Uncovering Implicit Racial Bias in the Brain: The Past, Present & Future

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Neuroscience is a fantastic tool for peeking inside our minds and unpacking the component processes that drive social group biases. Brain research is vital for studying racial bias because neuroscientists can investigate these questions without asking people how they think and feel, as some individuals may be unaware or reluctant to report it. For the past twenty-five years, neuroscientists have diligently mapped implicit racial bias's neural foundations. As with any new approach, the emergence of neuroscience in studying implicit racial bias has elicited excitement and skepticism: excitement about connecting social biases to biological machinery, and skepticism that neuroscience may provide little to our understanding of social injustice. In this essay, I dive into what we have learned about implicit racial bias from the brain and the limitations of our current approach. I conclude by discussing what is on the horizon for neuroscience research on racial bias and social injustice.

Racism is embedded in U.S. culture and systems. A foundation built not by accident, but with deliberate determinism, by and upon the enslaved and oppressed to uphold hegemony and hierarchy. Racism was enshrined in the Constitution through a provision limiting African Americans to three-fifths personhood. Years of slavery, lynching, and brutalism were supported by racist legislation, leading to a segregationist and discriminatory society. Despite this scorched foundation, after the U.S. civil rights movement, there was optimism for some that the country was forging a new path with the introduction of normative and legal changes. This optimism was ostensibly supported by national surveys revealing emerging positive sentiment toward Black people.[1] Contrasting the racialized beliefs before the 1960s with the changing culture offered signs of hope, as the nation appeared to support the principles of racial integration and equal treatment openly and enthusiastically. Enter the myth of racial progress, whereby White Americans began to falsely believe that the United States had achieved considerable racial equality, when in fact racial disparities were (and are) deeply ingrained in American society.[2] This myth was coupled with the growing societal perspective that bias, discrimination, and racism were wrong, and expressing such bias was, in many spheres of society, frowned upon.[3]

The Past: The Origins of Implicit Bias

Were racial biases actually decreasing? And could scientists find a way to assess the tension between a cultural shift toward favoring equality and the reality of racial bias embedded in systems and apparent in daily life? Intergroup scholars at the time thought that public opinion surveys may not accurately capture people's true beliefs. Furthermore, although there was progress in legal changes and norms, the racist structures and systems, prevalent stereotypes and prejudices, and human motivation to favor one's group cast looming shadows on equality. For example, although public opinion polls in the 1970s and 1980s showed the country moving away from explicit racial biases, discrimination could be identified in laboratory experiments, particularly when the participants were unaware that racial bias was the experiment's focus. Social psychologists Faye Crosby, Stephanie Bromley, and Leonard Saxe summarized these studies and called into question the assumption that verbal reports accurately reflect individuals' sentiments.[4] They concluded that White Americans were more prejudiced than they were willing to admit, theorizing that individuals might not disclose their genuine opinions on surveys for fear of judgment, but would reveal them when they felt safe or were unaware that researchers were investigating racial bias. Researchers at the time believed that even individuals who valued equality would sometimes exhibit discriminatory behavior.[5] Consequently, many considered self-reports to be unreliable. This perspective was consistent with a broader trend in social psychology that approached self-reports with skepticism and favored cognitive tasks as a more reliable measure of attitudes.[6] At this time, cognitive psychology was exploring how priming a concept for a subject (such as by showing someone a word or picture) before they performed a given task could shape their responses. This general approach, that one can prime a concept that activates related concepts or prepares folks to view others in a related way without needing self-reflection, would significantly shape the development of implicit racial bias measures.

Researchers viewed behavioral implicit measures as a way to understand why individuals who consciously reject prejudice, such as egalitarians, still exhibit biased behavior. Enter Patricia Devine. In 1989, Devine, a social psychologist specializing in prejudice and stereotypes, suggested that discriminatory behavior and self-reports represented authentic psychological processes in conflict.[7] One process was automatic antipathy, resulting from repeated exposure to negative cultural information about social groups. The other was a more deliberate reflection of genuine beliefs or values (for example, I want to be or should be egalitarian). This idea fostered the modern perspective that stereotypes and prejudices are learned associations influenced partly from culture.[8] Devine's perspective was popular among researchers: it offered optimism (people might be able to control their bias), intervention possibilities (perhaps we can foster self-control of bias),

and historical resonance (this is why self-reports are deviating from widespread systemic biases in wealth, health, education, policing, and employment). However, Devine did not provide a direct measure of spontaneous group associations (that is, implicit bias) but instead attempted to demonstrate them using "unobtrusive" methods: namely implicit behavioral measures.[9]

Social psychologist Russell H. Fazio and colleagues, and later Anthony G. Greenwald and colleagues, introduced indirect behavioral measures of spontaneous group associations, known as implicit bias, and introduced the term "implicit social cognition" to describe cognitive processes related to social psychological constructs that occur outside of awareness or control.[10] The general premise is that people lack self-reflective access to the cause of their behavior and are terrible at introspection, and that these new measures of implicit bias avoided the need for accurate self-reflection.[11] Researchers could immediately see the appeal of tapping into biases without needing self-report. Over the next twenty-five years, there was a proliferation of implicit behavioral measures and the application of these measures to real-world domains, such as mental health, consumer decision-making, policing, legal decisions, education, health care, and political behavior.[12] The popularity of these measures only gained as time went on. Implicit bias, measured behaviorally, quickly entered the public lexicon and was even mentioned in the 2020 presidential debate between Hillary Clinton and Donald Trump.[13]

But what is implicit bias, and how is it measured? Intergroup implicit (and explicit) associations are evaluations or beliefs about social groups. One difference between these associations is that individuals report explicit evaluations, whereas implicit associations are measured indirectly.[14] Therefore, like other memory/evaluative associations, implicit race-based evaluations are partly acquired through repeated paired associations with a group (such as culturally or environmentally learned association) and can be applied without deliberation. Explicit attitudes are also partly acquired through environmental/cultural learning. Therefore, discriminatory responses can occur without intention, even when counter to deliberative unbiased beliefs. Individuals may thus feel genuine positivity about an out-group (that is, a member from a different racial group than the perceiver) and support equality, but still exhibit implicit bias.[15]

Over the last twenty-four years, researchers have consistently found that the majority of people in the United States show some degree of negative implicit associations about Black people and positive associations about White people. Our research has even observed these associations with self-identified Black Americans when they interact more with White people.[16] Furthermore, researchers have observed greater implicit bias in more segregated counties in the United States, in places with a history of chattel slavery, or among individuals whose parents have greater implicit racial bias.[17] Therefore, substantial evidence shows that the systems, culture, and whom we interact with shape implicit racial biases. People are

absorbing these associations about groups from their environments whether they want to or not – even negative associations about their own group.

As the implicit bias revolution gained steam in social psychology, researchers wondered whether there were ways to assess the evaluative and cognitive processes underlying implicit bias without a response requirement. At this point, most of the research was conducted by social psychologists, and they were rightfully concerned that individuals would attempt to control their behaviors to avoid appearing biased when forced to respond or were aware that the measure might assess racial bias. Moreover, researchers were concerned that some implicit bias measures were potentially contaminated by task demands (such as forcing people to compare groups or to make a response).[18] These two factors partly motivated a new era in implicit bias research in which scholars sought means to assess racial bias uncontained by these factors. Starting in the 1990s and increasing in the early 2000s, a new field took form, social neuroscience, that allowed researchers to investigate implicit racial bias via neural measures without asking people what they think, while also allowing scholars to outline the underlying levers and gears that produce these biases.

The Present: Social Neuroscience of Implicit Bias

Neuroscience methods allow researchers to assess implicit processes impacting how we think, feel, and behave toward marginalized/minoritized individuals in real time without needing self-report or behavioral responses. In these ways, neuroscience is a fantastic tool for peeking inside our minds and unpacking component processes contributing to behavior, allowing scholars to understand how the brain works at the cellular and molecular levels, how different brain regions are connected and interact, and how information is processed and integrated. Fundamentally neuroscience allows us to measure mechanisms (think of mechanism as what is under the hood making the car move; the *how* of implicit bias). Knowledge about mechanisms can shed light on underlying cognitive, social, emotional, and behavioral processes. Because of this, neuroscience provides valuable insights into the cognitive and affective processes that drive racial bias, and minimizes many of the criticisms of behavioral measures of implicit bias.

The use of neuroscience in social psychology is a relatively recent development that has gained momentum.[19] More concretely, neuroimaging has provided several advantages for studying racial bias, including assessing ongoing psychological processes without the intrusive questions and socially desirable responses that can occur with self-report.[20] Moreover, neuroimaging offers sensitivity to the engagement of distinct psychological processes that underlie otherwise similar behavior, allowing scholars to determine, for example, whether lapses in cognitive control rather than negative evaluations are more predictive of implicit bias.[21] As-

sessing simultaneously multiple and rapid unfolding processing is extremely difficult, if not impossible, with most implicit behavioral measures.

In 1992, social psychologists John Cacioppo and Gary Berntson introduced the term social neuroscience to describe an interdisciplinary approach to mapping social behavior and cognition by integrating our understanding of psychology with neuroscience (that is, the mind and body). From there, the field rapidly expanded due to the increased availability of noninvasive central nervous system measures. Among the first technique was event-related brain potentials (ERPs), which are derived from electroencephalograms (EEGs) and measure electrical activity of the brain at the scalp.[22] ERPs allow scholars to assess electrical activity in real-time as people view others or respond to prompts. ERPs are particularly useful for studying racial bias because they allow researchers to understand when a process is happening in time. Researchers often strip away the context in the lab and simply show people faces varying in social group membership. When they do so, they find that individuals process information about perceived race, gender, age, status, and emotion within two hundred milliseconds of encountering someone.[23] That is incredibly fast! This tells us that information about these social categories gets into our minds early and can guide impressions. Most important, it is spontaneous. Even when we ask people to stop, the brain still processes social category information rapidly.[24]

We can not only understand when things are happening in time with EEG but also view which areas of the brain are processing social group information using functional magnetic resonance imaging (fMRI), which measures changes in blood flow in brain regions while participants perform tasks or view images, helping us map mechanisms, and is another essential tool for neuroscientists.[25] Although it does not provide precise timing information like ERPs, it offers excellent spatial resolution by providing information about the specific brain areas associated with mental operations. Over the years, researchers have found a host of regions involved in social group processing, including a few usual neural suspects.[26] Specifically, these regions support the identification of faces (fusiform face area [FFA]), the evaluation of others based on their perceived race (orbitofrontal cortex [OFC], amygdala, and ventral striatum [VS]), how we represent the minds of others based on their perceived race or perform theory of mind (dorsomedial prefrontal cortex [DMPFC] and temporoparietal junction [TPJ]), and the regulation of bias (dorsolateral prefrontal cortex [DLPFC], anterior cingulate cortex [ACC], and ventrolateral prefrontal cortex [VLPFC]). Importantly, these areas are very similar to the areas that are involved in the processing and regulation of other emotional and social stimuli more generally, as seen in Figure 1.

Therefore, researchers have found that individuals process perceived race both *extremely* fast and in the same way they process other emotion-laden stimuli. Most important, it is unintentional. Even when we ask people to stop, the brain

Figure 1
Brain Regions Supporting Processing of Social Group Membership
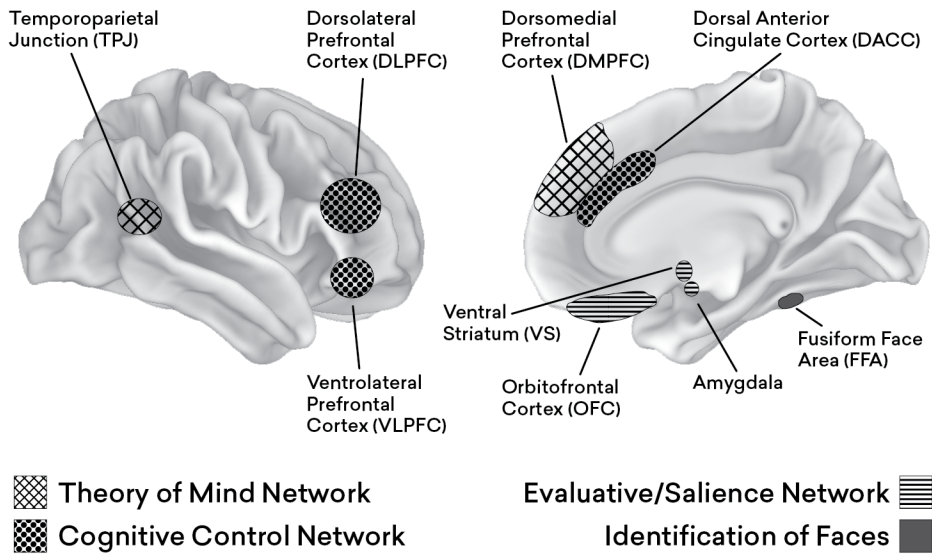
The brain regions supporting processing of social group membership include the Identification of Faces (FFA), Evaluative/Salience Network (amygdala, VS, and OFC), Theory of Mind Network (TPJ and DMPFC), and Cognitive Control Network (DLPFC, VLPFC, and DACC). Source: Illustration by the author.

still processes this information rapidly. During this time, neuroscientists began to disentangle the processing of another's perceived race from the production of implicit bias.[27] Although perceiving race, whether accurate or not, is necessary to produce implicit associations – that is, one must categorize someone as belonging to a group to bring to mind (or activate) stereotypes and prejudices about the group – it is not sufficient. Just because folks in the United States process race does not mean they will have implicit or explicit biases, or that perceived race is an innate category. Race is a culturally and socially constructed category imbued with evaluative and semantic meaning. Consequently, the brain processes this culturally and socially constructed category similarly to other emotionally charged or salient information in the environment that culture or one's social network has deemed positive, negative, or important.

For the past twenty-five years, neuroscientists have diligently mapped implicit racial bias's neural foundations. One key finding is that implicit racial bias ap-

pears to be rooted partly in the brain's evaluative system, which can operate spontaneously. This is not surprising given that individuals learn evaluative associations about groups from the culture and their environment, and this learning is then reflected in patterns of brain activity. One region that is part of the evaluative brain network, the amygdala, has been a common focus of fMRI studies examining how people process perceived race.[28] The amygdala is vital for retaining, forming, and expressing negative evaluations, including fear.[29] Additionally, the amygdala has a more extensive function in quickly identifying biologically significant stimuli, facilitating rapid attention and memory.[30] Specifically, the amygdala responds with greater activation to faces of people from racial groups that are less familiar or positively viewed.[31] Differences in amygdala activity to perceived race have sometimes, though certainly not always, correlated with implicit racial bias (and typically not explicit bias).[32] Despite some disagreement on its interpretation, the general consensus is that the discovery of amygdala responses to perceived race in the U.S. context suggests that White individuals perceive Black people as highly noticeable (salient) and potentially threatening.

Recent research has uncovered significant variation in how the amygdala responds to perceived race and the degree to which the amygdala is solely or partly producing implicit bias (if even producing it at all).[33] For example, when additional information about group membership or traits is available, preferential amygdala activity is frequently absent based on perceived race.[34] Therefore, our comprehension of the amygdala's role in perceived race-based assessment is more intricate and adaptable than previously believed. The current agreement suggests that this region is not the primary source of implicit racial bias. Instead, amygdala sensitivity to perceived race might result from several factors, ranging from culturally learned stereotypes to the social threat of being seen as prejudiced.[35] These cultural associations can differ from one person to another based on their formative experiences. In line with this perspective, more interracial interactions during childhood correlates with decreased amygdala responses to familiar (compared to unfamiliar) perceived Black individuals.[36]

Another key finding is that implicit bias depends on self-regulation. The ability to adjust and control our behavior is a valuable human skill that enables us to act flexibly to achieve goals. Researchers, such as Devine, have suggested that individuals in the United States have conflicts between culturally or environmentally acquired stereotypes and prejudices and personal or societal norms to appear antiracist.[37] In other words, inconsistency arises from the desire to respond without racial prejudice and the activation of stereotypical or prejudicial associations. This has led researchers to suggest that implicit bias is partly a self-control failure or an inability to regulate that conflict. Existing research has shed light on the neural mechanisms underlying this self-regulation process, revealing a network of brain regions that are believed to identify the need for control, maintain regulatory

goals, and facilitate the selection of actions that align with the desired goals while inhibiting actions that do not (that is, goal-congruent versus goal-incongruent responses).

The anterior cingulate cortex was initially linked to detecting conflicts between prepotent and intentional response tendencies.[38] However, in recent years, new models of ACC function suggest that this region is involved in computing the value of engaging in cognitive control based on various factors, including task difficulty, feedback, uncertainty, and reward.[39] A U.S. study found that implicit racial bias increases ACC activity when viewing perceived Black individuals (as opposed to White individuals) when the faces are less prototypical (that is, inconsistent with racial stereotypes).[40] These studies assume that cognitive conflict arises due to differences in the participants' implicit biases and their motivations to be and/or appear egalitarian. Sensitivity to race in the ACC and other control-related brain areas is consistently most evident when folks know the study is about race and when participants believe that task responses indicate racial bias.[41] Research also finds that a greater internal drive to respond without prejudice may amplify cognitive conflict, even without explicit instructions to control racial bias.[42] Therefore, when people are cognizant that racial bias might be assessed, they may engage in more self-control as a strategy to avoid bias.

Another important region involved in self-regulation of racial bias is the dorsolateral prefrontal cortex (DLPFC).[43] The DLPFC is responsible for the executive control of sensory and motor operations that align with operational goals.[44] Recent research indicates that younger adults exhibit greater DLPFC activity when viewing perceived Black faces compared to perceived White faces than do older adults, who, in this study, had less self-regulation abilities.[45] The DLPFC and ACC may work together to regulate implicit racial bias.[46] The ACC may detect conflicts between explicit intentions and implicit associations, while the DLPFC may help to regulate the expression of implicit bias.[47] However, like the amygdala, there is less evidence that self-regulation, as reflected by DLPFC or ACC activity, is the driver of implicit bias alone.

The work seems to suggest that the evaluative brain network and the cognitive-control regulatory brain network both seem to partly contribute to implicit racial bias. Therefore, current research suggests that implicit racial bias is a complex phenomenon involving multiple neural pathways and mechanisms that rely on evaluative and cognitive control systems. While neuroscience can help us understand the underlying processes, it is essential to again underscore that implicit bias is not just a matter of individual brain activity but also a product of cultural and social factors that shape our biases. Research suggests that vital brain systems have been co-opted, in a sense, to process this socially constructed category – race – and help to produce implicit bias because the culture has imbued racial groups with meaning, particularly negative biases toward marginalized or minoritized groups. Just

because researchers can identify how the brain processes others based on race does not mean racial bias is innate.

Because culture and the environment have amplified biases toward marginalized or minoritized groups, intervening at the systemic level would likely have the most significant impact. However, neuroscience can inform how changes in our environment or new pieces of information shape implicit bias, providing valuable insights about the flexibility of these processes. One of the most promising avenues for reducing racial bias (both implicit and explicit) that has behavioral and neuroscience support is via interracial contact. Psychologist Jasmin Cloutier and colleagues were some of the first neuroscientists to investigate how contact influences neural mechanisms and reduction in racial bias.[48] In their 2011 study, people were first familiarized with perceived Black faces and White faces, then went into the scanner and viewed faces, some of which were new, and some were the same faces they had already seen. What they found for the novel faces (faces they had never seen) was similar to what neuroscientist Elizabeth Phelps and colleagues detected in 2000.[49] For self-identified White Americans, the amygdala responses were greater to perceived Black individuals than White individuals. However, the amygdala difference disappeared when respondents were more familiar with the perceived individuals. This was even more pronounced for folks with more childhood interracial contact. In fact, Jasmin Cloutier and colleagues found in their 2014 study that greater interracial childhood contact reduced amygdala responses in adulthood eighteen-plus years later.[50] Around the same time, neuroscientist Eva Telzer and colleagues found that increased early deprivation, characterized by a delayed age of adoption, correlated with heightened amygdala differences toward race. These findings highlight the influence of early social intergroup interactions on the functioning of the amygdala in later stages of life.[51]

Interracial contact also shapes how individuals mentalize about out-group members. The ability to mentalize, also known as "theory of mind," enables humans to make inferences about the emotions, intentions, goals, and motivations of others, thereby aiding in navigating complex social interactions. One great thing about neuroscience tools is that they allow scientists to measure mentalizing in real time. Research indicates that the dorsomedial prefrontal cortex (DMPFC) and temporoparietal junction (TPJ), among other brain regions, are consistently activated when individuals infer the mental states of others, particularly for in-group members relative to out-group members.[52] However, recent research suggests that folks with more interracial contact (for example, quality contact with Black individuals for White participants) engage in similar mentalizing when viewing perceived Black faces and White faces.[53] Moreover, mentalizing processes may help perceivers determine whether they observe social injustice during violent interracial interactions. For example, our recent research with self-identified White Americans finds that greater interracial contact increases men-

talizing when watching videos showing violent arrests of perceived Black civilians by White officers.[54] Together this work points to the importance of mentalizing processes in diminishing racial bias and facilitating the identification of racial injustice. It appears that mentalizing may act on explicit rather than implicit bias, but more research must be done to investigate this possibility.

Early fMRI work focused on specific brain regions, but contemporary neuroscience considers how entire brain networks coordinate when encountering or interacting with others. What is fascinating is that interracial contact not only determines how one region of the brain responds – for example, the amygdala – but our recent research demonstrates that contact shapes how entire brain networks respond to others, particularly those involved in social evaluation and mentalizing.[55] Therefore, contact has a powerful impact on how our brain works in concert when encountering others. This research, combined with excellent behavioral work in social psychology, suggests that intergroup contact may work as an intervention in some situations, but it is only sometimes feasible. It can put marginalized and minoritized folks in spaces they might not want to be in, and creating meaningful contact where strangers build relationships is a challenge. So, it is not a perfect solution.

Overall, neuroscience can provide valuable insights into the evaluative and cognitive mechanisms underlying implicit bias and the effects of different interventions and social contexts on these biases. Additionally, the new network-neuroscience approach may be more suited for mapping not only the constellation of factors that give rise to implicit bias but also how they function in concert and how changes in the coordination of these networks may reduce implicit bias. By incorporating insights from neuroscience into implicit bias research, we may better understand how implicit biases operate and identify effective strategies for reducing their impact.

The Future: Skepticism and What Is on the Horizon for Neuroscience Research of Implicit Bias

Although neuroscience and social psychology have provided essential insights into implicit bias's origins, production, and consequences, the field of implicit bias has faced criticism. For one, researchers need to clarify how crucial implicit bias is in producing everyday discrimination.[56] Moreover, implicit bias training can enhance knowledge on the topic but does not consistently reduce implicit bias or impact behavior.[57] For example, while many individual studies have shown significant relationships between implicit measures and discriminatory behaviors, the overall impact tends to be small.[58] This has led some critics to consider the construct insignificant to our understanding of discrimination or racism.[59] Although

this possibility is important, it is premature to write off implicit bias entirely. For one, it is still vital to understand every contributing factor to racial bias and racism. Moreover, different implicit measures show different predictive validity, so throwing them all out rather than understanding their strengths and weaknesses could impair our understanding.[60] Finally, it appears that implicit bias at the population level is a relatively good predictor of some aspects of systemic biases and racism, and some neuroscientists have started to map how implicit bias at the population level shapes neural responses.[61] After all, individuals make up systems and institutions. Individual biases and racialized interactions are ingrained into institutional policies and societal systems, propagating the development and perpetuation of systemic racism.

However, during one-on-one interactions, it appears that having implicit racial bias does not necessarily indicate the presence of a single person's racial prejudice or the likelihood that someone will discriminate, as going from associations to actions is complex and multifaceted. Instead, the person, situation, and culture influence discriminatory actions. It remains unclear how critical implicit bias is to structural racism over and above needs for power or status, in-group, the group one identifies with or belongs to, favoritism, or explicit bias. Therefore, it may be inappropriate to generalize from a single implicit bias behavioral or neural measure, even if it pertains to a significant conceptual grouping, as it may not reflect a fundamental or widespread change in the level of prejudice in the population or decrease racism. These interpretations must be cautiously approached since social phenomena may continue to be influenced strongly by racism even as implicit bias decreases in the population.[62]

Neuroscience alone cannot fully explain social group biases. Racial bias is shaped by a complex interplay of cognitive, affective, social, cultural, and environmental factors. Neuroscientists can only partially understand this phenomenon as the current methods often focus on one person's mental operations. Although it can provide us with rich information about the mechanisms that occur when we process others from different racial groups, produce implicit bias, or take discriminatory actions, the field is relatively new. There is still much to discover! As we delve deeper into social neuroscience, we must be cautious and mindful of the potential pitfalls that can affect the rigor and inference of neuroscience research, especially when dealing with complex social interactions.[63] For example, most neuroscience research examining how people perceive race and respond to racial out-group members typically shows pictures of faces that are disembodied and out of context. Although this allows researchers to isolate different aspects of the process, it does not represent the multitude of information and contexts available in real-life encounters. Unfortunately, these factors may be critical drivers or mitigators of bias, but without investigating them, we may have a blind spot. Moreover, most current research fails to examine whether neural processes

predict discriminatory behavior. In other words, just because we see an area of the brain involved in processing individuals of different perceived racial groups, it does not mean that part of the brain is necessary for discrimination. Therefore, we do not have a sense of the predictive power of neuroscience for understanding real-world discrimination.[64]

Using brain imaging techniques to study implicit racial bias has been criticized for potentially reinforcing the idea of inherent or innate racial bias rather than focusing on the social and cultural factors contributing to biased attitudes and behaviors. The public and even other scholars will misconstrue a response in the brain as evidence of the innateness of bias. Social neuroscientists have firmly pushed back against this interpretation, suggesting that culture largely drives these biases, but this misinterpretation still plagues the science.[65] Moreover, once neuro measures are involved, the tendency to view the process as innate almost medicalizes the solutions. For example, one 2012 study demonstrated that a drug, a common beta blocker propranolol, reduced implicit bias.[66] One can imagine the headlines: Pills to Cure Racism! While potentially providing insights into some biological processes, this study raised troubling public discussions about developing a drug to treat racism and, in effect, biologizing racism.[67] Others suggested that focusing on a particular brain region and levying a neurological intervention would cure this social ill. The truth is that brain regions, like our neurophysiology and endocrinology, are intertwined, and each typically has multiple functions. In this way, these statements are wildly inappropriate and highly inaccurate, representing extreme forms of how neuroscience research can be misinterpreted. There is no magic pill. There is no neurological or biochemical solution, and making these claims distracts from the historical and social factors that shape and reinforce racism. Racism is rooted in our structures and systems. How we process information is a byproduct of those systems. Neuroscience measures allow us to assess that byproduct with more nuance than behavioral measures alone. They can guide our understanding of racial bias, but we cannot and should not turn to a biological solution for racism.

In addition, despite the inherent dynamism of social interactions and processes, there is a lack of neuroscience work examining dynamic intergroup interactions. New techniques are now changing this. To increase the generalizability of brain research, scholars have adopted approaches such as hyperscanning, mobile EEG, fNIRs (functional near-infrared spectroscopy), and portable physiological tools, which enable us to extend our inquiry to real dynamic interactions and reach communities that were previously difficult to include due to financial or geographical constraints. These portable methodologies also remove cost barriers associated with fMRI and expand the sample and researcher demographics who can participate in social neuroscience. Ultimately, this will improve our understanding of neural correlates of racial bias because we can assess these biases

during real interactions and with samples of individuals other than undergraduates at universities rich enough to afford an fMRI scanner.

While neuroscience research on implicit bias has provided essential insights that even behavioral research alone could not provide (for example, the role of mentalizing in intergroup bias), it is just a starting place for much-needed research. Current racial bias research may not generalize across samples, stimuli, cultures, or historical points. This is vital because race is a cultural construct, with the meaning changing across history and cultures. Most of the current research focuses on White folks in the United States viewing perceived Black faces and White faces. Additionally, the people included in the studies (the sample) and whom they view (the stimuli) are typically young and self-identify as cisgender men or women. Moreover, researchers often do not even ask about political ideology or sexual orientation. These oversights impair our understanding as certain groups are more or less likely to attend to and discriminate against others based on perceived race. Therefore, we know little about how intersectional identities shape how people process race, representing a more naturalistic understanding of intergroup dynamics.

Social psychologists and social neuroscientists have primarily examined bias with people who espouse equality. However, plenty of folks explicitly hate others based on their social group of belonging. This is a critical missing piece in our understanding of racial bias as these individuals express hate and an intention to act upon it. They might like intergroup discrimination and violence and perceive it as just. Understanding the drivers of explicit bias with neuroscience and behavioral research methods (not simply implicit bias) could allow researchers to characterize who is vulnerable to espousing hate or joining hate groups, what processes underlie explicit bias, and how we may intervene when individuals are entrenched in hate.

By examining the human brain, both neuroscience and the study of implicit bias can provide insight into why we treat others with cruelty or kindness and exhibit empathy or apathy. While social neuroscience has yet to contribute significantly to our understanding of overall social injustice, the discipline is poised to push this frontier further. However, achieving social justice requires understanding the complex issues, including historical and structural factors, that affect equity and inclusion and mitigate racial bias, and this understanding must be integrated into our scholarship. Although neuroscience can uncover our biases and prevent us from denying the inclinations of our minds, it does not justify maintaining or acting on those biases. By mapping how our brains function, we can acknowledge and start to understand racial biases. This awareness may assist us in defeating these biases in everyday interactions and collaborating toward a more fair and equitable society. To do so, we must consider structures, individuals, and groups in our research and be inclusive in our scientific endeavors. Final-

ly, addressing implicit bias alone is insufficient to create a genuinely united society in the twenty-first century. The most effective means of changing bias is likely through altering the overall social structures and conditions that underpin and reinforce racism. A united national leadership and culture must speak out against racial bias, discrimination, poverty, failing health care and schools, and other insidious factors contributing to injustice. The neuroscience of implicit bias must be understood as a situated approach, whereby we recognize the significance of environmental and cultural factors in shaping the cognitive and evaluative mechanisms that give rise to racial bias.

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ENDNOTES

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