



## **Synthesizing Research on Gender Biases and Intersectionality in Citation Analysis and Practices**

**Beth Mitchneck, PhD**

### **About the ARC Network**

Funded by the National Science Foundation ADVANCE Program, Awards HRD-1740860 and HRD-2121468, the ADVANCE Resource and Coordination (ARC) Network seeks to achieve gender equity for faculty in higher education science, technology, engineering, and mathematics (STEM) disciplines. As the STEM equity brain trust, the ARC Network recognizes the achievements made so far while producing new perspectives, methods and interventions with an intersectional, intentional and inclusive lens. The Women in Engineering ProActive Network (WEPAN) serves as the backbone organization of the ARC Network.

### **About the Virtual Visiting Scholars**

The Virtual Visiting Scholars (VVS) program provides a unique opportunity for select scholars across disciplines to pursue research meta-analysis, synthesis, and big data curation on topics crucial to STEM faculty equity. VVS analyze existing research and data, synthesizing different, sometimes competing, perspectives, frameworks, metrics, and outcomes to offer new insights and applications to the broader community.

### **About the Author**

Dr. Beth Mitchneck is Professor Emerita in the School of Geography, Development & Environment at the University of Arizona. She is currently leading a National Science Foundation project to develop metrics to assess institutional transformation at Hispanic-Serving Institutions. In addition, she is a higher education consultant specializing in faculty affairs and equity in STEM and works with numerous universities to promote equitable evaluation processes. She has held numerous administrative positions at the University of Arizona and, most recently, Vice Provost for Faculty Success at the University of Massachusetts at Lowell. She also was the lead program officer for the National Science Foundation's ADVANCE program to promote gender equity in academic STEM. Mitchneck has a dual research focus on migration and displaced populations with an emphasis on Georgia and Ukraine, and on gender equity in STEM. She has served on national boards for the Social Science Research Council, the Kennan Institute and editorial boards for the Annals of the Association of American Geographers and Soviet Geography. Her most recent publications include: "A Recipe for Change: Creating a more inclusive academy" in Science and "Displacing Blame: Divergent Accounts of the Georgia-Abkhazia Conflict" in Ethnopolitics.

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## Executive Summary

This meta synthesis of the multidisciplinary literature on citation practice and citation indices includes 100 different sources including peer-reviewed publications, books, websites and blogs. Although the meta synthesis was intersectional in framing, there is relatively little direct engagement within the literature about women of color and citation practice. The meta synthesis assesses 1) literature about influences over citation practice and citation indices; and 2) literature on those factors and how they impact the likelihood that faculty of color are on the receiving end of citation practice. The meta synthesis identifies key areas of thought including underlying theoretical frameworks to understand citation practice, the social influences over citation practice, and alternative ways to measure research impact and productivity. The practice of citing and the resulting citation indices generally reflect patterns of gender and racial biases found in the literature on evaluation and the underrepresentation of women in science. Recent publications highlight the ways that the lack of visibility and efforts to create an invisibility of men and women of color in STEM may be overcome by using big data methods and technologies. These promising methods can and should be used to analyze directly the intersecting roles of gender, race, and ethnicity of the person being cited and the person doing the citing into summary measures of productivity and impact. At a minimum, this meta synthesis finds that citation practice and thus citation indices are not normative measures of scholarly productivity and impact but are highly influenced by any number of factors in addition to merit and quality and are subject to any number of ways that they are consciously and unconsciously manipulated to the disadvantage of out groups. Thus, the use of citation indices as single measures of quality and impact directly embed biases into our standard measure of merit.

## Project Goals

**Goal 1:** To conduct a meta synthesis of the multidisciplinary literature on citation practice and analysis to document how social influences affect the calculation of citation measures and indices.

**Goal 2:** To use the findings to communicate broadly to the scientific community the risks of using these citation measures and indices in an uninformed manner.

**Goal 3:** To use the findings to improve alternative measures that more fairly describe all researchers' impacts.

## Sources and Methodologies

I used standard search and qualitative analytical methodologies for conducting the meta synthesis (e.g., Cooper 2017; Finfgeld-Connett 2018). The search process was begun in January 2019, prior to the beginning of the visiting scholar position, and monthly from August 2019 through January 2020. After which time, I added to the bibliography for the synthesis as new pieces/sources appeared online or in print until October 2020. Appendix 1: Sources for the Meta Synthesis provides a list of the journals and other media used to create the annotated bibliography.

## Multidisciplinary Sources and Multiple Media

I used several search engines (e.g., Academic Search Ultimate, Google Scholar, Google) in order to have as expansive a set of material as possible across different types of media. The topic of citation indices and citation practice is written about widely across humanities, social sciences, biomedical sciences, clinical sciences, life sciences, and natural, physical and mathematical sciences. The wide net cast allowed me to identify blog posts and

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websites as well as twitter posts related to people's experience and analysis of citation practice and indices. While published studies on intersectional approaches to citation analysis are rare; social media references recognizing relatively low citation levels, especially for African American faculty (e.g., <https://citeasista.com> and <https://www.citeblackwomencollective.org>) and a twitter handle to draw attention to citing women, #citeherwork, draw attention to a gap in the research literature.

I used relatively simple search terms because they were very productive in terms of producing interdisciplinary and international works on the topics from a large variety of sources. In this way, I was able to locate sources that may not appear if I searched by disciplinary or interdisciplinary journals. The search terms were: citation practice, citations, citation gender, citation race, citation index, H-index. See Appendix 2, Disciplines Represented in the Meta Synthesis, for the disciplines and study areas included in the collection.

### Meta Synthesis Methodology

This meta synthesis is based on a systematic, annotated bibliography of the literature in three areas: citation indices, social influences over the ways that people cite, and citation practice in general. I shape the meta synthesis to facilitate collection, synthesis, and interpretation of the findings across and within topics (Walsh & Downe 2005; Cooper 2017; Finfgeld-Connett 2014 and 2018). I selected themes through an iterative process of categorization and content analysis. In this way, I highlighted findings that are well-documented empirically and those that would benefit from additional research. The structure of the database includes the citation, findings by theme, and then memoing (e.g., reflective notes) to add additional information to the database about the themes. Memoing includes references to research that may explain why the practices occur. See Appendix 3, Template for Study Notes, for the structure of the annotation and memoing. Appendix 4, Tags, is the outcome of categorization and content analysis of the annotation and memoing.

I selected articles to include in the analysis with the following characteristics: a focus on citation process or practice, characteristics of citation indices, inclusion of discussion or analysis of gender and/or race and citation practice and/or indices. Because of the large volume of articles concerning improving the computation of indices, I included representative ones in the study sample since relatively few of those articles had a focus on differences across gender and/or intersectionality. In addition, I made every effort to select as many articles from across disciplines and study areas as possible. While I included articles from the biomedical sciences, I did not include all that I identified because of the NSF ADVANCE focus on STEM with the exclusion of most biomedical research.

### Meta Synthesis Process

This meta synthesis was conducted by qualitative assessment of the sources that I collected. The process included three key elements:

1. Analytical reading of each source using a template to guide notetaking (see Appendix 3)
2. Development of content analysis tags used to categorize and organize the sources (see Appendix 4)
3. Using the tags, I created a concept map to analyze the various threads of the literature and assess the scope, theoretical and practical framings of research related to citation practice and citation indices, and findings.

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The results of the first research goal, the meta synthesis, are discussed below in the section Principal Findings. The second two goals, to communicate broadly the findings and to improve the use of alternative measures of research impact, are discussed in the Dissemination section below.

## Principal Findings

Goal: To conduct a meta synthesis of the multidisciplinary literature on citation analysis to document how social influences affect the calculation of measures.

### Intersectional Concept Mapping of Citation Practice, Citation Indices, Citation Analysis

I discuss below the highest level of concepts and topics that structure the synthesis along with some key studies and findings from those concepts and topics. Next, I discuss some cross-cutting themes. The final section before discussion of dissemination is a discussion of research gaps and recommendations.

#### Citation Practice

The study of citation practice is in and of itself a multidisciplinary endeavor that stretches back in time to at least the mid-twentieth century. This literature includes two leading theories of citation, normative and social construction. The formative theory posits that people cite objectively the “best” or most appropriate research while the social construction theory views citation practice as an outcome of human behaviors.

Both leading theories have produced a large literature that describes the location in a publication where citations appear and posits explanations of patterns. These studies seek to explain why a paper is cited and why it may be cited in a particular portion of a paper. Some reasons here include the reputation of an author and documenting polarity or justification for approach taken.

Ding et al. (2014) provide an excellent review of semantic and syntactic studies of the citation process. This is especially important to provide potential tools for assessing how citation practices (the where and how/why of the citation) reflect the impact of the research. The context and content-based analyses highlighted by Ding et al. (2014) can lead to a nuanced study of the impact of research because it can assess if the citation is in a list of prior research, embedded in the discussion of research findings or if it is used in a positive or negative sense.

Numerous case studies identify general patterns of citation practice both by the author(s) doing the citation and by the author(s) being cited. The vast majority of these studies assess citation patterns within disciplines and study areas and by the gender, race, or ethnicity of the individuals being cited as a category. These are generally descriptive studies with little ability to explain why a paper or author is cited more or less than any other.

Significantly fewer studies are conducted intersectionality, making this intersectional meta synthesis challenging. In other words, most studies are limited to assessing one demographic characteristic of the process of citation. Figure 1, Core elements in the process of citing from Tahamtan and Bornmann (2018: 205) is a very useful and clear representation of the process of citing:

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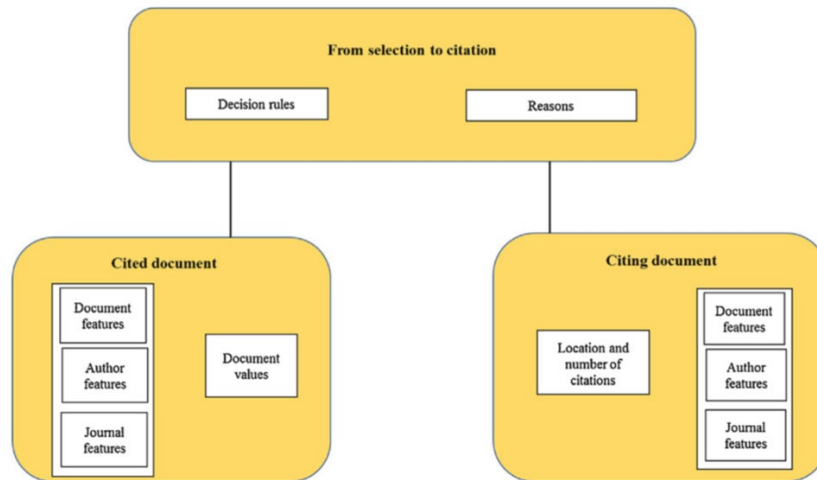


Fig. 1. Core elements in the process of citing.

This figure originates from another synthesis of the literature (Tahamtan & Bornmann 2019) which is a thorough review of citation practice. At the same time that this figure is a simple and elegant representation of the citation process, it is one of the few to explicitly include author features as an element of the citation process.

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The social construction of the citation process includes most of the studies that seek to identify characteristics of those being cited or the characteristics of those doing the citing. These studies deconstruct the citation process with the aim to understand why certain authors or papers are cited more than others. This is an especially rich literature that convincingly describes the citation process as socially constructed rather than a normative process or one that results singularly from merit demonstrating impact.

The topics demonstrated by the social construction theory is wide-ranging and has become of the object of interrogation itself. This perspective attacks the very notion of the normative construct of scientific merit. The simplest of these studies describe the extent to which features of the individual(s) being cited reflects the citation outcomes. For example, these studies analyze the author features (see Figure 1) of the document being cited. These features include gender, race, language the document is written in, the institutional affiliation of the author(s), the authors' advisors, or the impact factor of the journal in which the document is published. There are numerous studies across disciplines and study areas that interpret the findings of these studies as displaying evaluation bias or discrimination. They range from simple counts to multivariate analyses from relatively analysis of one author to many authors within a discipline or a set of disciplines, like STEM. Many, but not all, of these studies find that the

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citation process is gendered and racialized. In other words, many find that the demographic characteristics of the author(s) shape the extent to which the document/author is cited. (See more on this topic below).

These studies also document the usage of self-citation as being generally a male behavior, analyze how disciplinary traditions of collaboration and international collaboration may impact which papers are cited and by whom they are written. Additional studies look at the peer review process itself as determining both who gets published, who it is possible to cite, and how that process may influence citation practice.

An extremely useful portion of the literature uses network analysis to track the social patterns and power relations embedded within citation practice. This has led to the discovery of citation clubs or cartels as well as studies that assess positionality within a network to how often that document or author(s) are cited. For example, Milard (2014) finds that about 25% of those who are cited by people in his study sample are not known to them. Another way of saying this is that 75% of those people cited were known to the person doing the citation (Milard 2014). This is an astonishing documentation of the role of professional networks.

A fascinating portion of this literature frames citation practice as part of the gaming and manipulation of citation counts and indices (e.g., Oravec 2019). This intersects with power relations (that of the editor or reviewer and the author) and racial biases that are embedded within search engines (Noble 2018).

### Citation Indices and Assessment

Citation indices like the h-index or other versions of quantitative assessments of citation counts dominate the literature. These indices measure the number of citations an author receives weighted by the number of papers written over their career (career or professional age), over a defined time period or over some other mediating factor of an individual's career or the overall length of a career (e.g., Huang et al. 2020). There are also numerous studies that assess co-authorship and position of author within the list of co-authors. These studies suggest that women appear less often in the prestigious last place position among co-authors, have increasingly appeared in the first place position.

### Studies on Author Gender

Studies on gender and intersectional studies fit in this category as well as in the social construction of citation practice category. The majority of the papers included in this study find that evaluation biases and possible gender or racial discrimination appear to depress the total number of citations or the citation indices relative to the majority of authors who are white and male. For example, Lariviere et al. (2013) find that across time and disciplines, published papers with a woman as the first author have fewer citations than those where the first author is male.

A few papers do not find gender bias in their analysis and these are important to point out. Chibnik (2014) assesses the degree to which papers published in the *American Anthropologist* are cited based on the gender of the article authors. He finds:

I classified the authorship of articles in the data set into three categories: those written by one or more men (223), those written by one or more women (191), and those including at least one male

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author and at least one female author (48). Table 2 shows that there are little differences among these three groups in mean and median citation rates. (Chibnik 2014: 464)

He also finds that among the most cited papers in the journal are those written by women. In the way that the author framed his analysis, there are no clear patterns of gender bias in citation. He attributes the lack of bias to the greater number of men publishing in the journal in the earlier part of the time period (2000-06) and the increased number of women publishing in the second half of the time period (2007-2012). These findings may actually highlight that once more equitable editorial practices were instituted, more women were published. And the longer published papers by men did accrue more citations over a longer period of time. In this case, Chibnik did not assess the social construction of the figures, only the normative number.

In other social science fields, a recent paper draws the conclusion that gender bias in citation of women authors does not exist (Lynn et al. 2019). In a big data bibliometric study of flagship and regional journals in economics, political science, and sociology, the authors find gender parity in the rate of citation of papers published in those journals. This is an important finding, yet atypical for a number of reasons. First, many big data studies do in fact find gender bias. Second, the authors control for co-author gender distribution which has been found influential in citation counts. Lynn et al. (2019) classify papers as female or male-led. This feature of the research may explain, in part, its unique findings. The paper does indicate that the control variable for multiple authors is statistically significant for the flagship journal in Political Science and Economics and find many other similar relationships predicting citation rates. Finally, the authors' conclusion that there is gender parity in citation rates should be viewed as a tentative one and not negate the plurality of other studies indicating otherwise. Indeed, this study supports many other influences over citation rates that do in fact vary by gender.

Nielson (2017) also finds the lack of gender bias in citation practice and indices. His methodology defines, in part, his outcome. He analyses the top 10 percent of cited papers in management research and finds no gender differences among those papers. As the section below on intersectionality points out, those papers in the 10 percent are already biases because of many underlying social forces and social practices.

### Intersectional Studies

While numerous studies assess the extent to which an individuals' gender influences both whom they cite and who cites them, relatively few studies are intersectional with race. Several distinctly intersectional studies of citation practice and citation indices are models for future research. These models come in various forms and methodologies, both qualitative and leveraging big data analyses. On the qualitative side, studies and declarations of human experience are critical to informing larger-scale quantitative studies.

Price's 2008 Presidential Address abstract, for the National Economics Association entitled "Black Economists of the World You Cite!!," sums up the experience of both male and female scientists from minoritized groups:

Economists who publish research in the economics and political economy of race seem averse to citing similar research by black economists. As citations are an important determinant of success as a research economist, black economists can possibly offset the aversion of non-black economists in citing black economists, by citing black economists themselves. This NEA Presidential address considers the relevance citations of black economists and evaluates the extent to which economists studying issues of race cite other black economists. Price (2008)

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The importance of this address lies, in part, with the belief that even published studies on race do not cite the work of those outside of the dominant racial group. It prompts a call to use critical race theory (Ong et al. 2018) as a guiding principle in research design and interpretation of results of larger scale qualitative and quantitative studies. For example, studies on gender and race aspects of citation practice and citation indices should necessarily include in the construction of research questions, datasets, and the interpretation of results, factors such as segregation of academics by race (and/or gender) by institutional type and by field as well as the distribution of women and men of color in lower ranks and tenure rates (Villalpando & Bernal 2002). Even more importantly, critical race theory demands that we focus on the politics of citation (Mock & Cockayne 2017) and human practices that are fully embedded within academia as a racialized and gendered process.

Using a life history methodology to analyze the impact of race on career trajectories, Heward et al. (1995 and 1997) ask scientists and other faculty to reflect on the factors that account for success. They further assess their findings with respect to gender and racial differences. Both papers should be required reading for all who believe that the academy is a meritocracy because they explain how informal patronage and formal processes of networks impact career development and advancement. These are the very processes that are underlying the outcomes of larger scale quantitative studies.

Few analyses of both the presence and impact of intersectional processes, particularly around gender and race, have the power of the recently published “Diversity-Innovation Paradox in Science” by Hofstra et al. (2020). Among the many important findings in this paper is that intersectional analyses of innovation and impact in STEM that non-white women, non-white men and white women have higher rates of novelty in their research but that white men have higher rates of impactful novelty measured by the rates of adoption of novel ideas by demographic groups. This study uses in fact novel ideas and a big data natural language processing techniques of phrase extraction and structural topic modelling (2020: 2). Their methodology is a model for future big data studies that focus on intersectionality.

The peer review process in and of itself is a racialized and gendered process that presents real and effective barriers to the full participation in science of scientists from all backgrounds and races. Silbiger and Stubler (2019) document, in a quantitative study, the downstream and upstream effects on citations of receiving unprofessional peer reviews on faculty of color and non-binary faculty. They find that:

Specifically, women of color and non-binary people of color were the most likely to select that they had significant delays in career advancement as a result of receiving an unprofessional review (Silbiger & Stubler 2019:7)

Specifically, they conclude that unprofessional peer reviews disproportionately affect women of color contributing to barriers of advancement. These barriers affect the visibility of faculty of color in STEM through the institutions and fields in which women faculty of color predominate that in turn affects the human practice and politics of citation.

The underrepresentation of faculty of color is further impacted by homophily findings in analyses of co-authorship networks by ethnicity. Freeman and Huang (2015) find ethnically and nationally segregated ethnic networks in their analysis of co-authorship.

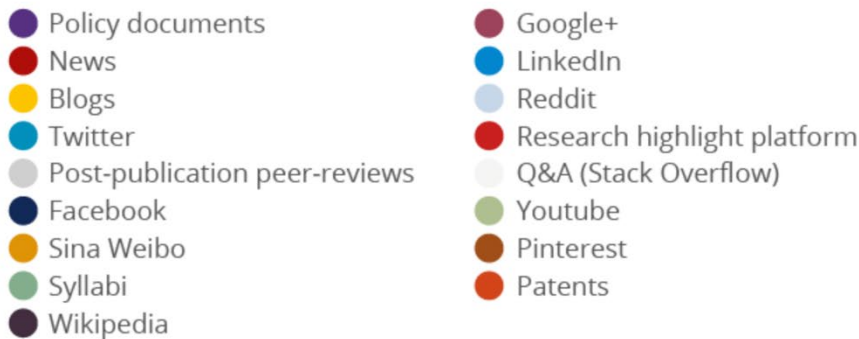
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## Alternatives to Citation Counts and Indices

A number of alternatives to gross citation counts or the weighted indices are appearing that should be given consideration for a more holistic assessment of publication and research impact. Altmetrics is geared to assess attention that a paper receives in a variety of venues that better represent the current publication environment and social media. Below is an explanation of the wide-ranging definition of attention beyond peer-reviewed publication that suggest that a paper is having an impact:

### The Colors of the Donut



The amount of each color in the donut will change depending on which [sources](#) a research output has received attention from:

Figure 2. Altmetrics Source: <https://www.altmetric.com/about-our-data/the-donut-and-score/>

HuMetricsHSS (<https://humetricshss.org>) is another initiative centered on the humanities and social sciences that takes a value approach to assessing the quality of scholarship. In other words, these measures focus on quality as a reflection of the degree to which the works demonstrates values such as social justice, empathy, transparency, and accountability.

Already mentioned are the concept citation and content-based citation analyses that assess the wording around the citation to an author's work. These methodologies rather than indices have the potential to draw out gender and intersectional differences in the locus of the citation and the nature of the citation. Mitchneck (2019) conducted a content-based citation analysis of two co-authored article to assess the degree to which the research goals were met. By examining the disciplinary and national characteristics of the authors and the disciplinary characteristics of the journals in which the citations appeared, I was able to assess that the majority of the citations were substantive in that they engaged with the findings in the publication and that the audience was international and multidisciplinary. The relatively modest number of citations obscured the visibility of the impact of the publications, while content-based citation analysis revealed elements of the impact.

## Big Data Alternatives

Big data analysis have the potential to extend content and context-based analysis to assessing gender parity and intersectionality. As noted above, big data techniques can be used effectively to conduct intersectional analyses (e.g. Hofstra et al. 2020). Big data analysis has already been used effectively to document the importance of citation

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network centrality (West et al. 2013) to citation patterns. Indeed, many recent uses of big data analyses have been used to identify elements of gender and racial inequity and inequality in citation patterns and career advancement. Yet, a gap in the machine learning/automated/big data studies is assessment of intersectionality as an important factor in outcomes.

### Citation Analysis Uses

Why does all of this matter? Why should any of us care that the politics of citation impacts which science is cited more than other science? The innovation-paradox (Hofstra et al. 2020) speaks for itself. But as noted throughout this study, biased measures of scientific influence and productivity result in deeply flawed assessments of the quality and impact of science produced by women and faculty of color. This means that the screening of job applicants and applicants for prestigious awards and honors relies of flawed reputational information.

### Meta Synthesis Themes

- Perfecting the **calculation** of citation indices (the worldview of the academy as a meritocracy)
- Forces underlying the **social construction** of citation indices (the worldview of the academy as a social construction)
  - **Disciplinary-specific** studies ranging from the humanities to social science to natural and physical sciences to the biomedical and life science literature
  - **Visibility versus invisibility** studies that focus on people, especially scientists from historically underrepresented and minoritized groups
- Citation **practice**
  - Role of academic networks
  - Role of collaboration networks and practices (e.g., international, disciplinary)
- **New forms** of citation analysis (e.g., citation concept mapping, Altmetrics, HuMetrics) that are more equitable than current indices.

### Dissemination

Goals:

- To use the findings to communicate broadly to the scientific community the dangers of using these measures in an uninformed manner.
- To use the findings to improve alternative measures that more fairly describe a researcher's impact.

The two final goals of this project are and will be realized through the communication of findings in peer-reviewed publications and through extensive invited presentations. I have already presented material from this study in seven national presentations in the past year. Several of those presentations also focus on using alternative measures to create more equitable faculty evaluation processes.

### Research Conclusions, Gaps, and Recommendations

- Intersectional studies are the exception and tend to be qualitative with a few major exceptions noted above.

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- In the absence of big data or easily obtainable data on intersectionality, thought pieces, qualitative assessments and community building has been used to document the intersectional aspects of citation practice that leads to embedded biases in citation indices.
- Citation concept and context analysis are underutilized as methodologies to refine citation indices and make the citation analysis more equitable.
- Citation counts and citation indices as methods to assess research impact and productivity are of limited use and their use should be discouraged because:
  - Manipulation of counts and indices is relatively simple
  - The measure is too gross to provide useful information about impact
  - The context in which we conduct research and communicate research has changed dramatically so should the ways that we assess research impact and attention
  - Altmetrics are very useful since people both communicate and consume research in different ways than they did even 20 years ago
- Use of big data has challenged the status quo, yet relatively few have used techniques to analyze gender, racial and intersectional differences in citation practice and citation indices. Although big data studies that are framed around critical race theory and qualitative studies of the impact of race and gender on career, generally have found evidence of gender and/or racial bias (e.g., Hofstra et al. 2020) and such should be used more frequently.
- The apparent lack of agreement of studies on gender and racial bias in citation practice and indices results from an analytical conflation, in the interpretation of the literature, of studies with different research goals and questions.

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## REFERENCES

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Cooper, H. (2017). *Research Synthesis and Meta-Analysis, A Step-by-Step Approach*. (5th ed., Vol. 2). Sage.

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## APPENDIX 1: Sources for the Meta Synthesis

### **Journals (in alphabetical order)**

Advances in Gender Research

AEA Papers and Proceedings

American Anthropologist

American Educational Research Journal

Archives of Scientific Psychology

bioRxiv

British Educational Research Journal

eLife

European Consortium for Political Research

Feminist Economics

Gender and Society

Gender, Place & Culture

International Organization

International Stud Perspectives

Journal of American Soc Inf Sci Tec

Journal of Advanced Nursing

Journal of the Association for Info Sci and Tech

Journal of Diversity in Higher Education

Journal of Documentation

Journal of Further and Higher Education

Journal of Information Science

Journal of Informetrics

Journal of Korean Medical Science

Journal of Research in Science Teaching

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Journal of Surgical Education

Journal of the American College of Radiology

Journal of the American Society For Information Science and Technology

Journal of the Association for Information Science and Technology

Journal of Vocational Behavior

Language in Society

LIBER Quarterly

Managing visibility and invisibility in the workplace

Nature Astronomy

Nature

Nature News in Focus

PeerJ

Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy

PLOS Biology

PLOS ONE

Procedia Computer Science

Proceedings of the Fifteenth International ISKO Conference 9-11 July 2018 Porto, Portugal

Proceedings of the National Academy of Sciences

Qualitative Research

Quantitative Science Studies

Research Policy

Review of Black Political Economy

Review of Higher Education

Science

Science Communication

Science, Technology, & Human Values

Scientometrics

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Social Forces

Social Sciences

Socius

Studies in Higher Education

The Review of Black Political Economy

Trends in Ecology & Evolution

United States Journal of Labor Economics

### **Blogs**

<https://harzing.com>

<https://kieranhealy.org/blog/archives/2015/02/25/gender-and-citation-in-four-general-interest-philosophy-journals-1993-2013/>

### **Books**

Noble, S. (2018) Algorithms of Oppression: How search engines reinforce racism. NY: NYU Press.

### **Websites**

<https://citeasista.com>

<https://www.citeblackwomencollective.org>

<https://trianglesci.org/2016/05/31/humetrics-building-humane-metrics-for-the-humanities>

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## APPENDIX 2: Disciplines Represented in the Meta Synthesis

Anthropology  
Astronomy  
Biomedical  
Biosciences  
Computer Science  
Earth Sciences  
Economics  
Education  
English  
Environmental Science  
Gender Studies  
Geography  
Health Sciences (e.g., Epidemiology, Nursing, Pharmacy)  
Information Sciences  
International Affairs  
Library Science  
Linguistic Anthropology  
Management  
Neuroscience  
Philosophy  
Political Science  
Psychology  
Science, Technology, Engineering, Mathematics (STEM)  
Socio-linguistics  
Sociology

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## APPENDIX 3: Template for Study Notes

Discipline  
Research Purpose  
Theoretical Framework  
Methodology  
Variables  
Key Findings  
Findings re: gender  
Findings re: race  
Reason for Inclusion  
Cross Study Notes  
Contradictory Evidence to?  
Tags

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## APPENDIX 4: Tags

Advancement  
Authorship  
Bias  
Bibliometrics  
Big data  
Citation  
Citation analysis  
Citation behavior  
Citation practice  
Citation theory  
Co-authorship  
Collaboration  
Decision making  
Disputes gender bias  
Diversity  
Ethnicity  
Ethno-racial  
Exclusion  
Faculty of color  
Gender  
Gender bias  
H-index  
Hypervisibility  
Impact factor  
International

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Interdisciplinarity  
Intersectionality  
Invisibility  
Meta  
Method Paper  
Minority status  
Networks  
No gender bias finding  
Peer review  
Political science  
Qualitative  
Quantitative  
Race  
Retention  
Self-citation  
Social Science  
STEM disciplines  
Tokenism  
Visibility  
Women of color

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