Childhood socioeconomic status (SES) has far-reaching linkages with children’s cognitive and socioemotional development, academic achievement, health, and brain structure and function. Rather than focusing on understandings about the neuroscience of socioeconomic inequality that have recently been reviewed elsewhere, the present article reviews several new directions in the field, beginning first with a consideration of the deficit versus adaptation framework. Although scientists largely agree that socioeconomic disparities in brain development are experience-dependent phenomena rooted in neuroplasticity, historically, such differences have been framed as deficits, which may benefit from intervention. However, emerging research suggests that some developmental differences among children experiencing adversity may alternatively be considered context-appropriate adaptations to the individual’s environment. We next discuss how socioeconomic circumstances are inextricably intertwined with race, and consider how measurement of racism and discrimination must be part of a full understanding of the neuroscience of socioeconomic inequality. We argue that scientists must consciously recruit racially and socioeconomically diverse samples—and include measures of SES, race, and discrimination in analyses—to promote a more complete understanding of the neuroplasticity specifically, and psychological science more broadly. We discuss the extent to which researcher and editor positionality have contributed to these problems historically, and conclude by considering paths forward.

Public Significance Statement
We review emerging research that suggests that some developmental differences among children experiencing socioeconomic inequality may best be considered adaptations to the individual’s environment. Noting that, in the United States, a child’s socioeconomic circumstances are inextricably intertwined with race, we consider how measurement of racism and discrimination must be part of a full understanding of the neuroscience of socioeconomic inequality. We conclude with evidence regarding the benefits of including more socioeconomically and racially diverse populations in research focused on neuroplasticity.

Keywords: socioeconomic inequality, race, brain development
2016), and such disparities are thought to be in large part rooted in differences in experience, such as exposure to responsive parenting or chronic stress (Noble & Giebler, 2020).

Rather than focusing on understandings about the neuro-science of socioeconomic inequality that have recently been reviewed elsewhere (Farah, 2017; Noble & Giebler, 2020), here we briefly review several new directions in the field, beginning first with a consideration of the deficit versus adaptation framework. That is, although scientists largely agree that socioeconomic disparities in brain development are experience-dependent phenomena rooted in neuroplasticity, historically, such differences have been framed as deficits, which may benefit from intervention. However, emerging research suggests that some developmental differences among children experiencing adversity may alternatively be considered contextually appropriate adaptations to the individual’s environment. We next discuss how socioeconomic circumstances are inextricably intertwined with race, and consider how measurement of racism and discrimination must be part of a full understanding of the neuroscience of socioeconomic inequality. We conclude with evidence regarding the benefits of including more socioeconomically and racially diverse populations in research focused on neuroplasticity.

**Deficits Versus Adaptations**

Skills that are characterized as a deficit in one context may be beneficial in another. Indeed, in recent years, evolutionary psychologists have argued that children raised in adverse conditions may be lacking in skills important for normative contexts precisely because such skills are not advantageous to their circumstance (Ellis et al., 2020). Instead, it may be advantageous for children facing adversity to develop other skills (sometimes termed “hidden talents”) that are more advantageous when facing adversity (Ellis et al., 2020). Such a framework proposes that children develop skills that are ecologically relevant to them (Frankenhuis & de Weerth, 2013). In other words, children adapt to their circumstances in ways that are most beneficial in light of those circumstances. Such adaptations, scholars argue, may be understudied amid a field—such as the study of socioeconomic inequality and brain development—that tends to be hyper-focused on the deficit model of adversity (Ellis et al., 2020).

Several examples can be used to illustrate these claims. First, consider the case of schools. In classrooms, children are expected to selectively attend to schoolwork while ignoring other stimuli for prolonged periods of time. However, sustaining attention in this way may not always be adaptive, especially in environments where vigilance toward other stimuli may be critical to wellbeing and safety. We can employ this interpretation in considering a study in which children were asked to selectively attend to a story being played in one ear while ignoring a different story played in the other ear (i.e., a dichotic listening paradigm; Stevens et al., 2009). Electrophysiological brain activity during the task was measured using event-related potentials (ERPs), and it was found that children from socioeconomically disadvantaged backgrounds tended to show less evidence of neural suppression to irrelevant stimuli compared with their more advantaged peers (Stevens et al., 2009). This result could be framed as a “deficit” in selective attention, or alternatively, as an “adaptation” to a world in which vigilance is prioritized. In a follow-up to this study, the researchers assessed the effects of a family based training program designed to improve selective attention among a group of children from lower-income households (Neville et al., 2013). Changes in brain function after the intervention suggested that children exposed to the intervention were better able to neurally suppress irrelevant stimuli. Again, this outcome could be interpreted as “reduction of a deficit” in selective attention, or as children adapting to new experiences and expectations after a period of intervention.

Other work has reported that children with a history of physical abuse tend to be better able to detect angry cues (Shackman et al., 2007). However, this skill comes at the expense of poorer attentional control and increased electrical brain activity in the presence of irrelevant angry stimuli (Shackman et al., 2007). This in turn puts children at a disadvantage in a classroom setting where a deficit in attentional control may impede academic success. Clearly, however, for a child who frequently faces imminent threat, the rapid detection of angry cues is highly adaptive.

Neuroscience has the potential to identify developmental adaptations that may be capitalized on to support children in classrooms and other environments. For example, children from socioeconomically disadvantaged backgrounds are more likely to engage in spatial rather than verbal strategies to solve arithmetic problems, whereas the opposite is frequently true for children from more advantaged backgrounds (Demir et al., 2015). Several other imaging studies also find SES-related differences in brain connectivity and structure in relation to cognitive performance (Ellwood-Lowe et al., 2020; Leonard et al., 2019). Taken together, this suggests that patterns in brain functioning may differ based on children’s environments (Ellwood-Lowe et al., 2020). This understanding could be used to design and test differentiated educational curricula that employ different strategies in response to neurobiological adaptations associated with different environmental contexts (Ellis et al., 2020).

The adaptation hypothesis has been tested in several studies. For example, Mittal et al. (2015) conducted a study in which adult participants were randomly assigned to complete a cognitive task under experimentally induced neutral or uncertain contexts. Findings indicated that adults who grew up in socioeconomically disadvantaged and/or chaotic households tended to show improved cognitive shifting, but
poorer inhibition and impulsivity, within the uncertain context. Similar findings among children have been recently reported by Fields et al. (2021), who found that children who had experienced caregiving instability tended to have better cognitive flexibility, but reduced attentional control and response inhibition, compared with children who had not experienced instability in caregiving. In both of these cases, a possible interpretation is that within the context of scarcity or chaos, individuals adapt to context, with resultant improvement in task switching, but at a cost to attention and response inhibition. These findings are useful as they help clarify the extent to which adaptations to the environment can be classified as adaptive or maladaptive.

Some work has suggested that short-term adaptations may come with long-term costs. For example, early caregiver neglect has been associated with an atypical pattern of prefrontal-limbic connectivity in childhood that appears more “adultlike” (Gee et al., 2013). This pattern, which is potentially consistent with stress-related accelerated maturation, has been shown to confer some degree of reduced anxiety, and may serve as a short-term adaptation (Gee et al., 2013). However, while adaptive in the moment, it comes at a cost, as this pattern may confer greater long-term risk of mental health problems (Tottenham, 2020).

Popular coverage of the literature linking socioeconomic inequality to brain development has commonly assumed that any differences along socioeconomic lines reflect a deficit at the lower end of the socioeconomic spectrum (Eck, 2015; Post, 2015; Rodgers, 2015). Even when this is couched as a call to action (Hodson, 2018; Proudfoot, 2020; Smith, 2015), it still centers brain development within socioeconomically advantaged contexts as “typical,” suggesting that children experiencing early socioeconomic disadvantage may have brain changes that need to be “overcome.” The framework of neuroplasticity-as-adaptation has the potential to reframe this narrative in a way that is not only poised to reduce stigma, but may also more accurately reflect experience-dependent mechanisms. Children from all backgrounds have a process of neurodevelopment that is shaped by experience—neural differences in response to experiences are expected. Note that this does not suggest that efforts to promote social justice are unwarranted, and indeed, the major organizations that promote developmental science include in their mission statements the goal that all children be provided the opportunity to reach their developmental potential (NIH, 2018; SRCD, 2021). However, it is important to recognize that neurodevelopmental differences after adversity frequently represent the expected and contextually appropriate response of the developing brain, and that it may be possible to capitalize on these adaptations within schools and beyond.

Also important is to acknowledge that the range of experiences conceptualized as “adverse” is wide and heterogeneous (DeJoseph et al., 2021). For example, the dimensional model of adversity and psychopathology (McLaughlin & Sheridan, 2016) theorizes that deprivation and threat are two distinct dimensions of adversity, differentially associated with development (Sheridan et al., 2017). Critically, work to test the adaptation model with consideration of these distinctions is in its infancy; future research on adaptation must focus on experimental, longitudinal research, to improve our ability to draw causal inferences. This will be crucial as interventionists and policymakers grapple with how to leverage stress-adapted skills to improve outcomes (Ellis et al., 2020), and potentially reduce the long-term sequelae of socioeconomic inequality.

**Socioeconomic Disparities, Race, and Adaptation**

When studying the role of socioeconomic inequality in child development, it is necessary to consider the intersecting role of race. Race and SES are inextricably linked in the United States context: 89% of children living in poverty are children of color (IES/NCES, 2019), and children of color are also more likely to experience adversity (Vogel et al., 2020). Indeed, it has been argued that developmental science must take an intersectionality lens to help us better understand the reinforcing and interacting effects of race, economic disadvantage, gender, and other characteristics that are associated with systemic oppression and widespread inequities (Crenshaw, 2018; Santos & Toomey, 2018). Focusing on just one aspect of an individual’s identity risks a great oversimplification of the individual’s experience.

Let us return to the example of schools, which serve as cornerstone institutions for many communities with high rates of poverty, providing resources such as food pantries, health care, laundry services, and mental health resources. When schools provide safe, nurturing, and predictable environments, they can help buffer against other risks associated with economic disadvantage (Dawson-McClure et al., 2017). At the same time, extensive evidence documents racial discrimination toward families and children of color within school administrations and classrooms (Gilliam et al., 2016; Gullo & Beachum, 2020). Indeed, racism may contribute to both dimensions of adversity suggested by the DMAP model (McLaughlin & Sheridan, 2016): Systems, policies, and individuals often limit access to both basic and enriching resources for children of color, consistent with the deprivation aspect of adversity, while direct experiences of racism are consistent with the threat dimension of adversity. As such, an intersectionality approach—including the measurement of racism and discrimination within the context of poverty—is necessary to more fully understand socioeconomic inequality within the educational context.

Traditional skills and behaviors emphasized in the modern classroom tend to reflect values of White families with socioeconomic privilege. Adaptations to meet such expectations in the classroom may activate the stress response system and
exacerbate long-term health disparities among students of color experiencing disadvantage. For example, self-regulation is considered a necessary skill in contemporary classrooms. Notably, teachers, especially White teachers, report more self-regulatory problems among kindergarteners at schools serving predominately children of color compared with schools serving predominantly White children (Rimm-Kaufman et al., 2000). However, Black teens experiencing disadvantage who rate themselves as having high self-control tend to have greater DNA methylation and poorer cardiometabolic outcomes in early adulthood compared with their peers who rated themselves lower in self-control (Brody et al., 2013; Miller et al., 2015). Despite these associations, those with higher self-control in adolescence tend to exhibit more positive psychosocial outcomes in early adulthood (Miller et al., 2015). These findings may be explained by the “weathering hypothesis”—when the effort of conforming to expectations results in positive social behaviors, but negative effects on the body. This physical toll may be the result of an overactive HPA axis, which releases stress hormones when the individual is exerting self-control (Miller et al., 2015). Without an opportunity for respite, the HPA axis can become blunted, leading to deleterious effects on the body and mind (Herman, 2013).

These findings highlight the importance of further investigation into the adaptive context-dependent basis of children’s behavior, and consideration of the ways that schools can best support behavior that is conducive to both student learning and well-being. Indeed, it is important to acknowledge the disproportionate disciplining of students of color (Townsend, 2000). Evidence suggests that as early as preschool White teachers display more vigilance around Black children’s actions than White children’s actions (Gilliam et al., 2016). This issue is related in part to a lack of culturally sustaining pedagogy in schools that, instead of centering White socioeconomically privileged behaviors as ideal, focuses on celebrating and encouraging culturally rooted differences in behavior (Paris, 2012). Reconsideration and reconfiguration of expectations for student behavior, built upon antiracist and culturally sustaining practices, may help to decrease disproportionate disciplinary patterns, and in turn catalyze optimal well-being for all students.

Given that race and poverty are so deeply intertwined, racial discrimination is an important stressor that should be measured when collecting data from communities of color (Inzlicht et al., 2006). Experimental evidence suggests that exposure to prejudice impairs Black students’ attentional and physical self-control (Inzlicht et al., 2006), which may also impair academic performance. Greater exposure to racial discrimination among adults is associated with stronger functional connectivity between the amygdala and several other brain regions (Clark et al., 2018), a potential consequence of chronically induced stress (Herman, 2013).

Psychological scientists must also carefully evaluate measurement tools for bias. Within a school context, Ellis et al. (2017) argue that many standardized tests are biased, in that they do not utilize content or contexts that match the skills of stress-adapted youth, essentially rigging the academic system against children facing adversity (Ellis et al., 2017). This measurement bias extends into research settings as well, as traditional cognitive assessments require skills like sustained attention that, as reviewed above, may not be adaptive for many children facing adversity (Ellis et al., 2017). It is necessary to reconceptualize measurement tools in both research and academic settings to better capture the variety of skills acquired by children through life experiences.

Diversity and Representation

To promote a more complete understanding of the neuroscience of socioeconomic inequality and adaptation—and to improve the rigor and quality of science overall—it is imperative that psychological scientists consciously recruit racially and socioeconomically diverse samples, and include measures of SES, race, and discrimination in analyses. To its detriment, the field of psychology has long relied on the convenience of studying White, middle- and high-SES samples. Further, it is imperative that we improve the pipeline for academic and editorial careers, to include more diverse scholars. Here, we briefly detail the pervasiveness of this problem, along with some of the potential causes. We conclude by motivating the importance of creating racially and socioeconomically representative samples for the production of better science, and we offer some suggestions for doing so.

Defining the Problem: Nonrepresentative Research Samples

Psychological research has always disproportionately studied Western, Educated, Industrialized, Rich, and Democratic populations. These populations have been aptly termed “WEIRD” given that these groups poorly represent the global population (Henrich et al., 2010). The ‘W’ in WEIRD can also denote “White,” given the overrepresentation of White populations in psychological research (Nzinga et al., 2018). The participation of WEIRD populations in studies is often attributed to researchers’ use of default samples, namely those most convenient and accessible in university settings (Nielsen et al., 2017; Nzinga et al., 2018). As noted by Nielsen et al. (2017), evidence of this representation bias is not new. Unfortunately, this issue continues to pervade the psychological sciences, despite having been acknowledged decades ago.

Recent reviews demonstrate the persistence of sampling bias in psychology. DeJesus et al. (2019) reported that among papers published in major psychology journals from 2015–2016; only 27% reported participants’ race/ethnicity,
Researchers and Editor Positionality Contributes to the Problem

Researchers and editors are disproportionately White and come from higher SES backgrounds. Roberts et al. (2020) analyses of studies published across cognitive, developmental, and social psychology revealed that 93% of journal editors were White. National data suggests that White people are also overrepresented as postsecondary faculty. While only 60% of the U.S. population is White, 81% of full professors, 76% of associate professors, and 73% of assistant professors are White (U. S. Census Bureau, 2019; NCES Statistics, 2020). Indeed, the vast majority of researchers and editors also come from middle to high SES backgrounds. In 2016, 69% of all doctoral degree recipients were from families where at least one parent had a bachelor’s degree. Case in point, all of the authors of this review are White.

This overrepresentation of White, middle- to high-SES researchers contributes to the lack of representation in sampling and publishing. Upsettingly, Roberts et al. (2020) found that editors-in-chief of color for psychology journals were almost three times more likely to publish papers highlighting race than White editors. Indeed, the positionality of White, middle- to high- SES researchers affects how research is conducted and may help explain why the issue of nonrepresentative samples has not been substantively addressed and improved.

One reason why White researchers and editors may continue to recruit racially homogeneous samples is a lack of attunement to racial identity and avoidance of the topic of race. As outlined by Roberts et al. (2020), race-related socialization differs greatly for people of color compared with White people. Because White people do not experience the racism that is insidious for individuals of color, they are often less attuned to racial issues, and even avoidant of conversations about race. Given their lack of experience in discussing these issues, White people may be fearful to explicitly study race and class for the possibility of appearing racist and classist in their interpretations of findings (Rowley & Camacho, 2015). This phenomenon suggests the importance of White researchers seeking and prioritizing self-education about race, racism, social class, classism, and their intersections, without which the pattern of nonrepresentative samples will likely continue.

This problem may also be rooted in the myth of meritocracy, postracialism, and color-blindness commonly held by White people (Bonilla-Silva, 2015; Brown et al., 2003). Specifically, White people can mistakenly assume that because they do not observe or partake in overt interpersonal racism, that racism is no longer a problem in the United States (Salter et al., 2018). In doing so, individuals fail to acknowledge the institutions and systems that continue to uphold racism in pernicious ways (Salter et al., 2018). As Syed et al. (2018) argue, the American value of meritocracy, suggesting that anyone can achieve anything if they just work hard enough, has translated into the psychological sciences by way of a strong focus on individuals and minimal consideration of oppressive structural forces, such as racism and classism, which critically contribute to psychological development and severely challenge individuals experiencing their force. Syed et al. (2018) argues that these sorts of colorblind, meritocratic perspectives create and sustain “invisibilities,” (e.g., race, SES), that, through their exclusion in research, are deemed unimportant to development and psychological processes.

Implicit biases may also influence the extent to which White researchers and editors prioritize recruiting diverse research samples and highlighting the racial demographics of their participants. Evidence has long suggested that White people, even those who report having no racial biases, have implicit negative biases against people of color and, specifically, Black people (Nosek et al., 2002). A complex network of brain regions is involved in these implicit biases including individuals’ identification of others’ races, subsequent formation of judgements using race-based stereotypes, self-monitoring of these judgements for racial bias, and regulation of these biases (Amodio & Cikara, 2021; Kubota et al., 2012). Indeed, implicit biases may have impacts on behavior. For example, in a lab-based task studying allocation of economic resources to strangers under conditions of economic scarcity, White participants showed deficits in the neural encoding of Black strangers’ faces and allocated less economic resources to Black than White strangers (Krosch & Amodio, 2019).

Why Recruit Racially Diverse Samples?

Racism persists perniciously at institutional and interpersonal levels, affecting individuals’ experience of the world and, subsequently, psychological phenomena (Roberts & Rizzo, 2021). Historical and intentional patterns of racism at institutional and interpersonal levels persist in the United States today (Alexander, 2020; Gershenson et al., 2018; Kendi, 2016; Morris, 2016; Rothstein, 2017), with marked negative consequences for individuals’ physical health, wellbeing, and educational experience (Benner et al., 2018; Mays et al., 2007; Williams & Mohammed, 2009).

Racial discrimination has also been linked to differences in brain function (Clark et al., 2018; Masten et al., 2011). As described above, this phenomenon is likely to represent an adaptation to experience. For example, greater exposure to discrimination has been associated with higher levels of spontaneous amygdala activity (Clark et al., 2018), when controlling for other measures of stress and mental health.
In circumstances where the individual must be primed and ready to rapidly detect threat—as in real-world situations where racism and discrimination are rampant and place the individual at risk for harm—this neurodevelopmental difference can be viewed as highly adaptive.

Failing to intentionally include racially diverse groups in research severely limits scientists’ ability to understand how the immediate environments and larger systems affect human psychological and neural development. Bioecological theory, widely embraced in the developmental sciences, is rooted in the idea that individuals’ interactions with close interpersonal and distant structural factors are the mechanisms of development itself (Bronfenbrenner & Ceci, 1994). The exclusion of racially diverse samples from psychological studies, then, suggests a belief that the very real sociocultural realities influenced by racial identity are not of central interest to those studying physiological phenomena and development. García Coll’s integrative theoretical model (García Coll et al., 1996) builds from Bronfenbrenner’s with explicit consideration of participants’ race, social class, gender, and subsequent interpersonal and structural forces of oppression and discrimination as key factors explaining development.

When investigating research questions about child development, it is paramount that researchers recruit racially diverse participants, particularly when studying normative, population-generalizable research questions. Failing to do so systematically ignores the role of wide-ranging and common experiences of inequality, racism, and discrimination on the developing brain. Unfortunately, due to the historical exclusion of racially diverse samples, major gaps exist in what researchers know about normative development and psychological processes among people of color (Syed et al., 2018). Further, it is critical to explicitly delineate the specific racial composition of the sample, instead of reporting vague characteristics such as, “White” and “non-White,” which do not acknowledge the heterogeneity of experiences for non-White groups and place White identity at the center (Roberts et al., 2020).

Moving Forward

In considering paths forward for recruiting racially diverse samples, it is important to first address the ways scientists have historically excluded, and inappropriately included, people of color in their research, and the resulting mistrust that may challenge recruitment today. Among some communities, serious mistrust in researchers exists. This well-founded mistrust stems from egregious historical research practices, such as the rampant racism used in past work (Vonderlehr et al., 1936), as well as the continued experience of discrimination, fear of deception, and concern for how researchers will portray them, and their community, in communicating findings (Corbie-Smith et al., 2002; Freimuth et al., 2001; Scharff et al., 2010). These challenges are likely magnified in studies of children’s brain development.

The nature of socioeconomic inequality can also pose challenges to recruiting and retaining socioeconomically diverse samples. Indeed, those experiencing economic disadvantage may be challenging to recruit and retain due to unreliable phone access, limited availability due to demanding work schedules, and frequent moves (Rowley & Camacho, 2015). Recruitment and retention might also require additional resources and/or skills such as having a research team fluent in multiple languages to overcome language barriers.

Given these challenges to recruiting and retaining racially and socioeconomically diverse participants, it is important for researchers to thoughtfully and intentionally build trust with socioeconomically and racially diverse communities through careful consideration of these histories and challenges. Researchers have developed and published best-practices in recruiting and retaining representative samples, including the creation of community advisory boards to aid in recruitment plans and research design (George et al., 2014; Rivas-Drake et al., 2016; Rowley & Camacho, 2015). For example, the landmark Adolescent Brain Cognitive Development (ABCD) study, a longitudinal brain development study explicitly including a nationally representative sample of over 10,000 racially and socioeconomically diverse adolescents, developed an intentional and thoughtful retention program in acknowledgment of the aforementioned histories and challenges that make representative sampling and retention difficult (Feldstein Ewing, Chang, et al., 2018). The ABCD approach focused heavily on cultivating strong, positive relationships between research staff and participants. As part of this effort the research staff worked to anticipate and meet participants needs to ensure the research experience was minimally burdensome (e.g., providing food, child care, and transportation). Research staff also met with community leaders to identify potential cultural and circumstantial barriers that might limit long-term participation among members of the particular community, and created plans together to address these. Involving historically excluded groups in the full-research process through community-researcher partnerships may be a particularly effective and exciting way forward (Minkler, 2005; Raver & Blair, 2020). Indeed, before ABCD, little was known as to whether models of neurodevelopment were similar across a range of racial, ethnic, and cultural backgrounds. By ensuring representation of historically excluded groups, the ABCD study is poised to dramatically improve our understanding of developmental psychology and cognitive neuroscience writ large (Feldstein Ewing, Bjork, & Luciana, 2018). Already, this approach has led to previously unknown insights regarding the dual roles of SES and race in shaping brain development (Assari, 2020; Assari & Boyce, 2021; Assari et al., 2020).
Along these lines, in addition to systematically improving how diverse research samples are recruited and retained, researchers can also take small concrete actions when presenting findings. Roberts et al. (2020) delineates that researchers should always detail their participants’ demographics, justify these demographics, and communicate how these demographics limit generalizability. Doing so, even when these samples are not representative, at the very least acknowledges that race and SES are legitimate factors that confer certain experiences and environments, which in turn influence psychological processes, phenomenon, and development.

Studying diverse groups is about doing better science. To progress psychological theories and deepen empirical understanding of phenomena that affect all individuals, we must include racially and socioeconomically diverse participants. Doing so requires an acknowledgment of the ways in which the field has historically and currently excluded these groups, the reasons why this may be the case, and the critical harms of doing so. Individual researchers, journal editors, and grant-funding agencies all have a role to play in transforming the psychological sciences into an inclusive science. Indeed, if the ultimate goal of our field is to use the scientific process to uncover truths about psychological phenomena and development, then understanding and applying knowledge of the realities of race and socioeconomic inequality—and how the developing brain adapts to these realities—is central to our mission.

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