Title:
The constraints of racialization: how classification and valuation hinder scientific research on human variation

Running title:
The constraints of racialization

Author:
Tina Lasisi

Affiliation:
Pennsylvania State University, Department of Anthropology

Abstract:
Human biological variation has historically been studied through the lens of racialization. Despite a general shift away from the use of overt racial terminologies, the underlying racialized frameworks used to describe and understand human variation still remain. Even in relatively recent anthropological and biomedical work, we can observe clear manifestations of such racial thinking.

This paper shows how classification and valuation are two specific processes which facilitate racialization and hinder attempts to move beyond such frameworks. The bias induced by classification distorts descriptions of phenotypic variation in a way that erroneously portrays European populations as more variable than others. Implicit valuation occurs in tandem with classification, and produces narratives of superiority/inferiority for certain phenotypic variants without an objective biological basis.

The bias of racialization is a persistent impediment stemming from the inheritance of scientific knowledge developed under explicitly racial paradigms. It is also an internalized cognitive distortion cultivated through socialization in a world where racialization is inescapable. Though undeniably challenging, this does not present an insurmountable barrier, and this bias can be mitigated through the critical evaluation of past work, the active inclusion of marginalized perspectives, and the direct confrontation of institutional structures enforcing racialized paradigms.

Keywords: race, human phenotypic variation, skin, hair, eye color

Racial thinking is deeply entrenched in the science of human biological variation. In much of the anthropological and biomedical work on human variation, we see the reproduction of race categories with new terminology due to an inability to surmount racialized frameworks [1–3]. As a consequence of this, scientific research has stagnated and reiterated thinly veiled race-based groupings [4].

Here, I illustrate how the use of classification systems and (implicit) valuing of certain trait variants over others entrenches the racialization of human variation. In light of this, I conclude with some thoughts on how we might move forward and overcome the issues that have led to our current state.

1 | CLASSIFICATION AND DISTORTION

A considerable number of classification systems used for human phenotypes are subjective and strongly influenced by racial ideas about human variation. This leads to the distortion of the biological variation they seek to represent and, frequently, the misdirection of scientific inquiry into those traits based on these biased perceptions. Examples of this can be found for every trait that has historically been used as a so-called "racial character" [5–8]. Many such typological approaches are still used today. Most importantly, we can see a distinct Eurocentric bias in many of these examples.

1.1 | The perceived variability of European traits

Eurocentric bias in classification schemes often manifests as the illusion of a wider range of variability in European populations than all other populations. The Fitzpatrick scale is one such example. This scale was originally developed exclusively for the classification of "white skin" according to its response to solar radiation [9]. The original scale only consisted of four categories (Roman numerals I through IV) of "white skin" (though type IV is often described as "light brown" in color). Additional "brown" and "black" skin categories (V and VI, respectively) were, by Fitzpatrick's own admission, an afterthought [10].

This skin typing system classifies an individual according to skin color, sunburn, and tanning response. However, the scale only allows for particular combinations of these distinct epidermal traits. Only types I to III burn and the distinction between these three types is in their ability to tan (type I does not tan, type II tans minimally and type III tans). Types IV, V and VI do not burn and do tan—their only distinction is skin color. This information is collected through self-report.

Unsurprisingly perhaps, there has long been evidence that this system does not work for "non-white" populations [11–16]. If we look at distributions of objective measures of skin reflectance around the world, the range of variation among European populations is the narrowest, while

many populations that would be simply described as ‘brown’ or ‘black’ according to the Fitzpatrick scale, possess a range of skin color that is quantifiably more vast [17,18].

Even among so-called “white-skinned” individuals the validity and value of this skin typing system is questionable. Rampen et al. [19] attempt to apply this system to a sample of Dutch students and find that only 41% of these cases can be classified according to the original scale. The authors explicitly criticize “the assumption that there is a reciprocal interdependence between the tendency to burn and the ability to tan” [19].

Despite these extensively discussed limitations, it continues to be used, even in such applications as DNA-based phenotyping [20]. Moreover, the literature contains many examples of studies that attempt to link other phenotypic traits (freckles, hair color, eye color) to the Fitzpatrick skin types, demonstrating the strong appeal of the idea that humans can be classified into types with coherent and categorically exclusive phenotypic attributes [11,21,22]. While the limitations of classification of skin type is well known and there are quantitative alternatives, classification of other phenotypes remains relatively unchallenged.

There are many examples of the perceived uniqueness of European populations with regard to their hair and eye color, as well as their scalp hair texture [7,23–25]. Even when privileging Eurocentric hair color typologies, the uniqueness of this European variability does not hold. For example, Melanesians are a well-known population in which blond hair is found [26,27]. This perception of unique European variability is heavily influenced by the range of variation that is encompassed by classificatory terminologies.

Categorical groupings of eye color, hair color and hair texture are inconsistent. Moreover, the categories that exist give a higher resolution to the variation associated with European populations. For example, eye color categories generally include blue and brown eyes, but may also distinguish grey, honey, hazel, brown, black, and various shades thereof.

Davenport and Davenport [28], for instance, claimed that “blue/grey and brown suffice”, the DNA phenotyping tool HIrisPlex-S claims to be able to predict eye color as being blue brown or “intermediate” [20], and a recent genome-wide association study (GWAS) on admixed Latin Americans used the categories: blue/grey, honey, green, light brown, and dark brown/black [29].

This inconsistency in the names and number of categories points to the subjectivity of these perceived phenotypes. The existence of these categories is asserted with little to no justification.

We see a similar pattern in hair color, where red, blond, brown and black are seen as distinct categories [30–33]. Even more expansive hair color classification systems, such as the Fischer-Saller scale still present more categorical options for gradations of color seen across and within

European populations [34]. With regards to hair texture, the most common classification is straight, wavy, curly, and sometimes the addition of a "frizzy" category or further subdivisions within these qualitative descriptors [24,35]. These qualitative descriptors are inconsistently interpreted and mask the range of variation that exists within tightly curled or "frizzy" hair [36].

In the cases where typologies are being proposed or justified, even a cursory examination of the populations informing these typologies reveals that Europeans are the main—if not, *exclusive*—pool of data [e.g. 34]. Mostly, however, phenotypic typologies are invoked without any rationalization of their validity—they are simply asserted as self-evident truth. To some, it may be tempting to conclude that, while vague, existing qualitative categories of eye color, hair color, and hair texture *are* distinct and that there simply exists more biological variation in Europeans. However, a closer look at the known biology of each of these traits reveals that emphasis on the European range of variability is not only disproportionate to any objective quantitative measure of phenotypic variability, but that the categories themselves are unwarranted on the basis of the underlying biological processes.

1.2 | Objective variation and subjective salience

Our perception of hair color is mainly influenced by the type and quantity of melanin that hair fibers contain. The chemical analysis of degradation products associated with eumelanin (a brown melanin) and pheomelanin (a red melanin) can quantitatively describe the hair color in terms of the amount and relative proportion of these two fundamental components [37,38].

These chemical analyses reveal that perceived hair categories differ on two main axes. The first is whether they have a significant amount of pheomelanin; such hair almost invariably appears red to some degree or another. The second axis of variation is a continuous increase in eumelanin that corresponds with our perception of light (blond) to dark brown and black hair [39].

However, existing data show a significant overlap in the eumelanin content between different perceived categories. Moreover, the range of variation seen black and dark brown hair, respectively, exceeds the collective range of variation seen in blond, light and medium brown hair combined [39,40]. This suggests that while apparently less salient according to the literature, from a biological perspective, there may be more meaningful variation that is being subsumed within these darker categories, as has been suggested elsewhere [41].

Eye color is pigmented by the same two melanins, but unlike hair and skin, where the melanin is deposited by the dendritic melanocyte that produces it, melanin in the eye is contained within the cytoplasm of the melanocyte [42]. Additionally, there are two divergent developmental lineages of melanocytes that contribute to pigmentation of the eyes: epithelial (of neural ectodermal origin) and uveal (of neural crest origin). Ocular pigment epithelium does not appear to

contribute to any visible variation. Most variation in apparent eye color appears to come from the uveal melanocytes, located in the iris and the choroid [42].

Much like hair color, current evidence does not suggest qualitative differences, but rather a continuous spectrum of melanin production. But unlike hair, there is no equivalent pheomelanogenic outlier (like red hair) - all eye color appears to vary primarily in eumelanin content. The qualitative difference we perceive (blue vs. brown) is a result of structural coloration that occurs when light scatters on (relatively) depigmented layers of the iris [43].

Classification of hair texture goes even one step further than hair and eye color typologies: it presents a tautology where the classification of humans by race or ethnicity is eponymous for the classification of hair texture (e.g. “Caucasian hair” or “Oriental hair”). This is seen most frequently in dermatology, cosmetology and forensics [7,44–46]. In the case of dermatology and cosmetology, this practice ironically stems from a relatively recent effort to cater to patients and consumers who, historically, have been excluded [44–46]. Forensic science, on the other hand, has a longer history of working with racialized hair categories, in part due to the overvaluation of racial profiling in criminal investigation [7,47].

Yet, what we know about hair biology suggests that variation is more complex than the asserted racial classifications suggest [36,40,48–50]. Various studies of hair fiber curvature and cross-sectional geometry show continuous variation across populations [40,49,51,52]. Still, qualitative descriptors of hair morphology persist and are the main mode of phenotyping for large-scale GWAS [24,35,53,54] and other fields of research [46,55,56]. The persistence (and continued justification) of all these classification systems demonstrates deep-rooted beliefs about whose variation actually matters.

2 | THINLY VEILED VALUE JUDGEMENTS

Classification works synergistically with valuation to add a dimension of racial hierarchy. While explicit mention of certain populations being superior to others is generally rebuked, more subtle echoes of longstanding ideas of racial superiority permeate much of the literature. By framing value judgements in the language of selection, much the same effect is achieved by designating certain populations as (representative of) ancestral humans that give a window into the primitive history of more derived populations [57].

2.1 | Valuation as sexual selection

This “ancestral vs. derived” dynamic that reproduces racial hierarchies is especially evident in narratives of sexual selection among human populations, which is corroborated by the recurrent (and widely cited) claim that sexual selection explains the evolution of depigmented populations [58].

The issue with the particular example cited here is that it argues for the significant influence of mate choice (specifically selection exerted over female individuals) and the existence of a universal preference for lighter skin. Aoki supports his claim of universal preference for lighter skin with a series of literary anecdotes and with selective evidence from social psychology experiments.

The historical narratives he uses including descriptions of beauty standards in Ancient Rome and 8th to 20th century Japan. Quite disturbingly, Aoki interprets the sexual exploitation of enslaved (light skinned North European) women by ancient Romans as a "predisposition to find light-skinned females attractive even when they are members of a conquered group." If sexual exploitation of enslaved women is evidence for their attractiveness, it is quite puzzling that Aoki does not mention the preponderance of evidence for Y-chromosomal contributions from (light-skinned) European males to (darker-skinned) Indigenous American, Pacific Islander and African women [59–61]. By his own reasoning, there appears to be far more evidence supporting the preference for darker skin.[1]

The selective evidence Aoki draws from social psychology are based on convoluted (and misleading) interpretations of results based on "Caucasian" university students from the 1970s[2] and a misrepresentation of a flawed analysis of ethnographic data across 312 groups.[3] Furthermore, he fails to include mention of the lengths to which lightly pigmented individuals

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[1] I make this argument to point out the lack of logic in Aoki's reasoning (as well as other supporters of these ideas). However, it is important to note that the sexual violence should not be interpreted simplistically as a manifestation of attraction (a naturalistic fallacy) when there is extensive evidence that humans use this as a means of domination against individuals across the spectrum of gender and other identities [62].

[2] Aoki makes reference to a 1978 study of around 1000 undergraduates identified as Caucasian who were surveyed about their likes and dislikes(Feinman and Gill 1978). He summarizes the findings as follows "Most individuals regardless of sex preferred 'medium white that tans to gold', which is the fourth lightest (fifth darkest) category on the list. In other words, both sexes appear to prefer a slightly lighter-than-average--more precisely, a lighter-than-median---skin colour".

Aoki also notes that "Many males dislike 'black', whereas the great majority of females dislike the two lightest shades." Of the eight possible choices students were given, the most "liked" options were the darkest options that are associated with their own "Caucasian" group. Leaving aside that the category of "dark white" is an oxymoron and that the authors of the study acknowledge racial connotations likely played a part in the student's choices, the data do not support Aoki's statements. Even the emphasis on dislike for 'black' skin in males is incomprehensible considering that the absolute largest percentage of dislike in that category was 'light skin which freckles'.

[3] The way Aoki summarizes the data from Van den Berghe & Frost [63], one would assume that the majority of the data showed a preference for lighter skin (as concluded by the original authors themselves). However, the article describes that of the 312 societies for which ethnographic data was available on beauty ideals, only 51 included any mention of skin color as part of those. The authors then focused on the categories that did mention something about the matter to draw their conclusions, but this dismisses the more readily apparent conclusion that: the majority of societies give no importance to skin pigmentation.

consciously risk skin cancer and cover themselves with tanning preparations [64–67]. Despite these flaws and thorough critique [68], the article continues to be cited as a scientifically valid and defensible hypothesis.

Selection (sexual or otherwise) is not inherently racist. But in its application, as far as the scientific literature is concerned, it has invariably depicted Europeans (and other populations with colonialist histories) as the culmination of evolutionary progress. These narratives of linear progress or racial superiority go against the very Darwinian theories they purport to apply. It is quite ironic that Aoki's article has the subtitle "Darwin's hypothesis revisited" when Darwin, himself, had the following to say on the matter:

> *"It seems at first sight a monstrous supposition that the jet-blackness of the negro should have been gained through sexual selection; but this view supported by various analogies, and we know that negroes admire their own colour." [69]*

Among other similar passages,[4] it appears a strange omission for Aoki to focus solely on evidence of the preference of light skin. A non-biased application of (sexual) selection should focus more directly on testable hypotheses that make predictions related to fitness.

If Aoki could for example demonstrate evidence that (within a population) female individuals with less pigmented skin have more offspring, his claim would be more convincing. In absence of direct evidence, at the very least, a hypothesis arguing for the selection of a particular trait variant should articulate the mechanism by which it would affect fitness. But this absence of a clear link to fitness (and focus on value-laden proxies such as "beauty" and "preference") is in line with the general tendency of research that implicitly naturalizes valuation using the language of selection.

This is not to say that it is impossible for mate choice to influence human phenotypic variation. A better example based on skin pigmentation data is seen in the complex and nuanced landscape of assortative mating seen in Indian populations [70]. But even here, the effects of skin color preference did not drive Indian populations unidirectionally towards some uniform level of

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[4] Chapter 19 from Darwin's Descent of Man gives many more anecdotes on which he bases his conclusion that each "race" prefers their own group's appearance. Another particularly interesting passage, cited from Mungo Park's Travels in Africa: "With respect to colour, the negroes rallied Mungo Park on the whiteness of his skin and the prominence of his nose, both of which they considered as "unsightly and unnatural conformations." He in return praised the glossy jet of their skins and the lovely depression of their noses; this they said was "honeymouth," nevertheless they gave him food. The African Moors, also, "knitted their brows and seemed to shudder" at the whiteness of his skin. On the eastern coast, the negro boys when they saw Burton, cried out, "Look at the white man; does he not look like a white ape?" On the western coast, as Mr. Winwood Reade informs me, the negroes admire a very black skin more than one of a lighter tint. But their horror of whiteness may be attributed, according to this same traveller, partly to the belief held by most negroes that demons and spirits are white, and partly to their thinking it a sign of ill-health." [69]

depigmentation, as Aoki would predict. If a case study with such clear social pressure for light skin does not result in a depigmented population, it is hardly imaginable that fickle individual "preference" could make a dent in the grand scheme of human evolution.

By contrast, strong, consistent, directional selection is very much plausible in a scenario where there is a selective pressure on biological factors (such as folate and vitamin D) directly affecting fetal development and numerous other aspects of human health [71–75]. It would be unfair to judge Aoki's conclusions on the basis of the preponderance of evidence that has been uncovered in the 20 years since this publication. Still, considering the subjective nature of the anecdotal evidence he presents in favor of a universal preference for lighter skin, it is quite interesting that supporters of this hypothesis could more readily believe selection based on the power of "white skin" as the pinnacle of beauty, rather than selection based on the abundance of a vitamin known to affect human health.

2.2 | Devaluation as pathologization

In contrast to the unmistakable valuation of traits associated with beauty, we can consider the manifestation of devaluation as pathologization. Something that is pathological (in the medical sense), causes disease. But there is general recognition for the fact that disease is not self-evident or absolute [76]. Defining what is "pathological" or "disease" requires a corresponding definition of what is "normal" or "healthy".

While some definitions of particular pathologies have changed as a result of advances in scientific knowledge, other "conditions" have moved in and out of the realm of pathology, not on the basis of self-reported patient suffering, but on the basis of political recognition for what is acceptable (or unacceptable) human variation [76–79]. Thus, pathologization can be considered a special case of valuation.

Though many debates surrounding definitions of pathology pertain to mental, behavioral and cognitive variation, the definition of a physical pathology is not clear-cut either, as is especially evident in discussions of the pathologization of differences in sex development [80–82]. The medicalization of individuals threatening a rigidly essentialized biological sex binary finds some parallels with pathologies defined on the basis of comparably deep-rooted ideas about what is "appropriate" phenotypic variation for an individual within a population according to racial paradigms. In a framework where humans must exist in discrete types, relegating aberrant individuals to the category of "pathological" functions as a tourniquet for a scientific paradigm unable to account for their existence.

Extreme overt examples of racialized pathology include the antiquated diagnosis of "mongolism" stemming from a paper entitled "Observations on Ethnic Classifications of Idiots" [83]. In this diagnosis, "mental retardation" is associated with "certain characteristic oriental

features" [84]. This description violently illustrates the successful dehumanization of both "races" perceived to be inferior, as well as individuals who do not live up to the narrow, ableist "racial standards" of their own group. The question is not whether any of the individuals described could justifiably be considered to suffer from a condition that benefits from medical treatment. The issue, rather, is the inclusion of certain racialized markers as diagnostic criteria.

The dermatological conditions of "woolly hair syndrome" and "uncombable hair syndrome" illustrate an inconsistent cluster of diagnostic criteria that center around the appearance of scalp hair in these individuals. Or, more specifically, the socially-determined unacceptability of their hair's appearance. "Woolly Hair (WH) is an uncommon congenital abnormality of the scalp hair consisting, by definition, of strongly coiled hair localized in a side or totally involving the scalp occurring in non-black people" [85]. Other descriptions give descriptions much to the same effect [86–89] varying maybe only in the terminology they use to communicate what "race," "ethnicity," or population this condition is (not) associated with. Interestingly, these descriptions lack concomitant medical issues (heart or skin related) that might justify "woolly" hair as a proxy for an underlying disease. The emphasis in the clinical literature is strongly on the abnormality of the hair morphology for the "race" in question.[5]

Uncombable hair syndrome differs in that there is no emphasis on explicit racial context, but the language used to describe the hair aligns with pejorative racialized descriptions of what is commonly stereotyped as "African" hair. Additionally, there is sometimes an emphasis on the association with blond or lightly pigmented hair, which can be used as a racialized proxy for who this condition affects due to ideas about the racial associations of blond hair.

The justification for the medicalization of this "syndrome" revolves entirely around the "unruliness" of the hair. Indeed, the name itself describes the central fault with this phenotypic variant: it cannot be combed. But the combing of hair hardly seems like a criterion for determining health. If styling potential were indeed a medical concern, there is an apparent lack of an equivalent "unbraidable hair syndrome" for individuals whose hair is too limp to hold a braid. But holding hair's ability to be "combed flat" in higher esteem than its ability to be braided can be explained by the regard for criteria of "whiteness" and associated beauty standards [90].

Some of the descriptions speak to the absurdity of pathologizing this phenotype: "The family and the boy have psychologically accepted the scalp hair anomaly without particular problems"[85]. Though some parents did indeed appear distressed as evidenced by one case of "uncombable hair syndrome" describing "a healthy 6-year-old girl with blond hair who sought medical attention for the frizzy, unmanageable, and unusual appearance of her hair" [91]. Without minimizing the

[5] For example, in Chen et al. [89] : "We report woolly hair in an Asian family, a race in which we have not found woolly hair reported." and in Horev et al. [88]: "Woolly hair is a structural variant of scalp hair that, when found among Caucasians or Asians, is considered abnormal.

potential suffering that might be inflicted on individuals presenting "undesirable" traits associated with other "races", one must ask where the medical reasoning is for treating this as a pathological medical condition.

Dermatology and plastic surgery are both branches of medicine that straddle pathology and enhancement, so it is not necessarily inappropriate to see attempts to "improve" appearance in these particular medical settings. However, labeling certain racialized traits as pathological with no further justification than their inherent undesirability is not scientifically justifiable.

Both in the case of selection and pathology, we see clear cases where the valuation of certain phenotypic variants over others crosses the line into subjective, unjustified (and unjustifi*able*) value judgement. Entire branches of philosophy would allow those interested in generating knowledge about the value of traits and aesthetic superiority to engage in appropriate scholarly discourse on the matter.

However, scientific inquiry is bound by method, as well as subject matter [92–95]. As regards the scientific study of human biological variation, the ascertainment of value is simply not appropriate as subject matter. The scientific method is not property equipped to evaluate the kinds of knowledge encompassed in values and aesthetics. In examples where those boundaries are crossed, we enter into the realm of pseudoscience, which is precisely where scientific racism exists [96].

3 | THE CONSTRAINTS OF RACIALIZATION

The overemphasis of European variability and the homogenization of other "races" is in line with expected cognitive biases of the people who have, for most of Western history, contributed to this body of knowledge [4]. The overemphasis on (and overvaluation of) European variability, especially in combination with the homogenization of the Other reflects the biases of the people who have contributed most extensively to the canon of scientific literature on human biological variation. Science is not immune to subjectivity despite its objective ideals.

The formalization of these Eurocentric biases was facilitated by the use of subjective classification systems, as well as the inherent biases of the languages used to develop those systems. The various classification systems discussed in this paper illustrate that categories are based not on the objective range of biological variability, but on the range of variability that appears salient to the scientist in question. Moreover, there is extensive psychological literature on the existence and hypothesized basis of the subjective perception of one's own (racial) group as more variable than others [97–100].

But even in cases less controversial than racial profiling, we see subjectivity elevated to fact through classificatory language. This is especially evident in linguistic differences in the

categorization of colors. For instance, English distinguishes between blue and green, while many languages around the world do not [101–104]. Even other European languages have linguistic color nuances that differ from English categories. For example, Russian has a distinct word for lighter blue and darker blue, which has been demonstrated to allow Russian speakers to more readily discriminate between the two [105].

These linguistic differences and related cognitive biases do not show a fundamentally altered capacity to perceive color, but rather a fine-tuned capacity to culturally (and linguistically) describe salient variation [103]. This can explain why existing categories appear so distinct for both eye and hair color. But with the inclusion of eye color terms like "hazel" and "honey", we delve into levels of nuances with cultural relevance, i.e. colors are named in reference to a naturally occurring object [102,106]. The linguistic limitations of classification are evident, but the effect of concomitant cognitive biases does not end there.

3.1 | Biased perceptions lead to misguided questions

The effect of language on our conceptualization of reality and subsequent scientific inquiry is significant. For example, a very palpable example of how misconceptions can misguide science is found in the scientific literature on skin color evolution.

In the mid-20th Century there was a distinct push against the idea that dark skin might confer some adaptive benefit in regions of high solar radiation. Despite the well-known geographical distribution of skin pigmentation and solar radiation, these scientists were perplexed at the seeming contradiction in "black" skin being advantageous over "white" skin in such conditions [107]. Their racialized idea of skin pigmentation as being comparable to the colors themselves set scientists up to formulate questions that were based on the complete absorption (black) and reflection (white) of light. Therefore, the inability of "Negro skin" to reflect as much light as "the white skinned race" was framed as a disadvantage causing Africans to absorb more solar radiation, which would (in the researchers' view) obviously be negative [107–109].

However, skin pigmentation is not described by the complete reflection or absorption of light (as the categories "black" and "white" would suggest). Rather, skin pigmentation is a function of the quantity of melanin in the epidermis. As such, humans do not vary in *color* so much as they vary from translucent to opaque due to the melanin content in their skin.

Melanin has a fascinating photochemistry. It is absorbed over the entire visible light spectrum, which is why it is perceived as brown.[6] The broad absorbance spectrum of melanin contributes to its quality as a photoprotectant [113–117]. Therefore the perceived disadvantage of skin that

[6] Brown does not exist as a distinct "color" in the sense of other colors that represent peaks in the range of visible wavelengths. However, reflection spectra that cover a broad range between red and green appear to us as brown [110–112]. In RGB space, however, brown is achieved by creating an orange with low luminosity.

contains these photoabsorbant chromophores is, in fact, the mechanism by which “black” skin stops UV-damage which can penetrate translucent, reflective “white” skin with little resistance. This misconception may appear silly in hindsight, but the way we currently classify hair and eye color is comparable in its level of misguidance considering the emphasis on perceived color and RGB spaces rather than measures of constitutive melanin content [20,29].

3.2 | Reckoning with the remnants of race

Confronting racial paradigms is crucial to an improved understanding of human biological variation. Advances we have made in the evolutionary genomics of human skin pigmentation were facilitated by the use of objective quantification methods and they have highlighted the extent to which we have underappreciated African and African-descendant variation [17,18,118].

Moreover, there is an increasing awareness of the ways in which racialized dermatology has failed all of us, but especially non-Europeans [14,48,119]. As a consequence, there is a push for the use of objective measures which will allow practitioners to evaluate their patients without relying on racial stereotypes [120,121].

New methods will supplant old subjective classification systems. However, we must still actively evaluate whether these new methods are objectively informed by the biological processes underpinning traits of interest, or whether they simply provide a way to give subjectivity the appearance of objectivity. The reproduction of race under a new name is particularly of concern in DNA phenotyping and broader genomic science where classifications of populations and ancestries can border on essentialism [2,122,123].

To stop reproducing racial paradigms of human variation, we must additionally do the work of critically evaluating existing work and halting the circulation of pseudoscience. An approach to our scholarship that relies on merely generating new and better data is, in effect, reliant on a flawed “marketplace of ideas” approach to manifest the “self-correcting” nature of science [124,125].

As illustrated by the widely cited example arguing for the universal preference of light skin [63], our current scientific process is not immune to poor scholarship permeating the literature. Moreover, as the work of human biology is extremely interdisciplinary, it is unlikely that we are able to fully evaluate the quality and validity of each citation we rely on. As such, it is our responsibility to do our part as reviewers and members of the scientific community to clearly articulate honest and constructive assessments of work we are qualified to speak on.

3.3 | Transforming knowledge and practice in human biological sciences

Transforming the way knowledge is created in human biological sciences requires changing the theoretical frameworks we use to interpret our data, but also changing the ways in which we "do" science. Knowledge is not created in a vacuum, but in intricate networks with actors and institutions whose influences are sometimes unnoticed and often unchallenged. Two ways of dealing with these influences are: centering marginalized scientists and scrutinizing institutionally imposed standards.

Certain parts of our scientific work are inherently subjective. The questions we have, the way we see the world, the variation we consider salient—all of this is affected by our positionality [126–131]. The kind of bias embedded in scientific knowledge generated by a group with homogeneous lived experiences can be mitigated by the active inclusion of diverse perspectives - especially, ones that have historically been marginalized [132,133].

The key to propelling scientific paradigm shifts is the ability to live in multiple paradigms at once [134]. Marginalized individuals are likely to have experienced this by force; living both in their own marginalized spheres and (trying to live) in the spheres of groups that oppress them [135–137]. This experience is aptly described by Du Bois's concept of double consciousness: "this sense of always looking at one's self through the eyes of others" [138]. Such experiences allow marginalized scientists to transcend certain limitations experienced by those who can only see the world from the perspective of dominant identities [131,139–145]. Consequently, these individuals are able to hold both paradigms at once and elucidate the incommensurabilities that are solved by a new paradigm [146,147].

Regardless of the composition of the scientific community, little progress can be made if institutions constrain work that ventures outside existing paradigms. Institutional power is a key force promoting the use of outdated racialized frameworks [148]. This power functions to promote science and scientists adhering to these ideas while hindering those who wish to unburden themselves of such limitations [135,149,150]. Progress also critically calls for a change in the institutional structures that reinforce outdated racialized standards of scientific research [151].

This work is by no means easy, nor does it have a clear and absolute end-goal. Dealing with racialized bias in science should be viewed as part of the perpetual process of self-reflexivity that should be inherent to scientific inquiry. Moving forward, scientists in human biology will need a more thorough understanding of and critical engagement with how racialization manifests in their research, including the terminologies, typologies, and citations they rely on [152–154]. Most importantly, this endeavor cannot succeed without a dedicated commitment to challenging the broader institutional and societal structures that seek to reinforce the very racial hierarchies that hinder scientific progress.

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DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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