Staking a Claim in Data: Expertise and Participation in a Rural Open Government Data Initiative

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Open government data initiatives have the potential to improve civic participation and trust in government by making government data more transparent to and inclusive of citizens. However, it remains under debate if and how open data initiatives can meet these goals. Through a case study of a state-level government open data initiative with rural hunters, we explore the impact that open data had on citizen-government relations and citizen perspectives on data more broadly. Interviews with 14 hunters led to findings that the open data initiative improved feelings of trust and respect between hunters and the government agency behind the open data initiative. Additionally, hunters' involvement with data collection and consumption led them to stake a role in the open data ecosystem and develop critical perspectives on data. We suggest that open data initiatives could better achieve these benefits by valuing citizen expertise in open data contributions and involving citizens more holistically in the open data ecosystem.

CCS Concepts: • **Human-centered computing → Collaborative and social computing theory, concepts and paradigms**; *User studies*; *HCI theory, concepts and models.*

Additional Key Words and Phrases: open data, citizen participation, rural computing

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1 Introduction

Open data initiatives to make government data publicly accessible have been widely adopted by governments at the federal, state, and local level [15]. These initiatives hold promise for increasing government transparency, with resulting benefits of increasing civic participation and public trust [37, 53]. Prior work has examined benefits and barriers of open data to understand how well existing initiatives fulfill this described potential, and how they might be redesigned to better meet these goals [25]. Open data has been of particular relevance to the HCI and CSCW communities due to the key role information and communications technology (ICT) plays in making data accessible to the public [51]. Prior work in CSCW has also looked at open data initiatives through critical lenses of participation to consider how accessible such initiatives actually are to the public [19, 33].

While prior work has explored many critical perspectives on open data, some suggest that citizen participant perspectives on their role in open data systems have been underexplored in the open data literature thus far [48]. To help address this gap, in this work, we explore the following research questions:

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RQ1: How does participation in an open government data initiative impact citizen perceptions of government?
RQ2: What value do citizens gain from participating in an open government data initiative?
RQ3: How does participating in an open government data initiative impact citizens' relationship with data?

We respond to these questions through a case study with rural hunters about an open data initiative by a US Midwestern state government agency, the Department of Natural Resources (DNR). While this open data initiative could be seen as limited because it provides processed, rather than raw, data back to citizens, we identified some benefits to their approach of prioritizing context and accessibility, without need for a specialized skillset to interpret the data. In collaboration with the DNR, we spoke with 14 rural hunters who had participated in the DNR's nascent open data initiative, and found that increased data collection and reporting efforts by the DNR has led hunters to claim a role in the data ecosystem as "the DNR's eyes and ears." Hunters' involvement as data collectors and consumers also led them to develop values for other aspects of the data system in which they were not involved. For instance, they scrutinized whether the DNR was analyzing their data in an overly reductive manner, ignoring the variety of experiences and goals across hunters. Thus, we found that even limited involvement in an imperfect open data system led to greater investment and critical thinking about data more broadly. We demonstrate how adopting an open data framework and respecting citizen data collectors can increase goodwill and lead to mutual benefit between citizens and government. However, these benefits can be capitalized on more fully if citizens are given access and power to all stages of the open data system.

Through a case study of an open data initiative with rural hunters, we offer new perspectives on citizen participation in open government data initiatives through three key contributions. First, addressing **RQ1** we contribute evidence of open data initiatives improving citizen participants' trust and respect of the government agency running the open data initiative. Secondly, addressing **RQ2** and **RQ3**, we contribute identified benefits that citizens gain from participating in open government data initiatives, such as increased critical perspectives of data and the subject matter of the open data initiative. Finally, we contribute recommendations for open data facilitators to capitalize on these benefits through increased citizen engagement in all stages of the data cycle, respecting citizens as experts in the open data ecosystem, and prioritizing factors of open data that facilitate citizen utility of data such as context and legibility.

2 Background

2.1 Open Data in Government

Open data is defined as data that "can be freely used, modified, and shared by anyone for any purpose" [1]. We define open government data initiatives in alignment with Attard et al. [4] as "any attempt, by a government or otherwise, to open data that is produced by a governmental entity." The word "attempt" in this definition recognizes that some open government data initiatives – like the one we explore in this paper – may fall short on standards of free use, modification, or sharing. Goals in implementing open government data include increased transparency, accountability, and citizen engagement [39, 53]. Open government data initiatives often result in benefits such as increased transparency and public empowerment, even when these were not established goals [53]. Alongside a wide range of potential benefits across political, social, economic, operational, and technical domains, open government data has been found to promote greater trust in government among citizens [25, 37]. However, it should not be assumed that these benefits will be achieved through simply implementing an open government data initiative. Instead, these benefits can be achieved through open data initiatives that include accessible and effective use of high-quality data

and accompany that data with appropriate action by government entities [37]. Here, we contribute to such ongoing discussions of what benefits open data initiatives can achieve and what factors of open data promote, or hinder, these benefits.

Researchers have previously explored barriers to access and effective use of open data [15, 40, 49] with aims of developing more accessible data interpretation frameworks [6, 40, 49]. Much prior work on open data has described the technical expertise and interdisciplinary skillset necessary to make good use of open data as a key barrier [12, 15]. This barrier falls within the purview of the data divide – a reproduction of the digital divide wherein citizens without strong data literacy skills are disadvantaged by an inability to make effective use of open data [16, 21, 25]. Through the data divide, open data can pose a risk of further empowering only those who already hold significant privilege [21]. Some have pointed to a lack of context as a key inhibitor to effective citizen use of open data, suggesting that appropriate contextual information must be included for data to be considered as open [9, 33], an argument we extend through our case study. In line with this argument, researchers have found that it is effective to orient data interpretation tools around an aspect of citizen interest, such as locality [34, 40] or social issues [27].

Prior work in HCI and adjacent fields has explored citizen perception of and participation in open data in a variety of data contexts, including financial data [27, 34], municipal decision-making [52], and smart city planning [19]. Citizens have been found to have a range of motivations for engaging with open government data, for example, using it as a resource for education [15], to explore data relevant to their local community [40], or to gain insight into municipal decision making [50]. However, citizens also demonstrate skepticism as to the promised value of open data, raising doubts that their technical skills are sufficient to effectively engage with open data [15] or that open data would improve the relationship between citizens and government entities [52]. Thus, even proponents of open data recognize limitations in its potential for relationship-building between citizens and data collection agencies.

While the capacity for open data to facilitate greater communication and relationship-building between citizens and government remains under debate, some have provided evidence for this potential. Hivon and Titah [23] developed a framework to conceptualize dimensions of citizen participation in open data including communication and relationship-building between citizens and open-data teams. Within these dimensions, they identified themes we reinforce through our case study, such as citizens being listened to, engaging in direct communication with data teams, becoming data literate, and ensuring data quality [23]. While Hivon and Titah [23] explored these dimensions of communication and relationship-building between citizens and developers of the data portal, our participants spoke about open data's role in communication and relationship-building between themselves and the *government agency* reporting and using the data for decision-making. Therefore, we are able to extrapolate these dimensions to make claims about open data's capacity to increase civic trust and engagement, beyond engagement with a data intermediary.

2.2 Power, Care, and Expertise in Data

More broadly, HCI and CSCW researchers have recently attended to matters of care and participants' personal investment in data collection, management, and reporting [5, 22]. Baker and Karasti [5] apply Puig de la Bellacasa's concept of "matters of care" to local scientific data practices; they surface the data care practices and labor undertaken by local data management stakeholders. They also briefly account for those involved in the data generation, depicting them as remaining involved in the data ecosystem, rather than becoming "marginalized voices" – a theme we extend through our case study with rural hunters. Researchers have also explored data collector involvement in data processes in the context of data donation, where participants "donate" personal data about themselves for the benefit of others, similar to blood donation [22]. In this work, Gómez Ortega et al.

[22] examine how to involve participants at different levels: as contributors, collaborators, or co-creators, based on participants' desired level of involvement. Participants had varying motivations for participating in data donation such as interest in using the data for personal benefit or a desire for their data to benefit their community. While our participants were not engaging in data donation in the sense of providing intimate, personal, or bio-metric data, they exhibited similar motivations for engaging with the data process as contributors and consumers, suggesting a level of personal investment in and concern for the data.

Increasingly, researchers have sought to investigate the relationship between the consumption and use of data with subjectivities and emotions. Within the realm of Information Visualization (InfoViz), for example, researchers have noted that users conceptualize visualizations as an objective, neutral, and standalone artifact (without thinking of the underlying data source) [26]; users maintain emotional distance with such an artifact [45]. Nonetheless, when probed, participants do incorporate their own personal experiences and have a "dialogue" with data, leading to seeing the information as more than graph, even, for example, beginning to emotionally experience data as real people [24]. Data analysis itself is not a straightforward or singular moment of time – in an "autospeculation," Kinnee et al. [28] find that analysis requires multiple, nuanced visits to data, each of which involves emotional labor and tensions on analytic representation. How data is presented has a dramatic difference in its impact on the user (e.g., in leaving a lasting impression) [7]. Overall, Lee-Robbins and Adar [30], after studying the affective intent of designers of data visualization, despite stigma against it, argue for a more subjective, emotion-laden view of data visualizations. The participants in our study similarly viewed data outputs and analysis often with an objective perspective but spoke of data sources, choices, decisions, and use in emotional terms that spoke of their commitments and values with hunting.

Lin et al. [31] introduce the concept of data hunches as personal knowledge that experts hold about data that surface explanations or inaccuracies through data contextualization, yet often go unrecorded in official data. Data hunches are inherently tied to expertise in the field that the data represents and are typically attributed to those with normative power in the data ecosystem: analysts, researchers, scientists, and other such data workers [31, 32]. Through the data hunches discussed by participants in the case study we present here, we expand perspectives on who holds expertise on scientific data collected through a citizen engaged open data initiative.

2.3 Case Study Context: Rural Hunters and Data

In HCI and CSCW, much open data work has centered on urban contexts (e.g., [9, 19, 33]). In this work, we explore citizen participation in a rural open government data initiative, broadening contextual applications of open data in our field and considering how existing themes for open data participation, such as data localism or personal interest in data, manifest in a rural context. In a study of data visualization perceptions among rural Pennsylvanians, Peck et al. [38] found that visualizations with local or personal relevance to participants were valued more highly by participants, echoing similar findings from open data reporting research [27, 34]. As rural contexts are often conceptualized as being on the disadvantaged end of digital and data divides (e.g., [38]), we demonstrate here how our participants' use of (processed) open data can help counter these narratives. Through their participation in an open data initiative, citizens developed a stronger role in data and civic ecosystems. Drawing from work on open data in the rural Global South, we similarly find that processed, contextualized data may be more effective in facilitating citizen use of and benefit from open data [20], as raw, decontextualized data may be ineffective in light of data divide impacts experienced by rural residents. Thus, while the open data in our case study is processed, we find that this format is more appropriate for this audience, and can still be considered open data.

Prior work across HCI and wildlife management have explored the dynamics between contemporary technologies and rural hunters. Researchers have long considered how emerging technology could be employed by wildlife agencies for more effective data collection with hunters [41]. However, as we found with our participants, hunters may still feel that they are not being listened to and that their hunting experience and expertise does not matter to wildlife agencies. Prior HCI research with rural hunters has demonstrated the thoughtfulness that hunters demonstrate regarding their hunting practices, making intentional choices regarding their weaponry and use of hunting aids guided by personal values and ethics [43]. This work also shows how hunters take great care to develop expertise about the land and animals they hunt, developing "country knowledge" that can sometimes be at odds with scientific knowledge [43]. Crowdsourcing has also been explored as a potential data collection method for rural data on nature, wildlife, and land use [29, 35, 44], demonstrating the value that citizens can provide in reporting such data, but with few implications or intentions for sharing data back to citizens. Crowdsourcing initiatives also tend to frame citizen contributors as non-experts [35] whereas we consider the hunters in this study to be experts in the domain of the open data initiative.

Similar data collection initiatives have been developed with rural hunters in a variety of contexts. In the Amazon, researchers developed a mobile app for public participation in scientific research to promote sustainable hunting and wildlife management [46]. The researchers opted for a public participation model that would involve hunters as data collectors in part to empower local hunters to guide decision-making on sustainable wildlife management [46]. In Sweden, a public participation Moose monitoring system has involved hunters as stewards, reporting Moose sightings to inform hunting season quotas [47]. However, this system has not been without conflict. Some hunters raised concerns about a lack of public transparency in the system, with suspicions that data is being manipulated by reporting agencies. Further, the system introduces a level of surveillance over hunters in its collection of location data, leading some to suspect that the real intention of the program is not to collect data on Moose populations, but hunters themselves [47].

Hunters have been characterized as citizen scientists in recent years, with scientists taking advantage of hunters' close relationship with wildlife to collect data [13, 36]. In Norway, researchers developed a surveillance system to track Chronic Wasting Disease (CWD) among local reindeer populations, using hunters as citizen scientist data collectors [36]. Through a comprehensive overview of hunters' scientific contributions to biodiversity monitoring across the European continent, Cretois et al. [13]. found that hunters were used as data collectors for at least one animal species in 32 out of 36 European countries. The ubiquity of hunters as citizen scientists demonstrates hunters' crucial role in natural resource management. However, Cretois et al. [13] also point to some limitations and challenges in relying on hunters as data collectors. For example, hunters may attempt to influence hunting season quotas by misreporting observation and harvest data, leading to mistrust between wildlife agencies and hunters. These works discussed the successes and challenges of using hunters as citizen scientists and data collectors, but did not capture hunters' perspectives on their role in the data ecosystem, as is our focus in this work.

3 Methodology

This work was conducted in partnership with a US Midwestern state government agency – the Department of Natural Resources (DNR). This collaboration developed from a prior, separate study conducted by the last author on the interaction of technology and hunting and connections between the DNR and that author's university. The DNR is tasked to with managing, preserving, and enhancing the use of natural resources in the state, including fish and wildlife. Deer hunting for both sport and meat is central to the state's history and culture. We collaborated with the DNR to evaluate its recent efforts to build trust with the local deer hunting community. Central to this

ID	Yrs deer hunting	Yrs deer hunting in state	Mostly public / private land (past yr)	County ID (living)	Rural?	County ID (hunting)	Rural?	Age	Gender
Jack	>20	>20	Private	NA	NA	9	N	69	Male
Steve	>20	>20	Private	1	Y	1	Y	60	Male
David	>20	>20	Private	2	N	2	N	42	Male
William	>20	10-20	Private	3	N	10	N	61	Male
Jim	>20	>20	Private	4	Y	4	Y	48	Male
Michael	>20	>20	Public	5	N	5	N	54	Male
Chris	10-20	10-20	Private	6	Y	11	Y	50	Male
Robert	>20	>20	Private	7	N	7	N	44	Male
Thomas	10-20	10-20	Public	1	Y	12	Y	26	Male
Scott	>20	>20	Public	7	N	13	N	62	Male
Brittany	6-10	6-10	Private	8	Y	8	Y	25	Female

Table 1. Hunter Informant Demographics

effort is the public release of data they collect. Participants were interviewed and were given a survey beforehand to indicate which data collection activities they had participated in and what public data sources they had used. We recruited both hunters and conservation officers (COs) (e.g., game wardens), who educate and liaise with hunters as well as enforce state hunting laws. We spoke with COs, because, among those employed by the DNR, COs are most frequently on the ground, interacting with and hearing from hunters. The DNR provided us a list of people of people who head various deer hunting groups in the state and conversation officers (i.e., game wardens) of counties with active deer hunting. The DNR also reached out on our behalf (due to privacy concerns) to people that have directly reached out to the them in the past (e.g., through telephone calls, social media, email, or written letters). We also recruited participants through social media groups about deer hunting in the state. All potential participants were asked to fill out a pre-interview survey to express interest. Tables 1 and 2 displays the demographics of our hunters. Ages are approximate because participants were asked what year they were born in. The rural column indicates whether the respective counties are classified as non-metropolitan as based on the 2023 Rural-Urban Continuum Codes published by the USDA (US Department of Agriculture) [3]; for our purposes we equate non-metropolitan as rural. Our participants are nearly all white males – hunting is heavily skewed towards white men in the US (a 2011 national report found 90% of deer hunters were men and 96% were white [18]). Overall, participants hunt, live, and work in a mix of rural areas. This study was approved by the authors' Institutional Review Boards as an Exempt study. Potential participants were provided with an information sheet detailing the study purpose, procedures, data confidentiality, and its voluntary nature (participants could withdraw at anytime).

3.1 Limitations

This work presents a case study of rural hunters from one state. Thus, the findings are not intended to be generalizable, but to highlight, through these participants in this context, opportunities and questions that future open data initiatives may take up across other contexts and larger-scale studies. Further, within the context of rural hunters, our sample has a high level of experience that may skew our findings. Our understanding of hunters as experts in hunting data and the level of

ID	Yrs at DNR	Hunting frequency	Mostly public / private land (past yr)	County ID (living)	Rural?	County ID (working)	Rural?	Age	Gender
Kevin	10-20	Frequently	Public	14	N	14, 15, 16	N, N, N	35	Male
Mark	6-10	Rarely	Even split	14	N	14	N	32	Male
Rick	10-20	Frequently	Private	1	Y	1	Y	39	Male

Table 2. Conservation Officer Demographics

care for data that they demonstrated may have been influenced by the expertise they developed across years of hunting. A sample with greater representation of less experienced hunters may have yielded different findings. However, as we will describe further throughout Section 5, we believe that all citizen participants in open data have expertise to contribute and we hope that future work in open data will continue to explore how treating citizens as experts in open data topics may yield more beneficial outcomes from open data initiatives.

3.2 Folk Theories of Data Collection and Action: Card Sorting Interviews

Drawing from previous studies on folk theories surrounding online platforms [14], we used a card sorting method to understand how hunters perceive how and why data is collected, analyzed, and presented by the DNR to make decisions. Card sorting provides an easy way for participants to visualize and articulate their mental models – in our case, the mental models of how data are related and have impact on the DNR's policy decisions. The data collection for this study happened in the midst of the COVID-19 pandemic, so remote methods were used.

In consultation with the DNR, two digital whiteboards (Miro platform) with cards representing data collected were created to run the card sorting session with participants. The data was collected by the DNR through the following instruments (anonymized):

Post Hunt Survey: Traditionally reported at physical deer check stations, this now digital version asks questions about their experience with the deer and the hunt. The DNR states that the survey is used to understand deer populations trends, hunter satisfaction, and deer biology.

Deer Registrar: It is required for hunters to register their harvested deer within two days.

Deer Management Survey: This is an expansive annual survey to obtain feedback from the public, including but not limited to hunters, on how the DNR is managing deer.

Trail Shot: The DNR provides trail cameras for landowners to deploy and capture data on the distribution of wildlife.

Bowhunters Index: Bowhunting requires long periods of silence (due to the close distance required to successfully hunt game), making bowhunters an ideal population to report observations of wildlife to biologists.

CWD Surveillance: The DNR allows hunters to report suspected cases of sick deer (e.g., chronic wasting disease).

The first version of the whiteboard presented all the instruments alongside the types of data collected; the second version organized all the data collected into categories. We presented these two whiteboards because, based on pilot interviews, some informants found it easier to make sense of the sheer quantity of data according to the instrument they came from, while others preferred

to discuss the different types of data collected, regardless of the instrument. In both boards we obscured but later revealed possible actions the DNR might take based on analyzing public data. Informants were also free to create new cards. Appendix A provides screenshots of the digital whiteboards we used.

Informants were prompted to arrange these cards to explain what they thought the DNR does with the data. To facilitate this exercise, we asked informants to first choose cards (i.e., data) they thought were particularly important to the DNR, arrange the cards, discuss how the data is *analyzed* by the DNR (e.g., "How do you think this data is analyzed by the DNR?"), and finally what *actions* are taken by the DNR based on their data analysis (e.g., "What actions do you think the DNR takes based on analyzing this data?"). Throughout the card sorting exercise, we also utilized auxiliary cards to ask hunters about stakeholders and topics intersecting with data (e.g., game wardens, biologists, state government, deer seasons). We also asked informants about their perceptions of the DNR – how effective the DNR is as an state agency primarily around deer management (e.g., "Can you tell me a specific time when you felt the DNR was doing a (good)/(needed to do a better) job with deer management?") and how it has changed over the last 5 years (to gauge how hunter trust with the DNR has changed over time).

During the interview we also probed informants on how they used public data released by the DNR (e.g., "Describe to me the last time you remember using this data"). We then asked how (e.g., over social media) they discussed the data with others, such as friends or family.

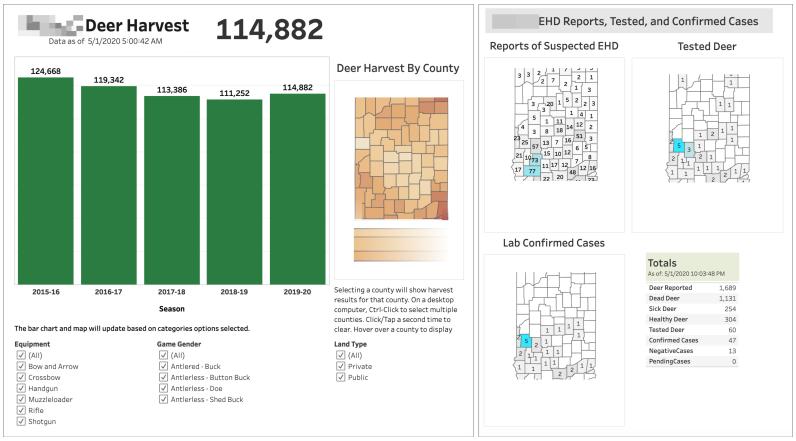

Fig. 1. Deer Harvest Data (left), EHD Maps (right)

For the above questions, informants were reminded of the various ways the DNR releases deer hunting-related data to the public:

Deer Harvest Data: Based on registrar data, this provides dynamic visualizations of current and historic deer harvest counts. Hunters can see harvest totals, harvests by county, harvest by types of deer (e.g., buck vs doe), and equipment (e.g., bow and arrow vs rifle) (Figure 1).

Epizootic Hemmorhagic Disease (EHD) Maps: This online interactive map dynamically shows counts of tested, suspected, and confirmed cases of deer infected with EHD by county, which is about 90% fatal (Figure 1).

White-tailed Deer Report: A nearly 200-page report of the state's deer herd, including hunting season data, deer vehicle collisions, and survey results (Figure 2).

Fig. 2. White-tailed Deer Report Excerpts: deer harvest trends, CWD opinions, Bowhunters index results, hunter desires, DNR opinions, county specific data (top-left to bottom-right)

3.3 Data analysis

The first and third authors conducted qualitative analysis of interview transcriptions. Both authors have extensive experience interacting with and studying rural communities, which we drew upon when using a constructivist grounded theory [11] approach to analyzing our data. In adopting this stance, our interest is not only in how hunters factually collect and use data, but how they implicitly construct boundaries around what counts for legitimate and good data (and its various practices). After transcribing all interviews, we did open coding [42], combining both a line-by-line and incident-by-incident strategy on analysis [11]. We did codings in cycles, in the first cycle we had codes such as *Wanting to feel respected by DNR; Time spent before harvest is important; Hunters want to help DNR;* and *More hunting experience is valuable for data collection.* Based on memos and discussions, we had identified as a key theme that hunters feel they have an important stake in the DNR's data ecosystem. We then did focused coding [42] to further break down codes and identify themes, such as *Hunter/DNR relationship; Hunters care about data; Hunters provide value to DNR.* In parallel with coding we wrote analytic memos to capture emergent themes and to reflect on the data. Memos and codes were discussed in regular meetings with the research team. An example memo that reflects our findings about diversity of hunters being represented in data is:

> *Interesting that interviewee Michael seems to be implying that hunters only spend as much time in the woods as it takes to harvest a deer. Many other interviewees have talked about letting many deer pass to wait for exactly the one they want to harvest or even as a means for connecting with nature and gaining insights into herd dynamics. This tells me that if the DNR were to draw these kinds of conclusions, they may reach incorrect insights by flattening the idea of what hunters value from the hunt. There is great diversity in why and how hunters hunt that those who analyze the data should be careful to consider.*

The codes and memos from our analysis form the genesis of our findings.

4 Findings

We identified three key themes as to how opening the data and involving hunters in data collection and consumption impacted members of this group. First, hunters claimed a role for themselves in the data ecosystem, considering themselves to be the DNR's "eyes and ears" out in the field (Section 4.1). Next, hunters developed values for data, within and beyond the stages of the data system where they were involved. Hunters were concerned with maintaining the validity of the data through data analysis, raising concerns about shortcomings with the data instruments (which they were not involved with designing) (Section 4.2). Finally, hunters' involvement in the open data system helped to improve hunters' perceptions and relations of the DNR. Feeling valued and respected by the DNR helped to mend damaged trust between hunters and the DNR (Section 4.3).

4.1 Becoming active players in the data ecosystem: the DNR's "eyes and ears"

Through their involvement as data contributors and consumers, hunters began staking a role for themselves in the data ecosystem. They described the value they provide to the DNR as observers in the field. Jack explained: "[The DNR] want us to be the eyes and ears because they haven't got time to go do that."

Participants described the expertise and investment they developed in their local environment and wildlife through their experience hunting. Some saw their contributions to the DNR's open data system as a natural, warranted use of their knowledge. As Jack states here, he saw hunting and being in the field as his "job" and described how his personal investment in his local environment went beyond "just buying a license":

> It's like, the DNR, don't tell me how to do my job, that's why I'm here. Don't tell me, "You don't know nothing." I sit in a tree and I look at it every day and I own my own property now. I got a stake in this more than just buying a license you know.

Here, part of Jack's expertise and investment comes from his ownership and hunting of private land. Private land owners and hunters we spoke to often made reference to their deeper knowledge of their land and its wildlife increasing the value of the data they reported to the DNR. As Thomas notes here, hunters developed close knowledge of the wildlife on their own land:

> I like watching them grow. I have pictures of deer from two years ago that I seen again last year. It's just – you can tell they're the same deer just by the way their antlers grow. And you just sit there, I can sit there and compare them. It's kind of neat to see stuff like that.

Hunters wanted to contribute their rich knowledge of land and wildlife to the DNR and in turn to be recognized by the DNR for the expertise they had to offer.

Some participants felt the open data process, with its expanded set of instruments implemented by the DNR, signaled that they were finally interested in really listening to and learning from hunters. Before, the DNR essentially only asked for reports of harvested deer (e.g., through the deer registrar). David explained:

> I think the hunters that are actually filling it out are happy that those questions are being asked. Because it feels like they can express an opinion. They can tell you what's going on and what they want to see. Where before it was just tell us how many you killed and we don't care about anything else.

For the DNR, a beneficial effect from their instruments proffering feelings of respect for hunters' expertise was in enrolling them as allies. Hunters described their desire to help the DNR – hunters sympathized with the DNR's limited time and resources to go into the woods and saw their role as data collectors as pivotal to wildlife management. Indeed, many hunters described the lengths they would go to to offer this help, as William describes here:

> My experience with the COs is of great, great regard for them and I think they do a good job. I think they're spread mighty thin. And I know that their ability to come to any one place quickly is not, you know, not great. But I feel like if I call the CO and said, "Hey, here's what I've found in the field. You know, I got this deer who's got this," my guess is, they'd say, "Hey, would you take some pictures of that?" or, "Would you mind taking a sample of the lung and put that in a bag?" and that kind of thing. So, I feel like they care. And, you know, I just try to be as helpful as I can.

In sum, through the DNR's open data practice, hunters were able to stake an active role in the data ecosystem that they had long felt they held, and deserved, but had not had the opportunity to enact. Hunters recognized their time in the woods during hunting season as a unique asset to the DNR. They saw the expertise they developed through their hours, days, and years hunting as holding great value for the DNR. The open data system created by the DNR gave the DNR the chance to leverage that expertise in a way that had not been possible, or at least easy, before. Feeling that the DNR was recognizing the value the hunters could provide, hunters were motivated to help the DNR and actively participate in the open data system.

4.2 Developing values for data processes: Impacts of hunter diversity on data collection

Now with a stake in the data ecosystem as data collectors and consumers, hunters began to develop values for data. Hunters were thoughtful data collectors, considering how their unique hunting styles would impact the data they collect and report. Their active involvement in the open data

system as data collectors led them to critique survey instruments; hunters desired more nuanced and detailed mechanisms for data reporting that could accurately capture their data and more importantly, their unique selves. In this way, hunters' involvement in the open data system as data collectors and consumers created opportunity for them to develop strong values around data analysis, even though this was not a stage of the system they had direct involvement with.

Participants often thought diversity in hunting style could impact data collection, noting how factors such as years of hunting experience, time spent hunting, hunting goals, and patience while hunting could influence the data contributed. Many participants spoke about how their many years of hunting and long hours in the woods each hunting season gave them a larger and more accurate view of the local herd and habitat which, in turn, made them valuable and reliable data collectors. For example, here, David notes how time spent hunting can skew the number of deer a hunter may report seeing:

> I may see a hundred deer in the season and the guy down the street might only see four. Well, I've spent hundreds of hours in those trees. He might only spend 10 or 12 hours in those trees and that's why he's seen fewer.

Hunters reported a variety of reasons they hunt, prioritizing different aspects of the hunting experience. These diverse and evolving priorities for hunting have been conceptualized in state hunter education materials as the five hunter development stages [2]. Hunters at different stages value different aspects of the hunt, beginning with the thrill of making a shot (Shooter stage), progressing to the quantity of game taken (Limiting Out stage), then the quality of game taken (Trophy stage), to the method of hunting (Method stage), and finally, the holistic experience (Sportsman stage). Hunters we spoke to fell into Trophy, Method, and Sportsman stages. Those at the Method and Sportsman stage, who had presumably arrived at these stages by progressing through all prior stages, particularly reflected on how hunters at different stages collect data differently. For example, Steve, a Sportsman hunter, describes here how his experience hunting and the data he collects while hunting will inevitably differ from a hunter at the Shooter stage:

> Some people, you know, they'll go out and shoot the first deer they see. And that really don't benefit them a whole lot as far as what's out there. I don't know. There's several times I've sat there and watched 15–18 deer go through and never squeezed a shot off you know?

More time in the woods leads to greater understanding of the herd and "what's out there." This theme of greater time and experience hunting making a more valuable data collector came up frequently in interviews.

In addition to time spent hunting, participants spoke on how location can impact hunting experiences, with implications for data collection and reporting. For example, Jack spoke about how hunting on private vs. public land may affect a hunter's values and hunting style:

> When you hunt anybody else's property but yours, you want all you can get…When you own your own land, you're not after killing everything. You're after conservation. You want to see them…You want to enjoy them.

Here, Jack suggests private land hunters may be more conservative in their hunting style, shooting fewer deer and developing a closer relationship with and greater knowledge of the land and herd.

Other aspects of location can also affect hunting experience. Several hunters spoke of the variance there can be in the number of deer even in a relatively small area. For example, Kevin, a conservation officer, hears vastly different reports from hunters on the same piece of land he surveys, as he shared here:

> It's funny dealing with the general public because… you'll be on the same, say, 500 acre parcel that's part of whether the state forest or state reservoir. You'll check one hunter that's like you know, "It's great. I can come down here year after a year. I don't have to worry about anybody being around me while I'm hunting." And then you go 300 yards down the road, check another guy and he's like, "Well, I had two guys walk in on me this morning. It's ridiculous. This happens every time I come down here." And it's like, well, this guy down here is perfectly fine and you're not. So, it's kind of funny how some of those interactions go.

As Kevin notes, hunters a mere 300 yards from one another can have vastly different experiences, leading to differences in data reporting that can only be considered representative of the herd when analyzed together. Similarly, hunters noted how, when hunting with friends, they can have vastly different experiences from one another when hunting in different locations on the same piece of land, as Steve described:

> There's times were I could be sitting in the high ground and one of my friends and my boy will be sitting in the bottom and I'll be seeing deer all day long and they won't see a thing. But then two days later it will flip flop, and they're seeing the deer and I'm not seeing anything.

Through considerations like these, hunters were cognizant of how their individual experiences may not constitute the full picture of what is going on with the herd and the land.

Frequently juxtaposed with the concern over the variance in the experiences of hunters was concern over data accuracy. Many participants wondered if data could potentially misrepresent the reality of their experiences or be misinterpreted, as Chris notes:

> If a guy takes a buck and he checks a buck, right now, all your data knows is he checked a buck. And you don't know that he was out there for two weeks to get that buck and that he let a dozen… walk by him before he took it or was that the first thing he saw?

Chris went on to note how he had changed his hunting style in recent years due to shifting herd management recommendations. He was frustrated that he couldn't provide context in surveys to explain why he was shooting fewer deer than he had in prior years. Chris spoke about other contextual questions he wished were included in the survey to ensure that data analysis would accurately account for hunters' experiences and choices, rather than making incorrect assumptions:

> I think one of the questions that I don't know if they ask is, "Why did you pass on… a deer?"… If you saw five, why did you, asking specifically, why did you pass on 1–5 before you shot six? Five might've been antlerless, it was a fawn, it was only a four pointer, you know, so then I waited until it [was a] 12 pointer, you know. But it might also be, why did I shoot that particular one? Well, it was my last day. And he's not what I wanted, but it was my last day, so I didn't want tag soup. So again, back to that thing of the guys that don't fill their tags, why didn't they fill their tags?

In the current open data system, hunters are included as data collectors and consumers but, as Chris demonstrates here, our participants had an interest in impacting other stages of the process, such as in instrument design. As data collectors, they thought critically about how their hunting style may impact the data they collect and how that data could be interpreted by the DNR. They cared that the data was analyzed in such a way that it accurately depicted their experiences, and viewed their data in combination with that of other hunters to form an accurate larger picture of the herd and habitat.

4.3 Increasing trust and respect with open data

Participants noted how their role in the open data ecosystem led to a sense of feeling respected by the DNR that had not been there in the past. Hunters often remarked on how the new open data practices put in place by the new management team at the DNR helped to repair historically broken trust and communication between hunters and the DNR, as Robert notes here:

> They're becoming more open minded and a little more transparent in the, in the recent years. And I, I think that that's the way they should be, you know, collecting the data. I don't think was ever really done in the past…it seemed like if the data was there, you know, even basic data on the deer herd, it was never presented and never, never kinda in public eye. You know, it was always a question of "what are we going to see this year?"…There was never any interaction, I think, much in-between hunters and fish and wildlife at that time…I've seen probably within the last five years an increase in the amount of data. Not only are they asking, but they're presenting back to the hunters. And I think that that is a great way to start and get higher involvement with the hunting public.

Here, Robert directly cites the breadth and depth of the open data that is collected by hunters and reported back to them as a driving factor in repairing trust. As described previously, hunters we spoke to felt deeply invested in the data ecosystem, both as collectors and consumers. Robert notes how a lack of transparency into data the DNR collected or their decision making process led to uncertainty and frustration for hunters. Robert's statement here demonstrates how a perceived lack of respect for hunters' expertise and investment in hunting created negative feelings between hunters and the DNR and how new open data practices has helped to repair the relationship. David corroborates this:

> There's a lot of hunters upset about [the previous herd management]. And they feel that the DNR just left them hanging and didn't care about their opinion. [The new biologist], although I can say has got a very good reputation with the deer hunters. The ones that pay attention know his name and realize that he cares and he's trying to collect more data.

Note that care and data are said in the same breath. This sentiment was echoed in other interviews. Nearly all of our participants mentioned the current deer biologist by name, noting their satisfaction with the changes he had introduced to the department. However, as David went on to note, the previously eroded trust between hunters and the DNR would take time and continued action to repair:

> [Current management] do care about the hunters, they do care about their opinion and they do try and represent them in meetings…hunters feel like they they've been left out for awhile. And I think that that sentiment's starting to go away with [current management]. But that doesn't change overnight.

These quotes are emblematic of a common theme that arose in our data, of hunters wanting to feel respected by the DNR, and open data practices helping to demonstrate that respect and build trust between hunters and the DNR. Open data practices helped to level hierarchies between government agencies and the public by involving the public in governmental decision-making. From a social standpoint, our data suggests that involving citizens as data collectors and consumers in open data systems can help to build trust between government agencies and citizens by demonstrating respect for citizens and offering transparency into government systems.

Another sign of improved government-citizen relations as a result of the open data initiative was the way that participants described using the open data to defend the DNR in response to

negative public opinion. Several participants described correcting misconceptions they came across on online social platforms such as Facebook, as Jim describes here:

> You know that I'm on a couple of different groups on social media and Facebook, where it's groups of hunters and outdoors people… And one thing that jumps to mind is in the last few years there has been this, this feeling by a lot of hunters that the deer population is just crashing and that the DNR is not managing it well. And our harvest numbers are low this year and this sort of sentiment is out there. And I love to be able to refute that when I get that harvest summary and say, well, you know if you look at the numbers, the numbers don't really support what you're saying.

Here, Jim demonstrates his alignment with the DNR through his use of the data to push back on negative perceptions of the DNR's herd management. Thus, the open data initiative has afforded hunters transparency into the DNR's decision-making process, and hunters have in turn used that transparency into the data to defend the DNR against perceived unfair criticism. In this way, the open data has created a positive bi-directional relationship between the public and the DNR as more transparent data has increased hunters' understanding around the DNR's management decisions.

5 Discussion

5.1 Building Data Literacy and Trust in Government Through Open Data

We found that our hunters had already seen themselves as having an important role in the hunting system before the DNR implemented their open data initiative (Section 4.1). Indeed, it was the hunters' perceived lack of recognition for their (diverse) skill, value, and stake in hunting decision-making by the DNR that had eroded trust between hunters and the DNR prior to the data system opening up (Section 4.3). Even without more holistic integration into the open data system, hunters' involvement in data collection and consumption through the DNR's open data initiative had benefits of allowing hunters to stake a claim and role in the data and develop critical perspectives on the whole data process more broadly (Section 4.2).

As data collectors, hunters thought carefully about the contextual factors not captured in the survey instruments that may skew how the data they reported would be interpreted (Section 4.2). These data hunches [31] often aligned with the five hunter development stages, and how hunters' values and goals change as they progress through the stages. For example, some participants expressed concern that time spent before harvest would be considered by the DNR as a proxy measure for herd size, if the DNR assumes that most hunters are in the Shooter or Limiting Out stages and will shoot the first deer they see. Many of our participants were in the later hunter development stages, where hunters are more discerning about the deer they harvest and place more value on the holistic experience of hunting and spending time connecting with nature. Therefore, they reported letting many deer pass and spending many "unnecessary" hours in the woods before harvesting a deer. They brought these personal values with hunting into their considerations of the data they contributed. They demonstrated care in thinking about how these preference-driven aspects of their hunting style and experience could impact the data they report and how it is perceived by the DNR. They hoped that the DNR's data instruments and analysis would avoid being overly reductive, instead capturing the rich diversity and nuance of hunter backgrounds and experiences. In these ways, hunters developed data hunches and demonstrated an affective relationship with data that expert data workers exhibit [30–32]. Therefore – despite hunters' somewhat limited involvement in the open data system, only participating as data collectors and consumers – this involvement still allowed them to develop values for the data more broadly, similar to the ways that expert data workers demonstrate, across stages such as data analysis and

instrument design where the hunters were not involved. We see this as a promising finding for open data initiatives.

Prior work on open data has advised researchers and open data agencies to steer away from overly optimistic or solutionist views of open data that claim that the release of data alone will help to achieve positive outcomes [25]. We largely agree with these perspectives. In this work, our participants seemed to gain the most benefit from their involvement in the open data system as data collectors. While we will also go on to argue that deeper involvement can yield greater benefit, we still want to recognize the benefit that can be achieved through merely engaging citizens in government data, even in limited ways. In particular, these findings hold promising implications for citizen data literacy. Although participants were not involved in survey development or data analysis, their involvement in data collection and consumption allowed them enough insight into the data process to be able to develop and articulate critical perspectives on these other stages of data. While we did not measure data literacy in this work, we find that hunters' broader considerations of how their data would be interpreted and how survey instruments may be better designed to allow for more accurate reporting suggest that hunters may have been able to develop greater understanding of data systems through their involvement. Moreover, regardless of impacts on understanding, our participants demonstrated investment in the data [30] and claimed a role in the system that suggests that some level of increased citizen empowerment was achieved through this initiative. However, as we have alluded to, the impact of these increased data perspectives are limited by the lack of structural involvement of hunters in other stages of the data system.

Without power or voice in other stages of the open data cycle, hunters' perspectives on instrument design and data analysis cannot reach those at the DNR with current power over these data systems. This lack of holistic involvement renders them "marginalized voices" [5] in the more comprehensive data initiative. Therefore, while open data initiatives like this have demonstrated benefits for improving citizen/agency relations, enhancing citizen data literacy, and empowering citizens to stake a role in the civic data ecosystem, simply involving citizens in data collection and consumption is not enough to satisfy citizens' needs and capacity for contribution.

5.2 Reframing Citizens as Experts in Open Data

The DNR's open data initiative was somewhat unique in the context of open data initiatives discussed in HCI literature, which commonly cover broader civic topics, such as government budgets [27] or Smart City planning [19]. In such cases, all citizens can be considered equal stakeholders, with similar expertise and investment in the context of the open data. This open data initiative was developed by a small, specialized government agency (the DNR) about a niche topic (hunting) with specific citizen stakeholders (hunters). These citizen stakeholders hold particular expertise about the topic of the open data. In this way, contribution to open data initiatives can share similarities with data donation [22], in contributors' care for and investment in their data [5] and the impacts their contributions will make to the overarching initiative. The hunters' unique investment in the data and relatively close relationship with the data collection agency likely results in unique impacts from the open data initiative, such as the increased trust and respect between citizens and the agency. This unique open data context may hold implications for how open data initiatives in other contexts can improve citizen/agency relations. Participants explicitly cited the open data initiative as a step towards repairing broken trust between hunters and the DNR (Section 4.3). This finding is particularly interesting in this rural context as prior work on trust in data in similar rural settings, such as that of Peck et al. [38] found (dis)trust to be a thorny issue among rural residents, often aligning with political identity. While we cannot speak to our participants' political identity, we saw that trust emerged between hunters and the DNR when hunters began to feel respected by the DNR through their inclusion in the open data initiative. This respect became a

two-way street and hunters described using the data resulting from the initiative to defend the DNR against distrust from other hunters. Therefore, we build upon Peck et al. [38]'s argument, that data is personal, by demonstrating how personal involvement in data collection systems may help to increase trust in data and data collection agencies.

Open data initiatives would benefit from seeing citizens as hunters in our case studies saw themselves: as helpful contributors with unique value to add to the data that agencies and government stakeholders could not access without citizen involvement. Rather than considering citizen involvement in open data as a measure that benefits only, or primarily, citizens through increased transparency and agency, data collection agencies should recognize the value that citizens bring to the data ecosystem through their "field" knowledge [31, 43].

We close by noting that the materials of open data initiatives, even in the DNR's more slightly limited format – survey instruments, visualizations, thick reports – serve an important symbolic role, signaling [17] overtures of trust and transparency towards hunters. Perhaps more important than the data itself, open data turns a new page in the previously contentious history of the DNR with the public. This has a cascading effect in enrolling [10] hunters onto the DNR's side, to not only have a stake in the data ecosystem and thoughtfully critique it, but to at times even defend it.

5.3 Implications for Open Data: The Value of Citizen Utility of Data

The DNR's open data initiative is arguably somewhat limited compared to other open government data initiatives. For example it would only score "one star" under measures like the 5-star open data principles [8] because data is only shared with the public in processed forms, such as tables and charts, rather than raw datasets. Despite this limitation, we found that this open data initiative to be quite effective along other evaluation metrics. For instance, the data provided is quite large in volume – the White-tailed Deer Report is an annual report nearly 200 pages in length. Considering recommendations from prior work emphasizing the importance of making data accessible and relevant to citizens [16, 33, 38], this open data initiative was strong in providing the data in easily interpretable and contextualized forms. This data is centered around relevant contextual framings, such as location (data is presented by county).

We argue that this simple processing of data and its localized presentation may have positively impacted citizen engagement with the data. Prior work has noted skill-based and technical barriers to citizen engagement with open data as key challenges, as working with raw data requires a high-level, diverse skillset that can preclude citizen engagement with open data [12, 15]. When working with populations who often experience negative impacts of digital divides, such as the rural hunters in our case study, this problem becomes even more relevant as data divides can reproduce digital divides [16, 21, 25]. Our participants did not speak directly to their perceived ability to work with raw data, as opposed to the processed data they received. However, nearly all participants did discuss how they used the data (e.g., Section 4.3) for a variety of purposes, from informing their hunting plans, to correcting misconceptions among their peers, to educating themselves further about hunting. Considering these findings alongside arguments like that of Loukissas and Ntabathia [33], that data is only open if it is accessible by citizens for contextual use as evidence in support of a claim, this initiative was certainly open in that regard – perhaps moreso than some others that score higher on the 5-star scale [8]. While we cannot say with certainty that these benefits would not have been achieved if the data was presented back in a raw dataset, we nonetheless find that the processed data achieved intentions and benefits of open data in its broad utility for citizens. The processed data presented back to the public by the DNR was also contextualized by location, aligning with findings from prior work on open data that data interpretation for open data should be contextualized around a topic of citizen interest, such as locality [34]. Therefore, the DNR's

open data initiative, despite its initial form, aligned with best practices for open government data and the particular context of the public citizens this data was intended to engage.

The strong capacity for citizen utility of this open data initiative suggests that open data initiatives may benefit from crafting data to be as legible and relevant as possible towards a target audience, to meet their particular needs and contexts. This is in contrast to how open data initiatives are often framed – in terms of civic engagement with a faceless general public. For instance Loukissas and Ntabathia [33] specifically note, and problematize, that open data often "focus[es] on making existing data sets available to broad audiences," emphasizing questions of who is centered and who is absent in open data initiatives. Likewise Zuiderwijk and Janssen [50, p. 24] describe the "target group(s) for the open data" across seven municipal open data policies as "everyone." While this is an egalitarian approach to open data, if one wishes to have an engaged public who feels they have a stake in the data process, a more focused, localized approach may have more success.

Indeed, processed and contextualized data was highly legible and engaging for many of our participants, and we surmise that providing raw data instead may actually decrease the legibility and usefulness of the data. Instead, our recommendations for how this, and similar, open data initiatives could improve align with calls for deeper public engagement in more stages of the open data cycle.

6 Conclusion

In this work, we have provided a case study of a state-level open data initiative between the Department of Natural Resources and rural hunters to examine, from the citizens' perspective, what benefits this open data initiative has achieved. Through interviews with 14 rural hunters involved in the open data initiative, we found that their involvement led to several key benefits. First, being involved as data collectors facilitated hunters in staking a role for themselves in the open data ecosystem and the civic processes it represents, suggesting benefits of increased civic participation and investment. Second, involvement in the open data initiative led hunters to develop critical perspectives on data more broadly, expressing personal values for data and stages of the data ecosystem beyond those in which they had direct involvement. This shows promise for open data initiatives to increase public data literacy. Third, being involved as data collectors meant that hunters felt listened to by the DNR, and felt a sense of overdue respect for their expertise. This feeling of respect helped to mend broken trust between hunters and the DNR, leading to improvements in citizen/government relations. However, we find that this initiative could have gone farther in capitalizing on these benefits by broadening citizen participation and transparency into the open data ecosystem. Through these findings, we contribute implications for open data initiatives to better achieve intended benefits. We suggest that open data initiatives learn from the benefits we identified here by showing respect for citizens' expertise and valuing them as active players in the open data ecosystem, rather than passive beneficiaries. We also recommend that open data initiatives offer more holistic transparency and opportunities for citizen involvement in all stages of the open data ecosystem.

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A Digital Whiteboards for Card Sorting

In this appendix, we detail the digital whiteboards we created for card sorting. These figures are facsimiles; some details have been anonymized or edited for clarity's sake. Figure 3 shows the digital whiteboard with all the instruments (e.g., Trail Shot, Deer Management Survey) alongside the types of data collected. Figure 4 shows another version but with the data organized by categories (e.g., hunter satisfaction, land information). Each white card represents a type of data collected by the DNR (e.g., how much time spent before shooting, level of enjoyment in hunt). The initially obscured area has a blue background and shows via pink cards possible actions the DNR might take based on analyzing public data. The gray area includes orange cards that represent generally known stakeholders and topics of interest around hunting to help facilitate the card sorting discussion. For full details, please refer back to Section 3.2.

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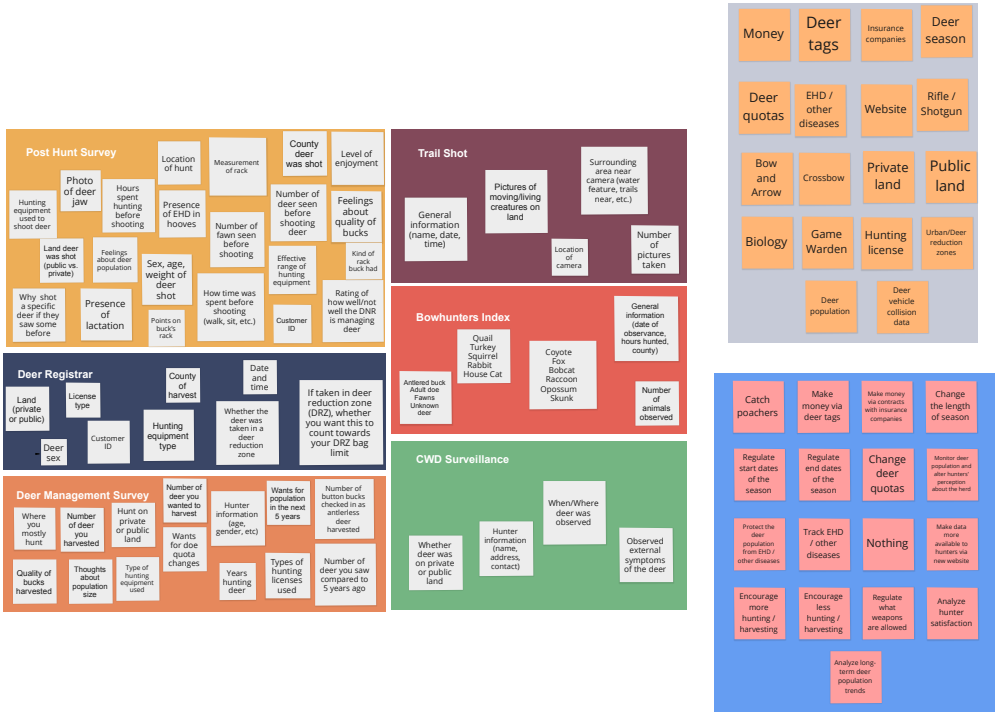

Fig. 3. Whiteboard with Data Arranged by Instrument

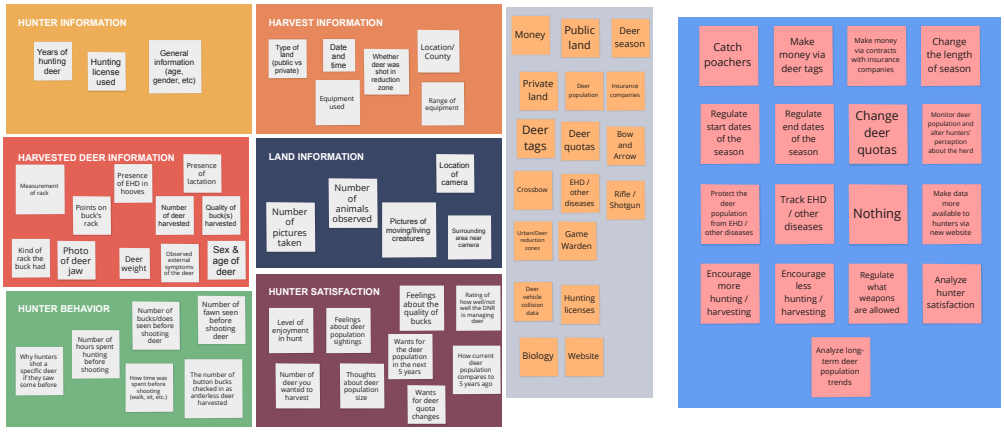

Fig. 4. Whiteboard with Data Arranged by Data Category