Participatory Art for Public Exploration of Algorithmic Decision-Making

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ABSTRACT

Machine learning and predictive algorithms find patterns in large stores of data and make predictions which corporations and governments use to support decision-making. Yet, the system's representation of reality can be more influential to outcomes than the complexities of daily life. They become problematic when they undermine the inclusivity of public decision making, and when their use perpetuates social or economic inequality.

To address these challenges, the public must be able to participate in discourse about the implications of algorithmic systems. I propose a series of participatory installations exploring the impacts of algorithmic systems, providing contexts for active exploration of these concerns. I will conduct phenomenographic interviews to better understand how visitors experience art installations about technical topics, providing insight for subsequent installations. I will consolidate the results into a set of best practices about engaging the public on these topics.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); HCI Design and Evaluation Methods.

KEYWORDS

Fine Arts, Physical Artifact, Education, Social Impact of Technology, Education, Participatory Art Installation

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1 INTRODUCTION

Today, machine learning and predictive algorithms can find patterns in increasingly available large stores of data and make predictions based on those patterns. Corporations and governments then use them to support decision-making: from to identifying individuals with Alzheimer's disease [14] or individuals who might be terrorists [13]. Such decision-making systems have widespread impact ranging from how people consume news [6] to who receives job interviews [3] (see Figure 1). The system's model of reality can determine outcomes more than the complexities of daily life.

This situation becomes problematic when systems undermine the responsiveness and inclusivity of public decision making, and when the results of the decisions introduce or perpetuate inequality in society. Such cases arise when systems are not **visible** (people do not know about the system), operate in an unbalanced **power** dynamic (people are under the control of those who make decisions using a system) and when the system lacks **accountability** mechanisms (to reflect the reality and concerns of the people impacted).

For example, the PredPol system is used by municipalities in the US to predict areas likely to see crime. Police focus their efforts on these predicted areas [8]. PredPol analyses past crime data patterns to form its predictions. If the system identifies patterns which caused by biased choices about where to police, those biases are compounded by more policing [2].

PredPol is proprietary software, so the way it utilizes data and generates predictions is **invisible** to the municipal governments and police forces that use it, as well as the public [17]. The government uses the algorithm to inform how it enforces law, exacerbating the **power imbalance** between itself and marginalized people. Predictive systems need data about their success to improve. With predictive policing, acting upon the prediction makes it true – increased police presence leads to higher arrest rates, short-circuiting the feedback mechanism [2] and removing technical **accountability** mechanisms. These factors make it harder for the people being policed to advocate for social accountability of these systems.

Because the implementation of algorithmic systems on a large scale is new, societies are setting precedents about how to use and make these systems. Now is the time to decide how best to maximize the benefits of data and information processing, balancing them with the inherent trade-offs of any resource allocation decision. As algorithmic systems run at global scales, they impact everyone. Everyone should have the opportunity to participate in public discourse about these issues. These systems create models that are "nowhere" but have impact "everywhere". The invisibility of the systems, combined with the inherent power differential in their use, makes it difficult for laypeople to contribute to discussions about them.

Participatory art provides compelling strategies to facilitate this conversation. Art that involves visitors speaks to relationships between people and institutions. I will create three participatory installations on this theme, and conduct semi-structured interviews with visitors to better understand how they experience each one [11]. Insights from analyzing the data will inform the subsequent installations, and a fourth installation synthesizing the work of the dissertation. These insights will also inform a set of best practices

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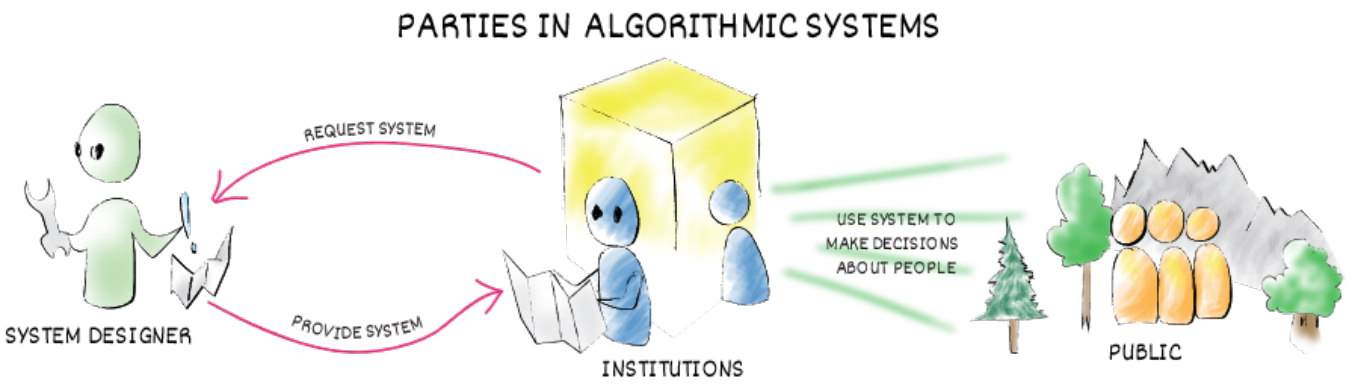

Figure 1: Parties involved in algorithmic system design, use and impact. For a full figure description see *A.1.1* Figure 1.

for engaging the public on algorithmic systems aimed at artists, algorithm designers, and institutions.

2 RELATED WORK: PARTICIPATION, PUBLIC, ART

Incorporating public consultation in the creation of algorithmic decision-making systems could address the **visibility**, **power imbalance**, and **accountability** problems simultaneously, and can be applied to developing specific solutions such as improved algorithms or public policy.

Participatory design aims to include the impacted people in responding to a given problem or situation [19]. Alvarado and Wearn use participatory workshops to develop ideas for rendering explicit the implicit connections between algorithms and user experience [1]. Participatory design uses small, focused workshops to gain input from a representative set of stakeholders [9]. The approach aims to improve specific systems.

Artistic approaches can be used to get broad public participation in HCI research. Sturdee et. al. developed a public installation format adapted to the needs of HCI research that could accommodate large numbers of participants in an exploration of shape-changing interfaces [21]. Skirpan, Cameron and Yeh developed an immersive theatre piece to prompt public consideration of personal data ownership that allowed visitors to participate in game-like parts of the performance [20]. The piece uses narrative to connect visitors' experiences to the technological context the creators explore. It provided a framework for visitors to think about data ownership with the goal of applying insights to design problems.

Pratim Sengupta, Marie-Claire Shanahan and their collaborators developed "public computing" open-ended environments where visitors can directly modify the Processing Flocking code [18]. They are installed in in public venues including TELUS Spark in Calgary [15]. Sengupta and Shanahan conceptualize their work as "boundary objects" between visitors' day to day experience of computing and computer science [5], facilitating "boundary play" and challenging their relationship to computing. This approach uses play and creation to facilitate embodied exploration. I take the framing of boundary play to situate the of experiences I create, facilitating negotiation of social roles in terms of visitors' willingness to participate in public discourse about algorithmic systems.

3 PARTICIPATORY INSTALLATIONS

I adopt the strategies of play, creation and narrative to create participatory art installations which explore three visibility issues with algorithmic systems. Each installation prompts visitors toward active exploration of the way that algorithmic systems enact social values.

Algorithmic Rituals uses creation to explore how people mold behavior within predictive systems by using a rule flow chart to shape participants movements in a collaborative Zoom workshop.

The Neural Net uses narrative to explore the way machine learning shapes predictive systems. By creating a neural network story together, visitors consider the way technical decisions impact outcomes.

Unraveled uses play to explore the way networks of algorithmic systems impact outcomes in individual lives. Following the path of a character's life through automated decisions, visitors take on the role of an algorithmic system.

4 PHENOMENOGRAPHIC RESEARCH

I chose a phenomenographic approach for the qualitative parts of this project, aimed at understanding different "ways of experiencing" a given context (see Figure 2).

I will conduct 12 interviews per installation, to capture a range of "ways of experiencing". Following the phenomenographic approach to analyzing interview data [10, 12] I will first identify patterns in the ways visitors experienced the installation using thematic analysis and affinity diagramming [13, 16]. Then, I will use comparative analysis to identify similarity between the themes and their meaning and structure [16]. Finally, I will identify the "ways of experiencing" that appear in the data.

Drawing from Sengupta and Shanahan's work on public computing, I will apply the lenses of boundary play [18], figured worlds [4] and cueing forms [7]. They will allow me to identify how visitors understand their relationship to algorithmic systems (boundary play and figured worlds), as well as what elements of the installation spur them to approach the installation in certain ways (cueing forms).

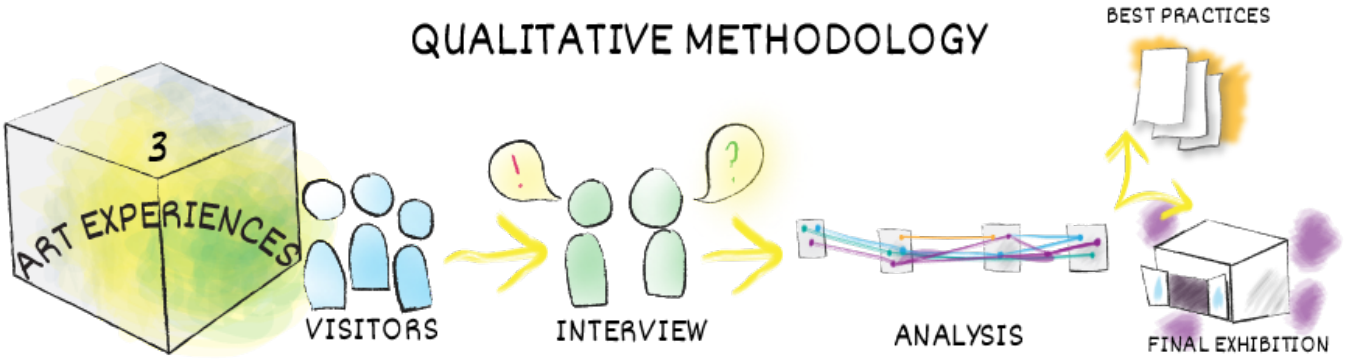

Figure 2: Research process, which will be undertaken for three installations. For a full figure description see *A.1.2* Figure 2.

5 CONTRIBUTIONS

I will use insights from the data analysis to inform subsequent installations. I work laterally from the data I collect to intensify elements that facilitated consideration of algorithmic systems and minimize confusing ones. Then, I will create a final installation that incorporates the knowledge gained from the first three installations, combining the most successful strategies into a single experience.

Completing the installations contributes to addressing problems of the invisibility of algorithmic systems. To bring my work to bear in the realms of power imbalance and accountability, I must make the insights gained from my data analysis useful for institutions and researchers seeking to engage the public.

Because there are no established guidelines for creating public engagement experiences about this issue, I will use the results of my creative process and qualitative research to provide methodological support for including the public in these conversations. After completing the analysis of the interview data and the final installation, I will consolidate a set of guidelines for developing installations that help visitors construct their understanding of algorithmic systems. The guidelines can then be used by technology designers, artists, and other civil society organizations to include the public in how to grapple with implementing algorithmic systems on a national or global scale.

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APPENDICES

A.1 DETAILED FIGURE DESCRIPTIONS

A.1.1 Figure 1

A diagram with the heading "Parties in Algorithmic Systems.". On the left is a person holding with tools labelled "System Designer." In the centre are two figures in front of a cubic building labelled "Institutions". Between the system designer and institution are two arrows, which indicate that institutions request systems and designers provide systems. To the right of the institutions, several orange figures in front of a mountain and trees represent the public.

Between the institution and public are lines labelled "use systems to make decisions about people" indicating the relationship between institutions and the members of the public.

A.1.2 Figure 2

A process diagram with the heading "Qualitative Methodology". On the left is a cube labelled "3 (three) Art experiences" beside three figures marked "Visitors". An arrow points to the right to two figures with speech bubbles marked "Interview". Another arrow points to the right, to an icon of several pieces of paper with circles and coloured lines connecting interesting points on the papers, labelled "Analysis". A branching arrow points upward and to the right. The upper branch points to a drawing of three (3) pieces of paper with labelled "Best Practices". The lower branch points to a drawing of a square building with its doors open labelled "Final Exhibition."