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Reports

Multiple group membership influences face-recognition: Recall and neurological evidence[☆]Eric Hehman^{*}, Emily M. Stanley, Samuel L. Gaertner, Robert F. Simons

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ABSTRACT

The limited face-recognition research involving targets categorizable on multiple dimensions has provided contradictory evidence as to how partial-ingroup members are processed and recognized. This research demonstrates that partial-ingroup members are recognized in a manner distinct from double-ingroup and double-outgroup targets. Specifically, when race and university-affiliation are crossed, university-affiliation does not influence recognition for own-race targets, but does for other-race targets, in that other-race/own-university targets are recalled more accurately than other-race/other-university targets. The neurological mechanisms involved in the effect are explored through the inclusion of electroencephalography.

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Introduction

Simply categorizing others as in- or outgroup members leads to a variety of serious consequences where the ingroup is favored over the outgroup (Sherif, Harvery, White, Hood, & Sherif, 1954). An abundance of research has focused on reducing intergroup conflict and bias by shifting categorizations such that former outgroup members are included within the ingroup (Gaertner & Dovidio, 2000). However, people are members of numerous groups simultaneously, and can be categorized as in- or outgroup members depending upon which categorization is most salient (Gaertner, Mann, Murrell, & Dovidio, 1989; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). The current research focuses on how the processing of simultaneous multiple group categorizations influences the ingroup face-recognition advantage.

The robust phenomenon of superior recognition for members of one's own group as compared to other groups has been widely replicated across different races (Meissner & Brigham, 2001), countries (Chiroro, Tredoux, Radaelli, & Meissner, 2008), and with non-racial groups such as university-affiliation (Bernstein, Young, & Hugenberg, 2007). However, though multiple group categorizations are well understood in how they influence evaluative biases and inclusion (Brewer & Gaertner, 2001; Ensari & Miller, 1998; Ensari, Stenstrom,

Pedersen, & Miller, 2009), it is less clear how simultaneous multiple group memberships influence face categorization, processing, and recognition.

Multiple categorization experiments typically include two orthogonal dimensions upon which targets vary in membership, producing four types of targets: double-ingroup, ingroup/outgroup and outgroup/ingroup, and double-outgroup. Multiple categorizations can influence evaluations in several different patterns. People sometimes favor others who most belong to their ingroups, such that double-ingroup members are preferred over partial-ingroup members, who are in turn preferred over double-outgroup members in what is called the additive pattern (Crisp & Hewstone, 1999). On the other hand, specific circumstances can elicit a social exclusion pattern in which double-ingroup members are preferred over all other groups (Kenworthy, Canales, Weaver, & Miller, 2003). Finally, there is some evidence of partial ingroup patterns, when a second category dimension matters only for outgroup members on the first dimension. For instance, university-affiliation didn't influence White participants' decisions to comply with an interview request from a White surveyor, but when the surveyor was Black, participants were more likely to consent when they attended the same university (Nier, Gaertner, Dovidio, Banker, & Ward, 2001).

In face-recognition research, only a handful of studies have involved multiple categorization, and the existing evidence is contradictory. For instance, among White middle-class college students, when Black and White targets were additionally categorized as ingroup or outgroup members upon a second dimension of socioeconomic status (SES), a social exclusion pattern occurred; double-ingroup (White/middle-SES) members were recognized best and there were no recognition differences for Black or White/low-SES targets (Shriver, Young,

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Hugenberg, Bernstein, & Lanter, 2008). Social exclusion effects were also found when targets were categorized as either pro-life or pro-choice regarding abortion attitudes, and either Republican or Democratic political party affiliation (Ray, Way, & Hamilton, 2010). In each of these studies, only ingroup membership on *both* dimensions produced an ingroup face-recognition advantage. These authors have postulated that face-recognition may only dichotomize targets into in- and outgroup categories, with no allowance for degrees of “ingroup-ness” to facilitate recognition in a continuous manner.

However, there is some evidence for partial ingroup effects in face-recognition. When Black and White targets were spatially grouped by race, a secondary dimension of university-affiliation did not influence recognition for own-race targets, but did for other-race targets, such that other-race/own-university targets were recognized more accurately than other-race/other-university targets, though this effect was only marginally reliable, $F(1, 27) = 3.11, p = .089, \eta_p^2 = .10$ (Hehman, Mania, & Gaertner, 2010). Similar evidence of social inclusion was recently demonstrated in a face inversion task (Cassidy, Quinn, & Humphreys, 2011). Ingroup faces are processed in a more holistic manner than outgroup faces, and the inversion of a face interferes with the ability to process it holistically. Therefore, when in- and outgroup member faces are inverted, the processing of ingroup faces is more disrupted than those of outgroup members (Hancock & Rhodes, 2008). When participants performed a matching task on upright and inverted Black and White targets additionally categorized as own- or other-university, participants were equally adept at matching own-race targets regardless of university-affiliation. However, other-race/own-university targets were more difficult to categorize than other-race/other-university when inverted, providing evidence that Black own-university targets were being processed as partial-ingroup members (Cassidy et al., 2011). These studies indicate that when multiple categorization is possible, sharing one dimension can be sufficient to trigger processing as an ingroup member, but that even outgroup members on the first dimension can be processed as ingroup members to some degree on a second dimension.

In summary, while previous work has theorized that face-recognition can only dichotomize multiply categorizable targets into in- and outgroups, some preliminary evidence indicates that partial-ingroup membership (i.e., outgroup membership on one dimension but ingroup membership on another) may lead to improved recognition. Building upon the above logic, we investigated multiple categorization patterns in face-recognition, and additionally included analysis of event-related potentials (ERPs) to examine neurological mechanisms to provide insight into when and how these effects occur.

Overview

As the existing evidence has been contradictory, we sought to confirm that partial ingroup patterns can occur in face-recognition. It is notable that the research showing improved recognition for partial-ingroup members has used race and university-affiliation as categorical dimensions (Cassidy et al., 2011; Hehman et al., 2010). Previous work has demonstrated the primacy and salience of racial categorization over other possible categorizations (Ito & Urland, 2003; Kubota & Ito, 2007; Willadsen-Jenson & Ito, 2006) and the difficulty in decreasing its salience (Shriver et al., 2008), and we hypothesized that race was a more powerful categorical dimension than university-affiliation. Therefore, we expected to replicate previous research (Hehman et al., 2010) finding main effects of superior recognition of ingroup members over outgroup members on both racial and university dimensions, but that larger effect sizes would be demonstrated on the racial dimension.

However, our primary hypothesis involved multiple categorizations. Specifically, we predicted that differences in recognition based on the secondary categorization dimension (i.e., university-affiliation) would occur only for outgroup targets on the more salient first

dimension (i.e., race). Therefore, we predicted that other-race/own-university targets would be recognized more accurately than other-race/other-university targets, but that there would be no differences in recognition for own-race/own-university and own-race/other-university targets.

Psychophysiological measures

As membership for partial-ingroup targets may be contingent upon the relative salience of the categorization dimensions, ERPs provide a reliable and subtle method of assessing salience, or the amount of attention devoted to a particular dimension, by comparing the magnitude of ERPs in response to both race and university-affiliation. Additionally, ERPs provide a method of distinguishing the mechanisms involved in the recognition of partial-ingroup targets, by exploring whether or not other-race/own-university targets are processed in a manner unique from all other types of targets.

ERPs derived from EEG have frequently demonstrated the degree to which perceivers automatically attend to (Bradley, 2009) and encode social category information (Ito & Urland, 2003; Kubota & Ito, 2007). A methodological advantage of this approach is high temporal specificity that allows for examination of processes occurring quickly and in succession; in the current experiment, categorization and attention to racial and university membership. Larger ERP components are associated with greater attention (Luck & Hillyard, 1994). We focused our investigation on several early components associated with selective attention processes, the P100, N100, P200, and the N200, as these have been previously demonstrated to be sensitive to categorization dimensions (Kubota & Ito, 2007; Rutman, Clapp, Chadick, & Gazzaley, 2010; Willadsen-Jensen & Ito, 2006). Beyond exploring whether these components simply vary in response to race and university-affiliation, we additionally examined relationships between ERP variation on these components and recognition.

In the current experiment we are predicting an interaction between race and university-affiliation such that other-race/own-university targets are recognized more accurately than other-race/other-university targets. However, superior recognition for other-race/own-university targets could result from one of two possible mechanisms. First, partial-ingroup targets may be processed uniquely from double-ingroup or double-outgroup targets. Ingroup members who differ from “typical” ingroup members regarding attitudes or norms can be treated and categorized in a manner distinct from both other ingroup and outgroup targets; otherwise known as the black sheep effect (Marques, Abrams, Paez, & Martinez-Taboada, 1998). A similar effect may be present in the current work. This possibility would be supported if there was an interaction of race and university-affiliation, such that other-race/own-university targets were uniquely associated with ERP amplitude.

However, an alternative possibility is that improved recognition for partial-ingroup members results from independent processing of multiple dimensions of a single target. Previous work has shown independent processing of race and gender (Ito & Urland, 2003) and race and facial expression (Kubota & Ito, 2007). Race and university-affiliation may also be processed independently, and the recognition benefits that other-race/own-university targets enjoy may stem from being processed as an ingroup member on this single, rather than on multiple, dimensions. Evidence of this possibility would be demonstrated by unique main effects of ERP components associated with race and university-affiliation.

Method

Participants and design

Thirty-five White University of Delaware undergraduates (12 male) participated for course credit. A 2(Race: Own-race, Other-

race) × 2 (University-affiliation: Own-university, Other-university) repeated measures design was employed.

Stimuli

One hundred and sixty gray-scale faces (80 Black, and 80 White) of college-age males displaying neutral expressions were presented as stimuli¹. Using Irfanview (Skiljan, 2010), photos were resized to approximately 190 × 140 pixels, cropped to show only face and hair, and placed on blue or purple backgrounds (80 blue, and 80 purple) similar in luminance (University of Delaware (UD) = 95.83 grayscale, James Madison University (JMU) = 79.81 grayscale) measuring 270 × 360 pixels representing UD or JMU school colors, respectively. In addition, “UD” or “JMU” labels were placed in black text beneath each face to reflect university-affiliation, though in reality targets were from neither UD nor JMU.

Procedure

Participants received a general description of the experiment while being fitted with an electrocap, and then completed a facial-recognition task with Black and White UD and JMU targets. Eighty faces were presented in random order during the learning phase: 20 Black UD, 20 Black JMU, and 20 White UD, 20 White JMU. Participants were told to pay attention to the faces, as they would be tested on their ability to recognize them later. Faces were presented for 2000 ms with an interstimulus interval of 500 ms using Presentation (Neurobehavioral Systems) on a 17 in. CRT monitor with a 100 Hz refresh rate. All faces were counterbalanced across both background color and label during the learning phase on a between subjects basis, such that each face was equally likely to appear as either a UD or JMU student, and equally likely to be seen or not seen during the learning phase.

Before beginning the test phase participants worked on a series of anagrams for 6 min as an unrelated distracter task. They were then informed that they would observe a second series of faces including both previously seen (Old) and novel (New) faces. For each face that appeared, participants were instructed to press the keys labeled “Old” or “New,” based upon if they recognized the face from the learning phase, or not. Each face remained on the screen until a decision was rendered, prompting immediate presentation of the next face. The 160 faces presented in the test phase included the 80 learning phase stimuli, as well as 80 additional faces with an identical Black/White, UD/JMU distribution presented randomly by participant.

Electrophysiological recording and processing

EEG was recorded using an electrocap (Electro-Cap International, Inc., Eaton, OH) with 30 embedded tin sensor electrodes. Two additional electrooculography (EOG) electrodes were placed 1 cm under each eye to record blink and eye movement artifacts. During recording, all activity was referenced to the right mastoid, while AFz served as a ground site. All EEG/EOG electrode impedances were below 20 K Ω , and the data from all channels was digitally recorded using Snapmaster software (HEM Data Corp.) with James Long Co. Isolated Bioelectric Amplifiers. EEG was sampled continuously at 500 Hz. EEG data was then analyzed offline with EEGLAB (Delorme & Makeig, 2004) and ERPLAB Toolbox (erpinfo.org). Data was band-pass filtered from .1 to 30 Hz with a Butterworth digital filter, and re-referenced to the average of the

¹ Stimuli were obtained from various sources including the NimStim Face Stimulus Set, overseen by Nim Tottenham and supported by the John D. and Catherine T. MacArthur Foundation Research Network on Early Experience and Brain Development (Tottenham et al., 2009) and the Center for Vitality Longevity database (Minear & Park, 2004), and the Cohn-Kanade Facial Expression Database (Kanade, Cohn, & Tian, 2000). We would also like to thank Kurt Hugenberg, Kareem J. Johnson, Eric W. Mania, and Carlos D. Navarrete for providing additional stimuli.

mastoids. Epochs were extracted from 200 ms before the picture to 800 ms afterwards for each trial. The EEG for each trial was corrected for vertical EOG artifacts through the use of an individual components analysis to remove eye-blink components (Jung et al., 2000). Trials were rejected if activity in any channel exceeded $\pm 75 \mu\text{V}$. The four conditions did not significantly differ with respect to the number of rejected trials. Six participants were not included in the final analysis as more than 25% of their trials were rejected, resulting in a final sample of 29 participants for EEG analysis. ERPs were constructed by separately averaging trials in each condition. For each ERP average, activity in the 200 ms window prior to stimulus onset served as baseline.

Data reduction and analysis

To reduce the dimensionality of the data, a spatial principle components analysis (PCA) was conducted on individual averages of each condition. The time period for this analysis was from stimulus onset until 600 ms after presentation. Time points from ERP averages at all electrode sites from all conditions from all participants were included in the PCA. The spatial PCA identifies and forms virtual electrodes from clusters of electrodes so highly correlated that some are redundant, and captures the variance uniquely associated with the scalp distribution of the ERPs. More simply, it reduces the number of electrodes without losing any unique information (Spencer, Dean, & Donchin, 2001). Three virtual electrode clusters emerged from the spatial PCA (see Fig. 2).

Four distinct deflections were identified (see Fig. 3). The P100 at the occipital electrode cluster (mean latency: 100–130 ms), the N100 at the frontal electrode cluster (mean latency: 105–135 ms), the P200 at both the frontal (mean latency: 140–160 ms) and central (mean latency: 140–160 ms) electrode clusters, and the N200 at both the central (mean latency: 200–300 ms) and occipital (mean latency: 210–255 ms) electrode clusters. The mean amplitude of each of these components was measured at the electrodes that comprised the virtual electrode where the component was largest. The mean amplitude of each component was averaged across this region of interest and subjected to statistical analysis.

Results

Recognition

An evaluation of performance on a facial-recognition task borrows from signal detection theory (Wickens, 2002), and can be created from the percentage of “Hits,” the correct identification of an old face, and “False Alarms,” the incorrect identification of a new face as an old face. This performance measure, known as sensitivity (d'), was calculated for each target category (i.e., White own-university,

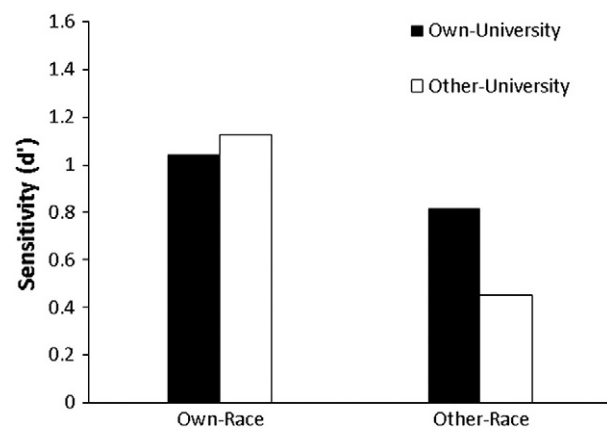


Fig. 1. Mean sensitivity (d') as a function of target race and university-affiliation.

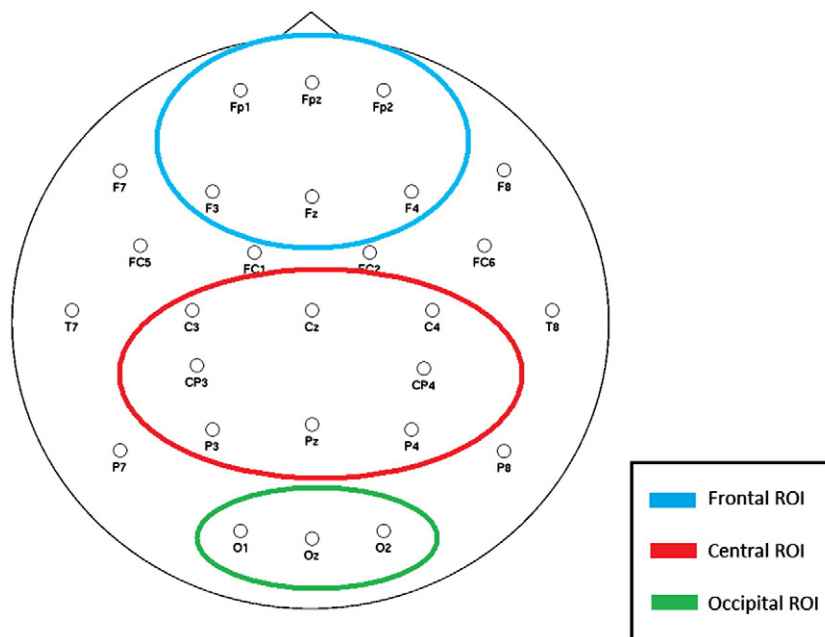


Fig. 2. Virtual electrode clusters extracted from the spatial PCA.

White other-university, Black own-university, Black other-university). Higher sensitivity (d') reflects more accurate recognition of targets.

Sensitivity ratings were subjected to a 2(Race: Own-race, Other-race) \times 2(University-Affiliation: Own-university, Other-university) \times 2(Gender: Male, Female) mixed model ANOVA², with repeated measures on the first two factors (see Fig. 1). The anticipated main effect of race was found, $F(1, 33) = 41.66$, $p < .001$, $\eta_p^2 = .56$, as own-race faces ($M = 1.09$, $SD = .46$) were recognized better than other-race faces ($M = .64$, $SD = .42$). Additionally, there was a marginal effect of university-affiliation, $F(1, 33) = 3.30$, $p = .079$, $\eta_p^2 = .09$, as own-university ($M = .93$, $SD = .43$) were recognized better than other-university targets ($M = .79$, $SD = .46$). Examining our primary hypothesis, these main effects were qualified by a significant Race \times University-affiliation interaction, $F(1, 33) = 7.52$, $p = .010$, $\eta_p^2 = .19$. The simple effects supported our predictions and replicated pilot work³. Recognition for own-race/own-university ($M = 1.05$, $SD = .43$) and own-race/other-university targets ($M = 1.13$, $SD = .50$) was not significantly different, $F(1, 33) = .49$, $p = .487$. However, all racial ingroup members were recognized better than partial ingroup members on the university dimension, as both own-race/own-university, $F(1, 33) = 4.93$, $p = .033$, $\eta_p^2 = .13$, and own-race/other-university targets, $F(1, 33) = 7.21$, $p = .011$, $\eta_p^2 = .18$, were recalled more accurately than other-race/own-university faces ($M = .82$, $SD = .43$). Finally, as predicted, these other-race/own-university partial ingroup members were recalled significantly better than other-race/other-university double outgroup targets ($M = .45$, $SD = .41$), $F(1, 33) = 11.87$, $p = .002$, $\eta_p^2 = .26$.

² There was an additional effect of gender, such that males ($M = .97$, $SD = .54$) had significantly better recognition than females ($M = .75$, $SD = .39$), $F(1, 33) = 5.01$, $p = .032$, $\eta_p^2 = .13$. However, gender effects do not contribute to the hypotheses of the paper, and were therefore controlled for in all subsequent analyses.

³ Prior to the current research, pilot work was conducted utilizing a similar paradigm ($n = 56$), though absent EEG. The current results replicate that work as own-race/own-university and own-race/other-university targets were recognized equally well, $F(1, 54) = .03$, ns , but other-race/own-university targets were recalled significantly better than other-race/other-university targets, $F(1, 54) = 7.48$, $p = .023$ (Hehman, Stanley, Gaertner, & Simons, 2011).

ERPs

We focus our analyses of each ERP component on the electrode clusters where activity was maximal. Each component was analyzed with a 2(Race: Own-race, Other-race) \times 2(University-affiliation: Own-university, Other-university) \times 2(Gender: Male, Female) mixed model ANOVA, with repeated measures on the first two factors.

P100 showed evidence of only racial processing, which was most pronounced on the occipital electrode cluster (see Fig. 3). Larger positive deflections were demonstrated in response to own-race ($M = 4.25 \mu V$, $SD = 3.48 \mu V$) than other-race targets ($M = 3.37 \mu V$, $SD = 2.97 \mu V$), $F(1, 28) = 9.58$, $p = .004$, $\eta_p^2 = .26$. There were no effects of university-affiliation or interactions noted at P100.

Effects of both race and university-affiliation were demonstrated at N200. First, racial effects were evident at two points. The central electrode cluster showed the larger effect, as larger negative deflections were noted for own-race ($M = -1.71 \mu V$, $SD = 4.19 \mu V$) than other-race targets at this location ($M = -.31 \mu V$, $SD = 4.50 \mu V$), $F(1, 28) = 23.53$, $p < .001$, $\eta_p^2 = .46$. A smaller, identical effect was additionally noted at the occipital electrode cluster, with larger negative deflections for own-race ($M = 3.95 \mu V$, $SD = 3.93 \mu V$) than other-race targets ($M = 4.63 \mu V$, $SD = 4.02 \mu V$), $F(1, 28) = 8.58$, $p = .007$, $\eta_p^2 = .23$. Each of these effects replicated previous research (Ito & Urland, 2003). Most important to the current work, significant university-based differences were maximal at the occipital electrode cluster, as larger negative deflections were elicited by own-university ($M = 4.09 \mu V$, $SD = 3.75 \mu V$) than other-university targets ($M = 4.50 \mu V$, $SD = 4.19 \mu V$), $F(1, 28) = 4.32$, $p = .047$, $\eta_p^2 = .13$. No interactions were noted at N200. Finally, there was no evidence of race or university-based differences at N100 or P200.

To explore direct links between ERPs and recognition, we examined correlations between ERP amplitudes in response to target presentation and recognition for that same target. We additionally examined whether the difference in ERP amplitude elicited by two types of targets (e.g., Whites and Blacks) predicted the difference in recognition for those same two types of targets. Direct relationships were not observed. We return to this matter in the Discussion.

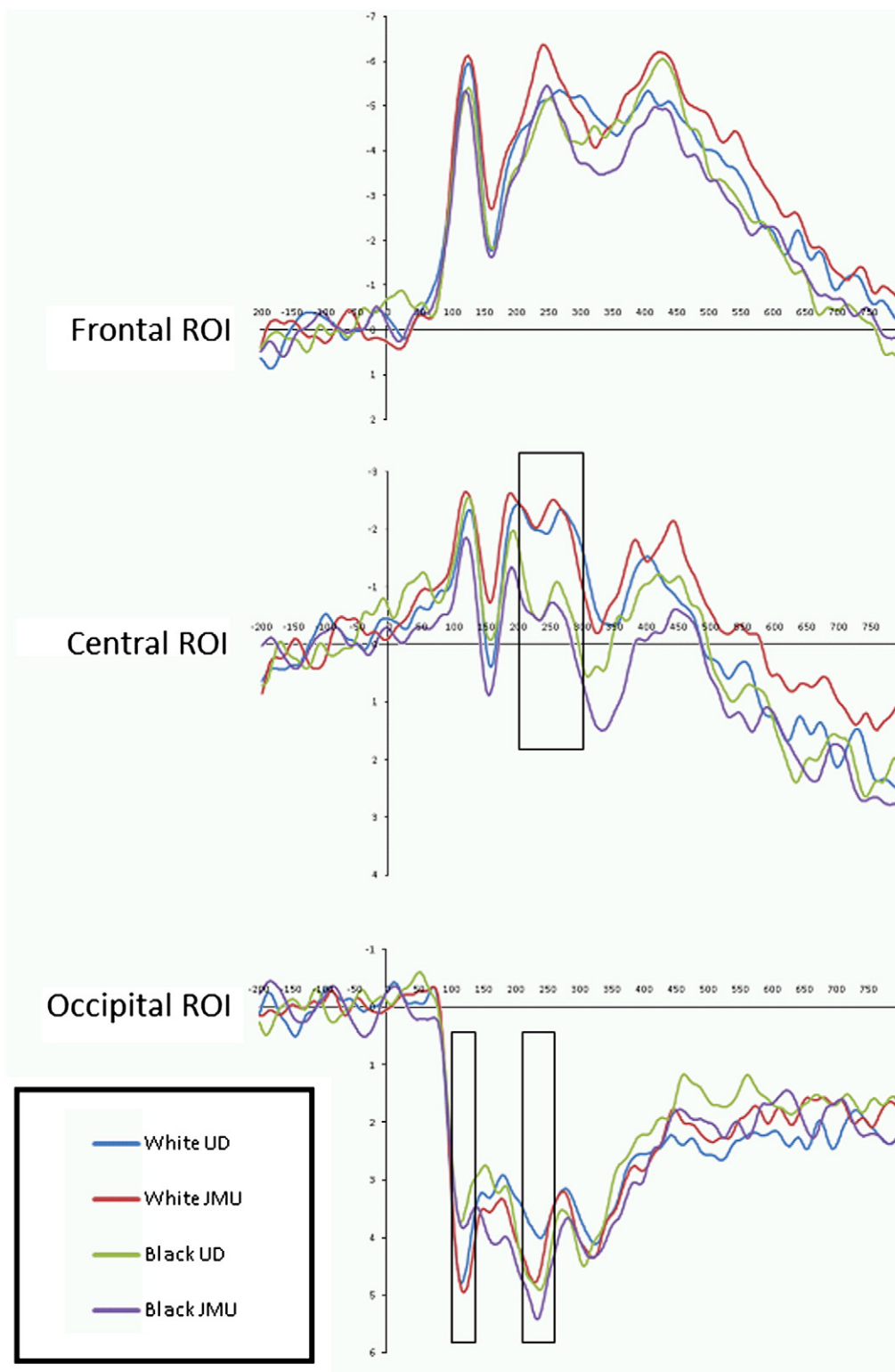


Fig. 3. Event-related potentials for all four conditions. Reported effects are highlighted.

Discussion

The current work provides evidence indicating that multiple categorization allows for recognition to occur in a continuous manner, where degrees of belonging to the ingroup facilitate recognition. Partial-ingroup members were recognized less accurately than double-ingroup targets but more accurately than double-outgroup

targets. Specifically, belonging to the ingroup on the secondary dimension did not facilitate recognition for those belonging to the ingroup on the first, but did for those who were outgroup members on the first dimension.

Additionally, converging evidence supports our claim that race is a more salient categorization dimension than university-affiliation. Larger face-recognition effect sizes were demonstrated on the racial

categorization dimension, as compared to university-affiliation. Additionally, ERPs elicited by race had larger effect sizes than those elicited by university-affiliation, and additionally occurred across a broader time range (i.e., both at P100 and N200). These results provide insight into mechanisms responsible for superior recognition for other-race partial-ingroup targets as compared to double-outgroup targets. The lack of a unique response for partial-ingroup members, and the main effect of university categorization on the N200 indicate that superior recognition for other-race/own-university targets is due ingroup processing benefits on the university dimension. Therefore, it appears that membership in secondary groups (e.g., university-affiliation) does evoke processing as an ingroup member to some degree, but to a lesser extent than ingroup membership on the primary dimension (e.g., race).

We posit that the relationship in salience of the two dimensions may determine what recognition pattern occurs when viewing multiply categorizable targets. In our paradigm, race was a more salient dimension than university-affiliation. Multiple categorization patterns may be elicited only when one category is more salient than another, yet the secondary dimension is still meaningful. Social exclusion patterns have been demonstrated when two equally salient categorizations are present, where lacking ingroup membership on both dimensions may trigger categorization as an outgroup member (Ray et al., 2010; Shriver et al., 2008). We additionally suspect that should one dimension be considered important (e.g., race) while the other is meaningless or unvalued (e.g., favorite dinosaur), categorization upon only the meaningful dimension may occur. However, elucidating which factors influence various recognition patterns when targets are multiply categorizable is beyond the scope of the current work, and may provide a fruitful avenue of future research.

There are multiple reasons as to why race might have been a more salient dimension than university-affiliation. One possibility is the fact that race carries more social meaning than university-affiliation, in terms of the information it conveys about and the outcomes it can have on an individual. Another might involve perceptual expertise or the idea that the ability to extract information from an environment improves with experience, and one's ability to process certain types of faces may improve with more exposure (Sporer, 2001). Our participants were likely raised in White environments and therefore had more exposure to White than Black faces. As a result, it is possible this dimension captured attention more so than university-affiliation, which is not based on physiognomic features participants could have had experience with. Finally, it could simply be that categorizations made based upon physiognomic features influence ERPs and recognition more so than those based upon membership in more abstract groups. Additional mechanisms are possible, and our data cannot speak as to why race was a more salient dimension. Thus, future research is necessary to examine these possibilities.

We did not observe direct links between ERP variation in response to targets and subsequent target recognition. We investigated this relationship because previous work has provided some evidence that the CRE is related to processing differences during the learning phase of a face-recognition paradigm (Young, Bernstein, & Hugenberg, 2010). Indeed, other work has found that stimuli eliciting larger ERP amplitudes during encoding are more likely to be subsequently recalled (Fabiani & Donchin, 1995). However, the current research involves facial processing, whereas the previous work observing relationships between ERP variation and recall has primarily utilized verbal stimuli. A related issue is that an abundance of literature demonstrates that faces are processed uniquely from all other stimuli (McKone, Kanwisher, & Duchaine, 2007), and ERP components predicting face-recognition perhaps should not be expected to be identical to those predicting other types of stimuli. Future work is necessary to better link ERP variation to subsequent facial recognition.

Finally, the current work focused on early ERP components to capture variation in automatic attentional mechanisms to various

dimensions of a face (Ito & Urland, 2003). However, beyond the initial encoding phase, accurate recognition of a target additionally entails the successful context updating (Otten & Donchin, 2000) and retrieval in the final test phase. Some research has found “memory signatures” in that brain areas activated during the encoding of stimuli are again activated when the stimuli are successfully recalled (Fabiani, Ho, Stinard, & Gratton, 2003). Future work would thus do well to additionally record EEG during the test phase of a face-recognition paradigm to examine electrophysiological correlations between encoding and retrieval processes.

Conclusion

A final important contribution of the current research lies in how partial-ingroup members were processed. Whereas previous work has found only that additional categorizations create additional outgroup targets (Ray et al., 2010; Shriver et al., 2008), the current research clarifies under what conditions multiply categorizable outgroup targets can be included as ingroup members. As all individuals are members of numerous groups and categories, inclusion in the ingroup based upon secondary categories provides a viable method of reducing negative intergroup perceptions.

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