneself and the out-group other (Hugenberg & Sacco, 2008). Therefore the implications of this, specifically for the upcoming generations, are significant, as it will indicate if the ideal non-discriminatory society is coming close to reality. Dependant on the results, insight could be obtained as to the state of the cross-race effect, and whether it plagues South African youth, or is diminishing and thereby helping to seal the interracial rift that is apartheid's legacy.

Literature Review

> The perception of a face allows us to recognize the person, infer his or her emotional state, better understand what the person is saying, and derive general information, such as age and gender. This unique visual stimulus has generated a wealth of research, and subsequently theoretical and methodological debate. (Young, De Haan & Bauer, 2008, p. 1)

Social Importance

> The functional organization of this [Face Recognition] system embodies a distinction between the representation of invariant aspects of faces, which is the basis for recognizing individuals, and the representation of changeable aspects, such as eye gaze, expression, and lip movement, which underlies the perception of information that facilitates social communication…Of regions in the extended system for face perception, the amygdala plays a central role in processing the social relevance of information gleaned from faces, particularly when that information may signal a potential threat. (Haxby, Hoffman & Gobbini, 2002, p 59)

Facial information is important for humans to be functionally social, from going to the shops, to being aware of potential attackers on the street. This can be traced along evolutionary lines where humans, as they began to evolve into a society, had to begin to distinguish friend from foe, not just human from animal (Zhao, Chellappa, Phillips & Rosenfeld, 2003). From this point the need to distinguish faces become more and more important, to the point where in today's society it would be exceptionally difficult, if not impossible, to make do without the ability. Any disruption to this ability would be to the detriment of the person involved, and their interaction within their society. This is illustrated in research by Yardley, McDermott, Pisarski, Duchaine, and Nakayama (2008) which explores the social confidence and interaction of people suffering from prosopagnosia (inability to recognise faces). Their research explored the traumatic social

interaction difficulties, the fear and avoidance of social interactions, and the negative psychosocial consequences and occupational difficulties caused by the inability to recognise faces. Their research highlights the social importance of the human ability to recognise faces. This therefore can be seen to be one of the primary motivations behind the research into facial recognition, and more specifically the cross-race effect, in other countries (Kubota & Ito, 2007).

The cross-race effect is the phenomenon whereby a person will more easily recognise the face of someone of their own race group than the face of a person from another race group (Chiroro, Tredoux, Radaelli & Meissner, 2008). Social psychology believes that this is due to the fact that one is generally around people of ones own race group more often, specifically in childhood, and one therefore becomes accustomed to the faces of ones own race group (Wright et al, 2003). Therefore by this logic, the cross-race effect would be more visible in countries that have almost exclusively one race (such as China or India), or countries where there is, or was, extreme racial segregation, such as South Africa (Leibowits, Rohleder, Bozalek, Carolissen & Swartz, 2007). For most of South Africa, there still exists a large amount of segregation in all areas of life, from segregated residential areas (Christopher, 2005), to segregation in various aspects of University life (Finchilescu, Tredoux, Mynhardt, Pillay & Muianga, 2007). This segregation should create a clear cross-race effect within the population.

Yet one must also consider other aspects, such as that presented in ‘the contact hypothesis’ (Allport, 1954). This hypothesis essentially predicts that increased intergroup contact, under the right (positive) conditions, leads to reduced prejudice. The contact hypothesis has been the centre of a considerable body of work, and a meta-analysis of this literature can be seen to conclude that intergroup contact does result in reduced prejudice (Pettigrew & Tropp, 2006). Leading from this hypothesis, with regards to the cross-race effect, one could theorise that the more contact one has with people from other races the more familiar one becomes with them, and therefore one would expect a decrease in the cross-race effect. The research performed by Wright et al (2003) confirms

this theory at sociological/conscious level, and the question that remains to be addressed is whether this is also true at a pre-conscious electrophysiological level.

In South Africa where racial integration has become an everyday reality for many people, one should theoretically expect to see differences within the cross-race effect, specifically a decreased effect, following from the contact hypothesis. Therefore, the discussed sample, taken as a representative of the future South African generations, should display this decreased effect due to the amount of early interracial contact in the sample.

Underlying Cognitive Framework

Cognitive researchers have theorised that there are different processes, and thereby models, used for object recognition and facial recognition. One of the basic and most used models of facial recognition was created by Bruce and Young (1986). This cognitive model is the underlying principle behind many of the newer models (Reisberg, 2006). The model is described as such:

> We have presented a functional framework for face recognition, in which a number of components are distinguished. Different processes are involved in the generation and storage of different kinds of information, or 'codes'. We have described seven codes that can be distinguished in face processing, which we label pictorial, structural, identity-specific semantic, visually derived semantic, name, expression and facial speech codes. The last two of these are not directly involved in face *recognition*, though they are clearly important for other aspects of face *perception*…Everyday face recognition is seen as involving use of structural codes to access identity-specific semantic information and names, where available, in that order. (Bruce & Young, 1986, p 19)

As described, one can see that, according to cognitive theorists, facial recognition employs a number of different processes to gather information about, and thereby recognise, a face. One must however note that this description more closely reflects the

recognition of a familiar face. Presumably facial recognition of the face of a stranger would be limited to the first two codes that were described: pictorial and structural. Facial recognition is seen as a bottom-up process (Bar, 2003; Reisberg, 2006) as first the face is recognised as a face before more specific and detailed information about the face is gathered, such as characteristics and, if available, the identity of the face.

Cognitive theorists agree with the social theorists that the more one is forced to recognise a certain thing, the more easily and efficiently it is recognised. This is known as priming (Reisberg, 2006). The more frequently a cognitive system is accessed, the more readily and easily it is accessed, thereby requiring far less time and effort. These cognitive frameworks have neurological correlates, which will be examined next. With regards to the cross-race effect, this would apply as the more the systems for cross-race facial recognition are activated (that is the more contact one has with people of another race) the more easily activated those systems will be. Recognising a common object (for example, a shoe) is very different from the requirements of a face-recognition task (for example, recognising your friend). Faces are visually confusable because they all have the same component parts (eyes, mouth, nose, and so on). In contrast, a shoe is composed of different parts compared with the objects you are asked to distinguish it from (for example, trousers and dogs). Identifying common objects might also be regarded as simpler because it is recognition at a supra-ordinate level (the category ‘shoe’ has many exemplars in the world), but face recognition requires the identification of a single instance of an object (only one person is your friend) (Gazzaniga, Ivry & Mangun, 2009; Reisberg, 2006). As there is a difference in the processes used for object recognition and facial recognition, one must examine whether the neurology of these different types of recognitions agree with this.

Neurology of Facial Recognition

There has been a vast amount of research on the neurology of a human’s ability to recognise other human faces (Zhao et al, 2003). This research has included most of the conceivable aspects of this phenomenon. Research in the field has essentially agreed that

humans have a completely separate cognitive and neural system for indentifying human faces than the system used for indentifying other objects or non-human faces.
Normal object recognition is generally understood as a bottom-up process (Bar, 2003). This process is such that visual information that enters the eye travels along the optic nerve to the primary visual cortex in the occipital lobe. From there the visual information splits into parallel streams of where and what. The where stream travels dorsally to the parietal lobe, where spatial and sensory-motor processing occurs, whilst the what stream travels ventrally to the inferotemporal cortex where object processing occurs (Walsh & Butler, 1996). It is here in the inferotemporal cortex where the process of normal object recognition begins. The brain first recognises something as an object, before sending the information to the memory centres where information about the object is retrieved, and the object is finally recognised.

Facial recognition uses a similar process to that of object recognition. Yet there are differences, as object recognition can uses both bottom-up (holistic analysis) and top-down (analysis by parts) analysis (Bar, 2003), where facial recognition is a purely bottom-up, or holistic analysis (a face is recognised as a face before the parts are analysed to recognise an identity) (Tanaka, Kiefer & Bukach, 2004). Information travels from the V1 in the occipital lobe along the ventral ‘what’ stream to where is further analysed.
Functional imaging studies have revealed areas of specific functional specialisation within the ventral stream. These areas of specialisation each deal with different forms of recognition. Examples of these areas are the Fusiform Face Area, which shows increased activation for faces of humans, the Parahippocampal Place Area for scenes vs. objects, the Extrastriate Body Area for body parts vs. objects, MT+/V5 for moving stimuli vs. static stimuli, and the Lateral Occipital Complex for discernable shapes vs. scrambled stimuli (Spiridon, Fischl & Kanwisher 2006). Facial information therefore travels to the fusiform gyrus which is the main neurological area localised for facial recognition, which is in the occipitotemporal area of the cerebral cortex (Allison et al, 1994). Specifically there the information goes to the fusiform face area, which is part of the fusiform gyrus, located in the inferior temporal gyri (Walsh & Butler, 1996; Zillmer, Spiers & Culbertson, 2008). This area of the brain is specifically designed to process and recognise

the uniqueness that is the human face. Research has suggested that the right hemisphere is activated for upright and unfamiliar faces, while the left hemisphere is activated for facial expression (Gazzaniga et al, 2009). Yet there are many areas within the two hemispheres that contribute to facial recognition, and therefore the facial recognition system is made up of a complex system of neural networks. "Recent face-processing models assume highly interconnected neural structures between different temporal, occipital, and frontal brain areas with several feedback loops" (Grüter et al, 2008, p. 1). This is due to the nature of recognition within the brain, which involves links between visual areas, recognition areas and finally memory areas. As previously stated recognition of a face as a face, as opposed to non-face stimuli, occurs at a preconscious level (Bruce & Young, 1986). With evoked potential research focusing on neuroelectrical events occurring between 150 and 300 ms after the presentation of the stimulus (although it is possible that the preconscious activity could be a precursor for the opinions and biases), this is an important aspect of this research as it facilitated an exploration into cross-race effect, in the absence of the confounding issues arising from personal opinions and biases.

As mentioned, the fusiform face area is very specific in that it can only recognise faces that are the right way up. If a face is presented inverted (upside down) humans battle to recognise the facial features (as per gestalt, one would still see it as a face) (Sinha, Balas, Ostrovsky & Russell, 2010). This can be seen in the famous pictures of Margret Thatcher whereby one picture was merely inverted while the other was inverted and modified. Yet these differences could only be seen when the pictures were put right side up (Reisberg, 2006). This phenomenon helps to highlight the exact specificity required by the fusiform face area to accurately recognise faces. From the above, is it clear that the neurology of object and facial recognition differ, and therefore agree with the theories proposed by cognitive researchers.

Another phenomenon that highlights this point is that of a disorder called prosopagnosia. Prosopagnosia which, although it may be accompanied by other types of recognition problems (such a place recognition, car recognition, facial expression of emotion and so on) often manifests solely as an inability to recognise faces (Grüter et al, 2008). This

renders the afflicted individual reliant on non-facial information such as hair, gait, clothing or voice to identify others .Reflecting impaired functioning of the mid-fusiform gyrus (fusiform face area) and/or the inferior occipital gyrus, the deficit may be acquired as part of a degenerative process, following trauma (such as a stroke) or present as a congenital developmental disorder (Hadjikhani & de Gelder, 2002). This phenomenon displays the sensitivity of the ability to recognise faces, where all other objects are able to be recognised other than faces due entirely to the malfunction of one small neurological area.

Previous Research

An examination of the research methodology used in previous studies is an integral part of conducting one's own research. Two separate studies that previously examined the cross-race effect with the use of electroencephalograms were conducted by Caldara et al in 2004, and Ito et al also in 2004. The study by Ito et al was conducted in the United States of America, at the University of Colorado, while the Caldara et al study was conducted in Switzerland, at the University of Geneva. The first noticeable link is that both studies used university students as their sample. Caldara et al included only White subjects in their research, while Ito el al, although they included both Black and White participants, included only males. The second notable point is that both of these studies occurred in countries where the White people are both the dominant and majority race group. This can be seen in America where 72.4% of the population is White (UScensus, 2010), and in Switzerland where 83.4% of the population are White or European (Swiss Confederation, 2010).

Regarding the electrophysiological recording procedures adopted in the research, they tended to differ in this. The Caldara et al study used 62 silver/silver-chloride electrodes embedded in a cap. The sampling rate was 500 Hz. Ocular artefacts were recorded on bipolar electrodes by each eye. An electrode placed on the tip of the nose was used as the reference electrode. Ito et al however differed from this procedure. They used tin electrodes in their study, but they were also embedded in an electrode cap. The details of

the electrode placement are left vague in this study, only stating "Data were recorded at sites over midline frontal (Fz), central (Cz), and parietal (Pz) areas" (Ito et al, 2004, p. 1270). Ito et al had a sampling rate of 1000 Hz, while Caldara had a sampling rate of 500 Hz. Both studies employed greyscale images for use as stimuli, as greyscale images were standardised in the studies that both Ito et al and Caldara et al referenced, as well as referring to the seminal Bruce and Young research (1986) which employed greyscale images.

Where these two studies indicated more agreement was with their results. Relevant to findings, both studies demonstrated significant differences in the amplitudes of the peaks recorded at 170 and 250 milliseconds, for recordings in response to own and other race facial stimuli. The significance appeared where own-race faces had greater peak amplitudes in comparison to the peak amplitudes for other-race faces. The researchers postulated that the greater amplitudes for own-race faces were inductive of greater preconscious attention being given to own-race faces. Another area of agreement was which electrode's data resulted in significance. Both studies state that the significant electrodes were located in the temporal electrode sites, which is where the fusiform face area is located (Hadjikhani & de Gelder, 2002).

By examining and understanding the methods and results of previous research, new research is able to learn, replicate, and possibly improve on past research. As newer research is able to draw on ever growing amounts of past research, theories and methods may vary from previous research, yet the strong theoretical grounding that previous research provides is invaluable.

Evoked-Response/Event-Related Potentials

Evoked response potentials have been used to measure cross-race effect of facial recognition as they are one of the few types of neuroanalytic techniques that give strength (amplitude of neuroelectric activity) and temporal (time of neuroelectric activity in milliseconds) readings (Kubota & Ito, 2007). Results from previous research have

demonstrated a difference in the amplitude of the electrical potentials evoked at specific latencies in response to faces of one's own race when compared to those evoked in response to faces of another racial grouping (Caldara et al, 2004; Ito et al, 2004). Based on this phenomenon researchers have established neurological evidence to correlate with what was previously just a social-cognitive theory (Young et al, 2008). Social-cognitive research has shown that there is a definite difference in the ability to recognise faces of ones own race (better ability) than faces of another race (worse ability). Evoked potential research has shown preconscious neuroelectric activity differences between recognition of same-race and other-race faces in conjunction to this, which thereby supports the social-cognitive theories. Therefore an evoked response potential is used instead of other neuroanalytic technology, as it allows one to get accurate readings of the differences of the peak amplitudes in facial recognition, thereby displaying the cross-race effect.

Evoked Potentials (also known as Evoked Response or Evoked Response Potentials) are the electrical potentials recorded from the brain (nervous system) of humans in response to a stimulus. Researchers specifically examine the latency and amplitude of peaks to understand the neurological response. The brain's response to a single stimulus (such as a face) is not usually visible in the electroencephalograph, as an electroencephalograph essentially takes readings of all neuroelectric activity during the assigned time via the attached electrodes, reflecting thousands of simultaneously ongoing brain processes, which do not allow the peak evoked in response to a stimulus to be visible (Luck, 2005). The response to a specific stimulus is time-locked to that stimulus, and a visible response can be elicited though an averaging process (over about 100 trials) whereby the ongoing activity is averaged out and the relevant event-related potential summated. In this way the normal neurelectric activity present in every functioning brain is screened out allowing the specific neuroelectric activity evoked from the stimulus to appear and thereby be studied (Di Russo, Martínez, Sereno, Pitzalis & Hillyard, 2001).

Evoked potentials are also used to give rough spatial data, to show where neurologically the stimulus evokes a response, but this does not give good specificity, unlike other tests such as the PET (Positron Emission Tomography) scan. An electroencephalogram

functions by measuring electrical activity though the scalp via attached surface electrodes (Morgan et al, 1996). The scalp locations of these electrodes are important, as they measure the neuroelectric activity in the directly underlying brain structures. Therefore in research such as this, where the reactions of a specific brain area (the fusiform face area) are being examined, the placement of these electrodes is important. Dependant on what is being examined, different electrode montages (number and placement of electrodes) are be used. There are two functions of electrodes electroencephalograms, active electrodes (which are actively recording activity) and reference electrodes (to which the other electrodes are referenced). The electroencephalogram can be performed with either a bipolar montage or a referential montage. Bipolar means that there are two electrodes per recodring channel, therefore having a reference electrode for each channel. In a referential montage there is a common reference electrode for all of the recording channels (Jasper & Carmichael, 1935). In this research a referential montage was used, with active electrodes placed at T3 and T5 on the left hemisphere, and T4 and T6 on the right hemisphere. These electrode placements were chosen due to their proximity to the fusiform face area in the occiptio-temporal cortex, as well as to be standardised with previous research (Caldara et al, 2004; Ito et al, 2004)

Previous international research on the evoked potentials of the cross-race effect of facial recognition has generated very similar results. In this line of research, the evoked potentials are triggered with pictures of in-group and out-group faces. The response to facial stimuli is first noticed is at 170 milliseconds, where there is a negative amplitude peak, called N170. Previous research has suggested that the significant of this peak is that at this time faces are distinguished from non-face stimuli (Caldara et al, 2004; Ito et al, 2004). The second peak of significant was located at 250 milliseconds. It is here where previous research has postulated that the cross-race effect becomes visible, as it is at this time that in-group faces are differentiated from out-group faces (Caldara et al, 2004; Ito et al, 2004).

Results from previous research have suggested that there are larger peak amplitudes at 250 milliseconds in response to in-group faces, in comparison to the response for out-

group faces. In line with the suggestion that this peak represents a process of specific analysis, research has demonstrated that morphology of the peak is also susceptible to an analysis of emotional expression. For this reason, in studies of cross-race effect, it is important that the stimuli utilised reflect a neutral expression (Miyoshi, Katayama & Morotomi, 2004). Therefore in an attempt to control for this, all faces that will be used as stimuli for the ERP will have a neutral facial expression.

Colour versus Black and White

In line with the seminal research by Bruce and Young (1986), standard procedure in evoked potential studies focusing on cross-race effect in facial recognition is to use greyscale stimuli (Caldara et al, 2004; Ito et al, 2004; Kubota & Ito, 2007; Miyoshi, Katayama & Morotomi, 2004; Shriver, Young, Hugenberg, Bernstein & Lanter, 2008). The advantage of this is that it allows one's research to be comparable, both with previous research, and with the seminal research, theoretically strengthening the results of all the research.

Basing one's research on strong seminal research is, of course, the usual and accepted manner of conducting research. Yet in this case it actually presents a methodological problem in that using greyscale images in the research would have serious negative consequences on the internal validity of the study. Human beings see the world in colour, therefore using images that are not in realistic colour compromise the ecological validity of the research (Frey, Honey & König, 2008), and therefore one must question whether the results of such studies actually show empirically meaningful results. Research by Frey, Honey and König (2008) explored the differences in visual attention in humans between greyscale and coloured images. Their results illustrated that there is a significant difference in the visual attention saliency maps between coloured and greyscale images. The differences varied over the types of images, but images of faces showed one of the greatest differences. "The improvement seen in saliency-based discrimination when color information is present means that subjects look at those locations more often in colored images than greyscale images" (Frey, Honey & König, 2008, p. 14). This implies that the

subjects devoted greater attention to the coloured images, thereby conforming to what is seen daily in human vision. This mean that greater neurological activity was devoted to the coloured images. These results therefore display important information with regards to this research. If, as suggested, the visual attention that a subject gives to an image is greater when the picture is in life-like colour, it stands to reason that the results obtained from using coloured images would elicit greater neurological activity. This increased neurological activity would allow theoretically one to record improved and more realistic results with regard to the neuroelectric activity associated with facial recognition.

Cultural Neuroscience

Cultural neuroscience is a relatively new term within the fields of psychology and neurology. This field could be constructed as an offshoot of the classic nature versus nurture debate on behaviour. That debate essentially states that the interchange between ones genetic makeup (nature) and ones environment (nurture) are what defines one's neurology and therefore one's behaviour (Chiao, 2011). Cultural neuroscience, however, seeks to change that dichotomy. Cultural neuroscience states that it is the interplay between genes and specific cultural traits that affects neural activity, which therefore affects behaviour (Chiao, 2011). This approach can obviously be seen to take root in the original, as one's culture is a part of one's environment. Yet this approach defines culture as the specific part of one's environment that is the affecter of neural activity. If one considers culture to represent a set of beliefs and behaviours shared within a community, then one must assume that culture has the power to alter the basic structure and function of the biological process (Chiao, 2010). Practitioners in the field adopt a co-constructivist approach in their understanding of the synergistic power of cultural and biological factors as mediators of behaviour (Losin, Dapretto & Iacoboni, 2010).

This approach has both strong positive and negative influences with regards to this research. South Africa is multicultural society, commonly dubbed the 'Rainbow Nation'. By the definition of this theory each specific culture will influence the neurology and therefore behaviour of the person who is part of that culture. This then creates a whole

host of different behaviours. One must question whether individual cultural identities are retained, or whether a universal culture emerges out of the melting pot of South African society, or whether prevalent cultural norms and values differentially impact on individual sectors mutating specific cultural representations.

Following from this, one could theorise that South Africa has a specific united culture of its own. This can be seen through the things that are uniquely 'South African' (such as the Vuvuzela), and the many things that unite the country, such as sport. An example of this, was in the months leading up to the FIFA 2010 Soccer World Cup held in South Africa, every Friday became Football Friday where everyone wore a soccer shirt in support of both the South African team and the country itself (SouthAfrica.info, 2010). This unity displays a country-wide culture, which would affect behaviour.

Although there are many different cultures within South Africa, evidence suggests that there is a united country-wide culture as well. Both of these would have an effect on a person's neurology, and behaviour (in accordance with the theory of cultural neuroscience). One could postulate that research will help define this theory further by providing evidence as to which has the greater effect on a person's neurology and behaviour: the microcosm of one's individual culture, or the macrocosm of the united country-wide culture (society).

Sample

Similarly to previous research in the area (Caldara et al, 2004; Kubota & Ito, 2007; Shriver, Young, Hugenberg, Bernstein & Lanter, 2008), the present study drew its sample from a university population. This ensured that the results established through previous research are comparable to this study. There was another purpose to using participants in this age range. Previous research demonstrates that the White race in general suffers more from the cross-race effect than the Black race (Anthony et al, 1992). This research, based on the past segregation and discrimination, assumed that the same could be applied in South Africa. In addition relative to the present South African socio-political climate, this

particular cohort (below the age of 24 years) have acculturalised within a legally integrated society.

One must question whether this integration has affected the standard cross-race effect for this integrated generation. University students were used as they fit into the criterion of previous research as well as fitting into the integrated age range. The University of the Witwatersrand (WITS) is one of the most integrated universities in South Africa showing the greatest racial student diversity (WITS, 2009). In 2009 out of the 28204 students enrolled at wits, 15251 were Black, 960 were Coloured, 4063 were Indian, and 7910 were White (with 20 unknowns). Students from WITS have received daily interracial exposure at university. Although the cohort used in this research is not representative of the general population, they have been exposed to specific acculturation variables making them a representation of a possible future general population.

Research Questions

-Does the cross-race effect for facial recognition exist in South African youth?

-Is there a gender effect with regards to facial recognition in South African youth?

-Is there a difference in the cross-race effect of facial recognition between Black and White South Africans?

Chapter 2: Methodology

Electroencephalogram and Evoked Response Potential

A Nihon Kohden Neurofax Electroencephalograph was used to record neuroelectric activity from silver-silver chloride disc electrodes individually attached at predetermined positions in accordance with the international 10-20 classification system (Jasper, 1958), with a sampling rate was 1000 Hz. Electrode placements were in the tempero-parietal area, specifically C3, T3 and T5 (left hemisphere) and C4, T4 and T6 (right hemisphere), all referred to Cz (the reference electrode), and a forehead grounding electrode. A1 and A2 were attached for the purpose of impedance checks (as required by the electroencephalogram), but were not recorded, and C3 and C4 were attached due to the recording requirements of the electroencephalogram, but were not analysed. Electrode impedance was all kept below 5 KΩ, in accordance to international standards. (Caharel et al, 2002).

The Stimulus was displayed on a High Definition 1080p screen at a resolution of 1366x768. All images were the same size and aspect ratio, and showed a frontal view, with eyes aligned on the horizontal midline of the image. Participants were seated approximately one meter from the screen, with their eyes aligned to the centre of the screen. A photo-sensor (light-sensor) was attached to the screen and then to the EEG setup, where the readings from the photo-sensor were measured via a special DC channel in the EEG montage. The stimuli pictures all had white strips bordering the sides. Whenever a picture was displayed on screen, the photo-sensor would send a current to the EEG setup, registering the increased voltage, and a black screen resulted in the machine registering a lowered voltage. This created a square-waveform. This waveform was used to extract the ERPs from the EEG. ERP extraction, filtering and ERP analysis was performed using EEGLAB version 9.0.2.3b (Delorme & Makeig, 2004).

The results of previous research on the evoked potential of the cross-race effect have displayed similar significant findings with regards to the latencies of peaks which display

significant results. As discussed, the first area of significance, where faces are distinguished, is at the N170, and the second area of significance is at 250 milliseconds, where in-group faces were differentiated from out-group faces (Caldara et al, 2004; Ito et al, 2004). From this a time base of 500 milliseconds was used (Evoked potentials were extracted for the 500 milliseconds after the onset of the stimulus). The results obtained were one latency-amplitude graph with a time base of 500 milliseconds (see figure 1 for example) per electrode (T3, T4, T5 and T6) per stimulus (the four sets of pictures). That is one graph recorded in response to Black Female faces, one for Black Male faces, one for White Female faces and one for White Male faces per electrodes. Graphs combined for race only and gender only faces were also obtained.

Faces used as stimuli were in the form of digital identity or passport photographs, obtained, with permission, from various photographers in and around Johannesburg. These photographs were used as, due to the requirements for passport and identification photographs from the Department of Home Affairs (2011), the faces used as stimuli all had a neutral facial expression (Miyoshi, Katayama & Morotomi, 2004), open eyes, clear lighting, frontal view and no hair touching the face, with all photographs being in equal proportions, with the face in the centre of the photograph.

Instruments

Two modified scales, combined referred to as the Racial Prejudice questionnaire in this study (See Appendix 4), were used as part of the exclusion criteria (see below with regards to the sample (Finchilescu et al, 2007). The sample was purposively selected as having specific acculturation variables and theoretically high interracial exposure. These scales were used to ensure that none of the participants were racially prejudiced.
The first scale was the Affective Prejudice Scale based on the original scale by Zanna (1994). This scale consisted of 6 items, where each item consisted of two bipolar adjectives (example: Trusting and Suspicious) at each ends of a 7-point Likert scale. Participants indicated their feelings on this scale using the provided words. The scale was

scored so that a lower score indicated a higher level of prejudice. The second scale was based on the Social Distance Scale created by Bogardus (1925). This scale consisted of six items answered on a 5-point descending scale (Any to None). The items essentially measure how close the participants are willing to allow the other racial group (or groups with regards to the Indian sample) into their lives. Again, a lower score indicated a high level of prejudice/desired social distance. Both these scales have been successfully used in the South African context in both White and Black samples. The Affective Prejudice scale and the Social Distance Scale have both obtained very good psychometric results in previous research, obtaining alpha coefficients averaging 0.83 and 0.88 respectively (Finchilescu et al, 2007).

Sample

The sample consisted of 40 individuals. In an attempt to maintain integrity of the internal validity, the sample only consisted of African (Black) and Caucasian (White) subjects, with a control group sample of Indian subjects. The sample was split evenly between males and females. Ultimately the sample consisted of eight Black males, eight Black females, eight White males, eight White females, and a control of four Indian males and four Indian females (See Table 1 below for breakdown). Mean age of the sample was 20.2 years, with an age range of 18 to 24 years old.

Sample	Male	Female	Total
Black	8	8	16
White	8	8	16
Indian	4	4	8
Total	20	20	40

Table 1: Sample Breakdown

The sampling technique used was purposive snowball sampling. Students were approached and had the criteria explained to them (Urban/suburban upbringing, interracial crèche, primary and secondary schooling). Those that fitted the criteria, and

were happy to participate did so. Participants were asked to encourage fellow students who they knew to fit the sampling criteria to participate.

The age range was between 18 and 24 years old, based upon the following reasoning. Research has shown that children as young as three years old display the cross-race effect (Sangrigoli et al, 2005). Yet an adoption study by Sangrigoli et al (2005) displayed that Korean children who were adopted by White families as old as the age of nine displayed an inverse cross-race effect (favouring the White race instead of their own Asian race) at adolescence. They surmised that as long as relative amount cross-race integration occurred before adolescence (12-14 years old) the effects of the cross-race effect could be minimised, if not completely removed, and their sample of children adopted at nine years old confirmed this. In South Africa in 1996 the South African schools act was passed allowing for equal opportunity schooling for all children within South Africa (South African Schools Act, 1996). Therefore, as of 1996, public schools were officially integrated leading to increased interracial exposure in schools. Although this is most specifically achieved within urban and suburban settings, the effects are slowly widening to encompass society as a whole (Christopher, 2005). Children who were nine years old or younger in 1996 would therefore have benefitted from this with regards to the effects on the cross-race effect (Sangrigoli et al, 2005). These children would be 24 years old or younger in 2011. Therefore, based on the literature, the age range of 18 to 24 years olds was chosen. Only subjects who had received sub/urban schooling, being more integrated than rural or township schools (Christopher, 2005; Hofmeyr, 2000), from a pre-primary through to high school level, were used in this study.

Most of the studies using Evoked potentials with regards to the cross-race effect of facial recognition, such as the studies of as Ito et al (2004) as well as Herrmann et al (2007) have only used one race within their test sample. This study attempted to expand on the knowledge of previous studies by incorporating both of the races being used in the experiments within the sample. This also allowed the study to examine the differences, if any, between the two races.

Exclusion Criteria

Individuals with a history of head injury and epilepsy were excluded. Specifically from an ethical point of view, individuals suffering from photo-sensitive epilepsy could be induced into an attack due to the changes of light from the flashing of the pictures (Frucht, Quigg, Schwaner & Fountain, 2000). Individuals who scored a low mark on the Racial Prejudice Scale (Any score lower than 42 on the combined scale) were excluded for having a high level of racial prejudice (which would, if included, confound the results). Only one participant from the main group was excluded for low scores on the Racial Prejudice scale, but another participant was found as a replacement.

Research Design

This is a non-experimental design as the Independent Variable, the history of South Africa and the subject's background within it, cannot be manipulated. The sample was compared both to themselves (within-subject comparison), and to each other (cross-race comparison). Specifically this study was a non IV-manipulated cross-sectional quasi-experimental post-test only control group design.

Procedure

Subjects were approached in lectures to participate in the study. Those volunteers who fitted the sample criteria were given further information. Those that agreed to participate were asked to sign the consent form.

The technical procedure was then explained to the participants and assurances given that that is was a completely safe and non-invasive procedure, and only recordings were being performed. As previously stated the information being gathered is at a preconscious level, and subjects were instructed to passively focus their attention on a central focal point on the screen. Therefore participants just needed to sit passively and stare at the screen, and this was explained to them. Instructions were then given and electrodes attached. Electrode attachment took between 15 to 20 minutes per person. The exact nature of the

experiment was not be explained to the participants as previous research by Ito et al (2004) has displayed that priming participants changes the obtained results to reflect a lower cross-race effect. Participants were then instructed to relax, put their feet flat on the floor, and focus their visual attention passively on the central fixation point. They were also informed that once the trial had begun they may not talk, and must attempt to move as little as possible as that would interfere with the obtained results, due to the fact that muscle activity is also a neuroelectric response, much more prominent than the response to facial recognition. Once they understood the instructions, and were relaxed, the trial began.

The stimulus presented was comprised of pictures of faces (see Appendix 3 for a sample face picture). The face stimuli were presented in four different sets. Each set consisted of a picture of a face for 500 milliseconds, followed by a black screen for 500 milliseconds, followed by another picture and so on, until 50 faces had been shown. Each set consisted of 50 various faces of one race and gender. Specifically the sets were (in order): Black Female, Black Male, White Female, and White Male. The sets were separated for two main reasons. Firstly due to the limitations of the analysis software in separating different stimuli in one set into different ERPs, sets containing a single type of stimulus were used. And secondly to avoid the effect that surprise (as induced by a sudden change between race and/or gender within one set) would have on the ERPs (Neville, Snyder, Woods & Galambos, 1982). Each set took 50 seconds to complete, and there was a space of 10 to 30 seconds in between each set. Total recording time was approximately four minutes.

Once the recording was completed, the participants were given the Racial Prejudice questionnaire to complete whilst the electrodes were removed and their scalps cleaned. The total time taken per participant was on average 30 minutes.

Chapter 3: Results

Results

The results obtained consisted of one ERP latency-amplitude graph per electrode per stimulus set (See Figure 1 below for an example). Electrodes that were analysed, with regards to results from previous research (Caldara et al, 2004; Ito et al, 2004) and their location over the Fusiform gyrus (Zillmer et al, 2008), were T3, T4, T5 and T6. Therefore there were four electrode readings for each stimulus set per participant. Within each reading, there were two obtained results from the two peaks at approximately 170ms and 250ms. Therefore a total of 1280 individual results were obtained for this study.

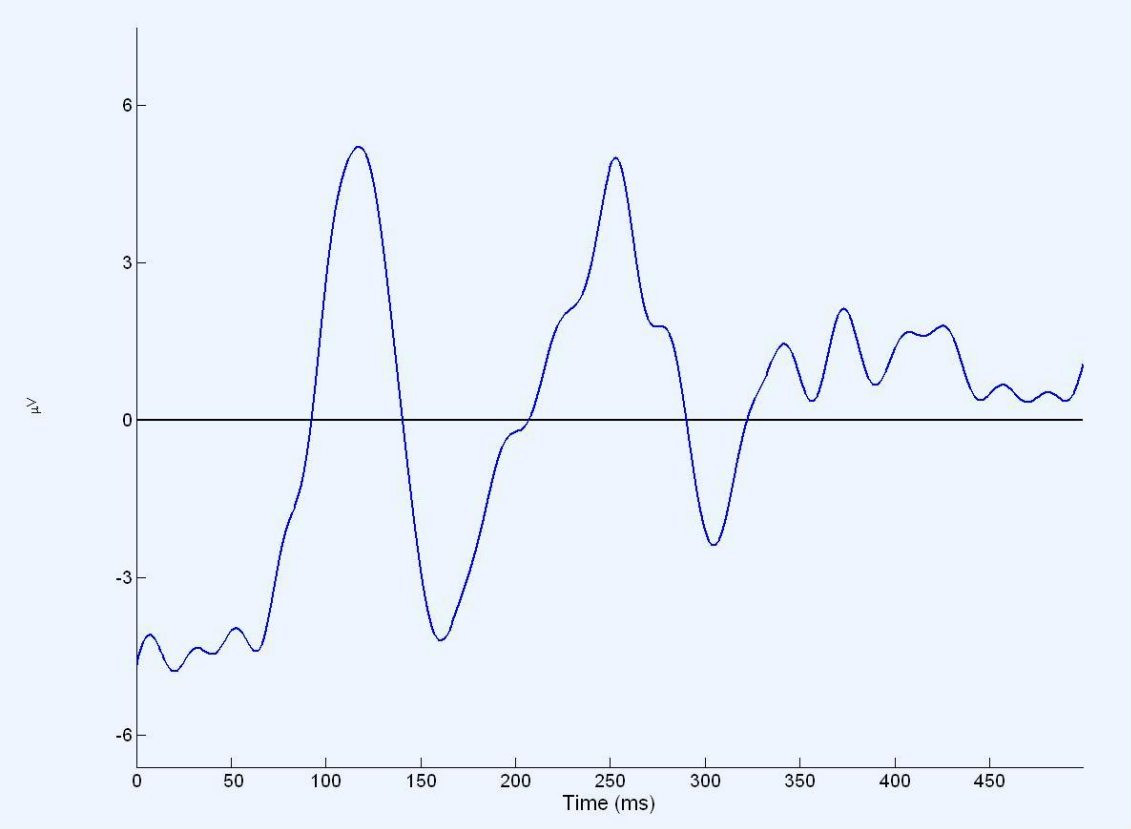


Figure 1: Evoked Response Potential

The data obtained was in the form of ratio data (peak latency in milliseconds, as well as peak amplitude length in microvolts). The Levene's test for homogeneity displayed that there was equal variance (F=1.1194; P=0.4605625). Normality was shown through Skewness (0.716075), Kurtosis (0.60105625) and the Kolmogorov-Smirnov Goodness-of-Fit test for Normal Distribution (D=0.0998; P=0.13725). Therefore the requirements for parametric tests were met.

A Matched-Pairs T-test was run between the data of T3 and T5 showed no significant differences between the two data sets (T=-0.9475; P=0.4122375), and a Matched-Pairs T-test run between the data of T4 and T6 also displayed no significant differences (T=0.83875; P=0.4782375). T5 and T6 are also located specifically closer to the fusiform face area, making them more suited for analysis. Therefore all subsequent data analysis was performed using the data sets from T5 and T6.

Repeated Measures Analysis of Variances (ANOVA) were run. Within the results from the MANOVAs (Multivariate ANOVAs) the following important results were examined. The degrees of freedom for all MANOVA results were (1,28). The effect of the electrode (the data obtained from the T5 electrode compared to the data obtained from the T6 electrode) was not significant (F=4.16; p=0.0509), but only barely so. Therefore subsequent statistical analysis, and results displayed, used combined electrode data, as well as individual electrode data, which is also examined with regards to the effect of hemispheric differentiation on the results. When the data for the 170 millisecond latency peak (Time) was compared to the data from the 250 millisecond latency peak, the differences in the results were found to be statistically significant (F=46.55; p<0.0001). The effect of the race of the face in the picture presented in trials (stimuli race) was also found to be statistically significant (F=14.49; p=0.0007). Yet a combined peak latency by stimuli race interaction was found to be not statistically significant (F=3.86; p=0.0603). A Stimuli Race by Subject Race (race of the participant) interaction was found to be statistically significant (F=15.16; p=0.0006), as well as a gender of the face in the picture presented in trials (stimuli gender) by Subject Race interaction (F=6.44; p=0.0198). When one examined the effect of a Stimuli Gender by Subject Gender (gender of the

participant) interaction, the results were found not to be statistically significant (F=0.35; p=0.5614).

Within Fixed Effects, when examining results for hemispheres separately, different significant results were displayed between the T5 results, T6 results, and combined results. Similarly when one examined those results both without (only Black and White participants) and with the Indian control group, the results differed. These are explored below.

Examining the results for the Test groups (Black and White participants only), the T5 results displayed statistically significant effects only in a *Stimuli Race by Subject Race* interaction (F=9.85; p=0.002). When the Indian control group was included in the analysis, the *Stimuli Race by Subject Race* interaction remained statistically significant (F=7.92; p=0.0005).

The results from T6 displayed many more significant effects than the T5 results. The Black and White participants displayed the following significant results: *Stimuli Race* revealed to have a significant effect (F15.02; p=0.001), as well as a *Stimuli Race by Subject Race* interaction being statistically significant (F=5.59; p=0.019). A *Stimuli Gender by Subject Race* interaction was found to be statistically significant (F=10; p=0.0018) together with a *Stimuli Race by Stimuli Gender* interaction (F=4.43; p=0.0366). With the inclusion of the control group, the results from the *Stimuli Race* effect (F=17.25; p<0.0001), the *Stimuli Race by Subject Race* interaction (F=3.04; p=0.0496) and *Stimuli Gender by Subject Race* interaction (F=5.49; p=0.0047) all remained statistically significant. There was also statistically significant results for a *Subject Race* effect (F=3.6; p=0.0288), as well as a *Stimuli Race by Stimuli Gender by Subject Race* interaction effect (F=3.58; p=0.0292).

When combining the sets from T5 and T6, the following results were found for the Black and White participants: *Stimuli Race* effect was statistically significant (F=7.10; p=0.008), together with a *Stimuli Race by Subject Race* interaction effect (F=7.43;

p=0.0067) and finally a *Stimuli Gender by Subject Race* interaction was statistically significant (F=5.3; p=0.0218).

When the Indian control group is included in the analysis, the only remaining statistically significant result is a *Stimuli Race by Subject Race* interaction (F=4.67; p=0.0098), with a *Stimuli Gender by Subject Race* interaction effect then becoming not significant (F=2.82; p=0.0583).

To find specific results within the significant data, a General Linear Model Least-Squares Means analysis was run on the various significant interactions.

Effect	Stimuli Race	Subject Race	Estimate	Degrees of Freedom	t Value	Pr > |t|
Stimuli Race x Subject Race	Black	Black	8.2816	459	11.1	<.0001
	Black	White	9.4381	459	12.65	<.0001
	White	Black	8.2937	459	11.12	<.0001
	White	White	8.3715	459	11.22	<.0001

Table 2: Stimuli Race by Subject Race Interaction Results – Test Groups

The results displayed in the above table indicate that there is no difference in the peak amplitudes when the Black participants viewed the White stimuli versus when the Black participants viewed the Black stimuli. Yet a difference can be seen with examination of the White participant's data. White participants generated greater peak amplitudes in response to a Black facial stimulus than for a White facial stimulus, displaying greater neuronal activation to the Black stimuli.

Effect	Stimuli Gender	Subject Race	Estimate	Degrees of Freedom	t Value	Pr > |t|
Stimuli Gender x Subject Race	Female	Black	8.1991	459	10.99	<.0001
	Female	White	9.2718	459	12.43	<.0001
	Male	Black	8.3762	459	11.23	<.0001
	Male	White	8.5378	459	11.45	<.0001

Table 3: Stimuli Gender by Subject Race Interaction Results – Test Groups

The results for Stimuli Gender by Subject Race interaction indicate very similar results to those of the Stimuli Race by Subject Race interaction. Black participants displayed no gender differentiation in their peak amplitudes, where White participants generated higher amplitude peaks in response to the Female stimuli than in response to the Male stimuli.

Effect	Stimuli Race	Subject Race	Estimate	Degrees of Freedom	t Value	Pr > |t|
Stimuli Race x Subject Race	Black	Black	8.2816	566	11.8	<.0001
	Black	Indian	6.4926	566	6.33	<.0001
	Black	White	9.4381	566	13.45	<.0001
	White	Black	8.2937	566	11.82	<.0001
	White	Indian	6.5067	566	6.35	<.0001
	White	White	8.3715	566	11.93	<.0001

Table 4: Stimuli Race by Subject Race Interaction Results – Whole Sample

When the control group is included within the Stimuli Race by Subject Race interaction, the results for the Black and White participants remain the same. The results for the

Indian participants indicated that there was no significant difference between peak amplitudes for the Black stimuli and the peak amplitudes for the White stimuli.

Although a Stimuli Race by Stimuli Gender by Subject Race by Subject Gender interaction was not significant (F=3.10; p=0.0893), the results were still examined as they display interesting trends. The table below displays the results for the Stimuli Race by Stimuli Gender by Subject Race by Subject Gender interaction for the test groups.

Effect	Stimuli Race	Stimuli Gender	Subject Race	Subject Gender	Estimate	Degrees of Freedom	t Value	Pr > |t|
Stimuli Race x Stimuli Gender x Subject Race x Subject Gender	Black	Female	Black	Female	9.4762	456	8.68	<.0001
	Black	Female	Black	Male	7.2144	456	6.61	<.0001
	Black	Female	White	Female	10.7351	456	9.84	<.0001
	Black	Female	White	Male	8.9861	456	8.23	<.0001
	Black	Male	Black	Female	9.2663	456	8.49	<.0001
	Black	Male	Black	Male	7.1696	456	6.57	<.0001
	Black	Male	White	Female	9.3846	456	8.6	<.0001
	Black	Male	White	Male	8.6465	456	7.92	<.0001
	White	Female	Black	Female	9.4921	456	8.7	<.0001
	White	Female	Black	Male	6.6139	456	6.06	<.0001
	White	Female	White	Female	8.8907	456	8.15	<.0001
	White	Female	White	Male	8.4752	456	7.77	<.0001
	White	Male	Black	Female	9.8148	456	8.99	<.0001
	White	Male	Black	Male	7.2539	456	6.65	<.0001
	White	Male	White	Female	8.581	456	7.86	<.0001
	White	Male	White	Male	7.539	456	6.91	<.0001

Table 5: Stimuli Race by Stimuli Gender by Subject Race by Subject Gender Interaction Results – Test Sample

It can be seen, as demonstrated in the table above, that the results indicate Black Females indicate no significant differences in their peak amplitudes when viewing themselves (Black Females), Black Males, White Females and White Males. Similarly, Black Males also display no significant peak amplitude differences between themselves, Black Females and White Males. There are, however, seemingly significant lower peak amplitudes in response to White Females. White Females indicate the highest peak amplitudes in response to Black Females, followed by the next highest amplitudes in response to Black Males. White Females reveal equal peak amplitudes in response to stimuli of White Males and White Females (themselves). White Males indicate no significant differences in peak amplitudes in response to Black Males, Black Females and White Females, yet there is a lowered peak amplitudes in response to stimuli of themselves (White Males).

With the inclusion of the control group in the table below (Table 6), the findings indicate that both Indian Males and Indian Females are similar in their results, revealing no significant differences in peak amplitudes in response to Black Males, Black Females, White Males and White Females.

Effect	Stimuli Race	Stimuli Gender	Subject Race	Subject Gender	Estimate	Degrees of Freedom	t Value	Pr > |t|
Stimuli Race x Stimuli Gender x Subject Race x Subject Gender	Black	Female	Black	Female	9.4762	566	9.21	<.0001
	Black	Female	Black	Male	7.2144	566	7.01	<.0001
	Black	Female	Indian	Female	6.2845	566	3.74	0.0002
	Black	Female	Indian	Male	6.6868	566	5.14	<.0001
	Black	Female	White	Female	10.7351	566	10.43	<.0001
	Black	Female	White	Male	8.9861	566	8.73	<.0001
	Black	Male	Black	Female	9.2663	566	9	<.0001
	Black	Male	Black	Male	7.1696	566	6.97	<.0001
	Black	Male	Indian	Female	6.0914	566	3.62	0.0003
	Black	Male	Indian	Male	6.9075	566	5.31	<.0001
	Black	Male	White	Female	9.3846	566	9.12	<.0001
	Black	Male	White	Male	8.6465	566	8.4	<.0001
	White	Female	Black	Female	9.4921	566	9.22	<.0001
	White	Female	Black	Male	6.6139	566	6.43	<.0001
	White	Female	Indian	Female	6.3918	566	3.8	0.0002
	White	Female	Indian	Male	6.8813	566	5.29	<.0001
	White	Female	White	Female	8.8907	566	8.64	<.0001
	White	Female	White	Male	8.4752	566	8.23	<.0001
	White	Male	Black	Female	9.8148	566	9.54	<.0001
	White	Male	Black	Male	7.2539	566	7.05	<.0001
	White	Male	Indian	Female	6.039	566	3.59	0.0004
	White	Male	Indian	Male	6.7146	566	5.16	<.0001
	White	Male	White	Female	8.581	566	8.34	<.0001
	White	Male	White	Male	7.539	566	7.32	<.0001

Table 6: Stimuli Race by Stimuli Gender by Subject Race by Subject Gender Interaction Results – Whole Sample

Chapter 4: Discussion

Discussion

South Africa has an infamous history of racial segregation and discrimination. The effect of this history, versus the effect of recent socio-political changes, is of great interest to researchers. South Africa is a dynamic society transitioning through significant change (Christopher, 2005), and there is a need to monitor the effect of this change. For this reason the study of inter-race relationships and effects is of vital importance within the South African context. The consequences of this history can still be seen in various aspects today. For this reason research into the ways in which the various races within South Africa view each other is important within the South African context.

The Cross-Race Effect

The classic cross-race effect has been seen and demonstrated internationally (Caldara et al, 2004; Herrmann et al, 2007; Ito et al, 2004). Previous research has shown the cross-race effect in evoked potential research through a difference in the mean peak amplitudes between viewed races. The difference that has been described is that the other race evokes significantly lower mean potential amplitudes than the same race.

Previous research postulated that the reason for the increased same race amplitudes was that greater attention was being paid to the same race faces. One study explains this as "Greater attention…possibly reflecting deeper processing of the group with whom participants had greater experience" (Ito et al, 2004, p. 1278). This theory is dependant on the participants of the research having had experience mainly within their own racial boundaries. In South Africa, however, one must are examine the opportunity for exposure and the real benefit of integration on a neuronal level. Other than in some very rural areas, limited racial contact is a thing of South Africa's past, and something that is not realistically achievable, or desirable, in most main areas of the country. This is especially pertinent with regards to the sample for this study. The social structure of South Africa is

such that the selection criteria for the sample would have resulted in the cohort being drawn from a suburban, middle to upper socioeconomic status (Christopher, 2005). South Africa has a history, which continues currently, where domestic workers form a large and strong sector of the labour market, and where most households, from lower-middle class upwards, employ a domestic worker (StatsSA, 2001). The implications of this, is that the sample (Black, White and Indian) would have grown up having a Black domestic worker, and possibly a Black gardener and a Black nanny. Therefore one must question the applicability of the classical cross-race effect in South Africa where daily interracial contact has been, and is, a reality.

This research's results have indicated very different results to that of previous research. In these results the Black sample displayed absolutely no cross-race effect. Within the Black participants there was no significant difference in peak amplitudes between the Black stimuli versus White stimuli. Based on the above, one might have expected the opposite results, both from a lifestyle and numbers perspective. Within the White sample there was a significant difference between the White and Black stimuli. However the differences displayed here are in contrast to international findings. The peak amplitudes for the Black stimuli were significantly higher than the amplitudes for the White stimuli. According to classical cross-race theory this infers that the White participants pay more attention to Black faces than to White faces, possibly caused by the numbers of Black people, and the integral place that they hold in their homes, that the White sample are exposed to..

This could appear to directly contrast the classic cross-race theory findings, which display increased own-race peak amplitudes in comparison to other-race peak amplitudes. Yet when one considers that cross-race theory implies that it is the increased contact with one's own race that results in the increased attention to one's own race. Therefore within the South African context where interracial contact is an everyday reality, these results can be seen to correlate with the theory of the cross-race effect.

Other research, however, would disagree with the above assumptions. Research has shown that as much as there is daily interracial contact in South Africa, there still exists a form of self-imposed segregation. As one piece of research stated "The persistence of informal segregation in post-apartheid South Africa is now well documented" (Finchilescu et al, 2007, p. 720). This is, however, only socially, and not generally applicable to outside of social scenarios, yet this could still have an effect. With this segregation, although there would be interracial contact, there could theoretically be more same-race contact than interracial contact. This however is more likely to be true with the Black population than with the White population, due to the Black to White population ratio of 9:1 in South Africa (StatsSA, 2011). Accounting for this theory, one would expect therefore to see a classic cross-race effect appearing in the Black sample. This however was not the case, with the Black participants showing no significant differences in peak amplitudes between the Black stimulus and the White stimulus. With regards to the White sample, even with self-imposed informal segregation, with the Black to White population ratio there would still be daily interracial contact. Therefore one would expect that, as with the Black participants, there would be equal mean amplitudes between racial stimuli. These results however display the opposite effect, suggesting that daily interracial contact is occurring. If is informal segregation does still exist socially, it does not appear to have an effect, possibly due to the population statistics, illustrating the large number of Black people in comparison to White people, thereby creating exposure out of chosen social groups.

Ito et al (2004) and Caldara et al (2004) both postulate that the increased peak amplitudes at 250ms for own-race faces are inductive of greater attention being devoted to one's own-race. Yet the results displayed in this research, specifically for the White participants, therefore suggest that greater preconscious attention is being directed towards other-race faces. As this directly contrasts international findings, an examination as to why greater attention is directed towards other-race faces by White participants would be of interest.

One theory that could be plausible is the correlation between race and crime. South Africa has some high crime statistics, with 2.1million serious crimes being reported in South Africa every year (SAPS, 2011). And of interest is the racial breakdown of the perpetrators of those crimes. Although there are very few readily available statistics of that breakdown, the results can be inferred by examining the racial makeup of South Africa's prison population. Within the total prison population 0.49% of prisoners are Asian, 17% are Coloured, 1.7% are White and 80% are Black (DoCS, 2011). One can clearly see here that the vast majority of the prison population of South Africa is Black. This is however reflective of the demographic breakdown of South Africa's population as a whole. The makeup of South Africa's population is as follows: 79.5% of the population are Black, 9% of the population are White, 9% are Coloured, and 2.5% of the total population are Asian (Indian and Asian). One can see that the makeup of the prison population is essentially representative of the population in general, with the exception of the White population being under-represented in prisons. One can say that most of the crime within South Africa is perpetrated by the Black population. Again one can see a logical reason for this. The link between crime and unemployment has been widely proven (Kapuscinski, Braithwaite & Chapman, 1998) and upon examination of the unemployment and poverty statistics of South Africa, is it seen that most of the unemployment is located within the Black population, consisting of 30% of the Black population being unemployed, and only 5% of the White population being unemployed (StatsSA, 2001), thus explaining the under-representation of Whites in prison. Although there is a link between unemployment and crime, it is not a definite correlation.

Once this has been reasoned through, one can begin to see one possible explanation as to the results of the White participants. If greater peak amplitudes are representative of greater attention paid, then one can conclude that the white participants paid more attention to the Black faces. One possible reason for this greater attention could be linked to the crime statistics stated above. The possible perception that the Black population in linked with crime in South Africa, the attention paid to the Black stimuli by the White participants can possibly be seen as a form of awareness. Yet this could also be seen to loop back to the initial theory that the increased exposure of the White population to the

Black population has resulted in the greater attention being paid to Black people by White people, with the crime link just being a small aspect of that. Another theoretical reason as to the increased awareness of White participants to Black faces could be a socio-political one. White participants could have theoretically developed an increased awareness with regards to Black faces to compensate for the classic cross-race effect, in response to the social climate that South Africa finds itself in. Moving from an era of open discrimination, where a White person could effectively ignore the Black separate class, to an era of open acceptance and equality for all, a form a hyperawareness could have been developed in response to, and to enable adaption to this socio-political change. In the creation of this increased awareness, one could theorise that South African's have begun to move away from a racial effect, as the increased attention creates more awareness, and through that awareness, more understanding and acceptance.

When one examines the Indian control group, one again notices interesting results. There was no significant difference between the peak amplitudes for the Black faces versus the White faces. This would seem to fit in with the cross-race effect theory, as the Black and White faces would both constitute as other-race for the Indian participants. The mean peak amplitudes for both stimuli were significantly lower than the lowest result for either of the other sample groups. This would indicate lower attention being paid to both racial groups, and therefore fitting in with the cross-race theory. In collaboration with this is the results from the Racial Prejudice Questionnaire for the Indian participants. The Indian participants (being the control group) completed the Racial Prejudice Questionnaire for both Black and White race groups to ensure there was no prejudice against either group. The results from this showed that there was no discrimination against either group, yet there were significant differences (in a matched-pairs t-test) between the results for White race and Black race groups in the questionnaire (T_7=-3.72, p=0.0205). When one considers that Indians, although not prejudiced, were significantly less prejudiced against the White race group than against the Black race group, one must consider then why there were no significant differences in the peak amplitudes in the Indian sample's results between the Black and White stimuli. Does their innate preconscious racial perception transcend their conscious racial prejudice therefore displaying a classic cross-race effect?

Or is the reasoning, rather, that the mean neuroelectric activity is just generally lower in this Indian sample, and if one were to repeat the experiment adding an Indian stimulus the results would possibly reflect this, as well as a lack of the cross-race effect. Further research exploring this is required to unlock the answers to those questions.

A Gender Effect

As the effect of race displayed in these results was not typically what one would have anticipated, of interest would be what other variables have an effect. Gender is one such variable that has significant results. The grouped data displays interesting race by gender interactions. Black participants displayed no significant differences in mean peak amplitudes between looking at female stimuli versus male stimuli. They gave slightly more attention to males than females, but this difference was too small to be significant. There was, however, interesting results with regards to the White participants. White participants gave significantly more attention to female faces than to male faces. A possible explanation as to this, which links to the cross-race effect theory, is an increased exposure to females. As discussed above, it is a probable scenario that the participant in this research all had domestic workers in their homes, which in South Africa would be female, as 97% of domestic workers in South Africa are female (StatsSA, 2001). The increased female exposure may have, as with the cross-race effect, resulted in an increased awareness of females, and therefore an increase in the peak potentials.

These results reveal even more interesting findings when one examines them with regard to hemispheric differences. Significant gender interactions were only found in the results for T6, which is located in the right hemisphere. And the results were only significant with regards to the stimuli gender, and not the participant gender. This would seem to suggest that the right hemisphere of the brain is more sensitive to the effects of gender than the left hemisphere. Research has illustrated that the right hemisphere is more dominant with regards to facial recognition. This has been examined in split-brain research where hemispheric differentiation is more readily visible: “To date, split-brain studies have been successful only in showing that the right hemisphere tends to dominate

responses" (Gazzaniga & Smylie, 1983, p. 536). It stands to reason, that gender identification is an integral part of face recognition, linking back to Bruce and Young's structural code stage of facial recognition (1986). Therefore as gender identification is part of facial recognition, which is right-hemisphere dominant, the gender interactions found in the right hemisphere in the results of this study are thereby logically explained.

Inter- and Intra-group Differences

The set of results that were of great interest were the stimuli race by stimuli gender by subject race by subject gender interactions. This essentially means what each race-gender groups (Black females, Black males, White females, White males) results were with regards to the other groups when examined with the stimuli in the same race-gender groups. Although these results were not significant ($p=0.0893$), the trends displayed within these results are of great interest, and may help to explain some of the other results.

Black females did not display any significant differences between any of the groups. The peak amplitudes were slightly higher for White males than for any other group, but all within the same small range. This suggests that Black females tend to give equal attention to all races and genders. One possible explanation for this is the relatively new station of the Black female within South Africa's society and economy.

Traditionally all African cultures within Southern Africa are patriarchal in nature, and even in modern society, where equality is emphasised, it still exists. As one researcher remarks: "Patriarchy, present in all races and cultures in South Africa, has endured in the postapartheid Era" (Bentley, 2004, p. 247). Due to this, females are generally not as highly regarded as their male counterparts within the social structures of African communities. Yet since the end of Apartheid there has been a concerted effort to right this wrong and bring out true gender equality. Examples of such efforts can be seen in The Constitution, the National Action Plan for the Promotion and Protection of Human Rights, ratified international law (such as CEDAW), evolving domestic law (Bentley,

2004) and also in the statutes of the Black Economic Empowerment (BEE) program (Tangri & Southall, 2008). Although this effect may not yet be seen to have reached the more rural or poverty-stricken areas of South Africa, within the Urban and Suburban areas this can be seen to have started to take effect. Therefore the young Black urban females have possibly grown up in an empowering environment that places value on both their race and gender. A possible explanation for the slightly greater peak amplitudes in response to White males could be that over half of the Black female sample revealed, in conversation, that they were in interracial relationships (with White males). As they were therefore receiving greater intimate exposure to White males, that exposure could have created the greater attention and awareness of White males. As this was not a specifically examined factor within this research, details about relationships, and race of partners were not asked for, and further research could bring more illumination to this factor.

This therefore helps one to begin to understand the results displayed by the African females within this study. In the specific environment that they have grown and developed in, they have seen themselves as equals (or in some economic-specific cases better than) their male counterparts. This could have therefore affected the way in which these young Black women view those around them, seeing people of all races and genders equally, giving no significantly greater or lesser attention to any one group.

Black males displayed similar reactions to Black females in their relative equality of peak amplitudes among the groups. They appear to give almost equal attention to all races. The only difference that could appear to be significant is the peak amplitudes towards White females. This amplitude appears to be lower than the amplitudes of all other groups. The reasoning behind this could be related to the inherent patriarchy in the African cultures, as discussed above (Bentley, 2004). The White females could be seen to be not as important, and therefore there is a less attention paid to them. This however does not explain why the reaction to Black females was not also lower. However, if there was a race effect occurring here one would expect to see lower amplitudes for White males as well as White females, which is not present. One possible explanation could be the lack of White Female exposure in childhood. Unlike with the White participants, the domestic

workers in the participant's homes would be same-race, and therefore the Black participants could possibly not had enjoyed the same level of other-race female exposure that the White participants received. The other option is if one considers if there is a race by gender effect occurring here. The fact that White females are of another (other) race, as well as the other gender could be enough of a cause to create the lowered attention effect.

Another possible explanation is the effect of sexual orientation. From observation and conversation during the testing process, if became apparent that seven out of the eight Black male participants were either openly homosexual or noticeably effeminate. As sexual orientation was not a variable within this study, questions on participants sexual orientation were not asked. Yet one could postulate that sexual orientation could have had a notable effect. If, hypothetically, the majority of the Black Male sample was homosexual in nature, that could help explain the results. In the displayed results the peak amplitudes for White females are lower as they represent a group that is not part of their race group, as well as being a group that is not a possible sexual or life-partner, whereas White Males, although being another race, represent a group that are possible sexual and life-partners, and therefore habitually a chosen area of focused attention, thus priming neural networks ready for perception. And the results from the Black females, although another group that are not sexual or life-partners, are part of the same race group, and as stated above, Black males have received greater exposure to Black females in the form of the mother and possibly the domestic worker, and the peak amplitudes are therefore higher. This could suggest that Black males display the cross-race effect. This does however also suggest that the effect of one's sexual orientation (or rather the effect of the desirability of a group as a sexual or life-partner) can override, or transcend, the cross-race effect. This is, of course, pure conjecture, and would require further research to confirm these results.

The results from the White males and the White females were essentially the same in their trends. The faces that received the highest peak amplitudes were Black females, closely followed by Black males. The next highest amplitudes were White females.

Lastly were White males. This patterning directly contradicts the classic cross-race effect, with the other race having higher peak amplitudes and therefore more attention, than the same race. This could, as previously postulated, be a factor of racial exposure. When one considers the Black to White racial ratio in the population, White people have very high exposure to Black people, which, in accordance to the cross-race effect theory, has resulted in the White participant giving more attention to Black other-race faces than to their own-race White faces.

Interestingly, this pattern seen within the White participants directly reflects the hierarchy that exists within the BEE programme in South Africa, as is stated in the BEE act of 2003 (RSA, 2004). This could be a display of how one aspect of society (the economy in this case) has huge crossover effects into the rest of society, especially pertinent in that modern South African society is seen to be a Capitalist society (Southall, 2004). This therefore suggests that the society of a country directly effects how the people in that country view each other. The underlying neurophysiology here could once again be linked to the aspect of exposure, but possibly a different aspect of exposure. With regards to the BEE hierarchy above, this preferential order is seen in many aspects of everyday South African life, from school classrooms, to newspapers, to university selection criteria. This is particularly relevant to this sample, as university students. Therefore South Africans get exposed to this hierarchy in multiple formats regularly. This could have resulted in reinforced neuronal pathways with regards to that hierarchy, which could have created a priming effect. For example, from the exposure White males realise that Black Women are important within South Africa, therefore their neural networks are highly primed for high attention directed towards Black females due to the high exposure and perceived importance.

Socio-Cultural Neuroscience

If one were to carry this thought further, then one could also suggest that the inherent racial prejudice seen in the classical cross-race effect has been placed there by the society in which the research was carried out. Yet in South Africa, this seems to be moving

towards a more positive effect, with the classic cross-race effect not being seen in the results of this research.

This would then seem to confirm previous conjectured theory that one's environment affects the way in which one's brain works. As previous research has stated that it is the culture in which one finds itself that helps define the way in which one's brain develops and functions (Chiao, 2011). However the results from this research would tend to suggest that society as a whole plays as pivotal a role in this. Therefore this research would suggest an amendment to the term 'Cultural Neuroscience' to the term of 'Socio-Cultural Neuroscience'. Although the effects of culture were visible in the results, the effects of society seemed to have the stronger influence. This is especially significant when one considers the strength of the cultural bonds that many cultures (especially the African cultures) within South Africa display (Bentley, 2004). This would seem to suggest that the only way in which to remove the racial prejudice that is the cross-race effect would be to create a society-wide change, as South Africa is attempting to do.

This society-wide change is seemly beginning to have an effect, as displayed by the results of this research. Yet it must be kept in mind that the sample of this research was purposefully chosen to be as integrated and as non-prejudiced as possible. So in this purpose-specific sample the effects of this change within society can begin to be seen, with the complete removal of the classic cross-race effect. Yet the results of this research cannot claim to be wide-ranging, or even exceptionally externally valid.

Even with this all accounted for, the results are clear in that South Africa is changing, and does not fit the international mould. This sample was chosen as they theoretically represent where South Africa is moving towards as a people and as a country. Therefore if South Africa continues along this path, there is hope that the negative prejudices that the cross-race effect has been proven to display internationally, could disappear completely from the South African population. If this were to happen, it would exponentially change the way in which South Africans of different races and cultures interact, for the better. If all South Africans arrive at the point that the Black female

participants of this research appear to have arrived at (having no discrimination between races or genders), then theoretically South Africans will stop viewing the world through racial eyes, and see people as people.

Limitations and Suggestions for Future Research

EEGs using visual stimuli should be performed in a dark, sound-proofed, and electrically insulated room in an attempt to avoid all possible interference to the results (Teplan, 2002). This research was performed in an office in the Psychology building within the University of the Witwatersrand. Attempts were made to darken the office, but it was not completely successful, especially since the office was west-facing and received full afternoon sun. And neither was the room sound-proofed or insulated. Therefore ambient noise from surrounding offices and lecture rooms was not completely removed.
Of most importance was the lack of proper insulation, which resulted in electrical-noise artefacts appearing in most of the ERPs. This generally consisted of 50Hz noise which resulted in a 50Hz filter being run on all ERPs, and some ERPs requiring further manual filtering. Therefore a limitation of this research was lack of a proper EEG recording space, which may have resulted in some of the recordings not being as perfect as they could have been. Another limitation of this research was a relatively small sample size (purely from the result of limited time). A larger sample size would have tightened the research design and possibly improved the results.

All of the results from this study would benefit from having further research performed to confirm these results. Future research including a larger Indian population, as well as including an Indian face stimulus is important, as the results from the Indian control group here are confounding by their lack of comparison data. The results from data of gender differences are also very interesting and another area that warrants further research, as it is an area, that in comparison to racial differences, has not received the same amount of research, but is as important a subject. Linked to this is the effect of interracial relationships and their effect on the cross-race effect. The results from this research suggest a possible effect here, therefore further research to confirm this would

be beneficial. Finally an area that again has received little to no attention, is the effect of sexual orientation on the racial and gender differences. Although not confirmed in this research, the data is suggestive of significant results, and therefore further research to confirm this is important.

Conclusions

The results of this research essentially culminate in the conclusion that the cross-race effect, as has been classically seen internationally, is not present within young South Africans.

There are however results that differ between racial groups, but those results are either the complete opposite of the international results, or are completely different, therefore displaying that young urban South Africans are evolving away from typical racial discrimination. Young Black South Africans have completely moved away from racial discrimination, displaying equal attention to all race groups, thereby displaying no racial discrimination whatsoever. Young White South Africans, however, have moved polarities from international norms and give more attention to Black South Africans (other race) than to White South Africans (same race). This research postulates that this is in response to the current social climate within South Africa, and is a move that should hopefully yield positive results for South Africa in the future. Young Indian South Africans displayed no differences between Black and White South Africans, but without further information it remains unclear whether this is a typical example of the cross-race effect (both races being other race), or whether they too have moved away from the classic cross-race effect.

With regard to the effects of gender, again young Black South Africans displayed no differentiation between South African males and females, giving attention on both equally. Young White South Africans displayed greater attention to females than to males. Again this research postulates that this is in response to the current social climate, and is again, a positive step towards removing gender discrimination within South Africa.

Although group by group interactions (stimuli race by stimuli gender by subject race by subject gender) were not significant, the trends displayed therein were of great interest. These trends generally and essentially displayed a good representation of the current South African social climate.

Therefore from these results, this research postulates that the society in which an individual finds themselves has a great effect of the functional neurology of the individual. And as culture has also been seen to have such an effect, this research seeks to transform the phrase of 'cultural neuroscience' into that of 'Socio-Cultural Neuroscience'. This therefore displays the important effect that society has on individuals, and therefore if a society makes positive steps, such as South Africa is doing towards the removal or racial and gender discrimination, then that effect will transform the neurology of the people in that society to mirror those steps. Therefore the importance on a positive stance of society as a whole cannot be emphasised enough, because, as is reflected in these results, the impact that society has on its people is enormously significant.

These results reflect that South Africa has made huge progress in the removal of racial and gender discrimination within its young urban population. Although this research focused on this specific population, it did so with the expectation that this population represented the, hopefully, utopian future of the country. If these results could be replicated again in further research it would be a great success for South Africa, and represent an enormously positive move away from our infamous history, towards a future of South Africa as beacon of equality and fairness in the world.

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Appendices

Appendix 1:Participant Consent Form

I, _____, consent to participate in this study:

I will participate in the Evoked-Response Procedure.

I understand that:

Participation is voluntary

I will have a harmless and non-invasive evoked potential test performed on me whilst looking at stimuli of faces

I may choose to stop the testing at any time with no negative outcome for me

My results will remain confidential

No positive or negative consequences will follow from choosing to, or not to, participate

By Participating I state that:

I have no history (or am aware of family history) of epilepsy

I have no history of head injury and no current neurological disorders

Signed: _____

Date:_____

Student Number:_____

Demographics:

Race: _____

Sex: _____

Age: _____

High School Attended:_____

Assigned Participant Number: _____

Appendix 2: Participant Information Sheet

School of Human and Community Development
Private Bag 3, Wits 2050, Johannesburg, South Africa
Tel: 27 (0)11 717 4524/5 Fax: 27 (0)11 717 4556
Email: nomonde.gogo@wits.ac.za

Hi! My name is Daniel Greenslade, and I am conducting research for the purpose of obtaining a Masters degree in Research Psychology at the University of the Witwatersrand. My area of focus is the Evoked Potential of Facial Recognition. I would like, on behalf of myself and my research supervisor, Enid Schutte, to invite you to participate in this study.

Participation in this research will entail having an event-related potential scan (which is a completely non-invasive and painless recording of electrical activity occurring in your brain) performed on you whilst looking at pictures of South African faces. The test itself should take approximately 30 minutes to complete. Participation is voluntary, and no individual will be advantaged or disadvantaged in any way for choosing to or not to participate. As the visual stimulus is pictures of faces flashing on a screen, there is a very small possibility that this could set off an epileptic attack in people with the underlying disorder. If your family has a history of epilepsy I would suggest not participating in this research.

Please be assured that confidentiality about the results between the researcher and you as a participant is guaranteed. The information you provide will only be seen by myself and my research supervisor; I will compile the information and produce data for the group. I will then analyse this data and provide a summary of the results for any interested participant when they contact me for the results. No individual feedback can be given. This grouped data may be used in publications or conference presentations, but no identifying individual data will be used.

Please note that you will be free to stop the procedure at any time and no negative consequences will follow. Your participation would be greatly appreciated; the information you provide will be kept confidential. This research will contribute to the larger body of knowledge of Neuropsychology.

Kind regards,

Daniel John Greenslade

Please feel free to contact myself or my supervisor (Enid Schutte) on:

082 920 6731 083 560 5017
enid.schutte@wits.ac.za Daniel.Greenslade@students.wits.ac.za

Appendix 3: Sample Face Stimuli



Appendix 4: Racial Prejudice Questionnaire

Name:_____ Participant Number:_____

Question 1

Please describe how you feel about the Black population group in general. Please select the number that best represents your feeling

I feel the following way towards Black people in general

Warm	1	2	3	4	5	6	7	Cold
Negative	1	2	3	4	5	6	7	Positive
Friendly	1	2	3	4	5	6	7	Hostile
Suspicious	1	2	3	4	5	6	7	Trusting
Respect	1	2	3	4	5	6	7	Disrespect
Admiration	1	2	3	4	5	6	7	Disgust

Question 2

Please select the word which expresses or most closely expresses your feelings in relation to the statement

My first feeling is to willingly allow:

Any	Most	Some	Few	No	Black students to my University
Any	Most	Some	Few	No	Black people to my street as neighbours
Any	Most	Some	Few	No	Black guests to my home
Any	Most	Some	Few	No	Black people to be my personal friends
Any	Most	Some	Few	No	Black people in my work/study group
Any	Most	Some	Few	No	Black people in close kinship by marriage

Name:_____ Participant Number:_____

Question 1

Please describe how you feel about the White population group in general. Please select the number that best represents your feeling

I feel the following way towards White people in general

Warm	1	2	3	4	5	6	7	Cold
Negative	1	2	3	4	5	6	7	Positive
Friendly	1	2	3	4	5	6	7	Hostile
Suspicious	1	2	3	4	5	6	7	Trusting
Respect	1	2	3	4	5	6	7	Disrespect
Admiration	1	2	3	4	5	6	7	Disgust

Question 2

Please select the word which expresses or most closely expresses your feelings in relation to the statement

My first feeling is to willingly allow:

Any	Most	Some	Few	No	White students to my University
Any	Most	Some	Few	No	White people to my street as neighbours
Any	Most	Some	Few	No	White guests to my home
Any	Most	Some	Few	No	White people to be my personal friends
Any	Most	Some	Few	No	White people in my work/study group
Any	Most	Some	Few	No	White people in close kinship by marriage