

The "Unusable" Data Crisis: Origins of Racial and Phenotypic Bias in Electrophysiology and a Roadmap for Inclusion

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Highlights

- Neuroscience may perpetuate racial bias in electrophysiological measures by labeling Black participants' data as "unusable".
- Both the design of electrodermal instruments and the lived experience of racism influence skin-conductance activity.
- Individuals, institutions, journals, and foundations can all play a role in curbing this bias and reducing its scientific and societal harms.

Empirical evidence from psychophysiology experiments

A **skin conductance response (SCR)** is a proxy of emotional arousal.⁹

- Electrodes are placed on two fingers.
- Conductivity increases with arousal and sweat gland activity (Fig. 1).

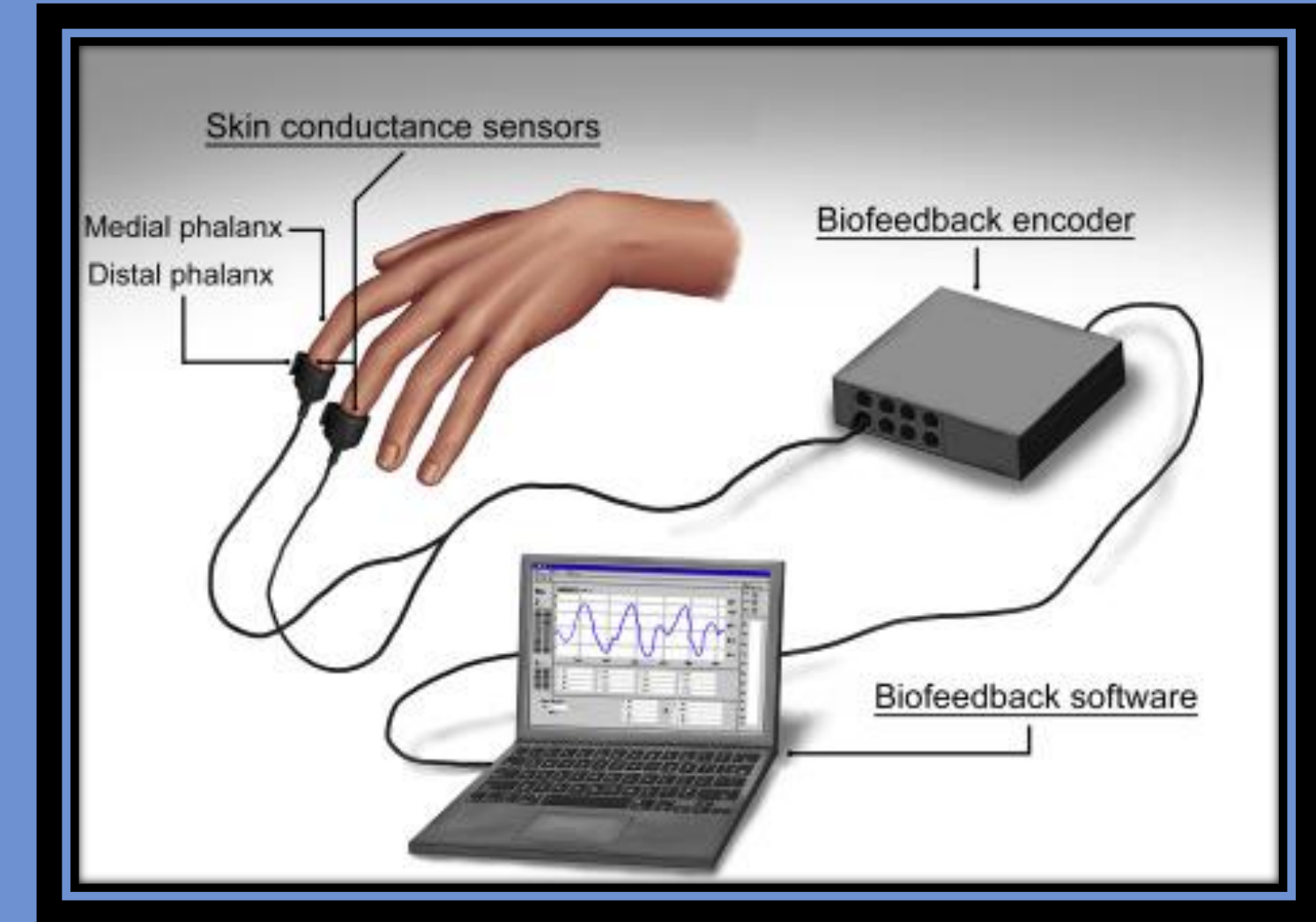
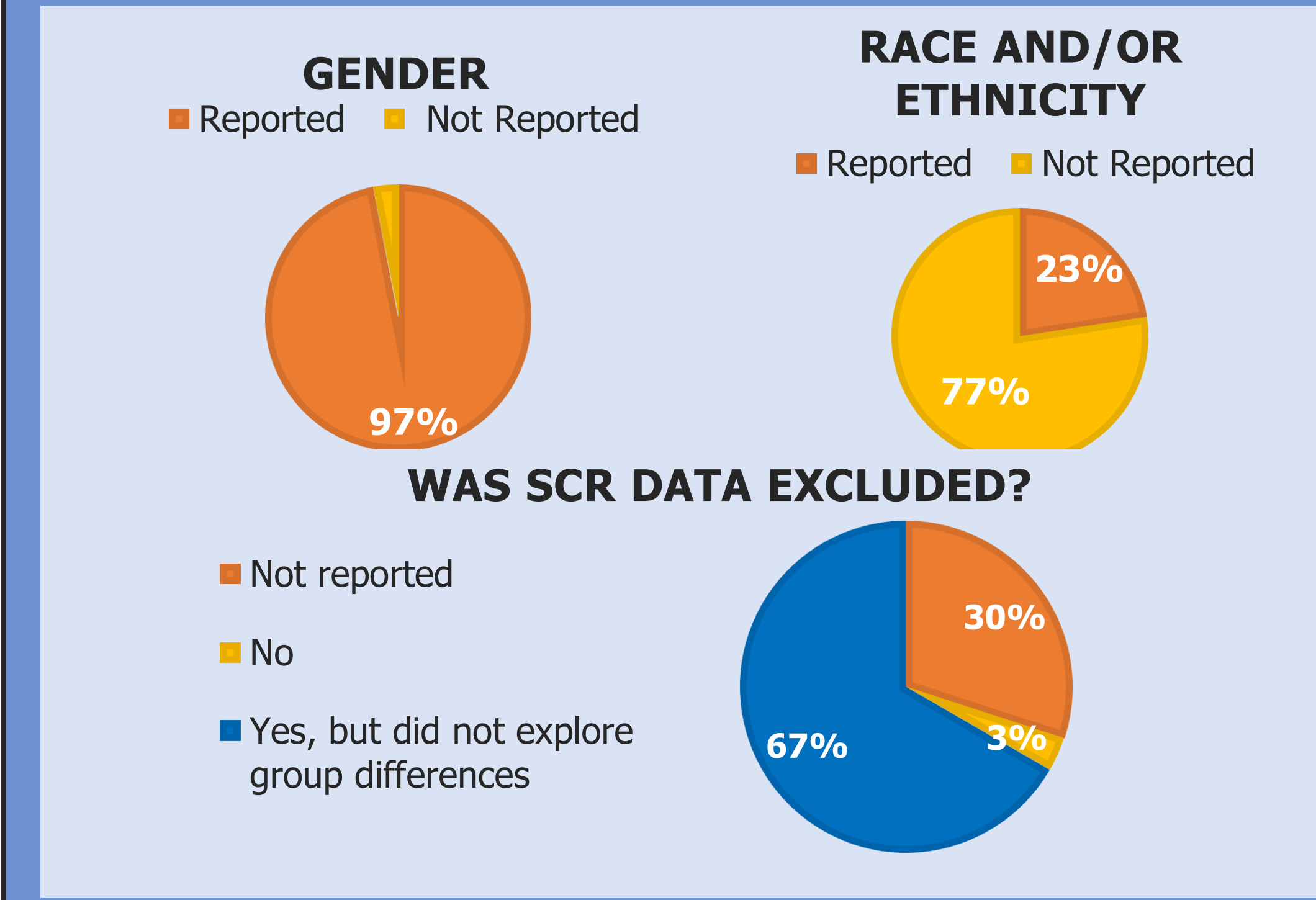


Fig1. An experimental set-up for acquiring SCR.

Participants are excluded from analyses if they:¹⁰

- 1) have immeasurable skin conductance activity at baseline or 2)
- 2) do not show a detectable change in SCR between conditions/stimuli (i.e., failed to learn the task).

Anecdotally, Black participants are disproportionately excluded in SCR studies because of low baseline activity (data deemed "Unusable") and/or characterization of a "non-learner".¹¹ We conducted a brief demographic survey to examine this.



Demographic Reporting and SCR Exclusion Survey

We reviewed empirical work to determine if studies examined race and ethnic differences in SCR.

- **Caveat:** Black participants *can* appropriately discriminate between stimuli and acquire fear learning.
- **Methods:** literature search
 - Keywords: "skin conductance" and "fear conditioning"
 - Years published: 2017-2021
 - # of Papers: 160

Results: Researchers exclude data without examining whether there are differences in SCR based on race and ethnicity!

Neuroscience has a long history of excluding marginalized groups and perpetuating harm.

The Era of Explicit Exclusion Historically, Racism Led to "Unusable" Data

Historically marginalized groups (e.g., women, LGBTQ+, Black and brown people, etc.) have been excluded from research and deemed unnecessary to include or study scientifically.¹⁻³

Excluding these groups directly harms patients and contributes to the development of biased biomedical technology, interventions, and treatments (such as eGFR).^{4,5}

We must remain vigilant in evaluating bias in science and remember how historical biases continue to affect scientific knowledge.

The Era of Ignorance Colorblind Methods Lead to "Unusable" Data

Electrophysiological tools were not designed for phenotypic variability. For example...

- Hair-type bias in EEG leads to the exclusion of participants with coarse and curly hair.⁶
- Skin-type bias in biomedical optics results in technology that is less effective in darker skin tones.^{7,8}

The term "unusable" is often synonymous with "minority" data, especially data from Black participants.

Celebrating and taking into account phenotypic diversity, rather than a colorblind approach, will lead to a more inclusive scientific enterprise!

Avoiding an Era of Negligence Negative Lived Experiences May Lead to "Unusable" Data

Evidence shows that negative lived experiences, such as racism, negatively impact psychological processes and thus our psychological measures.¹²⁻¹⁴

As scientists, we must disentangle the source of exclusion in electrophysiology. Are we excluding:

- marginalized phenotypes (e.g., skin and hair type)?
- mental health features that co-vary with phenotype in our society?
- an interaction of the two

For example: SCR is impacted by negative life experiences (e.g., discrimination and neighborhood disadvantage) that covary with race and ethnicity.

Roadmap to Inclusion: Our Shared Responsibility

Individual Researchers



- Design research that considers if data exclusion reflects phenotype bias and/or measures of participants' lived experiences.
- Implement *post-hoc* statistical tests to determine if demographics explain variability in psychophysiological measurements.
- Attempt to differentiate confounds (e.g., phenotype bias in the tool) from co-varying and real psychological effects (e.g., exposure to racism).

Institutional Review Boards



- IRBs share a responsibility to ask *why* racial and ethnic minorities are being excluded from recruitment and *how* this could be rectified.
- Personnel should receive ongoing training on biases in technology.
- Offer institutionally mandated best practices.

Scientific Journals



- Demographic reporting requirements must be enforced.
- When demographics are not representative, a statement within the manuscript must describe this as a limitation.

Fund Black Scientists!



- Black scientists and engineers receive less funding than their White counterparts.¹⁵
- Compared to White researchers, Black researchers have approximately 55% NIH award success rate.¹⁵

Selected References

- 9) Kredlow, M. A. *et al.* Assessment of Skin Conductance in African American and Non-African American Participants in Studies of Conditioned Fear. *Psychophysiology* **54**, 1741–1754 (2017).
- 13) Stevens, K. R. *et al.* Fund Black scientists. *Cell* **184**, 561–565 (2021).

Complete References:
<https://tinyurl.com/WEK-INSREF>

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