STUDENT **PAPER** 1

Investigating Neuro-cognitive Function in Individuals from Different Racial and Ethnic Backgrounds & its Interactions with Resilience

Morgan Montoya, Gillian Grennan, Jyoti Mishra
Department of Psychiatry, University of California San Diego, La Jolla, CA 92037, USA
Neural Engineering & Translation Labs,
University of California San Diego, La Jolla, CA 92037, USA

Faculty Mentors:
Dr. Jyoti Mishra, Ph.D.
Department of Psychiatry

Professor Andrea Chiba, Ph.D.
Department of Cognitive Science

Ronald E. McNair Postbaccalaureate Achievement Program
University of California, San Diego

ABSTRACT

Neuro-cognition is our brain's ability to perform context-appropriate cognitive functions, such as paying attention and maintaining information in working memory, which are associated with specific neural activations. The ability to generate context-appropriate, neuro-cognitively optimal responses to stressful life hardships is a shared aspect of resiliency across all races and ethnicities. We studied how resilience influence neuro-cognitive abilities and if a relationship exists with race and ethnicity. A series of rapid game-like, objective assessments were used to measure internal attention, working memory, distractor processing and emotion processing. We collected demographic characteristics (age, gender, race, ethnicity, socioeconomic status) and measured resilience using the Brief Resilience Scale (BRS). We used generalized linear mixed models to probe the association of demographic factors including race and ethnicity, and resilience with neuro-cognitive performance. Resilience scores alone was not a significant factor contributing to neuro-cognitive performance in these models; however, we found an interaction between multiracial participants and resilience scores for emotional processing consistency. Understanding how race/ethnicity and resilience interact to determine neuro-cognitive abilities can improve the quality of mental healthcare given to diverse Americans, serving to decrease the burden of mental healthcare disparities.

Keywords: neuro-cognitive performance, resilience, race, ethnicity, working memory, internal attention, distractor processing, emotion processing

Introduction

Life is complicated — filled with events that inspire joy, heartbreak, fear, or a surplus of other emotions. Recuperating and flourishing despite hardship, defined as resilience, is an enabling ability experienced across the lifetime. (American Psychological Association, 2012). Throughout the COVID-19 pandemic, there has been enormous pressure on every community across the United States. While all have felt the pressure and hardship, some communities of color have experienced greater mental healthcare inequities during this time of constant psychological stress. Examples of these inequities include: Blacks and Latinos experiencing lower access to psychological services, increased psychological stress on Indigenous individuals who already struggle with an underfunded healthcare system, and a burdening of livelihood insecurities that dissuades middle-to-lower income individuals from seeking mental healthcare (Cénat et al., 2020; SAMHSA, 2020; Sandoiu, 2020). Individuals facing considerable challenges are at risk of developing a maladaptive stress response due to constant exposure to stressors. Driven by chronic stress, this maladaptive response over time can impact brain functions that may result in the progression of neuropsychiatric disorders (Musazzi & Marrocco, 2016). However, developing neuropsychiatric disorders is not common among communities of color. Breslau et al. (2006) point out, people of color do not experience elevated disorders despite stress experienced from inequities.

NEATLabs at the University of California, San Diego (UCSD) aims to understand the neural circuitry underlying cognition across the spectrum of healthy functioning to neuropsychiatric disorders, and engineers scalable technologies to leverage for such research. Taking both race and ethnicity into consideration when studying neuropsychiatric disorders is important, as these variables have shown to influence diagnosis and treatment (Coleman et al., 2016). A previous study found "...Asian, Black, and Latino adults had lower lifetime risk for all major classes of mental disorder compared to White adults" (Alvarez et al., 2019). Here, we studied how resilience scores using the Brief Resilience Scale (BRS) influence neuro-cognitive abilities and if a relationship exists with race and ethnicity. Studying the impact of subjective resilience on objective neuro-cognition may help provide insight into measures of individual resilience, which may help better identify and provide proactive solutions for vulnerable individuals with a maladaptive stress response (Winslow et al., 2015).

LITERATURE REVIEW

Neuro-cognition:

The brain preforms context-appropriate cognitive functions which are associated with specific underlying neural processes. In this current study we focus on working memory (WM), emotional processing (EP), distractor processing (DP), and internal attention (IA). By observing DP and WM, which are a part of the three core executive functions, and EP and IA, both influence higher cognitive functions; we study a well-rounded view of neuro-cognition (Diamond, 2013; Raffone & Srinivasan, 2017; Tyng et al., 2017). DP and selective attention arise due to the complex interaction between the forebrain and midbrain, two areas that contain specialized circuits allowing for information processing for decision making (Knudsen, 2018). The forebrain specializes in selecting information based on the task at hand while the midbrain focuses on priority and relevance of the information being received (Knudsen, 2018). WM is a fascinating executive function due to the communication of the prefrontal cortex (PFC), posterior parietal cortex (PPC), and overlapping neural circuits found between each area (Murray et al., 2017). Effective EP is not secluded to one area of the brain like the amygdala, but requires an interconnected neural network between the insula, the medial prefrontal cortex (mPFC), PPC, dorsal lateral prefrontal cortex (dlPFC), and anterior cingulate cortex (ACC), just to name a few (Ma et al., 2017). Lastly, IA impacts the stability of attentional processes by improving neural mechanisms underlying attention across brain regions and networks (Lutz et al., 2009).

Resilience:

We frame resilience in a comprehensive context encompassing a neurobiological and social scope of an individual's life. Resilience is not a fixed trait; it grows as the individual develops throughout life (Cicchetti, 2010; Office of the Surgeon General (US) et al., 2001). Resilience is a regaining of a previous status before an adverse event and overcoming this event with positive adaptation (Carver, 1998; Smith et al., 2008). A resilient neurobiological system displays adaptability during times of chronic stress, not confined to one neural circuit but interconnected across brain regions, neurochemical systems, and genetic factors (Southwick et al., 2005). The interconnectedness between resilience, neuro-cognitive function, and neuropsychiatric disorders is observed in disorders like General Anxiety Disorder (GAD) or Major Depressive Disorder (MDD). These disorders demonstrate how neural circuits lose resiliency to a maladaptive neurochemical imbalance and require external intervention (McEwen, 2016). Important neural circuitry involving the amygdala, mPFC, and AAC contribute to top-down executive functioning, linking neurobiological resilience to behavioral responses in stressful socioemotional contexts (Yao & Hsieh, 2019).

Resilience to chronic stress is determined by neurobiology and by larger social systems that influence daily life (Southwick et al., 2016). Social systems include but are not limited to employment, education, income, culture, and mental health system accessibility. Yao & Hsieh (2019) explain this dynamic interaction through the Cognitive Appraisal of Resilience (CAR) model, stating that after an individual experiences an adverse event, cognitive appraisal comprises both top-down and bottom-up processing. This processing is influenced by endogenous resources like internal, goal-directed behaviors and exogenous resources, including external, stimuli-driven motivators (e.g., accessibility of mental healthcare resources) (Yao & Hsieh, 2019), which contribute to a positive adaptation.

Race & Ethnicity:

There are contrasting opinions within the scientific community on whether race should be included as a variable within research (Corbie-Smith et al., 2008). Our goal is to both define race and provide the importance of its use within this current study. We define race as a social construct that is multidimensional to cultural background and social group belonging. Race is often misconstrued as a biological construct despite no genetic or biological evidence to support this theory (Doris & The Moral Psychology Research Group, 2010; Kwabi-Addo, 2017; Office of the Surgeon General (US) et al., 2001; Saperstein, 2013). Genetic research and the completion of the Human Genome Project discovered that not only does humanity share a 99.5% similarity in genome sequencing, but that there is greater genetic variation within-group than between-group populations (Kwabi-Addo, 2017; Office of the Surgeon General (US) et al., 2001).

Ethnicity is frequently used to identify culture and is interchangeably used with race, making it difficult to agree upon the specific definition (Rice & O'Donohue, 2002). To facilitate understanding the results of this study, we will recognize race and ethnicity as similar social constructs, as this will help simplify understanding of our results.

Race categorization for demographic collection is a required practice by the US National Institutes of Health (NIH) for federal funding. It includes a list of 5 accepted categories of race and 2 accepted categories of ethnicity (National Institutes of Health, 2015). It is critical to recognize how racial categorization has been abused and has contributed to racism, not limited to governance and policy making but within scientific history as well (Skibba, 2019).

From the beginning of biological race categorization originating from Botanist Carl Linnaeus in 1759, to Francis Galton coining the word 'eugenics' to describe efforts at race betterment in 1883, and to Richard J. Hernstein and Charles Murray arguing for racial difference in intelligence, found in their 1994 publication The Bell Curve (Asian/Pacific/American Institute at NYU, 2015; Facing History and Ourselves, n.d.). Science has a checkered past with using race as a variable. With careful definition and use, categorization within research will better inform of mental health disparities rather than a race/ethnicity-blind approach. This stance is supported by (Simon, 2012) in which European human rights institutions reversed the decision to exclude collecting racial demographics, finding it was harder to push for effective decision making to help support marginalized communities.

We expect to find a correlation between high self-reported resilience scores and performance across neuro-cognitive functions. Additionally, we expect individuals who identify with communities of color and have higher self-reported resilience scores perform better at these neuro-cognitive functions.

METHODS AND MATERIALS

We use the Brain Engagement (BrainE) digital platform developed at NEATLabs, UCSD, comprising of a suite of game-like assays designed to measure neuro-cognitive processes simultaneously with electroencephalography (EEG) recordings (Misra A, Ojeda A, Mishra J., 2018). A qualitative mental health survey, behavioral responses during the game-like assays, and EEG neurophysiology were recorded for each participant. In this study of 281 healthy adults, we excluded data from 17 participants due to self-reported medication and/or diagnosed psychiatric disorders. Study eligibility was simply based on age, ranging from adolescent to senior. No participants were excluded from BrainE. A $20 gift card incentive was offered to all participants who completed the study. All participants provided written informed consent for the BrainE study approved by the UC San Diego Institutional Review Board (IRB #180140).

Mental Health Survey

Every participant had to complete the survey prior to or at the same visit as the BrainE neuro-cognitive assessments. It includes 12 different mental health questionnaires assessing a wide range of issues ranging from childhood trauma, a life events checklist, post-traumatic stress disorder (PTSD), attention deficit/hyperactivity disorder (ADHD), and mindfulness, etc. These questionnaires provide subjective data that can be used along with behavioral and EEG data to give a comprehensive neuro-cognitive snapshot of a participant. We focused on self-reported BRS resilience scores.

Computerized Assessments

After each participant finishes the mental health questionnaire, they complete a suite of 8 computerized assessments. These assessments are defined as closed-loop video games (CLVG) which provide continuous feedback to the participant and incorporate performance-adaptive levels, and further integrate real-time EEG recordings (Mishra et al., 2016). prior to or at the same visit as the BrainE neuro-cognitive assessments. It includes 12 different mental health questionnaires assessing a wide range of issues ranging from childhood trauma, a life events checklist, post-traumatic stress disorder (PTSD), attention deficit/hyperactivity disorder (ADHD), and mindfulness, etc. These questionnaires provide subjective data that can be used along with behavioral and EEG data to give a comprehensive neuro-cognitive snapshot of a participant. We focused on self-reported BRS resilience scores.

BrainE Assessment Modules *(Figure 1)*

This chart describes each test's name, duration and what neuro-cognitive construct examined. Each neuro-cognitive assessment is derived from standard task paradigms that have been used in prior cognitive neuroscience literature (Misra A, Ojeda A, Mishra J., 2018). This study focuses on the Middle Fish, Lost Star, Face Off, and Two Tap because these test critical internal/external executive functioning as previously discussed.

Middle Fish *(Figure 2)*

This game is an adaptation of the Eriksen Flanker Task primarily measuring DP (Eriksen & Eriksen, 1974; Misra A, Ojeda A, Mishra J., 2018). Individuals focus their attention on the direction of the middle fish appearing either above or below the fixation '+' sign and ignore the direction of the surrounding school of fish. The left and right arrow keys are pressed depending on which direction the middle fish is facing, resulting in a happy face feedback, if correct or sad face if incorrect. The inference made when faced with the incongruent set of fish can be measured cognitively and neurally (Balasubramani et al., 2020).

Lost Star *(Figure 3)*

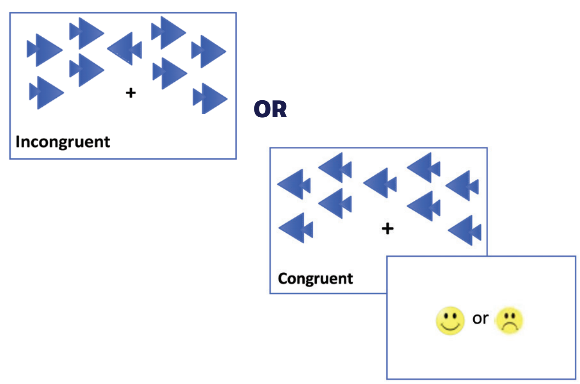
This task is an adaptation of the visuo-spatial Sternberg Task, widely used as an assay of WM (Sternberg, 1966). Participants hold a set of visuo-spatially distributed items in mind and compare a probe stimulus against these items stored in WM, deciding if that probe stimulus was a part of the original set or not (Misra A, Ojeda A, Mishra J., 2018; Sternberg, 1966; Vergauwe & Cowan, 2014). Lost Star was designed in two stages to gauge the number of items an individual can hold perceptually and then test WM. The first stage adaptively calibrates a participant's perceptual WM threshold as per number of items they can discriminate correctly without errors, using 1-8 blue stars. In the second stage, participants maintain their unique threshold set of stars in WM for a three second delay period, then respond whether a probe green-colored star is in the same location as one of the original set of blue-colored stars. Participants press the 'Y' key for yes or 'N' key for no. Lost Star's two-stage

FIGURE 1: BrainE Assessment Modules

Module	Duration with EEG	Problem Target
Go Wait	10 min	Selective Attention & Cognitive Flexibility
Middle Fish	8 min	Distractor Processing
Lost Star	6 min	Working Memory
Face Off	10 min	Emotion Processing
Lucky Door	6 min	Feedback & Reward Processing
Two Tap	4 min	Internal Attention
Lion Cage	3 min	Pre-attentive Processing
Rest	3 min	Resting State

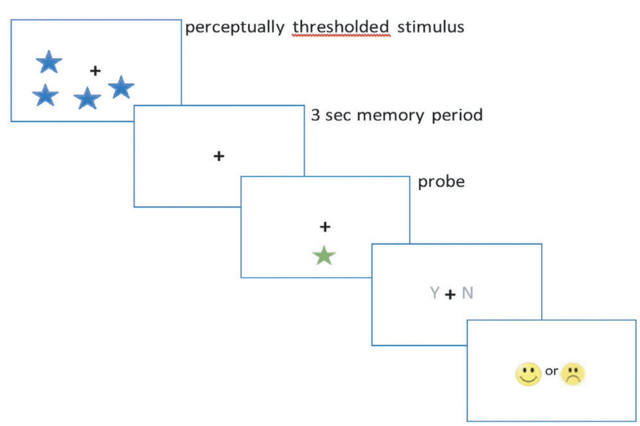
Misra A, Ojeda A, Mishra J. BrainE: a digital platform for evaluating, engaging and enhancing brain function. UCSD Copyright SD2018-816. 2018

FIGURE 2: Middle Fish



Task Stimuli and Feedback are shown. Misra A, Ojeda A, Mishra J. BrainE: a digital platform for evaluating, engaging and enhancing brain function. UCSD Copyright SD2018-816. 2018

FIGURE 3: Lone Star

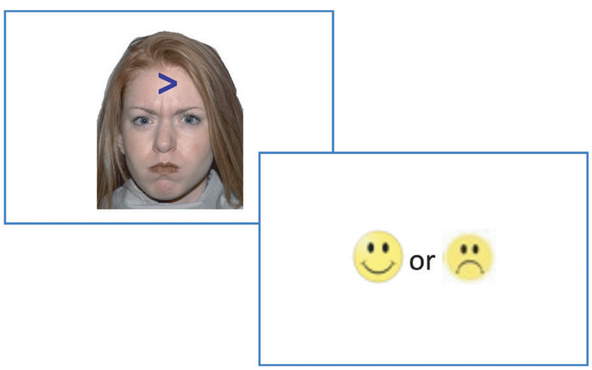


Task sequence is shown. Misra A, Ojeda A, Mishra J. BrainE: a digital platform for evaluating, engaging and enhancing brain function. UCSD Copyright SD2018-816. 2018 formatting enables us to curtail the experience to each individual's threshold and WM limits, allowing an equal perceptual load across participants (Lavie et al., 2004).

Face Off *(Figure 4)*

Face Off was designed to address two aspects of neuro-cognitive EP from prior studies: attention bias in an emotional context and how emotions interact with basic executive functioning and behavior (López-Martín et al., 2015; López-Martín et al., 2013; Misra A, Ojeda A, Mishra J., 2018; Pessoa, 2009; Thai et al., 2016). For this task, participants view a racially diverse set of faces that range from neutral, happy, sad, or angry emotional expressions, one-at-a-time with a superimposed blue arrow on top. Participants respond by pressing the left or right arrow key, depending on which direction the blue arrow points.

FIGURE 4: Face Off



Task stimuli and feedback are shown. Misra A, Ojeda A, Mishra J. BrainE: a digital platform for evaluating, engaging and enhancing brain function. UCSD Copyright SD2018-816. 2018

Two Tap

Two Tap assesses IA, that is commonly understood as mindfulness. Participants attend to their breathing, reporting a two-breath cycle with one tap on the keyboard, continuously for up to 4 minutes while keeping their eyes shut. If a participant taps the keyboard more consistently, meaning a more regulated breathing pattern, this signals that they have a higher IA. This task is supported by evidence in Levinson et al. (2014), who found that breath-counting was distinct from attention and WM while promoting less mind wandering and better mood. The usefulness of IA isn't limited to these two intrinsic changes, as it can also reduce symptoms of both anxiety and depression (Parmentier et al., 2019).

EEG Recording

To assess neural responses during neuro-cognitive processing, BrainE integrates non-invasive, semi-dry EEG recordings. The semi-dry EEG requires a saline solution for proper connectivity between the electrodes and the scalp. By utilizing a semi-dry method, as opposed to the traditional gel-electrode method, the experimental set-up is rapid and the BrainE program can be used in any mobile, community/clinic setting, which allows for greater accessibility. Spectro-temporal patterns of brain activity time-locked to the cognitive events are analyzed.

ANALYSIS

Survey data were collected and managed using the REDCap (Research Electronic Data Capture) tools hosted at UCSD (Harris et al., 2009, 2019). REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources. Data is imported from REDCap into MATLAB so that answers from the survey can be analyzed and flagged if a participant demonstrates a greater level of a mental illness. SPSS v.26 was used to analyze data using Generalized Linear Mixed Models (GLMM). These analyses include the neuro-cognitive performance data for each task of interest, including neuro-cognitive metrics as the dependent variable moderated by resilience, and race and ethnicity as our independent variables.

RESULTS

The current study draws upon a pool of 281 participants (mean age 33.58±19.32; age range 18 — 84 years) who had participated in the BrainE neuro-cognitive assessments in years 2018-2020 (Balasubramani et al., 2020). Racial demographics included White (n=148, 52.67%), Asian (n=69, 24.56%), Multiracial (n=34, 12.1%), and Other (n=30, 10.67%). The 'Other' racial demographic was comprised of Black/African American (n=4), American Indian (n=3), and Unknown (n=23). Ethnic demographics included Hispanic (n=53, 19.5%). Table 1 presents descriptive statistics for race and ethnicity. There was no association between gender and race group ($\chi2(3)=2.173$, $p=.537$) and ethnicity ($\chi2(1)=.169$, $p=.681$).

Correlations Between Resilience and Neuro-cognitive Functioning for different Race Groups.

We used Spearman's correlations for each of the five racial/ethnic groups to investigate the relationship between resilience and neurocognitive task performance (Table2). To control for multiple comparisons across 7 neuro-cognitive performance categories (consisting of efficiency and consistency scores) and 5 racial/ethnic categories, we set a family-wise error rate corrected p value threshold of p=0.003 (one-sided, because we hypothesized that greater resilience would be associated with greater neuro-cognitive performance).

There were two highly significant correlations in the Multiracial demographic category that surpassed the corrected p value threshold. For multiracial individuals, resilience was significantly associated with DP consistency on the Middle Fish task ($r_s(279)=.504$, $p=.001$) and with EP consistency on the Face Off task ($r_s(279)=.504$, $p=.001$).

Effects of Resilience, Race Groups, and Ethnicity on Neuro-cognitive Performance

We generated GLMM specifically for the interference processing and emotion interference processing consistency measures that showed significant relationships with multiracial resilience. Both models included fixed effects of age, gender, socioeconomic status, race groups, ethnicity, and resilience score. The models also included interaction terms for resilience x race group and resilience x ethnicity. GLMM models used a log link function to approximate normal distributions for the neuro-cognitive performance measures of task consistency.

The EP consistency model (on the Face Off task) found that the Multiracial category was a highly significant inverse predictor of EP consistency ($ß = -.193$, 95% CI [-.328, -.058], $p=.005$) while other racial/ethnic groups were not significant. Additionally, only the interaction of resilience

TABLE 1: Descriptive Statistics

	White	Asian	Miultiracial	Other	Hispanic
Sample Size	148	69	34	30	53
Age (years)	41.85 ± 22.76	24.43 ± 6.77	23.56 ± 5.42	25.13 ± 9.76	26.92 ± 13.63
Gender (# and % female)	95 (64.2%)	39 (56.5%)	24 (70.6%)	19 (63.3%)	35 (66.0%)
Resilience Mean Score	21.04 ± 6.73	20.47 ± 5.08	20.99 ± 6.05	19.32 ± 5.16	20.28 ± 5.17
Resilience Median	1.61 ± .489	1.44 ± .500	1.56 ± .504	1.43 ± .504	1.49 ± .505

Note. Resilience Score is a continuous variable ranging from 0 to 30. Resilience Median is a categorical variable ranging from 1 (Resilience Score ≤ 21) to 2 (Resilience Score > 21).

TABLE 2: Spearman Rho Correlations for Resilience Score versus Neuro-cognitive performance

		White	Asian	Multiracial	Other	Hispanic
Middle Fish efficiency	Correlation Coefficient	-.024	-.048	.289	-.053	-.205
	Sig.	.388	.349	.049	.390	.070
Middle Fish efficiency	Correlation Coefficient	-.019	.114	.504**	.087	.095
	Sig.	.409	.179	.001	.323	.250
Lost Star span weighted by efficiency	Correlation Coefficient	-.023	.181	.423	-.029	.135
	Sig.	.390	.070	.006	.439	.167
Lost Star consistency	Correlation Coefficient	.009	.059	.106	.179	.234
	Sig.	.455	.315	.257	.172	.046
Face Off efficiency	Correlation Coefficient	.008	-.067	.202	.125	-.138
	Sig.	.462	.296	.126	.255	.162
Face Off consistency	Correlation Coefficient	.025	-.019	.504**	-.149	.084
	Sig.	.382	.440	.001	.216	.275
Two Tap consistency	Correlation Coefficient	.069	.024	.251	.280	.059
	Sig.	.204	.423	.076	.067	.338

*Note: ** significant to .03 (1-tailed)*

by Multiracial category was a significant positive predictor (ß=.009, 95% CI [.002,.015], p =.011). Figure 5 shows the consistency scores for all race groups and ethnicity split by a categorical median resilience score variable. Specifically, high resiliency individuals in Multiracial category showed a greater consistency score. Other predictors of age, gender, socioeconomic status, and resilience alone were not significant.

We found no significant effects in the GLMM model for DP consistency (on the Middle Fish task).

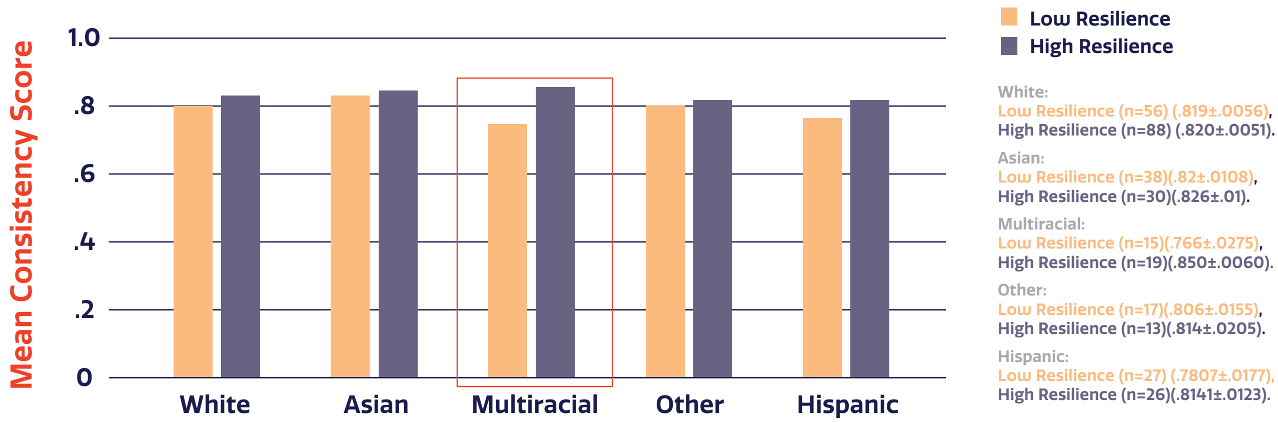
DISCUSSION

We found that there was an association of race, specifically multiracial category, and the moderator of resilience affecting consistent performance on emotion interference processing.

Figure 5 provides a visualization of how the EP consistency scores within the multiracial category compare to other race/ethnicity groupings, showing that greater resilience scores in this racial group are associated with higher performance consistency. There was an inverse relationship between the multiracial category and EP consistency (i.e., this category had lower consistency than other racial/ethnic categories as seen in Figure 5), whereas when an interaction between resilience and multiracial category was included, more resilient individuals in the multiracial category had greater performance consistency than less resilient individuals. This finding aligns with our hypothesis that self-reported subjective resilience may impact objective cognitive function.

Several affective neuroscience studies have demonstrated a connection between emotional affect and neuro-cognitive control

FIGURE 5: Face Off Consistency for Low and High Resilience Individuals across Racial Group



Note. Race group variables are separated by median resilience (Low Resilience ≤ 21, High Resilience > 21). Face Off consistency scores were averaged and standard error was calculated for each racial group's consistency score median resilience separation.

(Inzlicht et al., 2015). Inzlicht et al. (2015) discussed that emotional affect is crucial to control, promoting a 'good life.' This concept of a 'good life' hints that for an individual to respond to stressors, neuro-cognitive control must be resilient enough to respond to a wide range of affective situations. An example of living this 'good life' comes from Sarah Winnemucca Hopkins, a Northern Paiute activist who displayed an admirable amount of resilience in great hardship. Found in her book Life Among the Piutes: Their Wrongs and Claims, Hopkins (1883) narrates:

> ***When I think of my past life, and the bitter trials I have endured, I can scarcely believe I live, and yet I do; and, with the help of Him who notes the sparrow's fall, I mean to fight for my down-trodden race while life lasts. (p.6)***

This quote displays the nuance between resilience fostered by a neurobiological system supporting affective control, a sociocultural system from her tribe, and a Christian religious system that Hopkins drew strength from. This concept of a 'good life' doesn't exclude struggle and hardship but reframes it so that in the face of it, survival is possible.

Consequently, the ability to have flexible affective processing was found to predict differences in resilience levels across individuals in a study conducted by Genet & Siemer (2011). Interestingly, we did not find that resilience across all racial groups significantly affected EP performance.

One possible confounding variable for the Face Off task is the Other-Race Effect (ORE). ORE tends to selectively recognize and remember faces from the same race and is one of the most replicated phenomenon with well-documented consequences (e.g., eyewitness misidentification) (Yaros et al., 2019). This phenomenon is not merely attentional or perceptual but can be associated with neural activations in the ventral temporal cortex, superior temporal cortex, face-selective fusiform gyrus, and amygdala (Natu & O'Toole, 2013; Yaros et al., 2019). The amygdala is of particular importance because of its apparent connection with EP and fear regulation. A study from Cunningham et al. (2004) showed that the amygdala displayed greater activation when presented with other-race faces within participants who had implicit bias towards their race. The ORE bias may affect the Face Off task, as it draws from a pool of diverse faces that have an affective weight due to facial expression. The significant effects found for the multiracial category and its interaction with resilience suggest that this category of individuals may possibly have a specific ORE effect from other racial/ethnic categories, which needs to be addressed in future research.

Although our two GLMM models didn't demonstrate a relationship between neuro-cognitive function and socioeconomic scores, this doesn't exclude the argument that socioeconomic status (SES) could be a confounding variable. There is an interaction between SES and emotional development (Hackman et al., 2010). Indeed, SES's importance and its implications on brain development is a meaningful conversation when considering resilience. An analogy for SES is the low, middle, and upper-class experiences in the United States. There is a complex intersection of economic factors that are generally but imperfectly correlated to being 'better' or 'worse' off (Farah, 2017). The lower SES score an individual has, the more likely that psychological stress and a chaotic environment impact the brain's stress response (Muscatell, 2018; Schibli et al., 2017). These exogenous factors influencing endogenous factors like executive functioning could result in either a flourishing or diminishing of resilient cognitive adaptation. An example of a socioeconomic inequality that impacts an individual's neuro-cognitive functioning throughout life is accessibility to education (Zsembik & Peek, 2001). Zsembik & Peek (2001) show that there is an association between race and cognitive function due to social inequalities like the lack of education. Notably, in our study, all participants had at least a high-school level education. In future studies, education level should be accounted for.

Limitations

Our research draws racial and ethnic demographics solely from the accepted list of self-identification categories predetermined by the NIH. This single-measure approach does not accurately reflect the multifaceted nature of race and ethnicity. Adding additional questions regarding cultural background, social group belonging, and ancestry would parse out an individual's self-identification more than the current approach (Saperstein, 2013). Along with parsing out an individual's self-identification, we recommend taking a step beyond racial demographics and place greater emphasis on resilient-strengthening cultural experiences. A further limitation is the lack of American Indian and Black/African American group representation within this study. It is recommended that further investigation place particular focus on engagement and outreach to these specific populations, as they have been historically underrepresented in scientific research.

Finally, we note that our hypothesis for a positive correlation between self-reported resilience alone and performance across neuro-cognitive functions was not supported. Yet, our study shows the value of including both resilience and race/ethnicity as predictive factors. In a year when a pandemic has placed undue burden on the mental health system, resulting in inequities for individuals belonging to racial/ethnic minorities and lower SES, resilience needs to extend beyond an afterthought in both research and mental health interventions. By focusing on a mobile platform such as BrainE that can be implemented in any community setting, and including constructs such as resilience, race and ethnicity, we push for a more socially aware understanding of objective cognitive functioning. Ultimately advances in this domain may enable mental health practitioners to improve personalized services for communities of color, and engage in practices that bolster resilience in the community in which they serve.

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Morgan Montoya

McNair Cohort: 2019

Biography:

Behavioral Neuroscience degree, I want to utilize my experience with depression, neuroscience knowledge, and advocate mindset to help diminish the barriers for those who are struggling with mental illness. During my time at UCSD, I was an active member for my Christian student org Cru, the Intertribal Resource Center (ITRC), the Revelle Transer Tuesdays, and CASP events. A few of my favorite pastimes include learning more about my Northern Paiute tribal language, learning a song on a piano, or geeking out over Lord of the Rings.

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