Designing Tools for Data Advocacy

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Abstract

Local governments, nonprofits, and community-based organizations are increasingly producing data, but there remains a gap between producing data and using it to advocate for local change. In this Research through Design (RtD) engagement, we partner with a local nonprofit to build tools that support the work of data advocacy. Building on insights from interviews and ethnographic field notes, we designed, prototyped, developed, and deployed tools to support our partner in leveraging data for digital activism. We present three tools that employed data for *constructing*, *amplifying*, and *visibilizing* bird-building collisions. Reading across these artifacts and reflecting on our design process, we find that data production alone fails to meet the action goals of the organization. To better leverage data for social change, we recommend (1) exploring the uses of provisional data, (2) embracing heterogeneous data sources, and (3) supporting data work that cultivates deep engagement.

CCS Concepts

• **Human-centered computing** → **Empirical studies in HCI**; **Collaborative and social computing devices**.

Keywords

data advocacy, data activism, nonprofits, open data, research through design, community-based organizations

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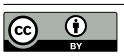
1 Introduction

Data that might guide civic work – from advocacy to governance – is more widely available and accessible than ever before. Efforts over the last 20 years in open data [27, 28], as well as bespoke projects to identify and collect tailored data [20, 26, 34, 51], have resulted in a surfeit of data resources. However, along with that ubiquity, has come an imperative for civic organizations of all kinds to strategically and tactically integrate data in their operations. One of the places where this imperative is having enormous impact is in community-based organizations, where a range of efforts are focused on developing new data resources as a vehicle for enabling social change (e.g., [2, 12, 29, 33, 38]).

For advocacy organizations, data often plays multiple important roles, legitimizing the work of the organization to external stakeholders, fostering innovation around quantifying social issues, mobilizing diverse audiences, and amplifying the visibility of marginalized groups [14]. In enacting these roles, we know that community-based organizations engage in a range of data work through strategies like storytelling [16], translation [65], and bricolage [67, 72]; and we recognize that those strategies are widely used to leverage data to garner support from stakeholders, guide decision making, or improve services [6, 14, 16, 22, 56, 65, 68]. However, those uses are often internally focused on the organization, and there remains a need to understand how to effectively design systems that support mobilizing data externally, at the scale of structural change, through digital activism.

By digital activism, we refer to a broad spectrum of digitally-mediated actions taken to promote social change [21]. Ranging from social media advocacy to hacking to achieve political objectives, digital activist activities are marked by six core operational mechanisms: *identification, construction, aggression, deception, visibilization, and amplification* [21]. Building on this definition, we use the term *data advocacy* to refer to the use of data for digital activism. In doing so, we differentiate the production of data by volunteer citizen scientists, more closely aligned with the term data activism [52], from the ways that community-based organizations implement data to advocate for structural and institutional change.

To understand how community-based organizations engage in digital activism, we partnered with a local citizen science project, Safe Flight, that monitors Bird Building Collisions in a U.S. city. These strikes occur when birds collide with man-made structures, a threat which kills between 365 million and one billion birds each year in the U.S. alone [41]. Ultimately, Safe Flight aimed to reduce local bird-building collisions by passing legislation that requires the use of bird-safe building materials. Over nine years, project



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staff directed a dedicated group of volunteers to observe and record bird-building collisions along three designated routes. In addition to the coordinated volunteer efforts, members of the general public reported collision observations through multiple platforms online. Between these initiatives and platforms, lots of time and effort were invested in monitoring and recording local collisions, producing data that was considered a valuable resource for influencing stakeholders around this topic.

In order to understand data practices at Safe Flight, the first author conducted a year of ethnographic observation, participating as a volunteer monitoring collisions and conducted 20 interviews with volunteers, Safe Flight staff, university partners, and building managers. Through these research activities, we find a gap between the work of data production and the use of data in digital activism. Despite robust social and technical systems supporting data production, our research shows that community-based organizations struggled to implement collected data in digital activist work. In addition to resource constraints, we find that the different modes of work between data collection and data advocacy and the prioritization of further data collection acted as barriers to leveraging collected data for digital activism. As a result, we argue that rather than activating social change, the production of data that does not directly contribute to activist strategies ultimately sustains the status quo.

In order to support our community partners in leveraging data for social action, we engaged in a Research through Design (RtD) intervention to create tools that could support data advocacy for our partners at Safe Flight. Drawing from insights garnered in our interviews and ethnographic observations, we prototyped seven artifacts to support data advocacy around bird-building collisions. After eliciting responses from our community partners, we delivered two fully functional artifacts aligned with the data practices at Safe Flight, and developed a third artifact that did not. Analyzing these artifacts and reflecting on the process of building them, we discuss how specific features of these tools contribute to digital activist activities of *constructing*, *amplifying*, and *visibilizing* [21].

Finally, we reflect on our RtD process to offer four key guidelines for supporting data advocacy. We suggest that researchers, designers, and community-based organizations looking to leverage data for digital activism should *explore uses of provisional data*, *maintain and take advantage of the heterogeneity of data sources*, and *support data work that cultivates deep engagement*. These guidelines can help designers, researchers, and community-based organizations take advantage of the flood of civic data by leveraging this under-used resource for digital activism, ultimately moving community-based organizations closer to their social action goals.

2 Related Work

In a time of increasing datafication [70] we see a large variety of public data initiatives, many of which promise to promote social change by democratizing information [28] or increasing transparency [39]. This project examines how data from a local nonprofit and crowdsourced open data can be leveraged for data advocacy. We cover work related to each of these themes, highlighting gaps between creating datasets and using them to support social action.

2.1 Data in Nonprofits

Nonprofits face enormous pressure to work with data [4, 25, 46, 62]. Data can be a valuable resource, used by nonprofits to garner support from stakeholders, increase funding, improve services, and guide decision making [4, 6]. Nonprofits also often face specific data collection requirements for the sake of management, accountability, and performance measurement including recording financial practices, volunteer efforts, and individual or community impact [47]. Proponents argue that data-driven-decision-making "better position[s] the social sector for impact and innovation" and these kinds of data practices are commonly incentivized by provision of resources from funders and other stakeholders [46]. As a result of the perceived value of data and the pressure to engage with data work, many nonprofits collect more data than they need [62].

Unfortunately, a number of constraints that challenge the ability of nonprofits to effectively employ data practices. Internally, NPOs often lack technical support and resources. Many nonprofit organizations have few or no staff with formal research training, lack access to affordable technical assistance, and face limitations in staff time, funding, technical expertise, and access to technical tools designed to support their work [8, 47, 49, 64, 73]. The lack of resources available in nonprofits leads many to adopt out-of-the-box technical tools that can be a poor fit for the organization [74], or develop "homebrew databases," technical infrastructures that are cobbled together to fit the organization's information needs [72]. Despite the creativity and labor of nonprofit staff, data in NPOs is characterized by fragmentation and data drift, creating a "cycle of disempowerment" for nonprofits [8].

Ultimately, the existence and accessibility of quality data related to the NPO's mission falls largely outside of the control of the organization [5]. The amount of information collected and released depends on how "enabling the domestic political, economic, and legal context for nonprofits" is within a state [5]; however, "open data around the activities of NPOs does not communicate well" facets of their activities such as finances and administrative costs [45]. In other words, there is no guarantee that nonprofits have access to quality, let alone, relevant, data related to their mission. Increasing the availability and accessibility of relevant civic data has become a central goal of the open data movement.

2.2 Open Data

Open data is touted as a way to increase trust in the government by promoting transparency [39] and allowing individuals and organizations, whether private sector or nonprofit, to utilize data [69]. However, open data may not be utilized to its full potential.

The majority of open data portals are published following the "data over the wall" model, where the provider supplies large amounts of data of inconsistent quality to a portal for end users to access for their own purposes [61]. This mode of data access aligns with one of the core challenges identified with open data: prioritizing quantity over quality leads to inconsistencies in formatting and metadata, making it difficult to synthesize data for application [3, 54, 69]. The lack of usability of these datasets decreases the trust users place in the government by increasing the complexity of available data, uncertainty in the accuracy of the data, and distrust in the inherent nature of open data, since the government is controlling what data

is being released for public use and could be prone to manipulation [10]. Further, these platforms can be highly technical, making it difficult for non-experts to take advantage of shared data.

Much of the design work around making open data more effective aims to make open data portals more accessible and more usable [3, 32, 39, 55]. One approach to improving the accessibility and usability of civic data has been to implement interactive features in data portals. Some of these features are aimed at making data portals easier to use; for example Liu et al. created a tool that transforms open data portals into interactive databases that are more user-friendly by incorporating search, joining, and sorting operations [37]. Other features like automatic visualizations [3], improved search and querrying tools [32], the ability to send requests to the provider for addressing the shortcomings of certain datasets [3, 69], and comments or tagging features [30, 39] increase the level of interaction between the citizen and government. The additional interactive features begin to shift away from the "data over the wall" model, particularly if the data provider could be responsive to the voiced data needs of the user [61]. However, there is concern that the associated costs with adding these features could result in the cessation of open data sharing altogether [10, 61].

Even when platforms are designed for accessability, open data has been critiqued because it "automatically correlates the publicizing of data with use and benefits," ignoring the additional labor required to make published data useable and useful in real-world contexts [27]. Increasingly, researchers are looking for ways to make public data meaningful and actionable, not just available and accessible [38, 68]. Participatory approaches have been used widely to improve the effectiveness of open data. For example, open government data might be enhanced by adding data collected and aggregated by users themselves, drawing on local knowledge [58, 61]. Puussaar offers the following guidelines for the "effective use" [23] of open data for advocacy:

(1) Place can be used as a way to make open data relevant to communities.
(2) Communities need to be able to make sense of and challenge open data in relation to their own experiences and their own data.
(3) Local knowledge can be used to enrich and promote collaborative exploration and evidencing of issues for civic action. [58]

These insights provide a helpful starting point for designing tools for data advocacy, but they assume the use of open data that is divorced from place. Since our partners had created a dataset that was already locally embedded and enriched with local knowledge [11], we turned our attention to digital activism and data advocacy to understand how that data could be leveraged to promote social change.

2.3 Data Activism

Increasing technology use, the development of information communication technologies, and rising datafication has led to new forms of digital activism [21, 52, 76]. There are a huge variety of digital activism activities that have emerged in the repetoires of social movement organizations, ranging from digital petitions, to creating social media bots, to exposing information through leaks [21]. These activities perform a variety of functions including legitimizing, creating new systems, protecting, disrupting, denouncing, exposing, communicating and educating [21]. Looking specifically at data, Milan & Van der Velden unite efforts to resist data collection and the production of new forms of data under the spectrum of data activism. By producing new forms of data, activists create systems that embody alternative epistemologies [52], a powerful shift of power in an information society [76].

Prior research in HCI has found activists and advocates using data to legitimize their work [14, 56], tell alternative kinds of stories [36, 44], and mobilize collective action [13]. Darian et al. find that data plays multiple roles in nonprofit advocacy work, including legitimizing the mission, key issues, or proposals of the organization, mobilizing multiple audiences, amplifying marginalized voices, and exploring innovative ways of quantifying civic issues [14]. Turning to grassroots climate activsits, Flawn et al. find that while these groups are already using data meaningfully to support their goals, the lack of control over the forms of data available to them hinders their ability to obtain the localized data they need to reflect the communities they are situated within [17]. Garcia et al. find that activists build alliances with community partners and institutional partners to make civic action possible despite imperfect public data that is often fragmented, incomplete, or contradictory [1].

Affect and storytelling have emerged as key strategies for data advocacy. The Anti-Eviction Mapping Project uses counter-mapping, an engaged methodology using critical cartographic and feminist data visualization practices to fight for housing justice [44]. Liboiron et al. describe how activists choose measurements that prompt visceral responses, such as blood in maternal wards and fecal matter in water quality. By quantifying the visceral materials of public health issues, activists create charismatic data that inspire action [36].

Previous work in HCI has highlighted a wide range of strategies that are used by nonprofits, activists, and other community based organizations to leverage data for social action. In the context of bird-building collisions, our partners are already deeply engaged in proactive data activism, using citizen science methodologies to produce data about local collisions. However, the social and political aims of the initiative have not yet been accomplished. Looking beyond the monitoring and recording work that is already being done by Safe Flight, we engaged in design research to explore other opportunities to leverage data for digital activism.

3 Methods

We used a Research through Design (RtD) approach that drew heavily on empirical work to explore the gap between data collection and data advocacy. Prototyping and building out these tools provides insight into the specific technological features that support data advocacy, allowing us to make scholarly contributions towards designing for data advocacy [75]. Throughout our design and development process we balanced multiple goals: using design artifacts to think through the particulars of data advocacy in this context and building tools that would support the day-to-day work of our community partners.

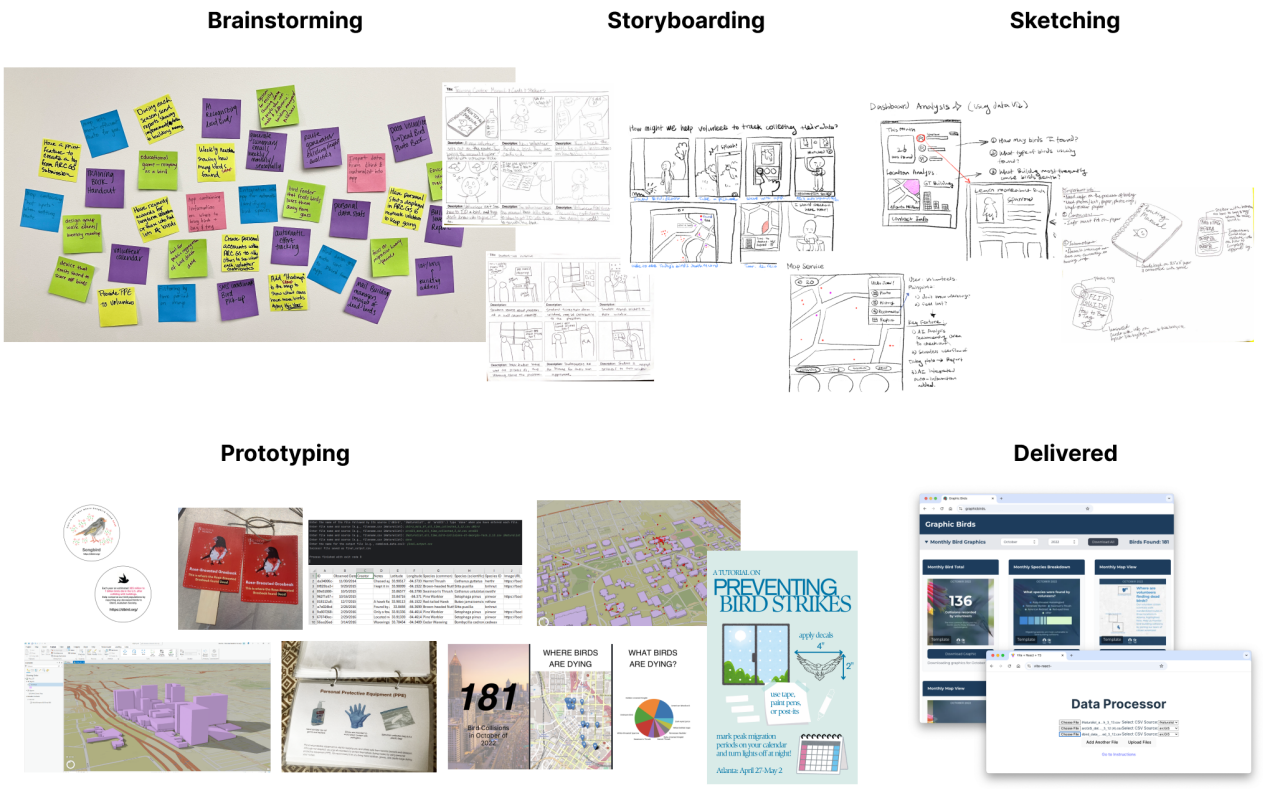

Figure 1: An overview of design activities iteratively used by our group.

Our research began with empirical work conducted with Safe Flight volunteers and stakeholders in bird-building collisions. Taking a qualitative approach, the first author conducted twenty semi-structured interviews with volunteers and stakeholders of bird-building collisions and participated in monitoring during Fall and Spring migration in 2023. This work resulted in a corpus of field notes, images, and interview transcripts which were analyzed with open coding by the first author, producing three overarching themes that focused on the digital data created by the project, the work the group did to coordinate collection of the bird specimens, and the monitoring experiences of volunteers. Here, we focus on the digital data produced by the project, informed by fifteen sub-themes generated by the open coding process. These codes shaped early questions asked in our RtD practice and provided a jumping off point for brainstorming potential tools for data advocacy.

The RtD team, led by the first author, consisted of six students with backgrounds in HCI and computer science. While the ethnographic observation and interviews with volunteers occurred around the city, the design work took place on our university campus. The question originally posed to the group was "how might we use data to affect change." In our first meeting, we reviewed the context and practices of Safe Flight, discussed the various forms of data produced by volunteers, and reflected on different ways of thinking about "change." These conversations and the empirical work completed prior to the start of the RtD engagement set the scene for our design work.

The early group conversations were organized by alternating between reading related work in HCI and interview transcripts produced by the first author. The group reviewed interview transcripts from Safe Flight volunteers and other stakeholders, including building managers, university collectors, and project managers and discussed related literature on citizen science, data advocacy, data feminism, and the posthuman. Bringing these topics into conversation with interview transcripts helped inform diverse perspectives on the design context. Individually and in groups, we brainstormed "challenges to reducing bird building collisions" and "challenges to producing or using data for local change" over multiple weeks, intertwining our brainstorming sessions with reviewing interview transcripts and discussion groups on relevant literature. Every student also participated in a citizen science project and wrote a short reflection on the experience of producing data and participating in citizen science data collection. Each student in the group chose three ideas to explore through sketching and storyboarding, then presented their work to the group. Through multiple rounds of feedback, students selected a project and iteratively prototyped an artifact to support data advocacy at Safe Flight. Final artifacts were presented to the Safe Flight Project Manager for feedback, providing insight into the organization's reaction to these designs. Based

on this feedback and the priorities of our partner organization, we continued with the development and deployment of two of these tools in fall 2024, providing further insight into local data advocacy practices. An overview of design activities can be seen in Fig. 1.

4 Designing for Data Advocacy

Safe Flight was one initiative of a large conservation nonprofit that advocated to protect and promote birds, prioritizing conservation, education, and community engagement. Preventing bird-building collisions was one aspect of conservation work pursued by this organization. The first author partnered with Safe Flight in an effort to better understand data activism in community-based organizations. Over a two year collaboration, we sought to detail the what and how of data activism in the messy world of local civics, critically reflect on the role of data activism in social action, and support the organization's action goals. Designing tools for data advocacy that responded to the rich context this organization operated in required a detailed understanding of data work at Project Safe Flight.

Data about bird-building collisions was produced by a committed group of volunteers who regularly traversed specific routes for observation. These routes were created by the Safe Flight project manager to represent a diverse sample of buildings in different areas of the city. Volunteers recorded their observations in a dedicated mobile application built on ArcGIS, where they created a record that indicated the latitude and longitude of the observation, the name of the species, the date the collision was observed, the status of the bird, and images of the collision trace. There was also a space for volunteers to leave comments as they saw fit. In addition to creating the digital record, volunteers collected the bird specimens left after a collision. The birds were delivered to the project manager's office, where they sorted through them, created ID numbers for each one, and matched it with incoming observations from volunteers.

Beyond observational data describing the bird-building collisions, volunteers also accounted for their time via an "effort log" Google sheet. This log tracked when observations were done and how much time was spent looking for collision traces. By tracking effort, the volunteers accounted for times when they might walk the route without finding any birds. Tracking volunteer effort allowed the group to perform analyses such as calculating the number of birds found per volunteer hour or mile walked, extrapolate observed collisions to broader areas that were not regularly monitored by volunteers and compare collision records to those observed by volunteers in other cities.

Members of the general public also contributed data about bird-building collisions through two external tools: dBird and iNaturalist. dBird.org is a web app designed specifically for tracking incidental observations of dead birds. iNaturalist, on the other hand, is a general app used to share images of nature, including plants and living animals. Though a general tool for creating records about the natural world, people regularly uploaded images of dead birds to iNaturalist, and some groups created "projects" within the app to organize collision observations. Both of these apps captured records of "incidental" observations – meaning that they were not observed on a standardized monitoring route.

At the end of each migration season, staff at Safe Flight updated The Collision List, a document that brought together collision records from the ArcGIS mobile app, records from dBird, along with bird specimens donated by volunteers and members of the general public. The Collision List included the date of the observed collision, route location, county, species code, species name, scientific name, family name, sex, age, notes about how the sex and age were determined, the building by which the bird was observed, the latitude/longitude coordinates of the observation, and whether the bird was found alive. If Safe Flight has a specimen for these birds, the row gets a specimen ID number.

Safe Flight collected records of bird-building collisions over the course of nine years, documenting over 4,000 individual collisions. Each year, staff at Safe Flight organized this sheet into two different reports that are submitted to state and federal regulators detailing the number of birds collected by species and, for state regulations, by county. These reports were not for the purpose of advocating for policy response to the collisions, but were required for compliance with the permits that allowed the group to collect bird specimens, under the Migratory Bird Treaty Act of 1918. In addition to reporting to regulatory agencies, the total number of birds found by volunteers was shared on Safe Flight's website.

Volunteers had access to the full set of monitoring data, but none of the interviewees reported reviewing past collision data – instead, they reviewed the effort log to get an idea of what other volunteers were doing. Often, the only ones who see the collision records produced by Safe Flight are the staff members that perform data entry and the state and national regulatory bodies. Nonetheless, volunteers and stakeholders were extremely optimistic about the value of the data and the ways collision records could become useful for advocacy. Volunteers and stakeholders discussed identifying windows to target for retrofitting, combining data with other local initiatives across North America, projecting the total scope of bird-building collisions across the city, or understanding which species and behaviors make birds more vulnerable to collisions.

However, those applications remained primarily speculative. Instead, the production of the collision data served a key outreach activity for the organizations, one that required developing long-term engagement, increased community member capacity, and created data that embodied a specific activist perspective [52]. Other central aspects of community engagement work in Safe Flight included hosting webinars, delivering invited talks, creating content for social media, and sharing updates with the broader membership. Safe Flight has also successfully installed bird safe glass at several local conservation and education centers. None of these activities drew on the actual records of bird-building collisions produced by volunteers.

Our empirical research highlights a gap between the work of data collection and the work of advocacy. While Safe Flight volunteers continued to produce highly detailed, contextualized records of collision, this data had an extremely limited reach. Through a semester long RtD exploration, we developed seven prototypes to share with our partners at Safe Flight.

Figure 2: Project prototypes, listed clockwise: Collision Calendar, 3-D Map, Training Manual, Window Workshop.

4.1 The Prototypes

Our early design work, rooted in the empirical findings from interviews and ethnographic observations, involved ideating, sketching, and storyboarding a wide variety of artifacts addressing different aspects of bird-building collisions. Early project ideas ranged from generating form letters to building managers about bird-building collisions, to training an image recognition algorithm on images of dead birds, to painting a mural to inform neighbors about bird-building collisions. Each member of the group was encouraged to select one idea to build into a full working prototype. The resulting artifacts included a training manual for volunteers, a workshop protocol for creating dorm window hangings, a 3-D rendering of collisions on campus, an automated data visualization generator, a program that collated data from multiple platforms, and a set of markers indicating where bird-building collisions had occurred. These prototypes, shown in Fig. 2, cross multiple forms and utilize different media.

Training Manual: Many volunteers reported feeling unsure about attempting their first routes. The training manual provided detailed instructions on how to execute a field search, record collisions in ArcGIS, and enter volunteer time in the Effort Log. The training manual was designed to be carried by Safe Flight volunteers in the field.

Window Workshop: The window workshop event was designed to educate students living on-campus about bird-building collisions and guide a creative activity to craft protective window decals. The ultimate goal was to raise awareness, start conversations around bird-building collisions, and encourage students to take simple actions to protect birds.

3-D Map: In order to visualize data in a more engaging way, this prototype used an interactive 3-D map plotting bird-building collisions on a local university campus. The 3-D elements of the map illustrated relationships between birds and buildings that are not apparent on a typical map. For example, the 3-D map highlighted how one courtyard acted as "a funnel" guiding birds towards a large glass structure, a phenomenon described by one interviewee.

Social Media Visualizer: To increase visibility of data collected by Safe Flight volunteers, this tool produced data visualizations summarizing monthly collision observations. Using a CSV file of collision records, a script created visual representations of the total number of bird collisions, a map of collision data, and a break down of the most common species found that month. The visualizations can be easily shared over social media.

Data Compiler: The data compiler addressed the fragmentation of data across platforms by combining collision records from multiple sources. Integrating CSV files downloaded in dbird, arcGIS, and iNaturalist, the script reconciled data formatting differences across platforms, creating a comprehensive list of local recorded observations.

Collision Markers: Despite their frequency, bird-building collisions often remained invisible. Volunteers would use the collision markers to indicate where they found collision victims on their routes, making the traces of bird-building collisions visible even after volunteers collected the bird body.

Collision Calendar: Rather than displaying data on a map, the collision calendar displayed collision records for a single building over the course of a year. With obscured images of dead birds radiating out from a center circle, the resulting images displayed a year of violence occurring at three buildings on a local university campus.

4.2 Responding to Prototypes

We shared the seven prototypes described in section 4.1 with our project partners at Safe Flight, eliciting reactions that provided insight into the strategies and challenges of data activism within the organization. From these conversations, we learned that tools for data advocacy would need to translate between ecological research and advocacy goals, carefully balance automation with engaged data work, and align with our partner's collaborative approaches to activism.

4.2.1 Moving from Research to Advocacy. Many of our prototypes had focused on data collected by Safe Flight volunteers, assuming that the organization would be most interested in visualizing and sharing their own data. However, in presenting our work to Safe Flight staff, we found that advocacy efforts would gain from using data from multiple sources. Data produced by Safe Flight volunteers was more rigorous than it needed to be for advocacy, which could minimize the perceived impact on bird populations to the general public. The use of standardized routes with a representative sample of building types and spreadsheets tracking volunteer efforts were key features of Safe Flight volunteer work that were shaped by recommendations from ecology researchers to support scientific studies of bird-building collisions [40]. Protecting the scientific validity of the Safe Flight data required separating it from other sources of collision records, which did not follow the same procedures. Maintaining boundaries between these streams of data is useful because it allows Safe Flight to apply a specific,

more rigorous methodology, producing a set of high quality data that is accountable to scientific norms like replicability. However, these expectations around data collection shift when translating between scientific and advocacy goals. Data considered useful for advocacy work was inclusive of more collision records, data collection platforms, and monitoring methodologies than data that met the stricter expectations for scientific validity or data that could be compared to monitoring efforts in other cities.

4.2.2 Data Work and Automation. Two of the prototypes we presented automated data work that has traditionally been done by staff at Safe Flight. Creating and discussing these tools within our research group, we had intentionally attended to the labor of data work [15], the tedious behind-the-scenes work of data activism that requires reviewing, cleaning, formatting, and analyzing large data sets. Looking to minimize barriers to data activism and aware of the resource and capacity limitations at our partner organization, we sought to remove barriers by making the data work behind advocacy easier. The social media visualizer and the data compiler both sought to reduce barriers to advocacy by automating aspects of data work in the organization. Discussing these tools with our community partners highlighted important aspects of work that could and could not be automated. For example, Safe Flight staff were responsible for reviewing ArcGIS submissions that list the bird species as "unknown" to correctly identify the bird species for the record. Additionally, staff manually check the Collision List for duplicates, referencing both species, time, and location as well as comparing images of the birds to determine whether similar posts are duplicates. Both tasks built on deep expertise about birds, local knowledge about the city, and familiarity with volunteers submitting data. These tasks were not well suited for automation and were an important touchpoint for staff to engage with incoming data. Moving forward with design work, we aimed to support these manual tasks by directing attention, rather than replacing the organizational expertise by fully automating data workflows.

4.2.3 Confrontation vs Collaboration. Our group had assumed that data advocacy would require confrontation and built tools to help facilitate denouncing and exposing high-collision buildings. However, Safe Flight imagined using these artifacts collaboratively, rather than confrontationally. Project leadership was extremely sensitive about confronting individuals with the data they had collected, and the project manager worried about jeopardizing relationships with building managers along the established routes if they publicly criticized specific buildings. We were asked to obscure the location of bird strikes so that specific building addresses would not be publicly visible. Similarly, the project manager pointed out that building maintenance crews would immediately throw out collision markers. Instead of placing Collision Markers in places where volunteers found dead birds, Safe Flight saw the markers as an opportunity to celebrate buildings they had worked with to install bird-safe glass. They wanted to flip the language on the Collision Markers to be more positive: "this bird is alive because of bird-safe glass." This shift illuminated two fundamentally different approaches to advocacy: one that uses confrontation and social pressure as a tool for change, another that prioritizes partnerships and collaboration. The imagined reaction to confrontation were not collaborative efforts to reduce bird-building collisions, but efforts that would make it harder for Safe Flight volunteers to collect data about bird-building collisions, ultimately undermining the monitoring efforts. Safe Flight's instinct to look for alignment of priorities as the basis for a collaboration spoke to the organization's impulse to prioritize building and maintaining partnerships rather than targeting the buildings with higher impacts on birds.

4.3 Tools for Data Advocacy

Building on prior empirical work, our initial design explorations, and the feedback we received from our partners, we selected the Data Compiler and Social Media Visualizer to develop and deploy as fully-functioning tools. We chose these prototypes based on our partner's priorities and advocacy strategies, which aligned with the digital-activist mechanisms of *construction* and *amplification*. We also discuss the collision markers as an example of the *visibilization* mechanism described by George and Leidner, though the confrontational aspects of this artifact ultimately did not align with the approach to advocacy work taken by our partners [21].

4.3.1 Constructing Activist Datasets by Joining Fragmented Data. In order to construct a dataset that bridged research and advocacy activities at Safe Flight, we implemented a Data Compiler that merged data from multiple available sources: ArcGIS, dBird.org, and iNaturalist. The comprehensive dataset, including recorded observations across these platforms, did not meet the scientific standards set forth by the Safe Flight observation protocol, but instead provided a source that accounted for a broader spectrum of local bird collisions. By joining fragmented data, this tool created a dataset inclusive of data that "might fall outside of the usual practices of legitimation and validation that characterizes scientific data" but nonetheless may be "just good enough" to serve activist purposes [19]. *Constructing* a combined dataset that harmonized data across multiple platforms created new data that was specifically oriented towards activism.

Critically, this tool maintained separate underlying data collection platforms, which allow for more agency and variety between individual communities, approaches, and methodologies. In our empirical work, we found that on-campus birding groups monitoring collisions hesitated to utilize the ArcGIS platform for recording observations. Instead, they used iNaturalist, where they were able to create a project geographically bounded at the campus area and develop their own norms for observing and recording collisions. Separating university data in the iNaturalist platform allowed the group more agency in what data was produced and how, and created a birding dataset that was specific to the university area. The underlying data heterogeneity between platforms afforded localized activist communities more agency in developing a dataset that was meaningful within their context. Solving the problem of fragmented data by centralizing collision observations to a single platform would ultimately undermine these data activist efforts deeply rooted in specific contexts and local knowledge. As such, we built a tool that works post-hoc to leverage heterogeneous, local data to create a more comprehensive dataset.

While we sought to streamline and minimize burdens of data work at Safe Flight, which acted as a barrier to data advocacy, we learned that some aspects of data work, though tedious, were important and valuable data practices. As we discussed in 4.2.2, data

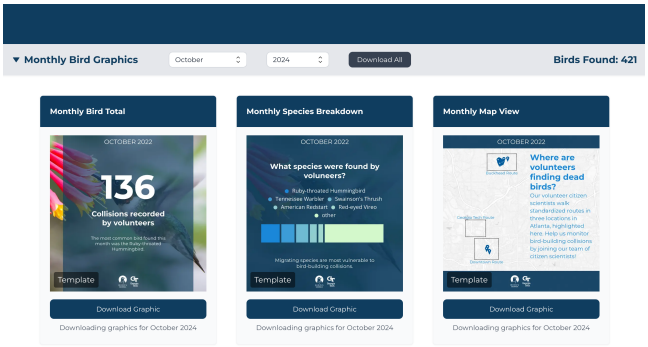

Figure 3: The Social Media Visualizer Interface allows user to select a month or seasonal time period and download data visualizations summarizing collisions recorded during that time.

work at Safe Flight involved expertise and local knowledge that could not be fully automated. One critical aspect of the manual review by Safe Flight staff was identifying duplicates. Duplicates could occur in the same platforms or across multiple platforms, and were more likely to occur in dBird and iNaturalist because the Safe Flight volunteers recording collisions in ArcGIS typically collected found bird specimens after recording the observation. To computationally identify duplicates, we compared the date, location, and species of bird collision records. However, overlaps in these columns did not always mean that the records were actually a duplicate. For example, one volunteer in our empirical work described a time when they found six Cedar Waxwings under the same window. Instead of eliminating duplicates, the data compiler flags these cases for manual review by Safe Flight staff. The final deployed system honors the role of Safe Flight staff in curating a local, contextualized dataset. This maintains the important element of local and birding expertise held by Safe Flight staff and makes space for a deep engagement with data, rather than automating the full work of joining fragmented data.

4.3.2 Amplifying Collisions by Making Data into Content. The Data Combiner operated largely behind the scenes, and as we discussed in section 4, collision records were rarely seen beyond the Safe Flight Team, volunteers, and regulators. Despite the significant investment in monitoring bird-building collisions, the constructed dataset had an extremely limited reach. More broadly, the threat that man-made structures pose to bird populations is unfamiliar to most of the general public. The social media visualizer *amplified* the data collected by volunteers and the threat of bird-building collisions to wider audiences.

Information communication technologies are well-suited to the task of amplification, which includes digital activist activities such as communicating, repeating, and educating [21]. Nearly two thirds of social media users have engaged with political content on social media at some point [59]. Whereas previously the work of analyzing data, producing visualizations, and creating content about them had posed barriers to sharing collision data more broadly, the social media visualizer automatically created content that could be shared on various media channels utilized by Safe Flight.

The social media visualizer used a CSV file containing records of bird-building collisions and a requested month or season time frame. The tool summarized the number of birds, the frequency of each species, and the locations of birds recorded during that time frame. The script then created a set of images optimized for social media sharing that feature these data visualizations. Users select which images they want to download on a GUI, seen in Fig. 3.

Designing the social media visualizer required careful attention to the kinds of data and visualization that would be compelling to the organization's audience. Our partners pointed out that they would not post a month-long summary of observations in July, because birds collisions are less frequent outside of Spring and Fall migration and volunteers don't monitor routes in July. Uninformed observers might see low numbers in summer months and assume that bird-building collisions are not a significant problem. Instead, they wanted to share summaries in high-contact months in the Fall and Spring. The concern around frequency of posting and the proper amount of time to be covered in each post highlighted how data has the potential to communicate a message that does not align with the overarching goals of the group.

While the prototype featured a detailed map of where collisions occurred on specific routes, the instinct of the project manager to avoid confrontation by denouncing specific buildings led us to obscure the location of the collisions in the final designs for social media. Similarly, Safe Flight requested that we not feature images of dead birds prominently in the social media visualizations, worrying the graphic nature of these images would alienate some viewers. Instead, we featured images of live birds that had been contributed by organization members, celebrating the photography of group members and leaning into the charisma and beauty of live birds.

The utilization of social media allowed the tool to take advantage of social media affordances including likes, sharing, and commenting. These features provided an easy way for a wide audience to interact with Safe Flight data, all be it in a limited manner. Interacting with political content on social media has been criticized as "clicktivism," indicating an extremely low level of engagement with digital activism and representing a noncommittal and impersonal endorsement [53, 60]. However, others have argued that low-threshold activities mediated by technology are an important tool among many activist activities [43], or found that digital activism has a net positive effect on off-line mobilization [9, 35, 50, 71] and "spectator activities" that are enabled by social media nonetheless represent a class of strategies that represent the greatest volume of digital activist activities and reach the greatest numbers of people [21]. By leveraging social media affordances to interact with Safe Flight data, the social media visualizer aims to amplify the data and message of the Safe Flight team, leveraging social media to reach a wide audience and "increasing the volume of the collective voice of the cause" [21].

4.3.3 Visibilizing Collisions by Connecting Data to Place. Where the Data Compiler and Social Media Visualizer operated by aggregating data, the central goal of the Collision Markers was to disaggregate data, focusing attention on individual collisions. We did not deliver this as a final artifact to our community partners because it ultimately did not align with the advocacy strategies of our partners. However, we have included it here to reflect on

Figure 4: There are seven Collision Marker designs, representing the seven most common found victims of local Bird Building Collisions.

a third mechanism of digital activism: *visibilization*. George and Leidner describe *visibilization* as the mechanism through which activist organizations "bringing visibility to people, organizations, actions, and causes," which includes functions such as commending, denouncing, and exposing [21]. The collision markers operated by exposing the negative impact on bird populations and denouncing specific buildings for their impact on birds. Rather than quantifying bird deaths, the collision markers were designed to record collisions in a way that creates an emotional connection with birds and places.

Because collision victims were often removed quickly, the impact of specific buildings on birds often remained invisible. Data on collision records could help speak to the prevalence of bird-building collisions, but quantification and aggregation divorce data from the emotional impact experienced by volunteers as they find and salvage birds in the field. The card included an illustration of the bird species that died and details of the incident. The Collision Markers can be seen in Figure 4. On the other side of the card was a QR code that links to the Safe Flight webpage containing information about the problem of bird collisions and what could be done to help.

The collision markers were designed to disaggregate data, spark an emotional connection with the collision records, and embed the data in the local context. The illustrations and bright colors are contrasted dramatically with the stark language accompanying the visual: "this is where the Rose-Breasted Grosbeak was found Dead." Representing each collision with its own marker disaggregated the data into individual collisions, a feature which helped activate the affective and narrative [13, 15], creating an emotional connection with the cause. This allowed the viewer to connect with a story about one particular bird by identifying aspects of the incident, including the location and species. By constructing a story surrounding each incident and concisely communicating that with viewers, the artifact aimed to humanize the data and evoke an emotional reaction, rather than an analytic one, to inspire action against the problem of bird collisions.

Placing the marker at the site of a bird collision physically connected the data to a specific place. Whereas the Social Media Visualizer targeted a generalized audience, the Collision Markers make collisions visible to a specific audience that regularly occupied the spaces where collisions occur. Though the two tools did similar work of informing and raising awareness, the physical markers are bounded in geographic space and time. Many other scholars have called attention to the importance of place in in situating data for social action [42, 58, 66]. Placing a physical representation of data in the local context it describes powerfully communicates relations in the built environment [63]. The Collision Markers tied data to place by placing a physical indicator where the represented event occurred, *visibilizing* collisions to people who frequent the area and thus have interest and influence over the space.

5 Discussion

5.1 Key Gaps in Data Activism

There are multiple technical challenges that have constrained data advocacy: inaccessible data portals and data analysis tools presented barriers to doing data work that added to the capacity demands associated with data activism [58, 77]. There are also constraints that come with working with resource-constrained organizations like nonprofits, grassroots organizations, and community-based organizations: limits to staff capacity, resources, and technical expertise broadly pose challenges to data work [8, 49, 62, 72]. However, our research and design work also indicated other social and political challenges that impacted the organization's data advocacy efforts.

One central challenge we observed was the gap between the work of data production and the work of data advocacy. These are separate spheres of work that require specific skills, resources, expertise, and tools. Because each of these modes of work requires different social and technical infrastructure, there are barriers to shifting between them. In the case of Safe Flight, the work of data production demanded all available project time, meaning that there was little capacity left over to plan new modes of action that might push the project forward in other ways. Furthermore, while the skillsets and capacities of project members were well suited to the work of producing alternative datasets with citizen science, we observed the group lose momentum when it came to the community organizing and activist work that is most effective at implementing social change [24, 48].

The focus on maintaining and protecting data production resulted in a holding pattern for collision data: the data production initiative was maintained but broader social and political goals remained out of reach. Broadly, it is clear that data is helpful, and potentially even required, to gain and maintain support from funders [6, 16], an essential step for sustaining many CBOs. However, the goals of community-based organizations often go far beyond

sustaining the organization – CBOs strive for social change. Interviews and ethnographic work with Safe Flight indicate that data is primarily used to sustain ongoing projects, initiatives, and organizations, rather than push for structural change. The primary audience of colision data was, in practice, the funders and regulators that allowed Safe Flight to continue collecting data. The result is a kind of stasis: the organization gets the resources they need to continue data collection, but they don't achieve the legislative goals the data is intended to support. Community-based organizations are turning to data activism as an emerging form of civic engagement and public participation [52], but if that data isn't activated for social action, it may ultimately fall short of social and political goals.

The tendency to maintain the status quo is a core challenge to the idea that open data and participatory data initiatives can be a democratizing force. While many researchers have focused on broadening access to data or building locally relevant and participatory datasets, we challenge the assumption that having more or better data will promote social change. Other critical data scholars, have argued that open data has overlooked the potential for open data to worsen existing injustices [28], participatory data initiatives place undue epistemic burden on minoritized communities [57], and that data activism exposes communities to risks even as it affords visibility and legitimacy [13]. Adding to these critical perspectives on data as a force for social action, we question whether data work - which often comes at a great cost to community-based organizations [8, 62], is meeting its expected utility. Through our group's design work, we explore how we might support community-based organizations in taking advantage of data resources through digital activism, moving one step closer to activating data for local change.

5.2 Using Data for Digital Activism

Previous work in civic data has advocated for and provided guidelines for designing tools that make data available, accessible, and actionable [58, 68]. However, to meet goals of social change we have to go further by supporting community-based organizations to actually mobilize data towards social action. Here, we have shared relatively lightweight tools that represent "modest, partial, and incremental shifts" towards alternative futures [18]. In section 4.3, we explored how three tools supported our community partner's digital activism by *constructing*, *amplifying*, and *visibilizing* collision data [21] In doing so, we covered how specific features of these tools contributed to digital activism at Safe Flight. Reading across these three tools and reflecting on our design process as a whole, we now take a broader perspective to provide three overarching guidelines to leverage data in digital activism.

5.2.1 Embrace Provisionality. Our empirical work revealed a tendency for community-based organizations to collect data indefinitely before making it public. Other scholars have already pointed out the epistemic burden placed on minoritized groups in participatory design research projects [57]. We argue that the impulse to maintain data collection practices undermines the ability for community-based organizations to use the data they collect for digital activism. Thus, we encourage designers and community-based organizations to explore uses of data that don't require fully complete, polished, or comprehensive datasets.

One approach to designing for provisionality is disaggregating data so that it can be shared progressively as the project continues. The Social Media Visualizer provides monthly and seasonal checkpoints, amplifying the data as it comes in. Similarly, the Collision Markers visibilize individual bird-building collisions as they are found by volunteers. In each of these cases, the artifacts provide opportunities for regularly publishing, sharing, and visualizing smaller segments of data.

5.2.2 Welcome Heterogeneity. Creating or maintaining spaces that support heterogeneous data practices creates datasets that are responsive to local concerns, deeply rooted in local knowledge, and contributes to a richer data landscape overall. We align with other HCI scholars in stressing the importance of rooting data in place [42, 58, 66], adding that tools for data advocacy should maintain and leverage the heterogeneity that develops from localized data initiatives. Many civic data initiatives turn attention to government data, with calls to make this data available and accessible as a mechanism for increasing transparency in government [39]. An overreliance on open government data misses the rich collection of citizen science, environmental monitoring, and participatory sensing projects, many of which have been supported by HCI researchers and designers. Because these projects operate in localized communities, respond to the concerns of a specific community, and adopt methodologies that work in these specific spaces, they produce a mosaic of data that are informed by local knowledge and deeply rooted in place. While open government data can be made useful for civic advocacy by making it relevant to place, connecting to lived experiences, and enriching it with local knowledge [58], we suggest that CBO and crowdsourced datasets are ripe for supporting data activism because they are already relevant and responsive to communities. The key to that relevance and responsiveness is the underlying heterogeneity between individual datasets.

Heterogeneity can make data more challenging to work with, a critical issue that limits the use of data by non-technical users [66]. Because this heterogeneity can make data more challenging to work with, standardization between projects is a tempting solution for supporting larger-scale analysis. However, to standardize data production methods could undermine social action at the local level. Instead of migrating data between platforms or proposing a new platform, The Data Combiner aggregates data coming from multiple platforms post-hoc, leaving space for the continued use of multiple bounded platforms recording bird-building collisions. We need tools that create that harmony between similar data efforts without compromising the richness that comes form the underlying heterogeneity of small data [31]. The ability for local groups to shape procedures, methods, and values for data production is critical for producing data that is embedded in place [66].

5.2.3 Engaging Data Work. The many resource constraints that face community-based organizations lead us to design tools that would make their work easier. However, we found that some data work tasks are extremely important for developing a dataset that will be useful for digital activism and a group of people that will be able to leverage that data for social action. Over the course of our design work, we chose to focus on creating tools that would support the work of project leaders and staff at Safe Flight, rather than the volunteer work of monitoring bird-building collisions. We made

this choice because the experiences of volunteers in the field are deeply meaningful and the work of monitoring collisions creates a group of people who are emotionally invested in reducing collisions [7]. Similarly, we found that the work of reviewing submitted data and managing duplicates was an opportunity for Safe Flight staff to attune and familiarize themselves with incoming data and the status of collisions in the city.

Though designers often look to make more efficient, efficiency does not necessarily make data meaningful for digital activism. Designers looking to support digital activism should carefully consider which aspects of data work contribute to a deeply engaged and informed organization. Tools that encourage digital activism should not replace these data practices, but rather build off of them to either support that work or build meaningful connections within it.

5.3 Advocacy, Mobilizing, Organizing

Digital activism is an inclusive term, referring to digitally-mediated social action ranging from social media engagement to gladiatorial hacking [21]. However, many community organizing scholars agree that there are hierarchies in forms of engagement, and that some forms of action may more meaningfully contribute to social change than others. Many forms of social media activism have been criticized as "clicktivism" or "slacktivism," a combination of the words "slacker" and "activism."

McAlevey argues that many contemporary progressive social movements fail to achieve social change because they rely too heavily on *advocacy* and *mobilizing*, rather than *organizing* that fundamentally transforms power structures [48]. Similarly, Han finds that an overreliance on building a large membership base, quick engagement from lots of people, and a centralized activist responsibility, rather than "transforming the capacity of their members" makes social movement organizations less effective than their counterparts that engaged in both mobilizing and organizing [24].

While data is well-suited to support the work of mobilization and advocacy, the work of social change will ultimately require organizing work that more fundamentally transforms power relations. Our research indicates that CBOs, nonprofits, and activists risk falling into a data production trap: the belief that we can act only after obtaining sufficient data. That is why we designed tools that can be used now as Safe Flight continues to engage volunteers as citizen scientists in data collection each season. These tools help our community partners take advantage of a currently untapped resource. However, reflecting on the artifacts presented here, we recognize that these tools fall primarily under the umbrella of advocacy and mobilization and reinforce a reliance on data to do the work of social change.

Ultimately, reliance on data for social action creates a holding pattern that upholds existing institutions, norms, and power structures. The distinction is not between online and offline activism, as both can be used to support the kind of organizing [24]. Rather, we question whether these tools can be meaningful agents of social change when they do not fundamentally challenge existing social structures. While these tools can help us leverage data for advocacy, they need to be matched by the work of organizing, negotiating, and relationship-building to result in real, material change. We challenge researchers and designers to consider how data might be leveraged to support deeper organizing that transforms capacities, builds relationships, and shifts power [24, 48]

6 Conclusion

Between open data, participatory data projects, and community-based organizations, we have access to a flood of civic information that presumably offers rich resources for social movements. To better understand how data can contribute to local social change, we partnered with a local community-based organization that aims to prevent bird-building collisions in one U.S. city. The first author conducted a series of interviews with stakeholders and participated in monitoring bird-building collisions over Spring and Fall migration seasons. Our work with Safe Flight indicates a gap between the work of data production and the work of data advocacy that made it difficult for Safe Flight to utilize data produced by volunteers to support the organizations social and political goals. Building on interviews and ethnographic observations, we used Research through Design to explore ways we might support Safe Flight in leveraging data for digital activism. Reporting on an iterative design process, we describe how three artifacts promoted data advocacy by *constructing* activist datasets, *amplifying* data on social media, and *visibilizing* buildings that caused disproportionate harm [21]. Reflecting across these artifacts, we suggest that researchers, designers, and community-based organizations looking to leverage data for digital activism should *explore uses of provisional data*, *maintain and take advantage of the heterogeneity of data sources*, and *support data work that cultivates deep engagement*. We often assume that having data will lead to social change and forget that additional work is needed to leverage data for social action. Given the wide availability of public data, the urgent questions in civic data are no longer about producing or accessing data, but how to marshal data to achieve social and political change rather than maintaining the status quo.

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