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Making sense of citizen science: Stories as a hermeneutic resource

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ABSTRACT

In communities on the front lines of energy facilities, citizen science has been seen as potent tool for environmental justice, giving residents access to quantitative data and, as a result, greater credibility with regulators and other experts. However, as in other realms of energy and environmental policy, greater access to data brings with it increased interpretive challenges—challenges which are especially acute for environmental justice-oriented citizen scientists seeking alternatives to scientists' frameworks for understanding pollution and environmental health. Drawing on Miranda Fricker's (2007) theory of epistemic injustice, this paper shows that frontline communities' struggles to understand air quality data manifest "hermeneutic injustices," or inequities in resources for meaning-making. Following research showing storytelling as one vehicle for making meaning, it argues that the stories told by frontline communities—stories of harms to health, systemic danger, dissembling, and disrespect—can in some circumstances serve as a crucial hermeneutic resource for making sense of air quality data for which scientific frameworks are inadequate. At the same time, it documents the limits of stories in giving meaning to data, pointing to areas of "narrative mismatch" which call for further hermeneutic invention by community groups working in collaboration with sympathetic scientists.

1. Introduction

Access to data is often seen as a key ingredient in environmental protection. Our expanding ability to generate and process data in what some have called the age of "big data" is seen as having the potential, for example, to reduce household energy consumption [1] and address major conservation challenges [2]. Simultaneously, absences of data, theorized as "knowledge gaps" and "undone science," have been argued to be major obstacles to environmental social movements' ability to effect change [3,4].

Interest in data is especially intense in U.S. communities on the front lines of energy production, from sites of extraction, such as unconventional natural gas drilling operations, to "midstream" facilities like oil refineries and processing plants for natural gas liquids, to sites of electricity generation, including coal, nuclear, and waste-to-energy plants. In many such communities, concerned citizens groups and allied environmental non-profits have confronted gaps in relevant data by collecting their own, using a combination of standardized and invented instruments [5–7,57]. Frequently, these community-led data-collection efforts have been accompanied by calls for additional monitoring of energy facilities by responsible authorities [6,8].

Across these arenas, the expansion of data brings with it the problem of interpretation. The meaning of data is underdetermined; different conclusions can be drawn from the same data depending on what frameworks or stories are used to interpret it [9]. For communities on

the front lines of energy production, making sense of expanding data—even data they themselves collect—is especially challenging. The added difficulties they face stem from fundamental disconnects between community and expert ways of knowing environmental hazards [10]; see also [11,12]: "frontline communities" ask questions that aren't being asked by regulatory scientists; they assert the relevance of factors that aren't represented in standard scientific paradigms; they call for different standards of proof. Their citizen science efforts—which this paper will take to include both data collection and sense-making efforts around publicly available data—thus exist in large part to offer alternatives to hegemonic scientific practices that do not adequately represent community experiences. But citizen scientists who wish not to adopt experts' interpretive frameworks confront a problem: how should they make meaning of their data, and make it meaningful to the regulators and others whom they want to persuade to take action?

In this paper, I ask whether stories told by frontline communities in the United States about their experiences living in close proximity to petrochemical polluters—sometimes mere blocks away; in every case close enough to feel directly affected by pollution—can be a resource for interpreting data in counter-hegemonic ways. Stories have been shown to play a role in making meaning of energy and environmental data in policy settings [9]. Storytelling is also widely recognized as a powerful core strategy of frontline communities in the environmental justice (EJ) movement. Yet scholars studying citizen engagement with data in EJ settings have thus far not focused on the role that story-

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telling might play in helping to make meaning—including meanings that challenge expert interpretations—of that data.

Using a framework of "epistemic injustice" [13] to conceptualize the work done by citizen science in environmental justice campaigns, I show that stories can be a powerful interpretive resource for frontline communities looking to leverage data into advocacy, even in cases where robust scientific frameworks for understanding the data are elusive. Drawing on ethnographic research among community air monitoring advocates, I show how residents of frontline communities have used their pre-existing narratives of living next to refineries and other petrochemical facilities to make sense of, and make claims about, the results of citizen science projects. In a number of cases, I show, combining stories and data has been a very successful strategy: stories supported with data—or, to think of it another way, data situated within stories—have in some cases compelled action to address local environmental hazards.

At the same time, however, I demonstrate that pre-existing stories are not a sufficient means of overcoming the interpretive gaps faced by frontline communities. I point to a series of "narrative mismatches," in which stories told about local conditions don't map on to available data. In situations of narrative mismatch, I argue, communities may be unable to mobilize information that could help to demonstrate the harms they suffer. Overcoming interpretive gaps in this area will require more active building of interpretive resources, including through collaboration with sympathetic scientists.

In the next (second) section, I introduce the idea of epistemic injustice and its major variants: testimonial injustice, or unfair attributions of credibility to speakers, and hermeneutic injustice, or structural disadvantages in access to resources for sense-making. I explain how epistemic injustices affect communities suffering from environmental injustices, and how frontline communities' citizen science efforts represent a strategy both for bolstering residents' credibility in the eyes of regulators and other experts and—more tenuously—for making sense of environmental hazards in a way that offers an alternative to expert interpretations. In Section 3, I discuss narrative as a tool of meaning-making, both for frontline communities trying to understand and communicate about their experiences, and for policy actors trying to contextualize complex, incomplete, and/or uncertain science. The use of story in science-rich policy environments, I suggest, suggests a likely parallel in the EJ movement, although the EJ literature has not made explicit connections between stories and data. Sections 4–6 respectively introduce the case of community-based air monitoring at energy and petrochemical facilities, describe my ethnographic methods for studying EJ-based advocacy for increased air monitoring, and catalog four kinds of stories common in frontline communities: stories of harms to health, stories of systemic danger, stories of dissembling, and stories of disrespect.

Section 7 documents the power of these stories as an interpretive resource—and partial remedy for hermeneutic injustice—through examples of communities using them to make sense of, and make politically powerful, data that resisted interpretation using scientific frameworks. Section 8 shows their limits, describing a number of narrative mismatches that have stymied community groups trying to mobilize potentially powerful data. I conclude by suggesting that the problem of narrative mismatch is not limited to frontline communities but extends across energy and climate policy arenas. Making sense of increasingly voluminous data may require innovations in the stories we tell about them (c.f. [9,14]—innovations that, I argue, are best pursued in collaborations that include community members and/or other so-called "lay" citizens working alongside scientists willing to go beyond existing interpretive frames to look for meaning that better represents the concerns and experiences of frontline communities (c.f. [15,16]).

2. Epistemic injustice and citizen science

As described by philosopher Miranda Fricker [13], epistemic

injustices occur when individuals from structurally marginalized groups are wronged *in their capacity as knowers*. Fricker suggests that epistemic injustices take two major forms: testimonial and hermeneutic injustice. Testimonial injustice occurs when a person's statement or account is dismissed because of the person's (structurally disadvantaged) identity: she is female, for example, or from a racial minority group. Hermeneutic injustice describes inequities in epistemic resources—the concepts, language, and frameworks that we use to understand situated experiences and render them visible and comprehensible in the public discourse [13,17,18]. Epistemic resources are shared throughout a society, but marginalized groups, more often than dominant groups, experience a tension or mismatch between their lived experiences and the resources available to talk about them [18]. Further, their efforts to conceptualize them in a way that can be "heard" in the dominant culture are likely to be met with microaggressive challenges to the categories or experiences of the marginalized group [19]. Fricker [13] gives the example of the difficulty that women had speaking of the coercive nature of sexual advances by supervisors in the workplace as recently as the 1970s. In this as in other cases where frameworks for making experience comprehensible to oneself and others are inadequate, a new category ("sexual harassment") had to be created before the phenomenon could be taken seriously in the dominant culture.

Because of the structural authority afforded to science and scientists in environmental politics, it is useful to think of "layperson" or "nonscientist" as a marginalized identity category in the context of epistemic injustice. Fricker [13] has little to say about the categories of "expert" and "lay" and in fact cites specialized knowledge as a permissible reason for valuing one person's testimony over another's. However, research in social studies of science has shown that distinctions made between laypeople and experts hinge on far more than whose knowledge is most accurate [20–22]. Women and people of color face significant challenges in establishing identities as "scientist" or "engineer" (e.g. [23,24]), and social class may also play a significant role in whose testimony is valued in scientific practice [25]. Working class whites may thus also be seen as potential victims of epistemic injustice, to the extent that their status as "laypeople" results in their not being taken seriously as knowers.

Theories of environmental justice have recognized that the concept, as articulated by EJ activists, has multiple facets. Schlosberg [26] identifies four: distributive justice, procedural justice, recognition, and capabilities. However, case studies, especially of frontline communities' engagements with science, show that EJ activists also attack epistemic injustices, which are rife in environmental justice conflicts. Testimonial injustices are most overt. Cole and Foster [27], for example, describe Kettleman City, California, activists' accounts of odors and illnesses related to pollution from a toxic waste dump being dismissed because they were Latino and, in many cases, not native English speakers. Similarly, former Love Canal, New York, resident and founder of the US-based Center for Health, Environment, and Justice, Lois Gibbs, describes how a public official refused to take her seriously when she alleged that her children were sickened by toxic waste buried under a playground. He branded her a "hysterical housewife"—an explicitly gendered denigration of her testimony [28]. Frontline community members' testimony is also frequently dismissed on the grounds that their comments are scientifically inaccurate or irrelevant [29,30], a move that pre-emptively denies the possibility that laypeople's local knowledge or ways of knowing can contribute to collective understanding.

Hermeneutic injustices also pervade environmental justice controversies. Perhaps the most striking example are the resources for making meaning of community exposures to chemicals. Quantitative risk assessment, a technique that uses toxicological data to produce probabilistic measures of increased risk of disease as a result of exposure, dominates regulatory responses to hazards in frontline communities. Environmental justice activists and social scientists writing about the movement have critiqued the framework, on two broad