Problematic Instruments:
Technology, Legitimization, and Citizen Science

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Abstract: At the intersection of science and society lies citizen scientists, and they are tasked with being part of the broader public as well as performing scientific legitimacy. This study aims to explore how citizen scientists interact with technology and legitimacy. The study site consists of a canoeing citizen science organization. The author conducted participant observation and collected video data. Results show that much of the anxiety related to legitimacy is deferred to their scientific instruments.

Introduction

Many citizen science programs aim to increase the public's engagement and understanding of science. However, citizen scientists exist in a liminal space between "ordinary folk" and privileged scientists (Irwin, 1995). In defending their claims, these citizen scientists will use the same empirical evidence and techniques that traditional scientists do. Yet, these citizen scientists have considerably less power than the traditional scientist despite mimicking their techniques. How then do citizen scientists handle problems of scientific legitimacy?

This research project aims to explore how the River Team (a pseudonym) handles issues of scientific legitimacy. The River Team consists of a group of water quality citizen scientists affiliated with a large Tier 1 university in the United States. Members of the River Team are provided water quality probes and instruments (Figure 1a) with a routinized protocol (Figure 1b) for "taking science" or collecting water quality data. This paper focuses on how River Team members' handles questions of scientific legitimacy centered on "taking science" and using the water quality instruments.

Theoretical framework

I take an interactionist stance (Jordan & Henderson, 1995) towards understanding how the River Team collects water quality data. I assume that the object of activity, talk, artifacts, and cultural norms are all crucial for interpretation. I particularly focus on the human-technology interactions and discourse between River Team members and water quality instrument probes. Imbuing technology with anthropomorphic properties as well as negotiating with them through talk provides technology with a sense of human-like agency, as previously seen in Actor Network Theory (Latour, 2005) and posthuman or more-than-human frameworks (Snaza et al., 2014).

In understanding scientific legitimacy, I turn towards sociologist Gieryn (1999) and his framework of boundary-work, which suggests that traditional scientists prescribe discursive and material boundaries that draw the line between authentic science and non-science. The boundary between scientists and non-scientists has often been shifted and continues to shift when convenient, even though there has been much effort to make school science (Roth, 2012) and citizen science (Dickinson, Zuckerberg, & Bonter, 2010) closer to "authentic science."

Methods

I have conducted a multi-year ethnographic participant observation (Wolcott, 1999) study of the River Team. Using wearable cameras or GoPros, I and a few members of the team recorded instances when we stopped on and alongside the river to collect water quality data. I watched and logged all the video data related to water quality data collection between Spring 2016 and Spring 2018. I then coded for emergent cases (Becker, 2014) related to how River Team members made sense of the water quality data in terms of scientific legitimacy with the water quality instrument probes. A case based approach (Luker, 2008) was used to compare cases of when team members felt the instrument probes were effectively legitimizing or de-legitimizing their scientific practice.

Results and discussion

Case analysis of video data suggests that River Team members felt both legitimized and de-legitimized by their usage of water quality instrument probes. Most cases however centered around team members feeling de-legitimized by the instruments. Team members would often focus on the instrument probe not working, not being accurate, and felt that the instrument was ill or sick.

For example, on a routine data collection protocol alongside the San Marcos River in Texas, Catherine and Henry (pseudonyms) are discussing the pH instrument probe. The pH, or the logarithmic concentration of Hydrogen ions, instrument probe reads a range from 1 to 14, and the pH value of water typically falls between 6

and 8. The pH probe Henry is working with reads a value of 2.5 (10:00). Catherine comments that "Jerry, [the name of the pH probe], is just gonna have to sit this trip out" (10:30). Eventually Catherine comes to Henry to help troubleshoot the probe (11:00) (Figure 1c). Catherine concludes that "the reality of the probe is that its insides has gone bad. It is dementia probe" (11:26). However, Henry keeps trying to get a better reading and says, "come on baby.." to it (11:36). Eventually Henry gives up and moves on to a different probe which also fails, and Catherine later comments how "she hates science, it gets so hard" (23:50).
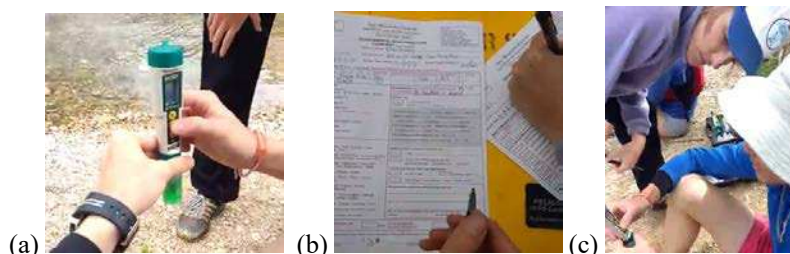

(a)   (b)   (c)

Figure 1. (a) pH instrument probe. (b) Water quality monitoring sheets. (c) Catherine and Henry troubleshooting.

We see here how the instruments are giving spurious and incorrect water quality values. However, these cases and type of talk regarding the faulty nature of the instruments continues throughout semesters, even if the instruments give more reliable readings. This suggests that some of the illegitimacy attributed to citizen science is deferred by its members to the scientific instruments they use. The stigma citizen scientists face as non-scientists is redirected to their scientific instruments, and their scientific instruments are often to blame for their less than ideal scientist status.

To remedy the problematic instruments, in Fall 2017, the River Team spent around $1000 on new instrument probes to improve their ability to take water quality data. Yet, they find many problems and errors with utilizing the new probes and again begin attributing problems with probes. This also reflects the tendencies of the River Team members to give anthropomorphic or human-like attributes to the instrument probes. Probes can go bad or have dementia or need encouragement. The instrument probes are given agentic and human-like properties in some hope that they will legitimize the River Team's scientific practice.

Seriously considering the role of human-technology interactions for human's legitimacy in scientific or other practices opens a discussion of how human-technology interactions can enable or disable certain groups of people. In this study, I explored how a citizen science team's interaction with technology left them feeling de-legitimized and drawn outside the boundary of science. Future work will explore how other interactions may enable feeling or legitimacy or illegitimacy.

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