

The Further Mismeasure: The Curious Use of Racial Categorizations in the Interpretation of Hair Analyses

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“Racially, I seem to have (who knows for sure) seven blood mixtures: French, Dutch, Welsh, Negro, German, Jewish, and Indian. Because of these my position in America has been a curious one. I have lived equally amid two race groups. Now white, now colored. From my own point of view I am naturally and inevitably an American. I have strived for a spiritual fusion

Jean Toomer, 1922

Introduction

It has been noted that some academics in the traditional physical sciences (e.g., chemistry, physics) have disparaged the social sciences for their lack of many of the features associated with a "mature" discipline. Those features consist mainly of:

- A relatively unified theoretical base
- A widely accepted inquiry method and measurement system
- A strong tradition of intensive experimental work
- The development of unambiguous empirical indicators which underlie their major constructs

I acknowledge that there is a debate about the nature of scientific method, and there is considerable argument over the correct "paradigm" that drives physical science (e.g., Kuhn versus Popper, etc.). However, it is generally true that social sciences are seen as "soft" or "fuzzy" (or even worse!) by many in the "hard science" community. It is also generally true that many social scientists are self-conscious about the degree to which they are "real scientists" in comparison to their "hard science" colleagues. Indeed, a recent example can be seen in the publicized poke in the eye that a physicist gave to "soft science" by writing a wholly fabricated and nonsensical article on "deconstruction" and getting it accepted in a peer-reviewed journal. Even within the social sciences those who are more quantitative in their work often seek to distance themselves from qualitative researchers. Few in the social sciences easily tread in both domains.

However, one can raise a substantial criticism of the traditional sciences and these often thinly disguised feelings of superior intellectual rigor (and I do acknowledging their clear and enviable record of useful and demonstrable

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products). The expertise one may have in a domain such as chemistry, engineering, physics, or optics does not translate into an "automatic" expertise in the "soft sciences". In fact, it may be that the "hard edges" of these sciences either dull the capacity to deal with "fuzzy systems" or desensitize the perception to the problems of ambiguity in analyzing problems.

In effect, does the perception that a failure in a discipline to attain the dominant consensus and product attributes associated with physical sciences entitle one to assume there is really no "genuine" basis to disciplines and their associated methods whose outcomes generate controversy, dissent, contradictory but logically consistent *explanans*, etc.? Does it also lead to a belief that "expertise" in such areas is attained with little or perhaps no intellectual effort in disciplines that seem to have (in the eye of the beholder) little or no substantive content? And can such attitudes themselves be dangerous, producing myopic, naïve, and even nonsensical ideas about the world?

There are multitudes of sub-problems that stem from contemplating this fundamental question. It is the modest ambition of this paper to identify and discuss some recent experiences in the assumption of what one might call "common sense" or "assumed" perspectives on a complex sociological and anthropological issue, that of race and racial identity. These events demonstrate dramatically erroneous conceptualizations about the "real world". In this case, I suggest that the simplistic treatment of a "soft science" construct (race) incorporated into a "hard science" context resulted in wildly inaccurate and even absurd conceptualizations and conclusions. The moral I try to draw from this description is that the experience demonstrates that there are dangers and costs associated with a failure to be sensitive to the subtleties and importance of data produced by social science and anthropological science. And there are dangers in not being reflective, historically informed, and situated to consider what I might characterize as a long view of even "simple variables" in any analytic endeavor.

"Race Bias" in a Technical Measure: The Controversy with Hair Analysis

Synopsis

The evolution of the idea that hair analysis for detection of xenobiotics, and for criminological purposes, for illegal drugs and toxins is a complex one, and is treated at some length in a variety of publications (Kintz 1996: Mieczkowski 1992). I can only give a brief synopsis of it here, and I refer the reader to the bibliography for a more in depth consideration of this topic and its history.

As many are aware, in the early 1950's it was proven possible to recover psychoactive substances from hair. Since the 1970's this capacity has been intensively explored and developed, largely in response to the general rise in interest and utilization of chemical analysis for illicit drug detection. This

intensification of development was undoubtedly an outcome of the increasingly militant "war on drugs" climate that permeated most official policy on drug control. Concomitant with this was an increasing interest by the private sector to identify drug users in the workplace, the criminal justice and correctional system to identify drug users in various settings, and the military to identify and exclude drug users from service.

Hair analysis has been of interest for primarily two reasons: it permits a long-term retrospection of drug use far beyond either blood or urine-based analysis, and it permits a relative quantitation of the degree or intensity of drug use. Of these two attributes, the first (retrospection) is generally accepted without much controversy, while the second (quantitation) is somewhat more contentious. However, for our purposes here, we will not dwell on these aspects of the technology. Suffice it to say that on a worldwide basis the efficacy of hair analysis is well accepted, and almost without exception the American judicial system has sustained the legality of hair analysis as a legitimate forensic technique. Indeed, millions of hair analyses for illegal drugs are done annually in the United States. The technology is used worldwide, and is likely to remain in place as a permanent part of the drug-screening and drug-monitoring repertoire.

The Race Bias Controversy

The basis of this controversy is easy to apprehend. It is argued, quite simply, that hair analysis performed by identical test protocols produces systematic differential outcomes in persons of different races. These systematic outcomes are labeled as a "racial bias" in the hair analysis procedure. These differences are alleged to be such that the test is biased *against* African Americans and by implication biased *toward* "Caucasians". "Biased" as used in this context means that the test will produce a positive result in one race (African-American) while under identical conditions it produces a negative result in the contrasted race ("Caucasians"). The controversy centers on a couple of critical concepts, the concept of "race" and the basis upon which races are identified and racial identities assigned, and the concept of "bias" as it is applied to the outcome of a bioassay. The race bias issue has entered into the "folk idiom" of drug testing. It is increasingly raised as a defense against a positive assay interpretation whenever hair analysis is under some review or consideration.

The first person to raise the race bias issue in print was a toxicologist, Robert Bost (Bost 1993). Bost himself did not do and has not published any original work on hair analysis that led to his suggestion that hair analysis may be racially biased. Rather, in a generalized review of hair analysis, he asked the question "are there any racial differences which might affect the deposition and retention of drugs in hair?" Bost did not define "race" or indicate how one establishes "racial identity" or in what ways hair would be associated with race, although clearly he intends to mean a biological conceptualization as opposed to a sociological one. Interestingly, Bost did not present data using any traditional

anthropological descriptor of race (e.g., Caucasian, Negroid, etc.). Rather, Bost presented data mainly descriptive of ethnic categories (French, German, Irish, Polish, etc.). He includes "African" and "African-American" as the only groupings that under current Federal guidelines would be identified as a racial group.

After his rhetorical question "are there any racial differences" he presented a series of gel electrophoresis slides done by another person (J.K. Dzandu: Dzandu was not a co-author on Bost's FSI article). As noted, Bost (and presumably he is using Dzandu's typology) presents categorical divisions that are ethnic groups. The categories are:

- German
- Polish
- Irish
- Croatian
- German/French
- German/French/Irish/Dutch
- German/English
- German/Mexican
- African
- African/American
- Chinese
- Hispanic

Dzandu's data, as presented by Bost, shows photographs of a series of gel electrophoresis plates for a variety of "racial/ethnic" groups. The relationship between this mix of race and ethnic descriptors and the physical nature of hair is unexplained by Bost, and in the cases of mixed racial and ethnic descriptors there is no discussion of the relative "contributions" of each of these discrete types to hair morphology.¹

The meaning of Bost's "ethnic/racial" categories does not appear to be based on any systematic or taxonomic idea of race. It is also interesting to note what is absent from the list, as well. If there is a "German" or "Mexican" keratin, why is there no "American" keratin category? Are African-Americans and Africans able to be treated as dichotomous racial groups? Considering Bost's conceptualization of race, the more one contemplates his categories, the odder they seem to be. For example, there is a "Mexican/German" category. Can't one be both "Mexican" and "German" at the same time? What aspect of the hair protein is "Mexican" and which aspect is "German"? Bost, in a pattern frequently repeated by others, uses interchangeably the terms "race" and "ethnicity" without consideration that one can possess both race and ethnicity at the same time. Curiously, Bost reports that Dzandu's conclusion was that "the keratin patterns of individuals belonging to different ethnic/racial groups are generally indistinguishable". What then leads Bost to state "the fact that there are some differences in some hair proteins should make us pause to consider whether there are ethnic differences that are significant factors in drug incorporation into hair"? This seems to contradict Dzandu's own statement of these racial types being "indistinguishable".

¹ I have not been able, to date, to locate J.K. Dzandu or retrieve a copy of this or any work he has presented or published in this area. However, I am continuing to try to locate this material for my own evaluation.

Unfortunately, Bost's writings on race are typical of the controversy on hair analysis. This very poor level of discernment on the complexities and problems confronting the issue of "race" has characterized the controversy on "race bias" in hair analysis. The social sciences, in this regard, have a much more sophisticated level of understanding of these complexities, and have generally reflected this in the published literature. Medical researchers, who span the domain of sociological, psychological, and biological variables, have also recognized the profound complexities of relying on "race" variables in the analysis of bio-phenomenon. Hahn (1992), for example, examined the accuracy of four basic assumptions on race ethnicity that underlie health statistics and their analysis. These included the assumptions that categories of race and ethnicity are consistently defined and ascertained in data collection, that race and ethnic categories are understood by those who are in these target populations, that participation, response, and enumeration characteristics are high and similar across race/ethnic categories, and that individual responses to race and ethnic identity are consistent over time and across different measurement instruments. In all four cases Hahn found that there are serious problems underlying each of these assumptions, and characterizes the collection of race and ethnicity data "problematic" in the health and epidemiological sciences. Similar to Hahn's concerns, Osborne and Feit (1992) noted that "when race is used as a variable in research there is a tendency to assume that the results obtained are a manifestation of the biology of racial differences . . . researchers, without saying so, lead readers to assume that certain racial groups have a special predisposition, risk, or susceptibility" to the problem studied. Zuckerman (1990) in examining racial differences in research in social and psychological domains called the examination of group differences based on racial categorization "questionable" and said the explanation of such differences in "strictly-biological-evolutionary" terms even more dubious". Fairchild (1991) in examining the use of race as a biological research variable concluded "sociobiological models of 'racial' differences promulgate a number of fatal flaws in their theoretical assumptions and interpretation of empirical databases". Yee and his colleagues (1993) in examining race as an analytic variable describe its use in scientific literature as "badly muddled", and state that the conceptualizations of race found in the research literature are "basically lay stereotypes that do not go beyond self-identification. Such definitions ignore heterogeneity, assume unproven race-behavior causal relationships, confuse race with intervening factors of bias (including inter-rater bias), ethnicity, social class, and culture, and have not been sanctioned by scientific and professional consensus."

The unreflective and unspecified use of racial and ethnic categorizations in the case of interpretation of hair analyses serves as a further example of the "badly muddled" method of data analysis and interpretation which permeates this literature. It is well beyond the scope of this paper to deal with every aspect of this issue, but I want to provide a few case examples that characterize the work purporting to show that this assay method is "racially biased".

Furthering Race Analysis: The Work of Kidwell and Blank, and Henderson and Harkey

Kidwell and Blank's Work on Race and Hair Type

The first group to raise the issue of possible racial bias based on their own research work were Kidwell and Blank (1990-96). They reported findings in the early 1990's on the cocaine recovery from ten hair samples (four black hair and six brown) analyzed in their laboratory. The dark hair showed a higher concentration of cocaine. The Kidwell/Blank team applied the term "hair types", which were *de facto* the color of the hair. The transition from hair color to hair types might seem trivial or inconsequential at first glance. But, on reflection, it is critical to ask what are the typologies that are implied in this? The major implication associated with this is that hair color is a racial phenotype, and as a consequence hair analysis is "racially biased". In fact when challenged about his implications of hair analysis as racially biased, Kidwell denied that such an implication was his intent at all. He stated that in reference to his own data "in any case, these results should NOT (emphasis original) be interpreted to imply a racial bias against hair analysis but only that a correction factor or different cut-off levels may be needed for different hair types."

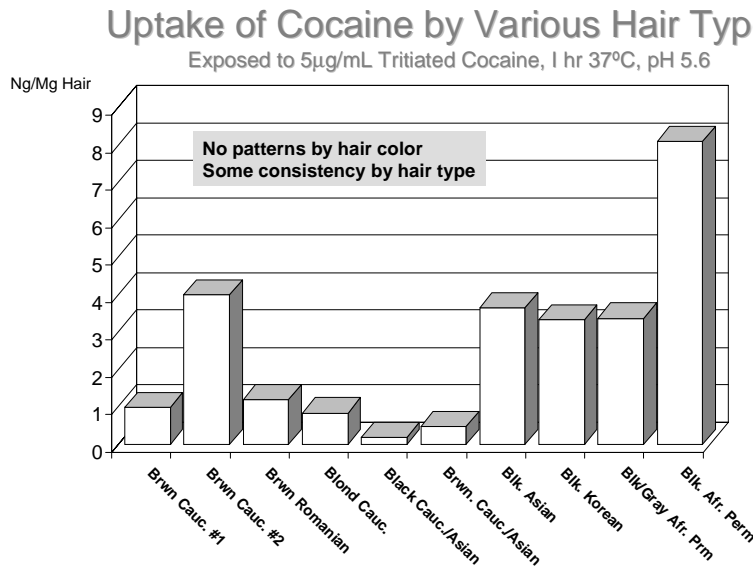
By 1996 Kidwell began to routinely use the term "hair type" in papers and presentations, although no definition or protocol was ever presented to establish how a "hair type" is identified and assigned to any hair specimen, except to note its color by observation. Indeed, in a frank admission of this in a 1996 article Kidwell states in presenting his data that "hair type is not a well defined term. However, it reflects hair color, hair history, race, and ethnicity of its donor". So, race becomes overtly introduced into hair "type" and by 1996 Kidwell was routinely using race and ethnic categories in his data presentations. And the basis for categorizing "hair types" was largely unspecified. The protocol for categorization was never presented. It primarily appeared to be hair color, although Kidwell emphasized and de-emphasized color in various papers and presentations. For example, in virtually all data he presented he listed three attributes: hair color, race/ethnicity, and cosmetic treatment he has labeled "permed"². He included various and sundry ethnic and racial categories as well, although the specific ethnic groups varied to some degree over time. In spite of his general expressions about "bias", however, he also recognized that outcomes for his experiments did not support the typology. Kidwell stated in 1996, for example, that in response to prolonged soaking of hair in a solution of cocaine:

"black African hair incorporated more cocaine than other hair types, perhaps indicative of prior hair history. However, variables other

² I assume this to mean the hair that has received a "permanent" type of hair treatment, usually meaning in colloquial use that is has been curled or waved by chemical processing. A more exact description of the procedure (e.g., straightening, tinting, etc) is not provided.

than color must be considered, as among the Caucasian hair types blond hair incorporated similar amounts of cocaine and morphine compared to other more pigmented types".

The data to which Kidwell refers is presented in Figure 1. Kidwell presented this data in 1994. It reflects data from a hair soaking experiment (the conditions of the soaking are in the subtitle) and utilized what have come to be the characteristic racial and ethnic typologies associated with his analysis. He also mixed in a number of curious and puzzling "hair types". Kidwell has the ethnicity, hair color, sex, and "race" all operationally mixed together in a kind of "racial/ethnic melange", and then each is presented as a "hair type".

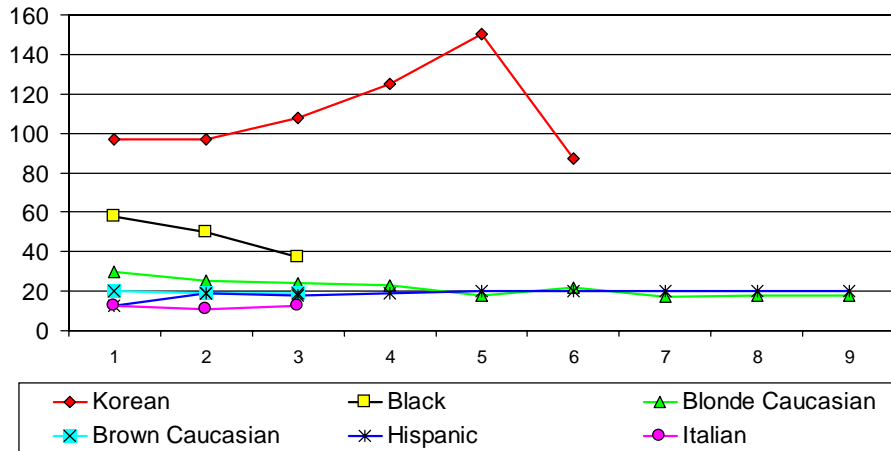


From Kidwell, 1994, TIAFT/SOFT Conference, Tampa, FL

Figure 1. Kidwell’s Hair Typologies Comparing Uptake of Cocaine from Soaking

This is a difficult operational measure to either comprehend or to analyze. First on a data analytic basis, there is no apparent consistent exhaustive and exclusive attributes which delineate categories. For example what are the distinctions between the "Black Korean" hair type and the "Black Asian" hair type? In Kidwell’s purview do Koreans constitute a separate "race" from "Asians"? Consider as well the contrasted "hair types" labeled "brown Caucasian" and "brown Romanian". *Post propter hoc*, one is forced to assume from an analytic perspective that in Kidwell’s racial schema Romanians are "non-Caucasians" and thus must constitute a distinct race. In a later article Kidwell (1995) included in his analysis "Italian hair". In one instance he compared six "hair types" of "female hair": "Korean", "Black", "Blonde Caucasian" "Brown Caucasian", "Hispanic", and "Italian". This data is presented in Figure 2:

The Binding of Cocaine to Six Different Types of Female Hair



Blank and Kidwell, Forensic Sci Int 70:13-38 (1995)

Figure 2. Cocaine Binding Data Reported by Kidwell on “Female” Hair Types

Kidwell noted that his data (Figure 2) showed that the “Korean” hair showed a dramatically larger binding of soaked cocaine, approximately double that of “Black” hair. “Italian hair” showed the least binding. He concludes, based on this data, that there are race differentials in cocaine binding. The appropriate assignment of racial differentials for binding intensity is postulated as “Asian hair > Black hair > Caucasian hair”. It is unclear whether he means this hierarchy to include hair irrespective of gender, or whether hair types must now reflect gender as one of the categorical variables. We do not know whether or not sex is necessarily a critical variable, but Figure 2 reflects only “female” although Kidwell had not previously identified sex as important in assigning “hair type”.

This hierarchy delineating an “Asian to Caucasian” differential is an interesting conclusion. Problematically, it is inconsistent with data he had reported earlier. Consider, for example, that Kidwell reported in 1994 (see Figure 1) that the highest concentration in his soaking experiments was attained by “permed black African” hair (slightly more than 8 ng/mg of hair). But a second sample of “permed black/gray African hair” attained less than ½ of that concentration. The second highest concentration value in that experiment was attained by “brown Caucasian” hair. This “brown Caucasian” sample attained higher retention values than “black Asian”, “black Korean”, “black/gray African permed” and “black Caucasian/Asian”. Gender, as we noted, in this instance was ignored as a categorical variable.

His second experiment, using hair collected from females, produced dramatically different results. So what are we left to deduce? There is no discussion of how sex by itself could affect the retention of drugs in hair, and there is no literature that has ever claimed to identify a biological/morphological or other marker for sex in hair. It is difficult to argue that these studies offer compelling supportive evidence of “bias” even granting the puzzling racial and hair “typologies” used in the analysis. Even Kidwell acknowledges that “there is no simple hypothesis that can account for this variation in uptake”.

If we take a large overview of this data, one must admit that nothing much can be concluded about a race bias hypothesis based on this data. Consider that in this method there was no effort to even test a series of *groups of hair samples*. One wonders if the importance of such a step was even considered. Without such a method it is impossible to ascertain anything whatsoever about the variability within any particular sample group or the variability that is associated within any of the “racial populations” to which Kidwell applied his findings. This stands out as one of the most serious flaws in the logic of his design. The use of these categories implies a monotonic “type” for each group. This is in direct contradiction to virtually all writing and analysis of the last century on the biology of race and ethnicity. And looking across the Kidwell’s own data, there is *prima facie* evidence of large, substantial variability. Consider Figure 1. We see that two “brown Caucasian” hair samples soaked in cocaine under identical conditions exhibited approximately a 400% difference in retention. The “blonde Caucasian” hair sample had approximately the same magnitude of variable when contrasted to the “black Caucasian/Asian”. Yet compared to the “black Caucasian/Asian” the “black Asian” sample had again a 300 to 400% difference in binding. Kidwell characterized this outcome as “some consistency by pattern”. What is the consistency to which he alludes? And he makes this deduction without the benefit of any statistical analysis. In the “female hair type” data (Figure 2), for example, a t test comparing the mean values by race does not show a significant difference ($t=2.438$, $df = 5$, $p=0.06$). Subjecting this same data set to a series of nonparametric analyses also fails to show any significant pattern by race. An analysis of Kidwell’s data from Figure 1 (where sex is not specified as a variable) also shows that there is no significant difference in comparing the cocaine concentrations by race or color categories. A Kolmogorov-Smirnov test shows no significance for cocaine concentration ($p = .704$) and a Kruskal-Wallis for cocaine and race/ethnicity ($p = .287$) and cocaine and hair color ($p = .540$) also fails to show any significant association. So, what is the “some consistency by hair type” to which Kidwell alludes?

These findings, and his own conclusion that no simple hypothesis can explain these outcomes did not deter him from continuing to claim the data show a “variability of drug incorporation along racial lines” (Kidwell 1996). Aside from the failure of the data itself to support such a conclusion, on logical grounds alone the assertion is difficult to comprehend. There is no clear definition of what

a “race” constitutes, or of what elements of the biology of hair allow the assignment of a “hair type” to any particular sample. Indeed, consider that it would be impossible to assign a “hair type” in Kidwell’s schema if one were to send to his laboratory a package of hair samples collected blindly. There is no reliable way to determine race/ethnicity from a hair sample, no way to assign it a “history” unless one talks to its associated human, no way to assign it an ethnic character without asking its associated human. How could a laboratory look at a specimen of hair and call it Italian? Even the coloration assignment, when made by unaided protocol can be problematic. Can we say there is only “brown hair”? Only “black hair”? In Kidwell’s published figures there is no presentation of samples of “Caucasian black” hair. Why? And consider that there has never been an attempt to determine such a simple but critical dimension of the “typologies” as inter-rater reliability pertinent to these categorizations. In 1999 Kidwell presented a paper which included the following:

‘We have shown through a number of *in vitro* experiments that different hair types incorporate different amounts of drugs when exposed under similar conditions. Incorporation of cocaine tends to be correlated with race in that the hair of African American females incorporate much more drugs than do Caucasian males or females”.

This statement is in conflict with the only published data Kidwell has produced on gender and race (Kidwell, 1995, 1996). As I indicated in discussing the findings in Figures 1 and 2, these claims of race are simply not sustained by this data. And this is assuming the statistical integrity of the racial categorizations. I do not, as indicated before, believe these classifications meet the appropriate criteria so that in both the theoretical and actual, these data fail to sustain the claimed “race differences”.

Kidwell in a 1999 presentation (Kidwell 1999) placed some distance between his earliest identification of race, and his current views. In reference to his earlier work and his current position he states:

‘We had termed this unequal uptake of drugs a matrix bias which grew into more popular usage as a racial bias. A number of studies have attempted to link this matrix bias with binding drugs to melanin. However, the results do not appear to be logically consistent. In contrast, recently we have proposed that the uptake and retention of drugs by hair has at least three components: (1) porosity of hair due to genetic influence, (2) the use of cosmetic hair treatments and hair care habits, and (3) removal by personal hygiene. Many of these components are culturally rather than genetically influenced. Therefore we now term the difference in uptake and retention of drugs as cultural bias.”

This statement signifies in Kidwell's hypothesizing a clear transition from biological to non-biological factors associated with the outcome of the hair assay as a "biasing" factor. The only one of these three factors that can be considered "biological" is (1) "the porosity of hair due to genetic influence". It is impossible to comment on this except to note that neither Kidwell nor any other researcher of which I am aware has suggested or developed a genetic model for hair porosity. Furthermore, for this to have an impact on the "race hypothesis" it would have to be shown that such a "genetic influence" was differentially distributed by "race". Neither Kidwell nor anyone else has ever shown such an effect, and the extant literature on hair morphology dating back to the 1930's has consistently found that hair does not have any biological distinctions which allow it to be used as an isolate identifier of race or ethnicity.

There is another issue to contend with in this suggestion of "assay bias" as well. If we examine the "cultural" component we must ask, what is this really saying? Well, in effect it is saying first, that people treat their hair differently in different cultures and subcultures and secondly, that as a consequence of this differential treatment they may be more or less likely to retain drug in hair over some rough set of constants. As a result these "cultural" practices, there exists a possible impact on aggregate outcomes for a bioassay. This, in turn gets labeled as a "cultural bias", but the bias is still somehow centered in the assay. That is, the assay is "biased" because of these cultural conditions.

Logically, this is nonsense. Consider another analogy. Some persons enjoy sunbathing, and actively seek to tan their skin by exposure to sunlight. This one might say is an exhibition of a "cultural preference". Others, fearful of the deleterious effects of sunlight, avoid it and even take active measures against even small exposures to sunlight. This population, tested over time, will show differential rates of skin cancers. Would we be inclined to call the test identifying these cancers "biased"? How can a bioassay determining the presence or absence of a biomarker be called "biased"? A biotest is the ultimately blinded observer. It is utterly unresponsive and culturally indifferent to the biosystem it is examining. It cannot respond to any placement of the biosystem in the cultural system. Yet it is the bioassay which Kidwell labels as "biased". In every circumstance with every bioassay there are conditions under which the specificity and sensitivity of the assay are maximized or minimized. These conditions cannot be considered in any meaningful sense to be biases. And they have never been treated as such in any other test matrix (i.e., Kidwell's hypothesized "matrix bias"). We might weigh the condition in considering how to interpret and apply the assay results, but that lies within the human who responds to the assay, not the assay itself.

Henderson and Harkey: Race as a Factor

The 1993 and 1999 Data Sets: 34 Subjects/21 Caucasians and 13 "Non-Caucasians"

The other major source of support for race bias and the conceptualization that hair is a "racial marker" can be found in two published papers and a report done by Harkey, Henderson and Jones and several colleagues. Like Kidwell, their views about race, when scrutinized are ambiguous and implied rather than explicit. These views and observations have to some degree shifted over time and become less firmly tied to race. It is worthwhile to consider their use of "race" in the same manner as the Kidwell analysis, and to critically examine their conclusions. I will consider these three papers individually, and then examine their overall conclusions of the work in totality. Bear in mind that, although there are three papers, they reflect two data collection efforts. The first data set was reported on in 1993 and has an N of 25 (21 "Caucasians" and 4 "non-Caucasians"). The second data set consists of an N of 9 subjects. This second data wave was reported in 1998. In the 1998 report the 9 "new" subjects were compared to a selected group of 6 subjects from the 1993 report. Thus the Henderson and Harkey 1998 paper is based on N = 15, and all the data on which their conclusions are based amounts to 34 total cases; 21 Caucasians, 6 African Americans, and 7 "non-Caucasian/non-African Americans"³.

In a National Institute of Justice Report in 1993 (Henderson, Harkey, Jones 1993), based on their controlled dose experiment with an N of 25 subjects (4 of who are classified as "non-Caucasians: 2 African Americans and 2 "Hispanic/Asian/East Indian" subjects), the authors in their conclusions stated:

"Race may be the most important variable in determining the amount of drug incorporated into hair. In fact, within the range of doses used in our studies, race was more important than dose in determining the level of d5-cocaine in hair. Although there were only four non-Caucasian subjects, all four were outliers . . ."

In an article in the Journal of Analytical Toxicology in 1996 (Henderson, Harkey, Zhou, Jones, Jacob 1996) they present this same NIJ data, but reach a somewhat different conclusion. The authors noted in the 1996 article that the cocaine assay values for the "four outliers" identified in the 1993 study (indicating, in their view, that race was the single "most important factor in drug incorporation") were probably *not* explained by race. They stated:

³ The "Non-Caucasian/Non-African-American" is my designation for their racially ambiguous categories which are mixes of both "racial" groups (e.g. Caucasian and African American") as well as groups which are normally not considered racial groups but rather ethnic groups (e.g., Hispanics, Arabs, East Indians, etc.). Henderson and Harkey operationally classify all these as "races" and aggregate them together as "non-Caucasians". This means, for example, that in their schema one could not be a Caucasian Hispanic. We utilize this scheme to analyze their data, but do not mean to imply an endorsement of it or accept its logic.

“The outlier subjects, all non-Caucasians, could have genotype-related differences in their drug distribution, metabolism, or elimination. However, this does not appear to be the cause of their unusual hair analysis results . . . Although the outliers were non-Caucasians, they were not all African Americans. Two of the four were of mixed Hispanic, Asian, and East Indian decent (sic). The one common feature this group did share was their coarse, dark hair . . . However, simple differences in melanin content are an unlikely explanation for the differences observed in our study.”

What is interesting here is that the data presented in the 1996 article is the same data as presented in the 1993 report. The strong declaration of 1993 - that race may be *the most important factor* in explaining drug concentration in hair - is modified without any further data or new analysis than appears in the 1993 report. Why would this be so? The critical additional information appearing in the 1996 article and not in the 1993 report is that the “non-Caucasians” are not a single racial category (e.g., all African American, etc) but a “mixed heritage” group of persons with both ethnic and “race” characteristics mixed together. Of the 25 cases (itself a convenience sample with no random selection or assignment) 4 are “non-Caucasian”. Of the four “non-Caucasians” two are “non-African-American” (see footnote 3). The “non-African American/non-Caucasians” are described as of “mixed Hispanic, Asian, and East Indian decent (sic)”.

When you analyze the data they offer including this new information the finding of a “racial bias” effect becomes very difficult to discern. Interestingly, in the 1993 report there is no statistical analysis of the data beyond the presentation of findings and aggregate measures such as means and standard deviations. A closer scrutiny of this data reveals some interesting findings:

- ◆ A one-way analysis of variance and shows that the relationship between either total cocaine recovered or mean value per segment of cocaine recovered and the “Caucasian/non-Caucasian/African-American” trichotomy is significant ($p = .05$), but *neither* of these measures meets the equality of sample variance requirement. The Levene test for equality of variance is significant for both (it should be non-significant), indicating that the equality of variance assumption is violated. Using a series of post-hoc tests (Tamhane, Dunnett T3, Dunnett C, and Games Howell), permitting the comparison of the three groups while allowing for unequal group variances, indicates that *none* of the tests attain significance at ($p = .05$). Furthermore, the analysis reveals that there are no homogeneous subsets by race designations for the three groups for either mean cocaine value per segment or for total cocaine recovered from all segments.
- ◆ The group which accounts for the significant variance by the simple ANOVA (that is, not controlling for the variance problems) is not the group labeled “African-American” but the group designated “non-

Caucasian/non-African American” and described by Henderson and Harkey as of “Hispanic, Asian, East Indian” origins. The subjects with the two highest values for both total cocaine recovered from all segments and mean cocaine recovered per segment are not African-Americans, but persons labeled as “Hispanic/Asian/East Indian”. This group of two subjects is the only group to attain a significant t value with appropriate controls for equality of variance applied to the analysis.

The 1998 “Race as a Factor” Article

In 1998 Henderson's group published an article again examining “race as a factor affecting the incorporation of drugs into human hair”, and included nine new subjects (Henderson, Harkey, Zhou, Jones, Jacob 1998). There was, once again, no description of how “race” as operationally treated is expressed biologically, and the only reference to racial categorization is a footnote in their data “Table 1” (p. 157) which notes that “racial characteristics as self described by the subjects”. Any further connection between “hair type” and race identification is unexplained. However, the authors frequently refer to “hair type” and observe that “coarse, dark, hair may incorporate more drug than fine brown or blond hair”. They do not identify a specific typology or taxonomy of “hair types”, and it appears that “hair types” are essentially subjective impressions of hair color, texture, and body: i.e., hair is “coarse” or “fine”, “black” or “brown”, “wavy” or “kinky”, etc. It appears as though the authors are implying a typological relationship between self-declared race and “hair type”, but there is no explicit description or discussion of this. There is no reference to the biological literature on hair morphology or any discussion of sample variability.

The reader must assume, as apparently do the authors, that the “coarseness” or “fineness” of hair can readily distinguish races and that hair is dichotomized into these categories. Problematically, however, virtually all who have studied hair morphology in relation to race since the 1920's to the present have rejected such a characterization (Hausman, 1925; Steggerda, Seibert 1941; Hrdy 1973; Sunderland 1975; Rook 1975; Leach 1975). Hausman, as early as 1925, stated that it is “not possible to identify individuals from samples of their hair, basing identification upon histological similarities in the structure of scales and medullas, since these may differ in hairs from the same head or in different parts of the same hair”. Rook (1975) pointed out nearly 50 years later out that “Negroid and Caucasoid hair” are “chemically indistinguishable”. In reviewing a series of studies he noted that hair from various populations and analyzed by a series of tests to determine amino acid composition, diffractive values for X-rays, stress-strain analysis, and electrophoretic studies showed “identical results were obtained for all samples”.

The method by which Henderson and Harkey move from one conceptualization (coarse hair/dark hair) to another (racial bias) is left unstated. And this is problematic in terms of their statements in the 1996 article that neither

pigmentation nor "genotypic expression" is a likely explanation for these putative differences in "hair type". Their hypothesis, for example, requires one to assume that "Caucasians" with coarse, dark hair are somehow be "immune" to the "race effect" they postulate for "non-Caucasians". The "race effect" is left to account for the heightened incorporation of cocaine into "non-Caucasian" hair since they explicitly exclude the likelihood that a "simple melanin effect" can account for their results. And, undergirding the analysis, one must assume the dichotomization of "race" into "Caucasians" and "non-Caucasians" with the concomitant requirement that an unknown, unidentified unifying "race factor" binds together all non-Caucasians and excludes all Caucasians.

Does The 1998 Data Support "Race Bias" in Hair Analysis?

In the 1998 article, with the addition of the 9 new cases, the Henderson et al. group concluded, "there appears to be a racial bias in the incorporation of cocaine into human hair". However, regardless of the method by which the data is analyzed, and even accepting the unorthodox "race dichotomy" of their method, the Study I/Study II comparison offered in the 1998 article does not show a significant difference between the Caucasians and "non-Caucasians".

As indicated earlier, this new data consisted of the addition of 9 subjects who were characterized as "moderate users of cocaine" but were not judged to be "cocaine dependent". They each received a single dose of deuterated cocaine of 2 mg/Kg of body weight, administered intranasally by liquid atomization. This was done in order to duplicate and make comparable this group's cocaine dosing level to the group that formed the basis of the 1993 study. In this section we will refer to the 1993 study as "Study 1" and the 1998 additional subjects as "Study 2".

The nine additional subjects added in Study 2 were all "non-Caucasians". Specifically, the "race composition" (with their hair color and "type" are shown in parentheses⁴) of the subjects was as follows:

- ◆ 4 African Americans (all black, all "kinky")
- ◆ 2 Hispanics (both black, one straight, one wavy)
- ◆ 2 Caucasian/African Americans (one black, one dyed, one kinky, one curly)
- ◆ 1 Arabic/Caucasian (black, wavy)

These nine individuals are contrasted to 6 individuals identified from Study 1. These six individuals are identified as "Caucasians" and all had brown hair (one

⁴ "Hair type" is undefined but appears to refer to whether or not the hair is curled or straight and to an impression of the degree of curvature. There is no discussion of the basis of the classification of either color or "type" except a footnote in Table 1 of the article that indicated "hair type as described by research staff". Whether there was a collaborative process to develop criteria or whether any inter-rater reliability study was done of the rating process is left undiscussed

subject had gray/brown hair). Three had “straight” hair, two had “wavy hair” and one had “curly” hair. It is unexplained if these six were selected from the Study 1 pool by a random process or whether these six were picked on some other basis.

Although Henderson et al. in Table III of the 1998 article indicate that the study groups are significantly different at ($p = .05$), a re-analysis of this data do not support this observation. An analysis of the cocaine recovered from the subjects hair of this study and contrasting the subjects in Study I (Caucasian) to Study II (non-Caucasian) does not show at ($p = .05$) by ANOVA, t test, or a series of non-parametric tests a statistically significant difference between the groups. Comparing cocaine recovered from all "racial" groups as included in Study 2 and comparing them to the selected 6 Caucasians from Study 1 by t test yields a finding of no significant difference ($t = -1.443$, $df = 13$, $p = .173$)⁵. This is true whether or not you include all subjects or whether you exclude the single “non-Caucasian” who had a zero value for their hair analysis and was excluded from the analysis by Harkey and Henderson.⁶ With Subject 3 excluded the contrast between Caucasians and non-Caucasians still fails to attain significance ($t = -1.820$, $df = 12$, $p = .094$). Furthermore, using the “maximum amount of cocaine found in any hair segment” also fails to produce a significant difference ($t = -.423$, $df = 13$, $p = .679$). These differences may come about because the authors used specialized considerations in the application of these tests that were not reported and consequently we could not duplicate.

Henderson et al. operationally treat their “race factor” as “differences in the incorporation of drugs into different hair types”. The authors, in the discussion section, reach the conclusion that “there appears to be a racial bias in the incorporation of cocaine into human hair”. However, they state in their summary that “these findings strongly suggest a racial bias” but “are not conclusive”. They believe that the data is not conclusive because of "sample size and the high degree of inter-subject variability" and because "none of the subjects seemed to be true outliers" in the 1998 study. Such a statement is not warranted by the data and analysis presented in the 1998 paper, and is not warranted in considering the totality of the data from the 1993 report to the present.

- ◆ The characterization of sample size and high inter-subject variability as the limitation on the strength of this data fails to acknowledge or recognize other serious sample defects. There is no attempt to assess

⁵ That is, accepting the concept that the addition subjects in Study 2 are a unified group of “non-Caucasians.

⁶ This exclusion of Study 2, Subject 3 is a questionable data manipulation. It appears that the case is excluded simply because it failed to yield an assay value above the limit of detection. There is no statistical basis for such exclusion. Furthermore, Henderson and Harkey have relied upon the detection of “outliers” in Study 1 as supportive of their hypothesis of a “racial bias”. They do not apply any conventional measure of an outlier (e.g. a value expressed as z units, etc.) but appear to simply mean values that appear as “outliers”. In any event, it is inconsistent to include outliers that fall above the mean as evidence for their hypothesis and simultaneously exclude outliers that fall below the mean that could be construed as support the null hypothesis.

variability by using groups of samples to represent the "types" which the research alleges to investigate. This is because an explicit definition of what constitutes a "type" is undefined. Thus the assumption that variability is high because of sample size cannot be made. Variability may be high under any circumstances. That certainly is closer in character with the historic observations on hair morphology.

- ◆ The failure to do any random assignment or investigator blinding at any stage of the assessment is a serious flaw. What would happen to a hair sample if the researcher assaying it did not know *a priori* the "race" of the donor? What would happen if the person doing the assessment were given samples deliberately selected to be ambiguous (e.g., "coarse, kinky hair" from a "Caucasian")? If a "race factor" accounts for serious variability in cocaine incorporation into hair, could the researchers identify the race of hair samples to which they were blinded by simply assigning them to categories based on the incorporation rates of cocaine alone?
- ◆ In the assignment of traits by staff evaluation - in areas such as hair color, hair texture, etc. - and the self-selection of "races", there is a lack of any assessment of inter-rater accuracy. This does not allow one to evaluate the degree to which subject variability may come from the reliance on unassessed impressions of the research staff. One cannot distinguish the empirical measures of the study from the sociological perceptions of staff with this design.
- ◆ The race conceptualization used is one that lacks any grounding in the historical anthropological literature or any basis in current governmental guidelines regarding the categorizations of citizens for legal purposes. It also lacks any clear internal logic, and does not appear to reflect an understanding of the distinction between race and ethnicity.
- ◆ Whatever feature of "race" that is targeted is unarticulated, and one cannot determine whether the "race factor" is present in any particular individual, and whether the "race factor" is a binary trait (present/absent) or is a quantitative trait which may be present in degrees. This is important since most of the subjects of the study categorized as "non-Caucasian" appear to have racially heterogeneous backgrounds.
- ◆ There is no articulation of how the "hair types" are related to "race". It appears that it is left to some sort of "common sense" or social stereotype regarding racial appearance. It is curious that the six Caucasian subjects from study 1 were all selected for brown hair. Why are no black-haired Caucasians included in the study? Perhaps there

are reasons for this, but if so, they are undiscussed. On what basis other than assumption can one assume that the hair coloration in these categories is uniform? Are all "brown-haired" subjects equivalent in coloration?

- ◆ Even assuming the use of "race" as implied or explicitly identified by the researchers, the data fail to show that there is significant difference between the groups considered. Furthermore the highest values in the study for "non- Caucasians" is associated with Hispanics, not African-Americans.

Summary

The allegation of a "racial bias" for a bioassay is intrinsically a sensational and attention-grabbing one. Often embedded in such an allegation are all manner of hidden assumptions, implied differences, and "appeals to common sense" and social stereotypes which are relied upon to lend social meaning to the concept of race. Yet in the history of looking at racial typology, regardless of the unit of analysis, these differentials tend to break down and collapse as useful markers of race. These are testimonies to both the power of the sociological concept of race and the weakness of race as a biological construct.

We witness, once again, a repeat of this folly in the "race factor" raised in the use of hair analysis for the detection of cocaine. Not only does careful scrutiny of the data fail to demonstrate such a "race effect", the naïve and outright erroneous uses of race and ethnicity make the categorical process useless.

It is tempting to those who work exclusively in the domain of physical science to treat "race" as an attribute analogous to some chemical or physical property of matter like mass or density. But it is not such a property. These series of studies suffer not only from a naïve use of "race" they suffer from poor study design as well. In the all literature purporting to show a "race bias" there has been only one controlled-dose study ever done (no random assignment, no blinding at any stage of evaluation), using doses from 10 to 100 times less than the typical chronic drug abuser. And the study conclusions on race are based on 6 African Americans and 5 mixed-race "non-Caucasians". To suggest that on this basis that the results are "strongly suggestive" of a race bias is an over-reaching of the data by gargantuan proportions. If a researcher believes race should be introduced into hair assay interpretation they should at least proceed in a responsible, careful, and scrupulous way.

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