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2015

https://doi.org/10.25595/3849

Veröffentlichungsversion / published version
Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:

Singh, Sarah; Klinge, Ineke: *Mining for Methods*, in: FZG (FZG – Freiburger Zeitschrift für GeschlechterStudien), Jg. 21 (2015) Nr: 2, 15–31. DOI: https://doi.org/10.25595/3849.

Erstmalig hier erschienen / Initial publication here: https://doi.org/10.3224/fzg.v21i2.20934

GenderOpen – Repositorium für die Geschlechterforschung: www.genderopen.de

FREIE UNIVERSITÄT BERLIN

HUMBOLDT-UNIVERSITÄT ZU BERLIN

Freiburger Zeitschrift für Geschlechterstudien 21/2: 15-31

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Mining for Methods

A Critical Review of the Theoretical and Methodological Contributions of Feminist Science Scholars for Biomedicine and Public Health Research

Abstract: This is a critical review of the feminist science scholarship that aims to differentiate various feminist approaches to using the concepts of sex, gender, race and/or ethnicity in biomedicine and public health research. With a focus on the conceptual and methodological contributions of various feminist science scholars, we identify three distinctly different feminist methodological frameworks that can be used in the practice of science. This is not an exhaustive review, but rather seeks to identify critical patterns in methodologies used by feminist science scholars to delineate the contribution of each framework and build the capacity of biomedicine and public health researchers and policy-makers seeking to integrate the concepts of sex, gender, race, and/or ethnicity into their work.

Keywords: feminism; science; gender; sex; race; methodology; biomedicine; public health.

Auf Spurensuche nach Methoden

Eine kritische Zusammenschau theoretischer und methodologischer Beiträge feministischer Debatten für die biomedizinische und gesundheitswissenschaftliche Forschung

Zusammenfassung: Das Ziel dieser breiten und kritischen Sichtung feministischer Ansätze ist es, unterschiedliche feministische Perspektiven sowie ihre Konzepte von sex, gender und race bzw. Ethnizität insbesondere für die Forschung im Bereich Biomedizin und Public Health nutzbar zu machen. Wir nehmen die konzeptionellen und methodologischen Beiträge verschiedener feministischer Forschungsrichtungen in den Blick und identifizieren drei verschiedene feministisch-methodologische Perspektiven, die genutzt werden können, um Forschung anders zu betreiben. Dies ist kein umfassender Überblick – vielmehr identifizieren wir zentrale Muster in den Methodologien feministischer Forschung, um den Beitrag der einzelnen Richtungen aufzuzeigen. Dies soll Forscher_innen aus Biomedizin und Public Health sowie Entscheidungsträger_innen darin unterstützen, Konzepte von sex, gender, race, bzw. Ethnizität in die eigene Arbeit zu integrieren.

Schlagwörter: Feminismus; Wissenschaft; Sex; Gender; Race; Methodologie; Biomedizin; Public Health.

Introduction

Increasingly, scientific researchers, particularly in the health sciences, are being required by international resolutions, funding institutions, and publishers to consider gender, sex, race and/or ethnicity in their research (Heidari et al. 2012; Johnson et al. 2014; Klinge 2008; Sharman/ Johnson, 2012). This is a response to

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the under-representation of women and minorities in public health research and clinical drug trials (Blauwet 2011; Geller et al. 2011; Yoon et al. 2014). Yet these policies have been introduced with little discussion about the concepts of gender, sex, race and/or ethnicity or the methodologies and theoretical frameworks that relate to them (Epstein 2008; Fausto-Sterling 2008; Jackson 2014; Shim 2002). Consequently, many feminist and anti-racist scholars have documented significant conceptual confusion related to the use of these concepts in biomedical and public health research (Braun et al. 2007; Hammarstrom/Annandale 2012; Kaiser 2012). Feminist researchers in the social and biological sciences have been studying and theorizing the use of sex, gender, race and/or ethnicity concepts in scientific research for over three decades, but have largely been ignored by mainstream science (Ritz et al. 2014; Rosser 2005; Åsberg/Birke 2010).

In this paper, we review feminist science scholarship[1] by using a combination of related search terms in Science Direct Database and Google Scholar with the aim to identify and differentiate various feminist approaches to using the concepts of sex, gender, race and/or ethnicity, particularly in biomedicine and public health research. Additional references were found through bibliographic searching. With a focus on the conceptual and methodological contributions of various feminist science scholars, we identify three distinctly different feminist methodological frameworks that can be used to guide scientific practice in the field. Drawing on concepts used by what we observed to be the founding scholars of these frameworks, we named these frameworks the 'strong objectivity framework', 'partial perspective framework' and the 'gendered innovations framework'. We argue that these frameworks, rather than acting as competing frameworks, offer distinctly different methodological approaches that can be used in combination to improve the practice of science.

While the 'strong objectivity' and 'partial perspectives' framework focus on epistemological and theoretical issues and encourage scientists to critically evaluate concepts, methodologies, theoretical frameworks, and research priorities, the 'gendered innovations' framework seeks to operationalize the theoretical contributions of feminist science scholars and introduce new practical methods that can be easily integrated into scientific practice. Many of the feminist scientists referenced in this paper cross over these categorical boundaries and these intersections are as much an indication of the intellectual development of the individual feminist science scholars as of the field of feminist science itself. It should also be noted that there are several other scholars who contributed to the formation or materialization of these frameworks that have not been mentioned but could also be located within these frameworks. This is not an exhaustive review, but rather seeks to identify the *key* feminist methodological contributions and uses examples from recent and relevant feminist science scholarship to illustrate the contribution of each framework. In doing so, we hope to explain the utility of feminist science scholarship and build the capacity of biomedicine and public health researchers and policy-makers seeking to integrate the concepts of sex, gender, race, and/or ethnicity into their work.

Feminist Science Studies

Feminist scholars have conducted similar reviews of the feminist science literature. For instance, Wylie (1989) compiled a bibliography of core feminist science literature, focusing primarily on critiques of biology that raise reflexive questions about the role of gender in scientific knowledge and practice. Similarly, Tuana (1986) provides a brief overview and bibliography of the contributions of feminism in the natural sciences, noting that feminists have recovered the work of women scientists, uncovered biases against women, and re-envisioned scientific methodologies. Schiebinger (2000) documents how the social, political and economic changes and specific feminist movements, namely liberal and difference feminism, facilitated the entry of women into the fields of science. She also identifies how feminist influences changed research practices, such as biased scientific practices that excluded women as research subjects. Rosser (2005) reviews various feminist theoretical lenses and their impact on the study of science. Recently, Subramaniam (2014) reviewed the broad group of issues addressed by feminist science scholars, including the practice of defining women by their reproductive capacities, patriarchal conceptions of nature, and the roles of colonialism and capitalism in science. While these reviews provide good summaries of feminist contributions to science and the historical contexts in which they developed, they do not differentiate or delineate the multiple conceptual and methodological approaches *within* the feminist science literature.

Strong Objectivity Framework

The first theoretical framework we identify is the 'strong objectivity' framework, as coined by feminist philosopher Sandra Harding. According to Harding, "strong objectivity extends the notion of scientific research to include systematic observations of background beliefs, and also draws attention to ideological assumptions built into scientific research" (Harding 1991:149). In other words, the strong objectivity framework means researchers think reflexively about social values, namely assumptions based on gender and racial norms, and how they inform choices made at every stage of scientific inquiry. For instance, scientific researchers make value based decisions in: the selection of problems to study; the formulation of hypotheses; the methods and theories used; and in the reporting and interpretation of research outcomes. The strong objectivity framework does not reject the scientific method or the notion of objectivity but rather delinks objectivity from neutrality and introduces adjustments to the scientific method. In doing so, scholarship that falls under this framework seeks to enhance the objectivity of scientific research while promoting scientific research designs that better serve a broader range of societal needs and interests.

We identify two methodological approaches that fall under this framework, feminist empiricism and feminist standpoint approach. Feminist empiricists, as Harding defines them, seek to identify "bad science" that often supports sexist and racist scientific claims (Harding 1991: 89). Harding's definition suggests

that feminist empiricism simply asks researchers to apply established scientific methods more carefully and rigorously and offers little towards a feminist challenge to the process of scientific knowledge production (Harding 1992). Several other feminist science scholars reject Harding's definition of feminist empiricism, including Campbell (1994), Nelson (1990), Longino (1990, 1993) and explain that the crucial contribution of feminist empiricism is the introduction of feminist political goals to the empirical study of science. Familiarity with feminist concepts is essential for feminist empiricism as it provides "scrutiny over and above the scrutiny we devote to the appropriate controls in experiments and the quality of the statistical analysis of our results" (Longino 1988: 568). To do this, feminist empiricists employ feminist conceptions of gender and race to critically analyze how social beliefs about gender and race inform hypotheses, scientific theories, measures, data collection processes, models, background assumptions, and the interpretation of evidence. In this way, feminist empiricism seeks to adjust the established boundaries of scientific practice by requiring researchers to critically examine social values, specifically normative beliefs about gender and race when designing, evaluating, and interpreting scientific research projects.

An example of contemporary feminist empiricism is the recent work of psychologist Cordelia Fine (2010). Fine's feminist understanding of gender, as socially constructed, makes her skeptical of scientific studies that "reflect and reinforce cultural beliefs about gender" (Fine 2010: xxvii). Specifically, Fine examines scientific studies that follow "the organizational-activational hypothesis" which puts forward the idea that "the same hormone involved in building male genitalia… also permanently 'organizes' the brain in a masculine way" (Fine 2010: 101). This hypothesis proposes that differences between women and men, specifically in the fields of math, science and engineering, are a result of hardwired differences in the brains of women and men. Fine identifies several flaws in the research designs that follow from the organizational-activational hypothesis, including unreliable methods used to measure fetal testosterone levels, inconsistently operationalized definitions of the male brain's "systematizing" capacity, small sample sizes, a failure to control for environmental influences and the over interpretation of results. Fine's research indicates that feminist conceptions of gender and race allow members of the scientific community, namely journal editors, granting agencies, and working scientists, to critically review research studies and identify flaws in scientific research designs and methods that have previously gone unnoticed.

In contrast to feminist empiricism, the feminist standpoint approach calls for starting research from the standpoint of women and other marginalized groups so that their experiences and interests are brought to bear on the scientific process. As Harding explains, "women's different lives have been erroneously devalued and neglected as starting points for scientific research and as generators of evidence for or against knowledge claims" (Harding 1991: 121). Research from women's lives is needed to overcome "excessive reliance on distinctively masculine lives" and to act as "checks against the validity of knowledge claims" (Harding 1991: 123). The emerging field of Gender Medicine provides a contemporary example of efforts to bring women into biomedical and public health

research to better understand sex differences in human disease (Legato 1998; Pinn 2003, 2005). Marianne Legato, the founder of the field, explains that most disease research has been done using male subjects and "extrapolated to women without modification" and so studying women is imperative to improve clinical care (Legato 2003: 924).

The critical social analysis component of the standpoint approach, however, is often missing in the field of Gender Medicine, often called 'gender specific medicine' (Hammarstrom/Annandale 2012). As Harding (1991: 133) explains, "biological differences between women and men [do not] provide the resources for feminist analysis". The standpoint approach requires researchers to apply a gender analysis and account for "differences between women's and men's situations" (Harding 1991: 119). In other words, the standpoint approach does not simply mean including women and other marginalized groups in scientific research but rather starting research from the standpoint or "social location" of historically marginalized groups (Crasnow 2008). Analyzing social conditions from the perspective of women and other marginalized groups, provides researchers insights into how the social context impacts the biological, specifically how social relations of gender and race shape and limit individual behaviours and biological conditions. Researchers in the fields of biomedicine and public health do not typically pay attention to social forces and so by adopting the standpoint approach they gain access to knowledge that would otherwise be ignored or obscured (Wylie 2003).

Harding (1990) argues that feminist empiricist and feminist standpoint approaches offer opposing methodological approaches. We argue, however, they both adopt the strong objectivity framework because they both use feminist conceptions of gender and/or race in research designs, and in doing so seek to promote better scientific research. In other words, both of these approaches challenge the notion of the value-neutral observer and, through their critiques, put forward methods to help researchers systematically explore the impact of social inequalities and social values that inform the design of scientific research. Conceptualized in this way, these approaches can be understood to be complimentary and, from our example below, it will be illustrated that they could most effectively be used in combination.

The work of biologist Anne Fausto-Sterling provides an example of how the feminist empiricist and feminist standpoint approaches can be combined to produce, what Intemann (2010) terms "feminist standpoint empiricism". In her two-part paper *The Bare Bones of Sex* (2005) and *The Bare Bones of Race* (2008) Fausto-Sterling begins her analysis using a feminist empiricist approach and reveals inconsistent classifications of race and sex in biomedical research that explores sex and/or racial differences in bone health. For instance, definitions of race in bone research range from: regional categorizations, self-identification, grandparental ancestry, genetic markers and groupings used by medical records. Similar inconsistent measurements plague research on sex difference in bone health because there "is a lack of standardization between instruments and sites at which measurements are taken" (Fausto-Sterling 2005: 1493) Fausto-Sterling suggests that bodies cannot be studied as objects existing "outside of politics,

culture, and social change" and even when using consistent forms of measurement sex and racial differences in bone health have been found to be "highly context specific" (Fausto-Sterling 2005: 1495).

She proposes, researchers adopt mixed-methods study designs, informed by the standpoint approach so that rather than categorizing different "specific anatomies and physiologies" researchers provide an understanding of how specific anatomies and physiologies "emerge over the lifecycle as a response to specific lived lives" (Fausto-Sterling 2008: 658). Fausto-Sterling makes the case that such research designs will help develop an understanding of the particular "environmental inputs and cellular responses" that contribute to racial and sex differences in bone health so that eventually researchers can begin to piece together the relationships among the "contributions of geographic ancestry, individual lifecycle experiences, race, and gender to varied patterns of health and disease" (ibid.). Using the case of bone research, Fausto-Sterling demonstrates how feminist empiricism and feminist standpoint act as complimentary approaches to help researchers, first, identify knowledge gaps and, second, develop new knowledge and approaches to research.

A key distinguishing methodological feature between feminist empiricists and feminist standpoint theorists is not simply that they "offer different conditions" for achieving strong objectivity, as suggested by Intemann (2010), but how they employ feminist conceptions of sex, gender, and race in scientific inquiry. Feminist empiricists encourage researchers to adopt a critical sex, gender, and race analysis of the study design to bring attention to assumptions about sex, gender, and race that inform the research design, namely formulating hypotheses, theories, concepts, data collection, and interpretation of results. The feminist standpoint approach, on the other hand, encourages researchers to use a feminist gender and race analysis of the social environment to incorporate qualitative research into their study design and consider social inequalities of gender and race on scientific research outcomes. As demonstrated by the work of Fausto-Sterling, both approaches can be combined to produce new scientific research designs, more accurate descriptions and more complex explanations than conventional scientific research methods.

Partial Perspectives Framework

The second theoretical framework we identify is the 'partial perspectives' framework which is informed by post-structural feminist theory and its textual critiques, specifically how language used by scientific researchers to access and observe the world is mediated by social power relations. The term 'partial perspectives' refers to feminist biologist Donna Haraway's work, which encourages feminist scientists to go beyond exposing gender and racial assumptions and "bad science" to examine the partial perspectives of scientific researchers and struggles over how to *see* such things as human biology, physiology, biological development, and so on. Haraway challenges a notion of objectivity or what she calls "The God Trick" that "represents while escaping representation" (Haraway

1988: 580). The partial perspective does not seek to provide a more objective or truer knowledge about the world but rather strives to achieve what Haraway terms a "feminist objectivity" that "privileges contestation, deconstruction, passionate construction, webbed connections and hope for transformation of systems of knowledge and ways of seeing" (Haraway 1988: 585). In this way, Haraway distinguishes her approach from feminist scientists who fall under the strong objectivity framework by redefining the notion of partiality and situatedness to refer to "knowledges that are self-reflexive concerning the material, historical, social conditions under which they came to being" (Prins 1995: 355). Achieving feminist objectivity requires researchers to acknowledge their own location in the networks of knowledge or organizational structures that allow certain conceptual understandings to be produced and naturalized.

In defining "networks of knowledge", Haraway, and other researchers who adopt the partial perspective framework, draw on Bruno Latour's (1987) actor-network theory, which "argues [that] in a sociological account of science all sorts of things are actors" (Penley et al. 1990: 9). By doing so, the partial perspectives framework moves beyond a simple analysis of the social context in which particular scientific studies were produced, and seeks to deconstruct scientific knowledge through locating all the players and the networks of power involved in producing the objects of science, including "any living or non-living entity involved (for example genes, agar gels, insects, hormones, etc.)" (Roberts 1999: 133). Drawing on Latour, Roberts (1999) explains that non-human actors such as genes and hormones "exist for a certain time within a network of forces and practices which allow them to flourish – they are allies in the scientific process" and often invoked to make scientific claims (ibid.). In this way, non-human actors are conceived as active allies in the process of scientific knowledge production rather than passive objects. Locating these power networks of knowledge production makes visible that biology is not simply discovered nor is it produced through a random or neutral process, but rather the biological body takes shape in particular ways due to interactions with historically contingent webs of power relations.

Roberts (2010, 2014) uses the partial perspective framework to critically investigate the public health issue of early puberty. Roberts identifies the "range of techno-scientific, biomedical, popular and environmentalist discourses" that draws on historically and culturally specific gender and racial norms to frame the seemingly biological problem of early puberty (Roberts 2010: 429). By using John Laws (2007) pinboard method of sticking multiple narratives produced in different times, spaces, locations, and styles on a surface, Roberts visually captures the juxtapositions and tensions and thereby illustrates the "diversity of discourses jostling to define the parameters of the problem [of early puberty]" (ibid.: 436). Roberts locates several actors currently involved in defining the problem of early puberty including "techno-science publications, media articles reporting on scientific studies, and environmental websites and publications" (ibid.: 433). Roberts explains that these various sources offer different and often contradictory understandings of the causes of early puberty (ibid.). Roberts also uncovers the debates among clinicians about the various indicators of early

puberty and subsequent health consequences. By identifying the divergent definitions, causes and consequences of early puberty, Roberts deconstructs the problem of early puberty and illustrates that it has not simply been "discovered" by researchers but rather that this constructed biological difference is made meaningful by the temporary consolidation of various human and non-human techno-scientific networks of power.

Yet those that adopt the partial perspectives framework not only seek to locate discursive power struggles, but rather ask how they become inscribed into the biological body. Haraway (1992: 298) invokes the term "apparatus of bodily production" to explain that "organisms emerge from a discursive process". Haraway is careful to clarify that understanding that "biology is a discourse" is not the same as claiming that organisms are ideological constructions. Rather unraveling the apparatus of bodily production requires more than an analysis of text and metaphors, it means documenting how historically specific living bodies "emerge at the intersection of biological research, writing, and publishing; medical and other business practices; cultural productions of all kinds, including available metaphors and narratives; and technology" (ibid.). The boundaries of nature or the body should not be understood to pre-exist "awaiting the right kind of instrument to note them correctly" but rather seen as generated through social power relations constituting human and nonhuman actors (ibid.). As Roberts (1999) explains, Haraway's apparatus of bodily production compels researchers to think about scientific 'discoveries' or the bodies of scientific investigation as moments of "corporealization", or rather "a particular historical and located 'congealed' interaction between a variety of actors" (Roberts 199: 133). Understanding how bodily differences become articulated through a web of historical interactions allows researchers to reconfigure biological boundaries, opening space for new possibilities of bodily constructions (Haraway 1994).

A contemporary example is the work of feminist science scholars El-Haj (2007), Gannett (2004) and M'charek (2005, 2013). These scholars use examples from population geneticists, DNA forensics and medical practices to trace how biological races have been re-constituted in and through these scientific technologies and practices. These authors denaturalize the meaning of discrete racial groupings while locating the various powerful networks of knowledge that produce them. For instance, Gannett (2004) explains how a typological notion of race based on "skin colour, hair form, or facial characteristics" has been replaced with statistically based grouping made possible by genotyping technologies and DNA data that allow researchers to map the frequency of genes (ibid: 341). Despite the fact that these "group identities may be indeterminate and/or multiple, with people belonging to more than one group and to any single group as a matter of degree" (ibid.: 342), these genetic groupings continue to be presented as "static, absolute, and discrete" biological facts (ibid.: 340). In doing so, biological scientists impose new and old taxonomic units to delineate biological racial categories and use genetic data to support their validity. These scholars demonstrate that current biological divisions among racial and ethnic populations are not stable objective facts but shifting historical and cultural constructs that have the potential to be reconfigured through a new coalition of human and non-human actors.

The methodological contribution of the partial perspectives framework is that it proposes a feminist gender and race analysis that begins by unpacking gendered, sexed, raced and ethnicized bodies. It requires researchers to work backwards to locate the numerous human and non-human actors that participated in the construction of these bodies and all the while paying attention to and accounting for power relations between these actors. In other words, it requires researchers to conceive of "'gender' or 'race' [not] as attributes or as properties" but rather to ask how "'gender,' 'race,' or any structured inequality in each interlocking specific instance gets built into the world" (Haraway 1994: 67). This gender and race analysis proposed by the partial perspectives framework is distinctly different from the strong objectivity approaches, which analyzes sites and contexts of the production and reproduction of gender and racial inequality in the field of science. The partial perspectives framework seeks to alter the research priorities even before researchers consider the concepts, theories, and methods they will use to design their research. It asks researchers to critically examine their own communities of practice, specifically the multiple actors involved in constructing configurations of sex, gender, race, and/or ethnic differences in particular disciplines, thereby destabilizing assumed biological facts and opening new possibilities for research.

Gendered Innovations Framework

The final framework, which we call the 'gendered innovations' framework, as first coined by feminist science historian Londa Schiebinger, explores scientific innovations produced by using feminist concepts in scientific practice.[2] Schiebinger argues that when feminist concepts such as gender and sex are applied "rigorously and creatively they have the potential to enhance human knowledge and technical systems by opening them to new perspectives, new questions, and new missions" (Schiebinger 2008: 4). Feminist scholars that fall under the gendered innovations framework introduce scientists to practical methods that allow scientists to use the concepts of sex, gender, race and/or ethnicity in new and innovative ways. In doing so, the gendered innovations aims to support feminist scientists practicing in the fields of biomedicine and public health and open up opportunities for exchange and collaborations across the disciplines.

Specifically, the gendered innovations framework draws on recent feminist science scholarship that demonstrates how more attention to sex and gender analysis in biomedical and public health research could lead to less biased research outcomes (Heidari et al. 2012; Raz/Miller 2012; Rogers 2010). Many of these scholars have further develop the methods of sex and gender analyses, beyond simply identifying sex and/or gender bias, through the proposal of various models, guidelines, and frameworks for integrating sex and gender analysis in biomedical and public health research (Beery/ Zucker, 2011; Bird/Rieker, 1999; Heidari et al., 2012; Johnson et al. 2009; Kaiser 2012; Krieger 2003; Nieuwenhoven/Klinge 2010; Springer et al. 2012). These scholars attempt to delineate what it means to operationalize feminist conceptions of sex and gender

so that they can be practically applied to produce better and more objective biomedical and public health research. For instance, Springer et al. (2012) present good practice guidelines for every stage of the research cycle. Specifically, they point out that researchers need to isolate and measure sex-specific biological mechanisms rather than use sex as a proxy for biological markers. Researchers also need to account for cofounding variables related to socially organized forms of gender inequality to ensure sex specific outcomes are not spurious. Essentially these scholars seek to operationalize the concepts of sex and gender into methodological tools so researchers can more accurately identify biological and multi-level social processes that contribute to differences in health and disease outcomes between women and men.

To ensure direct reference to both sex and gender influences, some researchers have proposed using the concept "sex/gender" or "s/g" in the title and interpretation of findings to ensure that scientists consider *both* social and biological aspects in their research designs and data analysis (Christianson et al. 2012; Geller 2008; Jordan-Young/Rumiati, 2012). In addition to ensuring that researchers acknowledge sex *and* gender factors, the introduction of these concepts seeks to complicate understandings of sex and gender as separable entities. Sex and gender are understood to act on each other and scientists are encouraged to capture how the biological body reflects innate as well as external social experiences.

The gendered innovations framework also includes scholarship that critiques this literature for silence around the concepts of race and ethnicity (Bowleg 2012; Connell 2012). Although race is no longer considered to be biologically real, as Krieger (2012) explains "the scientific study of how discrimination harms health" is still required and needs to be grounded in theory. Ford and Airhihenbuwa (2010) and Gravlee (2009) take on the challenge of translating important theoretical contributions, particularly from critical race theory, into practical methods that can easily be integrated into research designs. Similar to the sex/gender scholars, these scholars locate the body in context and draw off the work of "developmental biology [that] have brought attention to the profound importance of hierarchically embedded, multi-level, and historically contingent biologic process" (Krieger/Davey Smith 2004: 94). Ford and Airhihenbuwa (2010: 1391) provide a four-step process which scientists can "either [use] alone as a broad framework or in conjunction with other theories and method". It draws on the theoretical contributions of the previously discussed frameworks but breaks down the process into simple steps that guide researchers through conceptualizing and measuring historically specific racial relations and critically examining previous research that might inform the research question, research design and data interpretation. Gravlee's (2009) 'race becomes biology' method proposes using a more accurate measurement strategy that requires researchers to first assess the culturally, historically, and socially specific understandings of racial relations using systematic ethnographic methods and then use the culturally context specific models of racism derived from the ethnographic study to measure biological impacts. In doing so, Gravlee provides researchers with

a more accurate method of measuring the biological and health consequences of racism.

In addition, some feminist science scholars have critiqued these approaches for directing attention to particular forms of inequality while ignoring others and subsequently propose an intersectional method that requires researchers to consider the health impact of various forms of inequality. Intersectionality requires researchers to acknowledge multiple intersecting forms of inequality and to locate them in space and time. It proposes using qualitative research along with a multivariate quantitative analysis to account for historically and geographically specific intersecting forms of social inequality and within group differences in health outcomes (Hankivsky 2012; Kelly 2009; Shields 2008).

What distinguishes scholarship that falls under the gendered innovations framework from the work of previous frameworks is that it seeks to translate often abstract and theoretical contributions of feminist science scholarship into plain language and practical tools that can be readily employed by scientists. In essence, scholars that adopt this framework attempt to illustrate how concepts such as sex, gender, race and/or ethnicity can be easily integrated into every step of the scientific research process. In doing so, these scholars synthesize various methodological contributions and shortcomings of scientific research that uses the concepts of sex, gender, race and/or ethnicity and thereby promote collaboration to improve these forms of analyses across multiple disciplines. This creates a shared language that allows these concepts to travel across multiple disciplines as they are re-conceptualized, facilitating new approaches to understanding not only the biological but the social world (Hird 2009). In addition, synthesizing this research not only provides a shared intellectual space for collaboration, but provides clear examples of how improving methods of sex, gender, race and/or ethnicity analysis could advance scientific knowledge.

Further developing innovative methods of sex, gender, race and/or ethnicity analyses will depend on the skills and creativity of the research team concerned and will require multidisciplinary collaborations. It has been argued that to "develop truly innovative methodologies" there needs to be changes across both the social science and applied science disciplines (Åsberg/Birke 2010: 414). Fausto-Sterling has called for a two-way exchange where "women's studies scholars teach about science or require their students to learn about it" and that "science faculty teaches science where it rightfully belongs – in its social context" (Fausto-Sterling 1992: 339). Schiebinger and Klinge (2013) call for a number of institutional changes to facilitate the production of gendered innovations scholarship that includes three definitive actions. Namely, training practicing researchers and evaluators in gender methodology; ensure that those evaluating publications, grant proposals and job applications are familiar with sex and gender analysis; and provide a curriculum and materials to learn about sex and gender analysis. These recommendations would introduce institutional supports that will facilitate the advancement of cross-disciplinary collaborations and have the potential to produce new radical reformulations of the biological and social world. Recent announcements made by the National Institutes of Health (NIH) in the U.S. indicate a promising move in this direction (Clayton/Collins 2014).

The future of feminist science

Our critical review of feminist science literature, specifically in the fields of biomedicine and public health research, introduces three key theoretical and methodological feminist approaches that improve scientific practice and uses examples to illustrate the application of each framework in the practice of science. First, the strong objectivity framework argues that part of the scientific process must require researchers to think reflexively about the cultural context and socially constructed values about gender and race that have informed their own research designs or research that they rely on to formulate their research questions. The feminist empirical and feminist standpoint approaches provide researchers and evaluators methodological and conceptual tools to do this work. The second approach – the partial perspectives framework – maintains that the biological world is not simply presented to researchers but rather is historically produced through a network of human and non-human actors. And so, the partial perspective requires scientific researchers to deconstruct biological sexed, raced, gendered and ethnic bodies and objects prior to the conception of the research project and by doing so opens new avenues for research in the biomedical and health sciences. Finally, the 'gendered innovations' framework makes the case that researchers in the social and biological sciences need to work more collaboratively to produce more innovative knowledge and more complex understandings. By developing practical methods through cross-disciplinary collaborations, this framework provides a multitude of new scientific research designs that open new avenues for novel research outcomes.

Policies that require the integration of concepts of gender, sex, race, and/or ethnicity into biomedicine and public health research, present an opportunity for new research designs and pathways that could lead to better science. The concepts of gender, sex, race, and/or ethnicity if simply added to research designs as variables have the potential to produce sexist and racist science. These concepts are related to rich theoretical frameworks that require researchers to re-conceptualize their research designs and practices. By delineating these frameworks, we hope to give greater coherence to the valuable insights of feminist science scholars and provide policy-makers with the methodological tools to critically assess the science that is used to inform and shape scientific and public health policies.

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Anmerkungen

1 Feminist science "scholarship" was limited to feminist scientists and feminist science studies scholars in the fields of biomedicine and public health. These scholars explicitly indicate that they use feminist approaches to science or use feminist conceptions of gender, sex, race and/or ethnicity in their work.

2 Schiebinger developed the gendered innovations website (Schiebinger et al. 2011). The gendered innovations website is a project that first began in 2009 at Stanford University under the direction of Schiebinger and by 2011 transformed into an international project co-funded by the European Commission, Directorate-General for Research and Innovation. In 2012 the U.S. National Science Foundation also provided a supplementary grant. Over the course of 2011 and 2012, the gendered innovations project brought together Canadian, European and US scholars from various disciplinary backgrounds, including health sciences, social sciences, engineering, nutrigenomics, and technology studies, together with gender experts, to articulate methods of sex and gender analyses and develop case studies that provide concrete examples of how these methods can produce innovative scientific research (Schiebinger/ Klinge 2013).

Literatur

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