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Measuring the Biological Embedding of Racial Trauma Among Black Americans Utilizing the RDoC Approach

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Abstract

The NIMH Research Domain Criteria (RDoC) initiative aims to understand the mechanisms influencing psychopathology through a dimensional approach. Limited research thus far has considered potential racial/ethnic differences in RDoC constructs that are influenced by developmental and contextual processes. A growing body of research has demonstrated that racial trauma is a pervasive chronic stressor that impacts the health of Black Americans across the life course. In this review article, we examine the ways that an RDOC framework could allow us to better understand the biological embedding of racial trauma among Black Americans. We also specifically examine the Negative Valence System domain of RDoC to explore how racial trauma is informed by and can help expand our understanding of this domain. We end the review by providing some additional research considerations and future research directives in the area of racial trauma that build on the RDoC initiative.

Keywords

racial trauma; racism; Black Americans; RDoC; PTSD

> "*If we do not know how to meaningfully talk about racism, our actions will move in misleading directions*"
>
> - Angela Davis (2016), Freedom is a Constant Struggle

The National Institute of Mental Health has promoted the Research Domain Criteria (RDoC) framework to advance a dimensional approach to understanding mental health and mental illness that goes beyond diagnostic categorical boundaries (Insel et al., 2010). This framework posits that varying degrees of psychopathology are disorders of brain circuitry whereby multiple units of analysis that target neurobiological mechanisms aid in understanding root causes of psychopathology and guiding clinical interventions (Cuthbert & Insel, 2013). While the RDOC framework provides an important opportunity to systematically explore current conceptualizations of mental health and illness, there remains an underlying limitation within this mechanisms-focused research framework.

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For minoritized populations in the U.S., research focused on underlying mechanisms often ignores sources of psychopathology that are not within the individual but are better conceptualized as being within structures and systems that perpetuate injustice intergenerationally and over the life course. A closer examination of the role of larger societal structures on mental health and wellness has the potential to broaden our understanding of mental health categories and the etiology of mental health problems. This approach also provides an opportunity to focus on the impact of race-related stressors, particularly for Black Americans, and the enduring impact of racism over time on minoritized population's mental health and wellness. This approach is best accomplished by adopting a life-span developmental psychopathology perspective, underscoring the *cumulative effect* of multiple sources of chronic stress and trauma on a range of mental health and wellness outcomes.

A benefit of RDoC research is that it does not require DSM/ICD diagnoses to select study participants, allowing for a focus on dimensions of functioning that are central to a range of clinical conditions. This may be particularly useful in research with historically disenfranchised communities that disproportionately experience significant chronic stressors across their life course (Hampton-Anderson et al., 2021). Research has shown that experiences of chronic stressors can contribute to a diverse array of clinical presentations. Several studies utilizing the RDoC framework have examined the way in which chronic stressors related to acute and chronic trauma exposure influence trajectories toward psychopathology (Liu et al., 2017; Norrholm et al., 2014; Sumner, Powers, Jovanovic, & Koenen, 2016), with most emphasizing the RDoC "Negative Valence System." The Negative Valence System includes dimensions or constructs that examine underlying antecedents and consequences of areas such as acute threat, fear, and loss. Within research related to this domain as well as traumatic stress generally, studies have found significant genetic and physiological correlates with anxiety, depression, and posttraumatic stress disorder (PTSD).

Through the use of psychophysiological, neurobiological, and stress biomarker methodologies, research has steadily increased utilizing the RDoC framework to elucidate responses to trauma exposure that are both adaptive and maladaptive. Yet, too often these studies are interpreted as having significant translational potential without acknowledging or considering potential environmental, developmental, and contextual factors that could inform research conceptualizations and implications (Lilienfeld & Treadway, 2016; Matheson, Bombay, & Anisman, 2018). Although the RDoC framework encourages a focus on developmental and environmental factors that may be related to neural and biological circuits of human functioning, developmental and environmental considerations are not systematically incorporated in the RDoC matrix or domains. Furthermore, the emphasis on the role of brain circuits within RDoC lends itself to underestimating or overlooking the potential impact of experiences of race-related stress and systems of oppression and overemphasizing deficit-based biological mechanisms of mental health disorders. Within a society that needs to reckon with how past and present perpetuations of oppression influences many outcomes in minoritized populations, it is time for psychologists to consider the ways that the RDOC framework could be profitably expanded to better include the role of systems of oppression, experiences of racial discrimination, race-related stressors and racial trauma. Accordingly, we examine the ways in which an expanded RDOC

framework might allow us to better examine *the biological embedding of a range of race-related experiences that potentially contribute to psychopathology among Black Americans*. Doing so may highlight additional opportunities to challenge and possibly transcend the current boundaries of the RDoC framework.

Background Considerations

Due to structural racism in the U.S., Black Americans suffer both reduced educational outcomes and reduced lifetime income, with long lasting effects on their experience of chronic stressors. A quarter of Black students attend high schools that fail to offer college preparatory courses (U. S. Department of Education, 2014). Even when Black students earn a college degree, their unemployment rate is two-thirds higher and their salary substantially lower than that of white graduates (Brown, 2019). Approximately 1/3 of Black families live near or below the poverty line, and the ratio of Black to white median family income has remained constant (roughly 56%) since the late 1960s (Manduca, 2018). Differences in wealth are even more striking. Median wealth for white families is 10 times that of Black families (Kijakazi, 2019), resulting in greater vulnerability to even modest economic shocks. Thus, Black Americans are much more likely than other racial/ethnic groups to experience chronic economic hardship and the stressors that result from it (Massey, 2007; Sampson,1997).

In addition to effects on education and poverty, structural racism creates segregated neighborhoods, with Black Americans much more likely to live in a disadvantaged neighborhood, i.e., neighborhoods with concentrated poverty, low education, and high rates of unemployment (Keppel, Pearcy, & Wagener, 2002; McArdle, Osypuk, & Acevedo-Garcia, 2007; Sampson, 2011), as well as elevated risk of living in dangerous environments associated with neighborhoods having concentrated poverty. Historical practices of structural racism (e.g., redlining and residential segregation) have also significantly influenced Black American's disproportionate exposure to environmental pollutants and extreme heat that negatively impact health (Hoffman, Shandas, & Pendleton 2020). More than half of Black metropolitan residents live in segregated, disadvantaged neighborhoods; in fact, no other group in the history of the U.S. has experienced the degree of segregation that has been forced upon Black Americans (Sampson, 2011; Wilson, 1987). Even Black Americans in the top quintile of the income distribution often live in neighborhoods with high crime and disorder (Intrator, Tannen, & Massey, 2016). Importantly, residential segregation is a consequence, in large measure, of institutionalized prejudice and discrimination in the real estate and banking industries, including practices such as profiling, redlining and selective marketing (Massey, 2007). Again, residing in disadvantaged neighborhoods creates increased exposure to chronic stressors and specific traumas, some of which may constitute racial trauma, such as harassment by police. Finally, Black Americans often experience incidents of interpersonal racial discrimination, ranging from subtle insults to flagrantly racist incidents (e.g., English et al., 2020; Lanier, Sommers, Fletcher, Sutton, & Roberts, 2017) resulting in effects on mental health (e.g., Benner et al., 2018; Jones & Neblett, 2017; Lavner, Hart, Carter, & Beach, 2021). Because of these pervasive stressors, Black Americans routinely experience both chronic stress and discrete traumatic events with the potential to increase their risk for negative mental and physical

health outcomes, including increased exposure to death and loss (Massey, 2017) leading to elevated risk for early life morbidity and mortality (Geronimus, Arline, Hicken, Keene, & Bound, 2006; Simons et al., 2021) as well as the trauma associated with interpersonal loss.

These background considerations suggest that stress related to racism-driven injustice is embedded within the fabric of U.S. society. It has influenced mental health and well-being across multiple generations of Black Americans and would seem to require expanded definitions and a broader contextual understanding of violence and trauma in future research with Black Americans, and other minoritized groups, to better acknowledge and assess the full impact of exposures related to oppression (R.T. Carter, 2007; Sanders-Phillips, 2009). The lived experiences of Black Americans in U.S. society often lie within a story of survival, adaptation, and violence due to a broader context of oppression. Acknowledging this lived experience may help guide efforts to reconsider the RDoC framework and help the field move toward a more accurate and precise understanding of the psychological costs of the multisystemic traumas that occur due to racialized contexts.

Robins and Guze (1970) posit that the critical test to determine if research can alter clinical practice is how well neurobiological and cellular/molecular dimensional parameters predict clinical prognosis or treatment. Although the RDoC initiative is said to be an evolving framework (Insel et al., 2010; Lake, Yee, & Miller, 2017), a key assumption is that understanding neural and biological circuity will be sufficient to differentiate mental disorders and prognosis. Unfortunately, this stance tends to "decontextualize" psychopathology, potentially minimizing important causal processes for minoritized populations. RDoC constructs are stated to be situated within and influenced by neurodevelopmental and environmental contexts, but very little research has focused on examining mental health related to trauma exposure from a fully contextualized framework that includes historical and contemporary racism. Additionally, because Black Americans have been historically excluded from research, their experiences have had limited opportunity to influence diagnostic conceptualizations of mental health and illness, reducing opportunities to incorporate psychobiological constructs that may be most pertinent for them.

In the current review, we focus on utilizing and expanding the RDoC framework, using the example of racial trauma and its impact on Black Americans. We will first provide definitions as well as grounded research that supports the importance of an increased research focus on the biological embedding of racial trauma and its importance for mental health outcomes. Second, we will focus our attention on the Negative Valence System of RDoC to explore how racial trauma is informed by and can help expand our understanding of this domain. Lastly, we will provide some additional considerations and future research directives that build on the RDoC initiative and will include considerations for the measurement and assessment of the biological embedding of racial trauma.

Definitions and the Biological Embedding of Racial Trauma

What is Racial Trauma?

In 2020 and 2021, the Center for Disease Control and Prevention (CDC), the American Medical Association (AMA), the American Psychological Association (APA), the American Heart Association (AHA), and several other highly-regarded organizations identified racism as a serious threat to public health that cannot be ignored (Kuehn, 2021; O'Reilly, 2020; Walensky, 2021). These calls to action were, in part, a response to recent police killings (i.e., George Floyd, Breonna Taylor, Atatiana Jefferson, Ahmaud Aubery, Daunte Wright, etc.) and injustice toward Black Americans that led to a societal reckoning and a widespread movement for change. As defined by Jones (1997), racism is a belief in the inferiority of a person or people caused by prejudice against their ethnicity, phenotypic characteristics (e.g., skin tone or hair texture), or purported biology. Jones further describes racial discrimination as the differential behavioral treatment component of racism across a variety of contexts that include interpersonal situations, systems and structures, and institutions. Research indicates that the majority of Black American children and adults report experiences of racial discrimination, with rates ranging from 73% to 90% (Helms, Nicolas, & Green; Pachter, Bernstein, Szalacha, & Coll, 2010), and up to 93% in national polling data (National Public Radio, 2017).

Bryant-Davis & Ocampo (2005) indicated that an important feature of racism is that it "strikes at the core of one's selfhood." There is substantial research evidence that the stress and toll of racism-related experiences negatively impacts mental health, with recent research providing rigorous evidence that greater experiences of racial discrimination lead to greater depressive symptoms eight-months later, and that elevated experiences of racial discrimination relative to one's own average experience of racial discrimination also leads to increased depressive symptoms (e.g., Lavner et al., 2021). Also, there is a larger body of research indicating associations of racism with well-being across the lifespan (Brondolo et al., 2008; Brody et al., 2014; Pascoe & Richman, 2009), and associations with the health disparities seen in Black American populations. However, beyond the general effect on chronic stress, depression, well-being, and health, researchers have also recently begun to consider the ways in which experiences of racism may be traumatic in nature, hence the term "racial trauma."

Racial trauma is considered to be a form of racism-related stress and refers to stress responses and reactions to a multitude of racialized incidents including: threat of harm and injury, humiliating and shaming events, and witnessing racial discrimination or racialized violence towards other minoritized people (Comas-Díaz, Hall, & Neville, 2019). Several terms have been used interchangeably in the research literature to describe the construct of racial trauma including "racist incident–based trauma," "ethnoviolence," "racism-based trauma," and "race-based traumatic stress". With all of these terms there is a foundational conceptualization that exposure to racism, in itself, can produce traumatic stress reactions (i.e., hyperarousal, intrusion or re-experiencing, avoidance or numbing, and negative self-concept) that coincide with symptoms of posttraumatic stress disorder (PTSD; R.T. Carter, 2007). Research on PTSD indicates that Black Americans have higher rates and a more

severe course of PTSD symptomatology than white Americans--differences that are not accounted for by socioeconomic status or history of psychiatric disorders (R.T. Carter, 2007; Sibrava et al., 2019). Recent research by Sibrava and colleagues (2019) longitudinally examined the influence of racial discrimination on the clinical course of PTSD in a clinical sample of Black and Latinx American adults and found that, over five years, racial discrimination significantly predicted PTSD diagnostic status.

Although empirical research continues to grow demonstrating a relationship between racial trauma and PTSD (R.T. Carter et al., 2021; Williams, Metzger, Leins, & DeLapp, 2018), researchers have also highlighted the conceptual similarities as well as differences between racial trauma and other traumatic experiences related to PTSD. Racism is considered to be traumatic because like other traumatic experiences outlined in the DSM (i.e., sexual assault, rape, and interpersonal violence) racism is uncontrollable, unpredictable and motivated by the impulse for power (Bryant-Davis & Ocampo, 2005). Conversely, research scholars also state that racial trauma is distinct from traumatic experiences related to PTSD because racial trauma lacks a “post” trauma period for minoritized populations living in consistently-oppressive environments. Racial trauma entails ongoing direct, collective, and/or vicarious injuries from exposure and re-exposure to racial stressors (Comas-Díaz et al., 2019; Saleem et al., 2020). In addition, as noted above, due to the structural characteristics of segregated communities, racial trauma is often superimposed on other traumas, potentially amplifying and maintaining symptoms related to these other types of trauma.

Helms et al. (2012) suggest that one reason that racial trauma is missing from contemporary trauma research, theory and practice is that the broad historical foundations of racial trauma, and its developmental effects, often are sufficiently diffuse and pervasive that they do not provide objective evidence that a particular individual has been harmed more than others. Indeed, researchers such as Gee and colleagues (2012) note the importance of implementing a life-course perspective to understand the pernicious impact of racism and racial trauma, due to the complexity of the nature and intensity of racism exposure across development and across generations. Taken together, we believe that the research and theory in the area of racial trauma naturally lends itself to investigation through a RDoC framework. Though the link between racial trauma and negative psychological outcomes is quite clear, few studies have examined the biological embedding of racial trauma from a life course perspective to inform diagnostic and clinical practice.

The Biological Embedding of Racial Trauma: A Life Course Perspective

To begin to consider the biological embedding of racial trauma, we first explore research indicating that racism has biological effects among Black Americans similar to those seen for other forms of trauma, and that both racism and other forms of trauma can negatively influence psychological and physiological developmental processes (Brondolo et al., 2008; Brody et al., 2014; Pascoe & Richman, 2009; Lewis, Cogburn, & Williams, 2015; Tursich et al., 2014; Yang & Jiang, 2020). Racial discrimination, in primarily adult populations, has been linked to a number of stress biomarkers including elevated glucocorticoids, C-reactive proteins, proinflammatory cytokines, and neuroendocrine risk indicators (Brondolo et al., 2008; Lewis et al., 2015; Pascoe & Smart Richman, 2009). In the larger trauma and PTSD

literature, similar stress biomarkers have been reported (Tursich et al., 2014; Yang & Jiang, 2020). For Black Americans specifically, research indicates that the disparate experiences of adversity, trauma, and chronic stressors seen among this population are fundamentally driven by historical legacies of oppression (i.e., residential segregation, redlining, selective marketing, and carceral systems) that permeate our society and sustain mental and physical health inequity (Masse, 2007). With the growing recognition of the interconnection between the environment, brain, and behavior (Nusslock, et al., 2019; McEwen, 2017; Shonkoff, 2016), examining the foundation of psychopathology related to racial trauma starts with considering theoretical processes that illuminate how racism affects the mind and body over time.

Geronimus (1992, 2006) coined the term “weathering,” highlighting that health disparities for Black Americans do not start in adulthood, but reflect changes in biological processes that begin early in development and continue across the life course due to an erosive environment. The weathering hypothesis claims that physiological responses to the repeated experiences of structural racism and threats to one’s identity create wear and tear on the body’s regulatory systems over time. A number of studies conducted through the Center for Family Research (https://cfr.uga.edu/) over the last 15 years have focused on Geronimus’ lifespan perspective, identifying ways that chronic stressors, like racism, get “under the skin” and leave a “biological residue” of enduring health consequences among rural Black American populations (Brody et al., 2016). The findings among our team are compelling and consistent, demonstrating that socio-contextual factors above and beyond health risk factors such as diet, exercise, and alcohol consumption influence biological aging of Black Americans on multiple assessment measures. For example, in seminal work examining the effects of weathering among Black American adolescents in the rural South, Brody et al. (2014) found that racial discrimination experienced at age 16 was related to heightened allostatic load (i.e., summed measurement across multiple physiological systems: cortisol, blood pressure, body mass index, norepinephrine, and epinephrine) at age 20, but this relationship was ameliorated when adolescents received high levels of emotional support. Allostatic load is considered to reflect weathering processes from the body’s exertion over time to sustain homeostasis in response to stressors (McEwen, 1998), and this body dysregulation is shown in several physiological structures studied in RDoC approaches (e.g., metabolic, autonomic, endocrine, inflammatory and cardiovascular systems). We gathered from this study that not only is it important to think about the effects of early life experiences of racial discrimination on biological stress regulatory systems, but also that the stress-buffering effects of emotional support may have implications for considering psychobiological processes of health as well.

In another study examining processes of weathering from this team, Carter et al. (2019) examined the role of depressive symptoms in mediating the relationship between early life experiences of racial discrimination and accelerated cellular level aging in adulthood among Black Americans (i.e., prediction over a 19-year period; from age 10 to 29), after adjusting for health behaviors (i.e., healthful diet, exercise, alcohol consumption, and sleep quality). This research sought to further advance research examining the underlying mechanisms that influence racial health inequities, and importantly found that sustained negative affective states across early life development into young adulthood conferred risk for accelerated

cellular aging, and possibly premature disease and mortality in Black Americans. Studies such as this one suggest that constructs of clinical significance are associated with and caused by social inequities like racism and racial trauma.

Additional recent studies from the Center for Family Research further underscore the ways in which stress due to racism-- in both its interpersonal and structural forms-- can be biologically embedded to affect health for Black Americans. Simons et al. (2020) investigated the extent to which four types of strain often experienced by Black Americans due to historical and contemporary oppression-- living in disadvantaged neighborhoods, racial discrimination, limited income, and low education-- are related to GrimAge, which is a novel epigenetic measure of biological aging that has demonstrated capabilities of being a robust predictor of morbidity and mortality. This study was consistent with the weathering hypothesis and found that all four of these measures of racism-laden adversity, as well as an index combining the four, were significant predictors of GrimAge. An additional study worth noting drives home the extent to which multi-level forms of racism impact health. Chen, Miller, Yu, and Brody (2015) conducted a longitudinal study examining the impact of the Great Recession (which occurred from 2007–2009) on Black adolescents. They described the Great Recession as an externally occurring “macro-economic event” that allowed them to examine biological mechanisms in the context of changing macro-economic circumstances. Findings indicated that the more time Black American adolescents spent in economic hardship the higher their epigenetic aging and allostatic load, and the worse their self-reported health. Although this study could be categorized as solely a consideration of the effects of poverty, we believe that the study highlights the ways structural racism seeps into societal socioeconomic events and leads to unequally distributed penalties to marginalized communities, with accumulating biological and psychological costs. A vivid and more recent example that supports this notion is the COVID-19 pandemic. In 2020, Black American men’s life expectancy dropped 3 years in 6 months due to COVID-19 (Andrasfay & Goldman, 2021); and researchers noted that these statistics expose persistent problems in the U.S. In our own research we found that pre-pandemic stressor levels (i.e., financial strain, racial discrimination, and chronic stress) among Black Americans was significantly associated with exposure to COVID-19-related stressors during the pandemic, and with physical and mental health impacts of the pandemic (Adesogan, Lavner, Carter, & Beach, in press). Again, these findings underscore that macro-events like the pandemic pose the greatest threats to those who are already more vulnerable. In short, during the COVID-19 pandemic, those with greater pre-pandemic psychosocial risks and stressors-- i.e., Black Americans-- fared the worst.

The loss of lifespan due to the effects of racism is a theft of time from a group of people. It affects not only the person who dies prematurely, but also families and communities. Racial trauma therefore is also concerned with time: who owns it, who has more of it, and who has had it taken from them. Our historical consciousness of racial injustice in U.S. society suggests that considerations of death and loss of lifespan should be at the forefront of any discussion of health inequities, and are one source of racial trauma. Consistent with our broader conjecture, Black Americans’ experiences related to trauma cannot be easily decontextualized in clinically-driven research, and doing so is likely to distort the reality of important contributing factors. Instead, a paradigm shift is needed to better account for

the ways that the sociocultural environment, which includes historical and contemporary racial trauma, influences the biological embedding processes often studied within an RDoC framework.

RDoC Framework for Racial Trauma: The Negative Valence System

As previously mentioned there is a substantial body of research demonstrating the link between trauma exposure and damage to neuropsychobiological systems (Tursich et al., 2014; Wolf et al., 2018). Similar to the previously discussed research on racism, the impact of stress from trauma exposure is influenced by developmental processes and the chronicity of trauma exposure over the life course (Romens, McDonald, Svaren, & Pollak, 2015; Yehuda et al., 2010). Although research is clear that both racism and trauma can impact mental health and illness, the research literature on these topics have primarily separated into *non-race-related stressors* and *race-related stressors*; precluding contextual considerations of the interwoven or unique nature of these constructs in conceptualizing racial trauma among Black Americans.

Trauma exposure disproportionately impacts Black Americans across the lifespan. Almost 65% of Black American youth report traumatic experiences compared to 30% of their peers from other races and ethnicities (Bernard et al., 2021; Fitzpatrick & Boldizar, 1993; Slopen et al., 2016). Black Americans also experience more chronic and severe PTSD symptoms compared to other racial and ethnic groups (Gluck et al., 2021; Roberts, Gilman, Breslau, Breslau, & Koenen, 2011; Sibrava et al., 2019). Of additional note, Black Americans have significantly higher rates of objective life stressors, such as witnessing violence, receiving bad news, and losing a loved one prematurely (Massey, 2017; Turner & Avison, 2003). Research has indicated that the increased vulnerability to trauma exposure that Black Americans often face is due to concentrated disadvantage (i.e., living in communities with higher crime rates, poverty, and police brutality), risk factors that are direct outgrowths of structural forms of oppression. Therefore, an increasing number of research articles have pointed out that current theoretical models of trauma and adversity over the life course neglect the multifaceted influence of multiple forms of traumatic stressors on mental and physical health outcomes (Bernard et al., 2021; Hampton-Anderson et al., 2021).

The Negative Valence System domain within the RDoC framework pertains to research focused primarily on body regulatory systems responsible for reactions to aversive situations or context, such as fear, threat, anxiety, and loss. Emotional valence is a psychological construct that refers to experiences of aversive or attractive environmental stimuli, with negative valence capturing negative affective states that are often found in various anxiety and stress-related disorders. This particular domain has been studied extensively from a translational perspective for numerous stress-related psychiatric conditions, including trauma-related disorders (Liu et al., 2017; Norrholm et al., 2014; Sumner et al., 2016). Research that has utilized multiple units of analysis to understand underlying mental function and biological risk for psychopathology suggests that this domain plays an important role in PTSD. However, the contribution of this domain to understanding the development of trauma psychopathology and clinical applications remains limited. This may be due to the failure to account for contextually-laden factors in addition to biological

risk factors for trauma psychopathology, factors which can be more readily identified in the context of trauma occurring to Black Americans. It may also be due to failure to contemplate the ways in which biomarkers for psychopathology due to trauma exposure can function differently across groups and may even have adaptive aspects within the context of racial trauma, particularly when much of the risk for the biomarkers is driven by ongoing oppression and chronic stress. The next section of this paper will focus on considerations of context, specifically racial trauma, within the Negative Valence System domain, with particular attention to constructs that we believe have substantial relevance to understanding racial trauma and its links to psychopathology: acute threat, potential threat, and sustained threat. This section will conclude with a discussion of current research as well as potential future research directives that utilizes a life-span developmental psychopathology approach to the Negative Valence System domain.

Acute, Potential, and Sustained Threat: Living Beyond the Fear

Acute Threat—The acute threat construct of the Negative Valence System identifies differences in normal versus abnormal fear that can occur suddenly due to a significant threat or dangerous situation. Normal fear is said to involve a pattern of adaptive responses to conditioned or unconditioned threat stimuli. Several neurobiological paradigms and metrics have been used to measure acute threat, including startle response, skin conductance, and heart rate responses (Maples-Keller et al., 2019; Norrholm et al., 2014; Wangelin & Tuerk, 2015). Since PTSD is a heterogeneous disorder with several subtypes, researchers have considered that multiple neurobiological mechanisms cause the development of PTSD due to trauma exposure. Researchers believe they have identified that a key deficit in individuals with PTSD is the inability to regulate fear. While the number of studies in this area continues to steadily grow, researchers who study developmental contexts of trauma and violence caution against deficit-based frameworks and contend that, particularly for minoritized populations, what is considered pathology or deficits can often be potentially adaptive responses that increase effectiveness in navigating environments with high levels of concentrated disadvantage and racialized violence (Del Giudice, Ellis, & Shirtcliff, 2011; Gaylord-Harden, Barbarin, Tolan, & Murry, 2018). This leads to complex questions such as: What is optimal or normal fear in a context of chronic oppression for some Black Americans?

Fear conditioning, based on Pavlovian principles of conditioned and unconditioned stimuli, is a major paradigm within behavioral neuroscience and considered an exemplary experimental paradigm for research examining the construct of acute threat. These paradigms have been used for those with combat PTSD as well as civilian PTSD. Briefly, fear conditioning involves the pairing of a neutral conditioned stimulus (e.g., a shape) with an aversive unconditioned one (e.g., a shock), until the neutral stimulus itself produces a fear response. The inability to inhibit fear when there is apparent safety in these experimental paradigms is found to be translatable to clinical cases of PTSD whereby individuals who have deficits in fear inhibition experience arousal, intrusive reminders, and/or panic symptoms when confronted with trauma reminders (for further details see: Johnson, McGuire, Lazarus, & Palmer, 2012; Briscione, Jovanovic, & Norrholm, 2014). Fear conditioning paradigms as well as measurement of fear conditioning through

physiological responses (i.e., acoustic startle response and skin conductance response) have been employed to uncover mechanisms of fear-related dimensions of PTSD (fear extinction, fear inhibition, fear load) across multiple units of analysis, aligning with the RDoC mission. For example, in a study examining deficits in fear extinction due to high psychophysiological "over-expression of fear" (termed fear load) in a primarily Black American adult sample living in an urban and southern community, researchers found that fear load during extinction was associated with intrusive thoughts about a traumatic event and intense physiological reactions to trauma reminders (Norrholm et al., 2015). The authors noted excessive fear load represents a potential clinical target as it can interfere with vital attentional and cognitive processes.

There is also a growing body of research that has examined the construct of acute threat using multiple units of analyses, such as research investigating the genetic influences on the neural circuitry and physiology of acute threat (Sumner et al., 2016). Although this type of research is accumulating, research examining drugs targeting neural pathways in preclinical animal models of stress disorders are often found to be ineffective for human disorders; a failure to translate science to practice. In the conclusions of recent randomized control trials and reviews of the field of fear-related disorders (Jovanovic et al., 2020; Ressler, 2020), researchers have suggested that we are approaching a point of successfully translating neurobiological findings related to fear and threat processing into clinical practice, while also acknowledging that the field needs to continuously reassess research that is not found to be translational between the biology and targeted clinical and/or pharmacotherapy interventions.

The important potential need for reassessment to address gaps in translational understanding of acute threat and fear learning may lie within research that takes a developmental and contextual approach. When considering racial trauma as a chronic stressor with potentially similar threatening stimuli to non-race-based trauma, one could see how these experiences could align with the fear-learning literature of increased psychophysiological responses to threat and difficulties with fear inhibition. What makes racial trauma unique, however, is its uncontrollable and chronic nature as a stressor. Neblett (2019) discusses possible implications for threat appraisal when it comes to studying racism and health and notes that experiences of multi-systemic racism could lead to the development of negative schemas over the life course, increased threat appraisals, and inhibited neuropsychological functioning (e.g., cognitive control/flexibility) that negatively impact health outcomes. He hypothesizes that negative schemas due to racism might maintain perceptions of threat in one's environment even when there is safety, and that a developmental health framing of threat appraisal studies is needed to unpack this process. Taking this into consideration, Black Americans live in a world where ideas of threat versus safety are more complex than they may be among white Americans due to the context of longstanding oppression. The cognitive and physiological demand of identifying threats in one's environment could serve an important survival and life preservation function while over-taxing body regulatory systems, and contributing to physical and mental health problems. Therefore, perhaps labels utilized in RDoC studies of fear learning among minoritized and historically disenfranchised groups such as "dysfunction," "impaired," and "deficit" are inadequate descriptors to capture developmental trajectories or adaptive trade-offs when these are context dependent

(Lilienfeld & Treadway, 2016). In addition, these considerations suggest that the most effective interventions may not always involve reducing or eliminating fear responses when these can be shown to be adaptive and aid in survival in some contexts (Hill, 2005).

It may also be important to consider the ways in which experiences of racial trauma are connected to experiences of other forms of trauma (i.e., interpersonal violence, witnessing violence, etc.) among Black Americans, and the implications of this for threat-appraisal processes. It's possible that the symptoms that arise after experiences of non-race-related trauma are compounded by the effects of chronic exposure to racial trauma. This was examined in recent research we conducted at the Grady Trauma Project (a research team studying the clinical and physiological implications of trauma exposure; http://gradytraumaproject.com/). Results indicated a significant interaction between previous experiences of racial discrimination and experiences of interpersonal trauma (e.g., witnessing murder of a close family member/friend, being attacked with/without a weapon by a spouse/romantic partner or stranger, etc.) among Black women living in urban contexts, such that the association between PTSD symptoms and interpersonal trauma was stronger at higher levels of racial discrimination (Mekawi et al., 2021). Although this study did not examine processes of acute threat, it provides support for taking both race-related and non-race-related stressors into consideration when examining the etiology and development of PTSD among Black women. In addition, it suggests that experiences of racial discrimination may need to be explored to better understand PTSD symptoms in some contexts. To address the lack of research on racial trauma experiences, threat appraisal, and neural responses among Black Americans, we also conducted research at the Grady Trauma Project to examine the unique link between racial discrimination and neural response patterns throughout the brain during attention to threat cues in a trauma-exposed community sample of Black American women (Fani, Carter, Harnett, Ressler, & Bradley, in press). Findings from this study revealed that Black American women who reported more racial discrimination experiences showed heightened reactivity to trauma-relevant images in components of visual attention and emotion regulation/fear inhibition networks of the brain, even after accounting for variance associated with PTSD or trauma. This study calls attention to the need for further research examining neurobiological pathways related to the RDoC construct of acute threat through the lens of racial trauma for Black Americans across the lifespan.

Potential Threat—Acute threat is differentiated from potential threat based on the immediacy and imminent presence of threat. According to the RDoC framework, the construct of potential threat activates brain systems in situations where harm may potentially occur, but is ambiguous, low or uncertain in probability, and/or depicted as a pattern of responses of hypervigilance. Weston (2014) argues that fear is not necessarily the main characteristic of PTSD, as evidence has shown that individuals can develop PTSD in the absence of fear at the time of trauma exposure. He further discusses the etiology of PTSD through an emphasis on peritraumatic hyperarousal (e.g., hyperarousal during or immediately after a traumatic event) that is normal and adaptive in response to a traumatic threat but abnormal when it endures after the trauma has ended. This conceptualization of hyperarousal points to a dimensional framework for the development of PTSD within the

RDoC framework. However, the requirement that psychopathology related to hyperarousal and/or hypervigilance occurs in the absence of threat may fail to encapsulate Black American experiences. In the formative qualitative research by Smith and Patton (2016) that aimed to understand PTSD within context, researchers found that Black men living in areas of chronic violence exposure described the PTSD symptom of hypervigilance as "staying on point." These participants further described hyperarousal and hypervigilance as adaptive rather than maladaptive coping to potential threat that protected them from future violence exposure. In a recent study by Phan, So, Thomas, and Gaylord-Harden (2020) exploring the cost-benefits of these constructs, research findings indicated that self-reported hypervigilance among Black American male adolescents predicted decreases in witnessing violence, but not violent victimization one year later and self-reported physiological hyperarousal predicted decreases in violent victimization at high but not low levels of participant's self-reported physical aggression one year later. In consideration of these findings from a developmental framework, scholars have proposed that adaptive calibration models are useful strength-driven approaches for understanding mental health processes of trauma-exposed Black Americans (Del Giudice et al., 2011; Gaylord-Harden, Bai, & Simic, 2017; Gaylord-Harden et al., 2018).

The adaptive calibration model posits that individuals show different patterns of stress responsivity in response to varying levels of chronic or potential threat within their environment (Del Giudice et al., 2011). It also emphasizes that psychophysiological responses or behaviors that historically are interpreted as deficits or pathology can be viewed as agentic and effective responses for navigating violent and threat-laden environments over a lifespan. For example, a hypervigilant stress responsivity pattern may develop in response to growing up in an environment that has chronic unpredictable threats (Ellis, Oldehinkel, & Nederhof, 2017). Gaylord-Harden et al. (2018) further convey that the adaptive calibration model allows researchers to consider the pathways to development of maladaptive stress responses among Black American young men that manifest due to efforts to cope with known structural and societal barriers in the U.S. Considering that Black Americans disproportionately live in neighborhoods characterized by concentrated disadvantage and violence, with high levels of unpredictability, mechanism-driven research must consider how Black Americans living in these environments have to balance cognitive and physiological demands to gauge potential threat versus safety. Barbarin, Tolan, Gaylord-Harden, and Murry (2020) further challenges researchers to utilize adaptive calibration models as a conceptual tool to redirect research that historically uses a deficit lens rather than a competency-based lens to examine the behavior of Black Americans who successfully adapt to chronically toxic environments. To our knowledge there are no known research studies that have examined the biological embedding of racial trauma from this perspective among Black Americans.

Research has also shown that racial trauma is often chronic, uncontrollable, and unpredictable. The construct of potential threat in this domain is thought-provoking when considering the U.S. sociopolitical context and historical legacy of oppression. We are currently living in a time where the current generation of young Black Americans have been raised witnessing public, repeatedly streamed, and vivid imagery of racialized violence. From Trayvon Martin, Michael Brown, Sandra Bland, Eric Gardner, Philando Castille,

etc., images and videos from police dashcams and cell phones intrude into our homes and minds. Partially titled *"That's my number one fear in life. It's the police,"* a qualitative paper reveals personal narratives of 40 young Black American men's trauma and grief resulting from police violence in Baltimore, Maryland (Smith-Lee & Robinson, 2019). These participants' stories of police violence started in childhood and continued into early adulthood, highlighting potential avenues of future research that can examine the biological embedding of racial trauma over time. Utilizing the innovative methodology of "life history calendars" that provide a time anchor for accurate participant recollection of lifetime exposures to violence and homicide death, researchers were able to consider how life course experiences of witnessing violent death(s) of a loved one and experiences of racial profiling/harassment from police influences continuous anxiety about navigating unpredictable threats to one's safety and wellbeing.

According to Helms et al. (2012), the killing of unarmed Black men by police can be conceptualized under racial trauma as "racial or ethnic cultural cataclysmic events." Research also now shows that Black adults living in states where one or more police killings of unarmed Black people occurred in the last 3 months reported experiencing a greater number of dire mental health days than white adults residing in the same state (Bor, Venkataramani, Williams, & Tsai, 2018). Studies such as these hopefully can promote a change in RDoC-related research to more fully consider cultural context, development, and the intersection of racial discrimination with other traumas in examining mental health outcomes and particularly PTSD symptoms. This research also provides guidance for future research questions that RDoC informed research could address regarding the impact of structures of power (i.e., criminal justice/policing) on threat-appraisal and biological processes related to hypervigilance to potential threat. These research questions could: (1) examine the impact of exposures through social media on the neurobiology of experiences of racial trauma for Black Americans (Patton, Eschmann, & Butler, 2013; Volpe, Hoggard, Willis, & Tynes, 2021); (2) address how to conceptualize the construct of potential threat when the threat originates from individuals in positions of power, i.e., those who are expected to protect and serve; (3) utilize multiple units of analysis to examine optimal versus suboptimal hypervigilance for Black Americans diagnosed with PTSD who report experiencing racial trauma.

Sustained Threat—The last construct of the Negative Valence System domain that we want to discuss in relation to racial trauma is sustained threat. This construct involves negative emotional states that result from prolonged threat exposure to internal or external conditions, states, or stimuli for which escape or avoidance is adaptive. The psychophysiological changes or behaviors caused by prolonged threat exposure, by definition, are often chronic and persist in the absence of the threat. In studies that examine this RDoC construct in relation to trauma exposure, a common theme is examining activation of stress-response systems, such as the hypothalamic-pituitary-adrenal (HPA) axis dysregulation. The HPA axis releases the stress hormone, cortisol, to assist in the response to acute stress; but with continuous and chronic stress, the body becomes physiologically taxed. Subsequently, the construct of sustained threat aligns with the previously discussed research related to the "weathering" hypothesis suggesting that the chronic stress of racism

can influence prolonged activation of body regulatory systems over time that are linked to chronic illnesses and diseases that disproportionately affect Black Americans.

The RDoC matrix indicates that elements of sustained threat can include increased perseverative cognitions and behaviors. Perseverative cognitions are described as recurrent patterns of negative, reflective thinking (i.e., rumination) as well as anticipatory thinking (i.e., worry) after a stressful event has occurred (Brosschot, Gerin, & Thayer, 2006). These cognitive processes can prolong both emotional and physiological reactions to stressors. In contrast to stress and coping models that typically attend to acute and short-term effects of stressors, Brosschot and colleague's (2006) theory of prolonged activation hypothesizes that perseverative cognitions and anticipatory stress mediate the link between stressors and chronic illness. Utsey et al. (2013) built on this theoretical model of prolonged activation of stress to conceptualize how chronic stress due to racism is related to perseverative cognitions and anticipatory stress and promotes the racial health inequities seen among Black Americans. In partial alignment with this theory, research by Hoggard, Hill, Gray, and Sellers (2015) found that heart rate variability (a physiological indicator of stress) in Black American women can remain elevated for a day after an experience of racial discrimination, suggesting that prolonged, and not acute or momentary physiological responses to stressful events influence long-term negative health outcomes. Interestingly, this study did not find evidence that cardiovascular activity two days after experiencing racial discrimination was mediated by cognitive perseveration; but the study did reveal that self-reported perseveration (intrusion) as well as avoidance of thoughts about the experience was associated with higher heart rate activity two days after experiencing racial discrimination. Moreover, the researchers note that their findings suggest that thinking about a racially discriminatory act that happened in one's life and/or returning to environments where such discrimination occurred could have dire consequences on health. When considering the biological embedding of racial trauma over the life course, studies such as these further confirm that the RDoC construct of sustained threat could be usefully contextualized in future studies to investigate how long the neurobiological effects of racial trauma linger to affect body regulatory systems after racial trauma is initially experienced. It is also important to examine how these effects differ across different stages of development. Furthermore, in RDoC-related research focused on non-race-related trauma exposure among Black Americans, it is plausible that contextualizing responses by giving greater consideration to racism as a traumatic stressor and contributor to the stress response, could provide better understanding of responses and more nuanced clinical conceptualizations of trauma-related symptoms of avoidance, rumination, and re-experiencing symptoms (Lewis et al., 2015).

In Coates' (2015) book *Between the World and Me* he writes as a Black father to his Black son: "*But the price of error is higher for you than it is for your countrymen, and so that America might justify itself, the story of a black body's destruction must always begin with his or her error, real or imagined—with Eric Garner's anger, with Trayvon Martin's mythical words ("You are gonna die tonight"), with Sean Bell's mistake of running with the wrong crowd."* This message aids in conceptualizing the potential roots of constructs related to sustained threat for Black Americans across generations. The historical context of perseverative cognitions is possibly related to Black Americans accrued relevant knowledge, experiences, or witnessing of the substantial costs of making

"mistakes" in a racialized society. Thus, Black Americans may analyze previous encounters of racial trauma as well as expect and prepare for future encounters in order to reduce the likelihood that another racist event occurs that could substantially harm them. Although there is a lack of research that examines this process from this angle, Hope et al. (2021) recently explored the multidimensional nature of racism (e.g., individual, institutional, and cultural) in relation to anticipatory racism-related stress responses (e.g., prolonged negative thinking, arousal in expectation of future racism) among Black adolescents. Results indicated that more experiences of racism at each level were related to greater anticipatory racism-related stress responses, measured as more cognitive activation of racial stressors, appraisal of coping strategies, and physiological anticipation of future racism. Continued developmental and contextually-guided research is needed in this area to further explore the psychophysiological risks and benefits of engagement in sustained cognitive processes to prepare for continuous experiences of racial trauma.

Negative Valence System from a Developmental Psychopathology Approach

In comparison to the RDoC framework, developmental psychopathology research also places emphasis on utilizing multiple units of analysis to understand psychopathology. However, developmental psychopathology places less concentrated attention on neural circuits and promotes a more equal distribution of attention to multiple units of analysis and their interaction to inform etiology of psychopathology across development (Cicchetti, 2008; Franklin, Jamieson, Glenn, & Nock, 2015). Taking a developmental psychopathology approach to the Negative Valence System domain of RDoC allows for broader contextual viewpoints on sociocultural and environmental processes, such as racial trauma, that may serve as mechanisms impacting negative affective states across the lifespan. Several studies conducted through the Center for Family Research have used developmental psychopathology frameworks in longitudinal studies to show the long-term impact of racial discrimination on mental health states through multiple units of analysis (Brody et al., 2006; Gerrard, Gibbons, Fleischli, Cutrona, & Stock, 2018; Gibbons et al., 2012; Walker et al., 2017). These studies have also revealed that the effects of racial discrimination might be particularly harmful in childhood or early adolescence; possibly pointing to areas of important future research under the Negative Valence System domain. For example, Gibbons et al. (2012) utilized an evolutionary-developmental framework to examine three sources of stress (i.e., environmental, low parental investment, and interpersonal experiences of racial discrimination) on "life history strategies", associated cognitions, and resilience among 889 Black American adolescents across 11 years (from age 10.5 to 21.5). Life history strategies are considered strategies or tactics utilized by individuals that promote survival, growth, and reproduction based on context. In this study, researchers found that all three sources of stress predicted faster life history strategies, whereby some Black American adolescents adopted an outlook reflective of focusing on the present more than the future through attentiveness to more short-term outcomes such as tolerance of deviance and willingness to engage in risky sex due to living in environmental contexts that are both acutely as well as chronically threatening. Of note, this study also examined potential resilience factors through analysis of genetic environmental "sensitivity" (measured through alleles of two monoamine-regulating genes--the serotonin transporter gene-5HTTLPR and the dopamine D4 receptor gene-DRD4). Research findings revealed that genetic environmental sensitivity

moderated the impact of racial discrimination on the previously mentioned life history strategies; with Black adolescents with more risk alleles (higher "sensitivity") reporting faster life history strategies at age 18 and less resilience at age 21, if they had experienced higher amounts of racial discrimination; and slower life history strategies (i.e., thinking more about the future) and more resilience if they had experienced smaller amounts of racial discrimination. Although this study did not directly examine components of the Negative Valence System domain of the RDoC framework, it facilitates further considerations of ways to examine this domain from a developmental and contextual framework that acknowledges minoritized populations disproportionate risk of living in threat-laden environments across the lifespan. To conceptualize "acute threat", "fear" "potential threat," or "sustained threat" on psychopathology among minoritized populations, researchers will need to use multiple units of analysis across development and consider negative affective states and/or emotions as dynamic and evolving processes situated within certain contexts rather than static occurrences.

As longitudinal research on the effects of racism and racial trauma continuously increases, research is beginning to reveal that these experiences might be particularly harmful at certain developmental stages of childhood and early adolescence. In a recent study by Lavner, Ong, Carter, Hart, & Beach (under review), researchers examined between- and within-person bidirectional linkages between racial discrimination and depressive symptoms among Black adolescents; testing whether the magnitude of these associations differed across a wide range of adolescence (from age 10 to 18). Results revealed that Black youth experiencing more racial discrimination relative to other Black youth reported increased depressive symptoms concurrently and over time, and Black youth experiencing more racial discrimination relative to their own average reported increased depressive symptoms concurrently and over time. There were also no significant lagged effects from depressive symptoms to racial discrimination in either model, supporting biopsychosocial theoretical hypotheses regarding directional effects from racial discrimination to negative affective states. Given that research on the importance of developmental timing in understanding effects of trauma exposure is growing and demonstrating that early-life trauma exposure, in comparison to trauma exposure at later developmental stages, is particularly impactful on depression and PTSD symptoms in adulthood (Dunn, Nishimi, Powers, & Bradley, 2017), further research is needed examining developmental trajectories to psychopathology from experiences of racial trauma as well as potential buffers among Black Americans. From a developmental psychopathology perspective, if early childhood and adolescence factors such as racial trauma can be identified as influencing developmental trajectories of negative valence systems over time, this research could substantially inform etiological pathways of psychopathology and points of intervention. Furthermore, a main goal of the RDoC framework is to uncover the neurodevelopmental origins of psychopathology; yet no known research has utilized the Negative Valence System RDoC domain units of analysis to uncover mechanisms of psychopathology that could be influenced by the interwoven nature of experiences of racism and trauma among Black Americans across development. Future research is needed in this area to increase understanding of how, when, and under what developmental contexts racial trauma impacts negative valence system constructs over time.

Future Research Directives

In the last section of this paper we will briefly provide some additional considerations for studying the biological embedding of racial trauma within an RDoC framework. This is not meant to be an exhaustive list of recommendations, but rather we aim to provide some key future research directives for science related to RDoC frameworks and for examining the biological embedding of racial trauma among Black Americans.

RDoC Measurement and Methodological Considerations

The Diagnostic and Statistical Manual of Mental Disorders–Fifth Edition (DSM-5; American Psychiatric Association, APA, p. 271) defines trauma as exposure to actual or threatened death, serious injury, or sexual violence. The DSM-5 stipulates that individuals can directly experience a traumatic event or be indirectly exposed through: (a) witnessing a traumatic event, (b) learning that a loved one has experienced a traumatic event, (c) learning that a loved one died from a traumatic event that was violent or accidental in nature, or (d) experiencing repeated or aversive details of a traumatic event through one's occupation (e.g., first responders). The definition of what can be considered traumatic-- and therefore influence trauma symptomatology-- has changed over time. What diagnostic tools, as well as what society deems as traumatic, has a ripple effect on how individuals see their own life experiences and how they believe others may view those experiences as well. One impetus for the development of the term "racial trauma" was the need for acknowledgment, where research scholars of color noted that healing from racism would require recognition of its traumatic effects (Bryant-Davis, 2007). Perhaps one reason that racial trauma is not already considered within widely used diagnostic tools is the legacy of structural racism that avoids recognition of harm inflicted on those of color. What society views and acknowledges as traumatic can significantly influence the measurement and assessment of racial trauma as a construct. For example, traditional inventories assessing lifetime experiences of traumatic events (e.g., The Traumatic Events Inventory, Trauma History Questionnaire, Life Events Checklist for DSM-5, Brief Trauma Questionnaire) often utilize DSM-5 definitions of trauma to categorize what is traumatic in an individual's life experience and what is not. When a Black American fills out a traumatic events inventory, even a racialized violence incident that may have occurred and would meet criteria for a DSM-5 definition of "trauma" (e.g., being beaten by the police because of one's race and fearing for one's life) may not be reported because they may feel that such racism-based events do not fit within societies definition of trauma. Furthermore, contextual and cultural dynamics such as the race or positionality of the perpetrator of violence, are often not evaluated in assessments of trauma among Black Americans. This can lead to missing and inaccurate information that could negatively impact research and clinical practice. Diagnostic systems must consider their own impact in influencing what society deems as traumatic as this can influence the way minoritized populations disclose and report traumatic experiences, as well as the way researchers frame research questions around traumatic experiences. The promise of the RDoC framework is in the philosophical and science-driven perspective that the mechanisms for uncovering normal versus abnormal behavior is on a continuum of complex processes that must be examined through multiple forms of assessment. By further opening this framework to more centrally consider culture and socio-structural contexts as driving forces

in mental health wellness, the RDoC framework has the potential to lead to the development of maximally useful assessment measures for Black Americans.

Another consideration associated with measuring and assessing racial trauma is grounded in the ways researchers have studied and defined this construct to date. In 2007, R.T. Carter defined the term “race-based traumatic stress” as (a) an emotional injury that is motivated by hate or fear of a person or group of people as a result of their race; (b) a racially motivated stressor that overwhelms a person’s capacity to cope; (c) a racially motivated, interpersonal severe stressor that causes bodily harm or threatens one’s life integrity; or (d) a severe interpersonal or institutional stressor motivated by racism that causes fear, helplessness, or horror. In R.T. Carter’s article and in subsequent research, researchers conceptualized racial trauma as a non-pathological response to racism-related stress that would not align with DSM frameworks of PTSD. Due to research indicating that racial trauma may be a unique stressor separate from other forms of traditionally studied traumatic stressors, R.T. Carter and colleagues (2013) developed a measure called the Race-Based Traumatic Stress Symptom Scale (RBTSSS) that was designed to assess experiences of racism and related psychological and emotion reactions to this stressor. Within the development of this measure and conceptualization of racial trauma (R.T. Carter and Helms, 2002), these researchers argued that distinct types or classes of racism are likely needed rather than a broad social definition of racism that could entail a wide range of racism experiences over time. In line with this premise, Roberson & R.T. Carter (2021) recently completed a study where they utilized the RBTSSS scale to examine the link between differing levels of racism-related stress and the Trauma Symptom Checklist. These researchers created “racial stress-level groups” where the “racial trauma group” was considered to be the label for participants who scored in the highest level on the RBTSSS scale. Findings from this study further indicated that the “racial stress-level groups” were significantly different from each other and led to different trauma symptom presentations among Black Americans. Hence, this research suggests that there may be categories or hierarchical levels of distress associated with different types of racial discrimination experiences that could be explored further in future research.

Williams and colleagues (2018) suggest there is a cumulative nature to racial trauma experiences across the lifespan that influences the development of clinically significant distress and trauma-related reactions. Therefore, having hierarchical levels of distress related to different types of racial discrimination experiences does not account for the accumulating stings and bruises of microaggressions and/or vicarious racism that can impact clinical presentations related to trauma exposure. This aligns with work within the non-race-related trauma literature showing that clinically significant traumatic reactions from multiple traumatic events accumulate to increase the vulnerability that future traumatic events will result in PTSD (Breslau, Chilcoat, Kessler, & Davis, 1999; McLaughlin, Conron, Koenen, & Gilman, 2010). To account for these noted gaps in the assessment of racial trauma, Williams et al. (2018) introduced a measure entitled the UConn Racial/Ethnic Stress & Trauma Survey (UnRESTS) based on a life course conceptual framework of the development of clinically significant racial trauma symptoms. The UnRESTS is a clinician-administered semi-structured interview for racial trauma that is intended to aid clinicians in assessing various forms of racism experienced by minoritized clients over their life course and

determine whether these experiences are collectively causing traumatic stress and meet DSM-5 criteria for PTSD.

Even in our current conceptualization of racial trauma the field has differing opinions about how racial trauma can arise and how it is linked to mental health outcomes. With increasing attention to the negative impact of racism on mental health for Black Americans, particularly after the killing of George Floyd in 2020, important treatment considerations have recently been described, addressing Black American's stress related to racial trauma (Anderson & Stevenson, 2019; Metzger, Anderson, Are, & Ritchwood, 2021). Yet, to our knowledge, no studies have been conducted to qualitatively assess Black Americans viewpoints on how they would differentially define racial discrimination, racial trauma, and trauma experiences in the U.S. and if these experiences are perceived as similar, hierarchical, or unique forms of stress. Qualitative research is designed to amplify the personal stories of minoritized populations and illuminate issues and concepts that are not readily captured in current methodological approaches. This valuable research methodology is not discussed as a unit of analysis for research conducted within a RDOC framework. Given that language is a dynamic process, it is possible that the current terminology and definitions of "racial trauma" do not fully capture the complex ways that these experiences influence health. Furthermore, research focused on understanding the neurobiological and developmental mechanisms connecting racial trauma over the life course to the onset of mental health difficulties and disorders is sparse. Researchers note that the solutions to multi-level and multi-systemic issues like racial trauma must include mixed-method approaches that can better address and illuminate the complex ways in which racial oppression operates in the U.S. (Neblett, 2019). The RDoC framework has the opportunity to promote research strategies that align with its goals of utilizing several units of analysis to define mechanisms underlying behaviors related to racial trauma, but can also better contextualize these research tools by listening to the voices of Black Americans who have been historically excluded from this research process.

A last consideration for the measurement of racial trauma includes the need for research examining the intergenerational effects of this construct. Interestingly, the concept of intergenerational trauma (e.g., trauma can be transferred between generations) was first introduced in the research literature with studies on the offspring of Holocaust survivors (Rakoff, 1966). This initial research led to an increase in research of Holocaust survivors over time, with a case study indicating that third generations of Holocaust survivors experienced PTSD symptoms that paralleled their ancestors (P. Rosenthal & S. Rosenthal, 1980). In recent years, the research enthusiasm for understanding intergenerational trauma among offspring of Holocaust survivors has remained, with research beginning to examine epigenetic mechanisms in intergenerational effects of this historical trauma (Yehuda et al., 2014, Yehuda et al., 2016). Research has also grown in this area among trauma survivors, with some documented neuroendocrine and epigenetic alterations related to maternal and paternal trauma exposure but no conclusive evidence of epigenetic transmission of trauma effect (Yehuda & Lehrner, 2018). Yet, even with this growing research interest in intergenerational trauma, very little research has considered how the historical trauma of enslavement of Black people in the U.S. influences biological embedding processes across generations that have possible implications today. The term "Post-traumatic Slave

Syndrome" was introduced by Degruy-Leary (2005, 2017) and suggested that the traumas Black people experienced during enslavement, and through continued oppression in the U.S., is a historical racial trauma that has enduring psychological and behavioral effects on their descendants today. Similar to the Holocaust, it would seem that the research efforts to understand the biological mechanisms underlying the impact of the historical trauma of enslavement would have growing research interest but there is no known research in this area to our knowledge.

While the process of assessing and measuring the biological embedding of a racial trauma that occurred deep within our history is likely complex, this type of research could eventually lead to a more potent grasp of how societal stressors penetrate our biology and contribute to a range of health outcomes. Additionally, by further examining the history of oppression in the U.S. we can consider nuanced ways to explore how context influences mental health among Black Americans across time. For example, the social environments in places where racialized U.S. massacres occurred against Black Americans, including the Tulsa, OK massacre (1921), Colfax, LA massacre (1873), Wilmington, N.C. massacre (1898), Rosewood, FL massacre (1923) and several others, might be important to examine. In addition, the impact of those environments on current Black residents may be just as important and illuminating as the examination of Black descendants of those who survived the massacres. There could potentially be unforgettable memories, vigilance, avoidance, and arousal patterns that become embedded within the structures of the places where the massacres occurred to affect the health of Black Americans living within these spaces that multi-level research could examine. It is also important to acknowledge that epigenetic changes or other processes of intergenerational transmission reflect environmental exposures, and are therefore modifiable with changing conditions. This recognition allows for research in this area to also be guided by strength-based and culturally-grounded principles (i.e., racial identity, racial socialization, structural policy changes, structural equity-focused interventions) that can identify buffers against the intergenerational effects of racial trauma.

Future research on the intergenerational impact of racial trauma should also focus on biological embedding processes that begin before birth and influence severe health inequities. A recent review of the literature with our colleagues suggests that racial trauma could have physiological consequences in the mother and fetus that may help explain racism-related health inequities in birth outcomes among Black American women (Conradt, Carter, & Crowell, 2020). Currently in the U.S., Black women have the highest rates of preterm birth, which is one of the leading causes of infant mortality and is linked to negative cognitive and neurodevelopmental health of Black children. There are currently only 11 published studies of biological changes that occur as a result of chronic racial discrimination in pregnant Black women, with noted limitations in study sample sizes and measurement of racial discrimination during pregnancy (Chaney, Lopez, Wiley, Meyer, & Valeggia, 2019). No known research has examined how chronic non-race-related trauma and race-related trauma among Black pregnant women differentially exert programming influences on the mother and fetus. Overall, examining the intergenerational effects of racial trauma across generations of Black Americans with attention to time, history, and contextual influences could inform the conceptualization of racial trauma and there is evidence that the RDoC

framework is a promising approach for studies of the intergenerational impact of prenatal stress (Gao et al., 2021).

Some Concluding Remarks

In this review, we discuss how racial trauma is a part of our past and present, exerting a number of documented effects on mental and physical health outcomes among Black Americans across time and development. Though research continues to steadily accrue in the area of racial trauma, generally racial trauma is still an understudied and under-acknowledged chronic stressor that deserves much more research attention. Additionally, the biological mechanisms underlying the effects of racial trauma over the lifespan for Black Americans remain unclear. The ability for future research to use innovative ideas, techniques, and methodologies to examine the impact of racial trauma on Black lives is impacted by structures and current diagnostic frameworks that do not fully consider how sociostructural processes are underlying mechanisms driving disease and illness for Black Americans. Given the limited work thus far on racial/ethnic differences in RDoC constructs, we believe research is really just beginning to apply RDoC approaches appropriately to Black Americans. A next generation of RDoC-relevant research is needed that includes multi-level research to elucidate mechanisms involved in the developmental processes of the biological embedding of racial trauma. As illuminated throughout this review, the next generation of RDoC-relevant research will also consider research methodologies that could reveal that the etiology of mental health illnesses such as PTSD are driven by societal ills rather than neurobiological deficits among Black Americans.

Policy makers, researchers, and clinicians are increasingly aware of the effects of racial trauma on health and an aim of the RDoC framework is to increase translational research that can point towards therapeutic targets. Our review of the research literature provides an opportunity for RDoC initiatives to promote a rigorous focus on the impact of racial trauma on health and explore the need for multisystemic intervention strategies to promote health equity for Black Americans. The structural and collective consequences of racial trauma experienced by Black Americans, as outlined in this review, may need to be addressed by structural and collective solutions that are not currently viewed as treatment targets within an RDoC framework. Studying the enduring legacy of racial trauma across the life course among Black Americans provides vital space for reflection and commitment to challenge current conceptualizations of psychopathology for populations that have been continuously marginalized in research and clinical practice. Centering the experiences of Black Americans in research, including their triumphs as well as their struggles in the face of racial trauma, will aid research aimed at finding mechanistic pathways that can ameliorate illness and suffering and promote long-lasting healing.

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