Whither Humane-Computer Interaction? Adult and Child Value Conflicts in the Biometric Fingerprinting for Food

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ABSTRACT
This paper reports on the value conflicts that beneficiaries experience when engaging in the monthly ritual of the biometric authentication of their fingerprints to claim state-sponsored food entitlements in India. Drawing on value-based orientations to HCI inquiry, the study locates the interactions around the biometric process to illustrate the ways in which beneficiaries find their values of time, dignity, and privacy, consistently disregarded by the interactive demands of the biometric system. Additionally, to cope with these value conflicts, some beneficiaries pass on the responsibilities of completing the biometric process to the children in their families. While adult beneficiaries are vocal and articulate about the value tensions in their lives, children cope with the anxieties of interacting with the biometric process, silently; even as they experience conflicts in their education, play, and study time.

Author Keywords
Food security; biometrics; values; social justice; Aadhaar

CSS Concepts
• **Human-centered computing~Human computer interaction (HCI)**; User studies;

INTRODUCTION
The turn towards biometric forms of identification to organize and execute administrative functions by governments, the private sector, and aid agencies draws attention to newer contexts of morals and values that guide human machine interactions in the submission and authentication of biometric data. HCI scholarship has a growing body of work that makes visible the politics contributing to the ethics of technology design. Researchers have advocated for value sensitivity through frameworks such as the Value Sensitive Design (VSD) methodology to recognize and strengthen design based on values that support human welfare [5, 12, 13, 20, 21, 22, 23, 24, 44, 50]. Yet another call to advance ethics and values in design has been through the critical design methodology [3]. Most recently, Dombrowski et al called for a social justice orientation to sensitize design towards inequality and marginalization [14]. Collectively, they inspire and motivate this paper's inquiry into the value conflicts that emerge in the biometric authentication process of the public distribution scheme (PDS), a cornerstone of India's food security program for the poor.

Specifically, the paper seeks to understand the value tensions that beneficiaries experience during their monthly interactions with a biometric fingerprint authentication system, amidst frequent infrastructural disruptions and biometric rejections. It illustrates the ways in which adult beneficiaries find the values that they attach to their time, dignity, and privacy, consistently disregarded by the workings of the system. It surfaces the unintended consequences that children have to bear as a direct result of the value conflicts that adults experience with the biometric process. The children find themselves becoming reluctant participants in the biometric authentication process even as they experience anxiety and forego school and play in their bid to secure food entitlements for their families.

The administration of the PDS through Aadhaar, India's citizen biometric database, is not a new subject for HCI analysis. Scrutinizing Aadhaar's claims of being more inclusive of the poor and the marginalized in the PDS, Singh and Jackson argue that the overlaying of the Aadhaar infrastructure on the PDS system leads to users being awkwardly situated between two overlapping infrastructures. Users thus have to constantly work and negotiate the seams that emerge between the boundaries of the two infrastructures to ensure their inclusion. They do this by enrolling their biometrics in the Aadhaar database, seeding their Aadhaar numbers into the PDS system, and performing monthly authentication to claim their entitlements [44].

While Singh and Jackson's analysis of the Aadhaar and the PDS adopts an urban centric, infrastructural lens, this paper's analytical focus is centered specifically on the monthly process of fingerprint authentication in the PDS situated within a rural setting. The authentication process in the PDS is a highly unstable procedure that is dependent on multiple interlinked infrastructures that are all prone to breakdowns. These include reliable mobile Internet signals, functional remote Aadhaar servers, working point of sale (POS) machines, and bodies seamlessly matching with their biometric data [2, 15, 16, 49]. Despite its inherent

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precariousness, the biometric authentication process remains an unyielding assertion of governance and administration in the PDS. For the beneficiaries it is akin to an enforced socio-technical ritual that they have to accomplish in the face of several odds, failing which, they would have no recourse to their monthly food entitlements.

Although the centrality of the biometrics in PDS has often been critiqued, there is little research on how beneficiaries view and respond to the disruptions and failures that is now an established, regular, and monthly routine in their lives. This study began with an open-ended, qualitative interrogation of the disruptions faced by beneficiaries in the PDS biometric process. As fieldwork and analysis progressed, the tensions and conflicts that beneficiaries reported were found to be grounded in the values that shaped the concerns of their daily lives. At the same time, I observed that children were actively participating in the biometric authentication process owing to the authentication challenges that adults faced. The study then expanded to recognize and include children as stakeholders in the PDS process who experience value tensions and conflicts in their own right when performing biometric authentication.

This paper is thus framed around two questions. First, it asks what value conflicts do adult beneficiaries experience when interacting with the PDS biometric authentication system? Second, it asks what value conflicts do children participating in the PDS biometric authentication process experience as a result of the adults' own value conflicts?

In this paper, I argue that as a "complex communicative act" that takes place between biometric scanners, people, and institutions [31:10], the authentication process is a site of interaction that hosts a variety of value conflicts and acts of coping from beneficiaries. It thus seeks to evaluate the PDS biometric system vis-a-vis the values of the beneficiaries who seek food security through their interactions with the system. The paper roots its interrogation and analysis in the local conditions that define the infrastructural and lived realities of this interactive event for PDS beneficiaries. It offers a situated view of their interactions and negotiations with the biometric authentication system and the value conflicts that emerge from these encounters.

RELATED WORK

Values Against Hunger

The eradication of hunger has been vigorously pursued by countries all over the world seeking to improve the economics of production, distribution, and access to food for their citizens. At the same time, the dilemma of hunger has always been viewed through an ethical, moral, and human rights lens. The Food and Agricultural Organization (FAO) that was established in 1945 to support global research in agriculture and nutrition-related issues, acknowledges that a host of concerns such as biases against the poor, sustainability of natural resources, trade barriers, foreign investment, cultural identities and diversities, food aid in crises, and individual rights, make it imperative that ethics and values play a central role in the organization's functioning. Specifically, on hunger, the FAO observes that the ethical systems of every society deem failure to provide food to those who are unable to feed themselves as an unjust and unethical act [17, 18].

Scholars of welfare economics and philosophy have also brought morals and ethical concerns to bear on their discussions of hunger. Noteworthy among them is the economist Amartya Sen who argues that the right to food and freedom from hunger is invested with the intrinsic weight of moral values. In the context of India, he notes that the recognition of the right to food as a valuable moral has served to reinforce public opinion and political will to prevent starvation. He further writes that the right to not be hungry is both an assertion of a moral claim about the value of food while also being attentive to the kind of institutional structures that can guarantee the fulfilment of the claim. In his writing on famines, Sen demonstrates that hunger is caused not by the lack of food, but by the reduced freedom of people in terms of both opportunities and processes to access food. Thus, Sen contends that the ways and means employed in the pursuit of freedom from hunger goals are also equally subject to moral assessment [42].

India's institutional structures supporting the right to freedom from hunger are based on the National Food Security Act (NFSA) that was passed in 2013. Among other things, it included the targeted public distribution system through which eligible households covering up to almost 2/3rd of the population (75% rural and 50% of urban) would receive subsidized food grains through fair price shops. The NFSA also stated that in its quest to reform the PDS, it would leverage the beneficiaries' biometric details through Aadhaar, the largest citizen biometric database of its kind in the world, to ensure proper targeting of aid benefits and full transparency of records [29]. Further, in October 2018, the Supreme Court of India ruled that Aadhaar would be mandatory to access government benefits such as the PDS [41]. The use of biometric technology is therefore an inalienable part of the institutional structure and process that guarantees right to freedom from hunger in India.

Value Discourses Around Biometric Systems

Biometric identification systems are no strangers to value debates on morals and ethics. The biometric discourse in STS, HCI, and feminist literature is dominated by value concerns ranging from privacy implications, surveillance, social sorting of bodies, racial discrimination, data security, reliability of biometric data, and social inclusion of the marginalized in welfare schemes [6, 7, 8, 11, 19, 25, 26, 27, 28, 31, 35, 36, 37, 38, 39, 40]. At the same time, the adoption of biometrics in humanitarian and welfare schemes that began in the early 2000s by international aid agencies such as the United National High Commissioner for Refugees (UNHCR) was also driven by strong claims to moral values such as greater inclusion, more accurate and efficient

targeting of aid, and the elimination of corruption and leakages in the supply chain [27, 28]. In recent times, international aid and donor agencies such as the UNHCR and the United Nation's World Food Programme (WFP) who serve refugee populations are increasingly turning to biometric tools to demonstrate the effectiveness of their work.

Most recently, the WFP partially suspended its food aid to the Houthi rebels-controlled territories of Yemen over a dispute on ownership and control of biometric data in June 2019 [9]. The use of biometrics for aid in the form of fingerprinting and iris scans has thus invited critical commentary on how 'humanitarian refugee biometrics' is increasingly facilitating normative acceptability of biometric forms of identification. It is also critiqued for testing newer forms of engagement with vulnerable refugee bodies and extending state power into more expansive domains of life [27, 28].

In India, Aadhaar has been a contentious project, provoking intense debates around the collection of biometric data and its deployment for various purposes. The state's argument for Aadhaar-enabled PDS, is that it enables targeted delivery of entitlements. It also curbs corruption and leakages in the PDS process by preventing the diversion of food grains into the open market by the dealers [29]. For instance, in the state of Jharkhand, almost 85% of the food grains in the PDS were found to have been leaked to the open market [16, 30].

Over time, the PDS has thus been subject to various technology interventions by several states in India including digitization of the PDS database, installation of GPS devices to track food grain trucks, and informing beneficiaries of PDS processes through SMS [2, 30]. With the introduction of Aadhaar, biometrics were made mandatory for food entitlement. Beneficiaries are required to enroll their biometrics in the Aadhaar database after which their Aadhaar numbers are linked to their ration cards in the PDS database. To claim their entitlements, beneficiaries are then required to perform biometric authentication every month with the PDS system.

Academics, journalists, and activists have documented multiple reasons that pose various challenges to the smooth functioning of the Aadhaar linked PDS process. These include incorrect seeding of Aadhaar numbers with ration cards in the PDS database, infrastructural challenges such as lack of Internet connectivity and malfunctioning of POS machines, all of which, disrupt the ration distribution process and contribute to beneficiary dissatisfaction. [2, 15, 40, 49]. However, these accounts have seldom examined the beneficiaries interactive experience with the biometric authentication process from a value perspective.

FIELD SITES AND SETTINGS

The fieldwork for this study was conducted in rural agricultural communities located in Ajmer district in Rajasthan. By January 2016, these areas had transitioned to the Aadhaar-based PDS system. The field work began a year later in March 2017 and lasted until June 2019 over three phases of data collection. The data collection lasted between four weeks to ten days and was mainly conducted during the winter and summer months.

The month of March was especially significant for fieldwork as it was also the harvest season of the *channa* or the chickpea crop that is mainly grown in this part of Rajasthan. Since the harvesting process involves pulling the thorny crops by the root with bare hands, it results in deep cuts on the hands of the workers who work without protective gear. Although official figures on failure rates of biometric authentication are not available from the Rajasthan government, dealers and beneficiaries attest that the damage to their fingers during harvest season has a direct impact on the biometric authentication process and they experience more authentication failures during March in comparison to other months.

The food commodity distributed through the PDS is wheat grains at Rs. 2/kilogram. (0.028 cents/kilogram). The commencement of the PDS process depends on the arrival of stock from the Food Corporation of India (FCI). Hence, there are no pre-determined days in the month when the disbursement takes place. Although the dealers can estimate tentative dates, the stock does not always arrive according to their calculations. Both early arrivals and delays are a matter of routine. Some beneficiaries receive SMS notification of the arrival of the stock at their dealer, but this is not a commonly cited source of information by the beneficiaries since not everyone has a mobile number or even a stable mobile number.

Once stocks arrive and disbursement begins, it usually continues for a week with beneficiaries visiting the shop to collect their entitlements. This distributed pattern of disbursement allowed for field observations at a variety of PDS dealerships in different villages since they did not all receive their stocks at the same time. On account of their large population, some villages were served by two or three PDS dealers. Conversely, some villages with low populations were also attached to a bigger village's PDS dealer.

While the PDS shops were the primary site of field work, regular visits to the District Supply Office in Ajmer city, the nodal PDS coordinating agency for Ajmer district was also undertaken for observations and interviews with visiting dealers and beneficiaries and government functionaries. Additionally, administrators in the state government with direct oversight of the biometric system for the PDS in Rajasthan, based in the state capital Jaipur, were also interviewed. Lastly, visits to literal fields where crops are grown were undertaken to observe the harvesting process and interview laborers engaged in harvest activities.

Self-Disclosure

Casual conversations and observations of the PDS authentication process were first recorded in June 2016

during fieldwork on a national broadband infrastructure project [32]. The familiarity with the region and connections forged on the field during that time helped facilitate initial introductions to PDS dealers for this study. Suggestions for dealers were also solicited from the government officials and I independently approached some dealers to minimize biases in snowballing. Along with the Marwari dialect, Hindi is widely spoken in the region and the fieldwork was conducted in Hindi in which I have native fluency.

As detailed in [32], I had navigated many challenges on the field on account of being a woman, which continued. However, I had also established social ties in the region that deepened during the lengthy engagement with the field for this study. Hence, I did not face any significant challenges in interacting with the PDS dealers and beneficiaries who were the primary participants in this study.

During interviews, beneficiaries often asked to be recorded on camera while waiting in the queue or while performing authentication so that the recordings be shown to government officials to demonstrate their struggles. My response would usually be to record their complaints and transactions on my phone and play it back to them. I would tell participants that while I was trying to understand their challenges with the authentication process and would make my findings public, I was also neither a journalist with media affiliation nor someone who could assure them redressal.

METHODS

Data Collection

The data for this study was collected through deep ethnographic observation and interviewing mainly at PDS shops and at beneficiary homes for extended periods of time over 28 months. The observation process involved recording detailed descriptions of: a) settings, b) the verbal and non-verbal actions and reactions of the beneficiaries during the authentication process, c) the number of authentication trials they performed, d) reactions and comments of the dealers, bystanders, and other beneficiaries witnessing the transaction.

Interviews with dealers and beneficiaries were conducted both formally and informally before, during, and after the authentication procedure. When permitted by beneficiaries, interviews were audio recorded. Since the authentication procedure usually resulted in long wait times, interviews also took the form of group discussions. Beneficiaries were also interviewed at their homes. Children were interviewed along with their parents at their homes or at the PDS shops. To understand the impact that authentication had on schooling of children participating in the PDS process, five government school teachers teaching in schools in Ajmer district were also interviewed.

The total number of PDS shops where observations and interviews were conducted totaled 14 across ten villages. The shop owners were snowballed during every field visit and all shopkeepers who were approached for access readily agreed to be a part of the study. From the 14 shops, four were dealerships run by the village cooperative societies while 10 were privately owned enterprises that were the primary source of livelihood for their owners. The number of adults who were part of the observations of the biometric authentication interactions and interviews were 136 of which 67 were men and 69 were women. The number of children observed to be performing authentication were 42 with 16 girls and 26 boys. The youngest child performing authentication was a six-year-old girl while the oldest was a 17-year-old girl.

Additionally, to determine the number of children (beneficiaries below 18 years of age) who are performing biometric authentication in the PDS in Rajasthan state, I also filed three Right to Information (RTI) applications and a first appeal on all the three unanswered RTI applications between June 2019 to December 2019 with the state government. Since at the time of this writing, all the RTI queries remain unanswered despite meeting with the officials responsible for the information, the extent of children performing PDS authentication transactions is difficult to estimate.

Data Analysis

All recorded interviews were transcribed into English by me. The transcripts were read in conjunction with detailed field notes that were maintained through the duration of the fieldwork. Following the process of open coding and constant comparative analysis [47], the notes and transcripts were read multiple times to identify the different stakeholders and the nature of their interactions with the POS machine. A preliminary coding of the data from the previous field visits was undertaken before subsequent visits. The themes from the first rounds of coding was discussed with the PDS dealers, beneficiaries, and government officials for their feedback. The second and third round of analysis incorporated comparisons that were discovered during the later field visits.

FINDINGS

The findings are organized in three sections. In the first section, I describe the nature of the two most frequent disruptions that created value conflicts for the beneficiaries during the authentication process i.e. Internet-related disruptions and biometric authentication failures. The second section analyzes the kind of value conflicts experienced by adult beneficiaries. Lastly, the third section presents the unintended value conflicts borne by children who assume responsibility for the authentication process for their families.

Disruptions in the Authentication Process

Outwardly, the biometric authentication procedure is a seemingly reasonable and straightforward process. Beneficiaries visit the PDS dealer with their ration cards. The dealer connects the point of sale (POS) terminal that is referred to by everyone in the PDS ecosystem as ‘machine’ to his mobile Internet data. He then enters the ration card number into the machine, which displays the list of members attached to the ration card. From this list, the dealer selects

the name of the beneficiary who will perform the authentication. The beneficiary then places a finger on the biometric sensor of the machine. The machine scans the fingerprint and sends it to the Aadhaar server for a match. If a match is found, the beneficiary collects the food grain entitlement for the family and leaves. If the machine's speaker is functional, the machine responds with pre-programed voice prompts, in a female voice, at every stage of the process. These prompts announce the expected action to be taken as well as the outcome. The voice prompts that are a part of the process include:

- *Krupaya apni ungli sensor pe lagayein*
  (Please place your finger on the sensor) – the beneficiary places a finger on the sensor.
- *Prakriya jaari hain, krupaya prateeksha kijiye* (The process is on, please wait) – the beneficiary continues to hold the finger in place while waiting for the authentication result.
- *Aapka Aadhaar sahi hain*
  (Your Aadhaar is correct) –this signals a successful biometric authentication.
- *Aapka Aadhaar sahi nahin hain*
  (Your Aadhaar is incorrect) – this signals a failed biometric authentication.

In practice however, the authentication procedure is riven with numerous delays, lengthy wait times, and repeat visits to the PDS dealer to complete authentication and collect the wheat entitlements. In this study, the two most frequently observed disruptions were a result of weak or absent mobile connectivity, and authentication failures experienced by beneficiaries. These disruptions, in turn, contributed to lengthy wait times for beneficiaries. If they couldn't wait for long, beneficiaries would opt to make repeat trips to complete the authentication process for their entitlements. I describe the nature of both disruptions below.

Weak Internet Infrastructure:

Internet related disruptions were common at nine of the 14 shops where this study was conducted. The five shops that received good Internet connectivity were usually in close proximity to the NH-8 Jaipur-Ajmer highway (5-10 kilometers) or were large villages with cellphone towers that provided seamless mobile Internet connectivity. The other nine villages were located approximately 15 – 45 kilometers from the highway, had no cellphone towers in the immediate vicinity and received very weak Internet connectivity.

To augment the Internet signals, the dealers received high gain antennae from the DSO office in Ajmer to attach to their POS machines. However, the antennae are of limited use and dealers often seek elevated places to conduct authentication or rope in children to climb up trees and terraces to hoist the antenna and maximize connectivity. These efforts at elevation helps only marginally and does not usually result in a strong Internet signal strength. Both dealers and beneficiaries point to weak Internet as the most common infrastructural disruption afflicting the disbursement process since it results in long queues and lengthy wait times. As long as the machine has sufficient connectivity to process the authentications, the queue moves along at a reasonable pace. During fieldwork, only one village witnessed an improvement in its connectivity issues by using a high gain antenna. The lack of mobile connectivity affects both beneficiaries and the dealers equally as it means an indefinite wait for the signal to return. In the event of weak signals, the authentication process takes place in slow instalments with the signal strength flickering even while the transaction is ongoing.

To combat connectivity challenges, it is not uncommon for dealers to constantly switch between the SIMs of every mobile service provider available after each transaction, hoping to maximize on whatever signal strength is available. Mostly however, connectivity from all service providers continues to be equally poor in the region and the SIM switching maneuver only adds to the long wait times. To better organize their operational work flow in sync with adequate signal strength, dealers often opt to conduct the PDS process in two separate steps. They begin the wheat distribution only once all the biometric authentications are completed, but this means that beneficiaries often cannot leave after their authentication procedure as they have to collect their entitlements. Also, owing to long distances, not all beneficiaries find it convenient to make multiple trips.

Additionally, when dealers have more than one village affiliated to their shop, they allot specific days to different villages for better crowd management. This again means that beneficiaries do not have the flexibility to visit the dealer according to their convenience and are required to complete both the authentication as well as collection of the wheat only during their allotted day. Lastly, if the dealer is able to hire help, then the biometric authentication and wheat distribution tasks can be carried out simultaneously. However, only cooperative societies are able to afford the hiring of additional help. Individual dealers work by themselves to coordinate the authentication and distribution tasks, leaving the beneficiaries with no option but to await their turn for both authentication and receipt of entitlement.

Biometric Authentication Failures:

From the 136 biometric authentication processes that were observed during the course of the study, 41% i.e. 56 beneficiaries succeeded in authenticating their fingerprints on the first attempt. 22% i.e. 30 beneficiaries could authenticate on second and third attempts while the remaining 36 % i.e. 50 beneficiaries experienced repeated authentication failures above 4 attempts. These numbers only reflect the failure of biometric authentication attempts and not interruptions due to Internet failures. Every failed authentication attempt adds to the wait time and its intersection with Internet disruptions makes the authentication process particularly vexing for all beneficiaries. For people confronted with repeated failures, the experience can be particularly embarrassing given that

the authentication process usually takes place in a very public and crowded setting. Beneficiaries continue making repeated attempts at authentication until the dealer asks them to return after cleaning their fingers or the waiting people in the queue begin protesting for their own turn. Depending on the number of people waiting and the availability of Internet signal, dealers often allow beneficiaries anywhere between four to ten trials with different fingers before asking them to wash their fingers and again await their turn. Common reasons for biometric failures were advancing age and engagement in various kinds of manual labor such as house work, harvesting of crops, construction work, and vehicle mechanic work that caused an erosion in fingerprint quality.

While beneficiaries who had experienced repeated failures in the past were mindful of scrubbing their fingers with salt and moisturizing them with oil to soften calluses before queuing up for authentication, their efforts were not always successful. For instance, beneficiaries complained that the long wait times dried up their fingers even if they had moisturized them when leaving home.

Beneficiaries experiencing authentication failures usually engage in repair and remedial work on their fingers at the PDS shop itself. If even after several tries with different fingers, their authentication fails, they resort to acts of grooming to clean their fingers. For this purpose, they squat on the ground and use the materiality of the natural and built environment such as the earth's soil or pieces of concrete to scrub and wash any residual dirt from their fingers. The coarseness of the soil helps to clean and define the ridges of their fingerprint, which is essential for a successful authentication. If there is no water source close to the PDS shop such as a water pump or a water trough for cattle, then dealers arrange for buckets and cans of water to enable people to wash their fingers.

P-23, a dealer said, "*We have to arrange for water during the biometric procedure so that people can wash their fingers. There is no water source near my shop so I store water in buckets here. We do ask everyone to scrub their hands with salt before coming, but that does not always work and then they scrub their fingers in the dirt outside."*

While officially, failure in biometric authentication can be remedied by using the one-time password (OTP) option that beneficiaries receive on their mobile phones, it is rarely exercised. In March 2017 during the first round of fieldwork, dealers reported receiving notices from the PDS administration to justify their use of the OTPs. This led to most dealers protesting and refusing to perform OTP transactions. The administrators on their part maintained that the OTP option was being misused by dealers to divert unclaimed entitlements. Secondly, not all beneficiaries had access to mobile phones or even remembered the mobile number that they had submitted at the time of registration. which also rendered the OTP option impractical. Hence, there was no evidence during fieldwork that the OTP option was being used in the event of authentication failures.

In response to growing reports about the difficulties faced by senior citizens and the infirm in authenticating their fingerprints, the PDS administration in Rajasthan has recently allowed for people to petition the government to excuse them from the biometric procedure. For this purpose, beneficiaries have to present themselves to the designated authorities and demonstrate why they cannot perform authentication, after which their names are added to a biometric authentication exemption list. Decisions to grant exemption depend on the examining authority being persuaded of a beneficiary's case. Officials interviewed for this study said that they mainly examine the state of hands and if it looks worn out due to age, accident, medical condition, or labor then exemptions are granted. However, exemptions are not granted easily and also have to be renewed periodically through physical verification by a government official.

Value Conflicts Experienced by Adult Beneficiaries

Owing to the frequent Internet-related disruptions, even beneficiaries who did not experience biometric authentication failures reported that the PDS biometric system did little to recognize and accommodate the lived realities of their lives. A recurring phrase that participants employed to describe their experience was that *"machine pareshaan karti hai"* (the machine harasses us). Another commonly expressed sentiment was *"gareebon ki kaun sunnta hai?"* (who listens to the poor?) Some would point to the machine's prompts and say that while the machine could tell them what to do, it could not hear their complaints in return.

In their interviews, participants reported that their interactions with the biometric system led to a feeling of being unacknowledged as people, experiencing a loss of autonomy, and feeling punished for growing old, or for pursuing jobs that rendered their fingerprints illegible. They often expressed that they felt helpless, unheard, and uncared for in the way the biometric procedure infringed and devalued three main areas of their life that overlap and intersect with each other during the biometric authentication procedure namely that of 1) time, 2) dignity of self, and 3) privacy. While beneficiaries often experience all three value conflicts together, the nature of the three values are discussed separately below.

Time

Participants, including those who experienced no difficulty in biometric authentication, emphasized that the system placed disproportionate demands on their time, taking away from their livelihood and sometimes resulting in loss of wages. For daily wage earners, obtaining their entitlements through the PDS meant risking their wages for a day, with no assurance that they would actually be able to complete the authentication process. Dealers reported that the fear of the loss of a day's wage sometimes caused people to forego their entitlements. P-24, a 37-year old male was employed as a mason. His family was classified as state BPL family and entitled to 35 kilograms of wheat every month. He said,

"Lining up for authentication is always an anxious affair because there is no accounting for our time. I have lost out on a day's earnings, sometimes even two days of wages. We never know how long it is going to take. Sometimes, it takes as little as 30 minutes or it can take 4 hours, or even an entire day. We are always unsure if we should wait or if we should return later. Since we can only come on the dates that are set aside for our village, it is not like we have the liberty to come according to our convenience."

In addition to livelihood concerns that both adult women and men reported, women additionally also faced challenges in navigating domestic and child care responsibilities with the time demands of the biometric system. Depending on the availability of other family members, women found ways to share their domestic responsibilities when they had to perform authentication. However, this was not always possible for everyone. In some instances, women were often the only available household member who could perform authentication. P-22, a widowed mother of two children aged 3 and 5, said,

"My mother-in-law and I are the only adults in the family now. We are both daily wage laborers and her fingerprints don't work while I experience failures. The dealer also gets frustrated and asks me to come later. When my sister-in-law was here, I could leave the children at home, but they have now moved to the city. It is challenging to wait in the line as children get restless and cry. It is also difficult to return later because we have to walk 4 kilometers. So, I wait until everybody else is done to try again."

Irrespective of the ease with which they could clear authentication and the circumstances of their daily life, all beneficiaries expressed frustration at the long and unpredictable wait times that they could have otherwise used for other tasks.

Dignity of Self

In her work, Rao observes that converting bodies into machine readable entities is often exclusionary towards the working class. She notes that engaging with the accept/reject dualism of fingerprint devices in governance and welfare related activities is a highly nervous and anxious activity that negatively affects perceptions of self [40]. Similarly, this study also finds that for beneficiaries, the entire authentication process is fraught with anxieties about the ways in which they feel betrayed by their bodies and the consequent embarrassment that they experience. At such times, beneficiaries expansively reflect on their lives reacting either with sadness or anger at the machine's refusal to recognize them and their bodies' limits. Beneficiaries often used the Hindi word "*pehchaan",* which means both to be recognized and also a reference to one's identity, to complain about experiencing a sense of their devaluation as human beings and their needs.

P-67, a 35-year-old laborer expressed sadness when even after scrubbing his fingers multiple times in the soil, his authentication continued to fail. Reacting with a deep sense of weariness after the dealer asked him to return the next day, he used the Hindi word *"majboori"* or helplessness to describe his situation He said,

"The machine wants to only recognize my fingers that are already worn out with work, but I am right here and I need the wheat for my family. Even the dealer knows that, but I am helpless because nobody is able to tell the machine about me or my needs."

Some beneficiaries react with anger at being rejected by the machines and wonder why their chosen vocations turns into an erosion of their dignities. P-09, a 41-year-old vehicle mechanic, found that the layers of grease on his hands did not allow for an easy authentication process. He said,

"I scrub my fingers in the soil every month when I come for authentication. The authentication ultimately succeeds, but it is only after repeated scrubbing and many trials. It's not like I can change my line of work only for PDS biometrics. When you are poor everything is a curse. The government needs to recognize the dignity of labor and how it affects our bodies before introducing systems like this."

Some beneficiaries wondered if their illiteracy is responsible for the biometric rejections they face. P-10, a 29-year-old woman who was working to harvest *channa* and had fresh cuts on her fingers said,

"I am illiterate and don't understand what the machine does. The dealer tells me to wash my hands and I do it, but my fingers still don't work. I feel I am at fault. Maybe I don't understand what to do because of my illiteracy."

For other beneficiaries, biometrics was a violation of their social honor that compromised the dignity of their bodies on gender or caste lines by forcing unwanted contact or accidental touches with a stranger's hands. This is because the dealer often held people's fingers to place it correctly on the biometric scanner. P-87, who was very vocal in asserting his identity as an upper caste Rajput said,

"I perform manual labor on my own field and hence my fingers fail authentication often, but still I am the only one from my family who can do this. I keep returning several times until I succeed. We Rajputs cannot allow our womenfolk to authenticate. Look at how the dealer touches all the women's fingers. This system is no good."

Given that ration distribution days are marked by long queues, the authentication process has a social and public character with numerous onlookers following the proceedings. Additionally, the voice prompts announcing the success and failure of an authentication trial also creates an audience for itself. Both successful and failed trials incite commentary and discussion among the waiting people. These proceedings are usually punctuated by beneficiaries examining and discussing the state of each other's hands and expressing anxiety about their turn at the machine. Sometimes, other people's bodies are roped in to help with

the grooming of fingers. At one ration shop, people took turns rubbing their fingers on the oily scalp of a young dealer until he yelled in protest and prohibited any further touching of his head. His comical protestations of fighting away anybody who was in his proximity caused much laughter among the anxious beneficiaries who began rubbing their fingers on each other's scalps instead.

In such instances, a spirit of camaraderie and social support emerges among the beneficiaries and partially alleviates their anxiety and frustration. Humor also becomes a coping mechanism and allows beneficiaries an opportunity to assert some degree of agency over the machine's verdicts on their bodies. In one instance, beneficiaries mockingly bowed before the machine to seek its blessing before authentication and thanked it with exaggerated gratitude after they succeeded. One beneficiary mimicked the machine's voice prompts and replaced it with the real reasons why biometrics were failing for the beneficiaries. His commentary after every failure evoked much laughter. It included statements such as:

- *Aap channe kaat ke aaye hain. Aapka Aadhaar sahi nahin hai*
  (You have been harvesting chickpeas. Your Aadhaar is incorrect.)
- *Aap buddhe ho gaye hain. Aapka Aadhaar sahi nahin hai*
  (You have become old. Your Aadhaar is incorrect)

These social interactions while a welcome diversion for the beneficiaries during their long wait times, also underlines the dark humor that they employ to cope with the vagaries of the authentication process.

Privacy

Biometric infrastructures are often primarily critiqued on privacy concerns stemming from the potential misuse of personal data and a lack of adequate safeguards for data protection and security [26, 31, 35, 36]. However, the privacy issues that beneficiaries experienced in this study, qualitatively differ from the traditional understandings of privacy in biometric discourse. Instead, beneficiaries spoke about the settings and the performative nature of the authentication process that renders their failures and attempts to clean their fingers into a very public spectacle with several onlookers.

Squatting outside the hand pump at a cooperative-run PDS, 72-year-old P-02 was engaged in rubbing his fingers into the earth as people looked on. He rubbed each finger with soil and then pumped water with one hand while washing the other. Also using the term "*majboori*" (helplessness) to describe his situation, he said,

"I am 72-years old and, my family sends me to authenticate since I am the only one who can afford to spend time here. I clean my fingers with salt and oil them before coming, but I have been waiting since 10:00 am and the oil has long dried up. I have to now rub them with dirt to clean them. It makes me very sad to have to do this at my age with everyone watching me."

When squatting to clean their fingers at the shops, beneficiaries usually engage in self-disclosure about themselves as they coax their fingers into producing biometric information. They talk about their age, their jobs, and the lives they lead with whoever is watching them as a way to contextualize and minimize the awkwardness of being rejected.

For women, especially, the act of squatting and rubbing their fingers in the earth makes them feel even more vulnerable and exposed to the public gaze as compared to men. Sometimes, passing acquaintances call out advice to women on the correct way to scrub their fingers or merely note their act of scrubbing with a hearty cheer inducing a sense of deep shame and embarrassment in them. In the context of the deeply conservative social norms of rural Rajasthan where women usually veil their faces, women beneficiaries become acutely aware of being watched. As P-80 said,

"I am grateful that I am fully veiled and can hide my face when I sit down to clean my fingers. Everybody can see me doing it and I feel very ashamed at having to scrub my fingers in the mud every time my authentication fails."

There is thus also a gendered quality to the need for privacy that speaks to the way authentication failures and acts of coping are experienced by the beneficiaries.

The intersection values of time, dignity, and privacy, collectively become the source of tensions and conflicts that adults experience in the authentication process. An unintended consequence of these conflicts is the responsibility that children have to assume in performing authentication for their families.

Children's Experiences of Biometric Authentication

Literature on biometric infrastructures rarely represent the experiences of children who may also be active or potential users of the system. The few examples that exist, discuss privacy and data protection of children's biometric data in the context of Western countries [e.g. 10, 48]. Consequently, there is very little that is known about how children interact with and experience the biometric authentication process. In this study, the value conflicts that adults faced in their interactions and failures with the authentication process meant that children emerged as unwitting participants in the PDS process too.

Moreover, government representatives too frequently cite the presence of children as a way for families to get their entitlements when they experience biometric authentication failures. Owing to their young age, their fingers pass authentication easily and every government officer interviewed mentioned that families with children should not be worrying about authentication failures. However, how do children experience the authentication process in the PDS system?

Children as young as 6 years of age were observed to be accompanying their parents to authenticate for their family's entitlement. With slightly older children who were upwards of eight years of age, families felt they could assume independent responsibility for authentication. If they were very young, children would often wait long hours after authentication, for their parents to fetch them as they could not carry the heavy wheat bags by themselves. In some instances, families moved around the beneficiaries on their ration cards to ensure that at least one child was present on the cards of different family groups so that they would be available to perform authentication.

For instance, P-44, a 68-year-old, added his grandson to his ration card so that he could perform authentication for him. He said,

"Previously, my son used to sign on my behalf and collect my wheat entitlement. Now, the machine does not recognize me so we added my grandson to my card and due to him, I am able to get my entitlement."

P-34, a parent who was interviewed when he arrived to pick up his 11-year old son at the PDS shop said,

"All the adults in my family including my parents work as daily wage earners and none of us can afford to spend time for the PDS. So, my son usually stops by after school for the authentication and I pick up him up later."

Parents also structured their children's schedules to ensure their availability for authentication. P-38, a construction laborer who depended on his 8-year-old daughter for authentication said,

"She is the only one in our family whose fingerprints work. In fact, whenever my wife wants to take her for a visit to her village, we schedule it around the PDS process. One time, I had to fetch her back for a day only to complete authentication since there had been a delay in the arrival of the stock that month."

Shouldering the responsibility of completing the biometric authentication was not a task that sat easy with children. They expressed the following value conflicts in their interactions with the biometric system:

Anxiety

Children expressed feeling a sense of apprehension when performing the authentication process because they were uncertain if they were doing things correctly. Like adults, they too reported experiencing anxiety when authenticating. P-45, the 12-year-old grandson of P-44 said,

"My authentication doesn't always succeed in the first attempt. Today, I was sent by the dealer to wash my fingers after they failed several times. I was quite scared because I felt I had done something wrong. I don't mind going for the authentication, but when I experience failure, I get scared."

Additionally, children who visit the PDS shops confessed to experiencing fear and an inability to express themselves adequately when interacting with the dealer and other adults at the shop. P-50, a 10-year-old boy who goes by himself to perform authentication said,

"I often don't follow what is going on with the Internet or the distribution process. The dealer answers questions when adults ask him, but if my friends and I ask about things such as how long the process will take or when we could get our wheat, he scolds us and tells us to move away from his desk. Also, adults behind us jump the line and I am unable to say anything to them because I get scared."

Interrupted Schooling and Play

Given the monthly cycle of the authentication process, children often reported missing school to complete the authentication. Teachers interviewed in the study said that while absenteeism occurred due to other reasons too, biometric authentication for the PDS was a monthly affair that was more frequent than other reasons. P-62, a primary school teacher supervising classes from grades 1 – 6 said,

"It is not that children have not missed school for house errands before the PDS biometric system was introduced. Elder siblings often have childcare responsibilities and also cattle grazing responsibilities. It is common for them to occasionally skip school to attend to these tasks. However, the biometric system is a monthly recurrence, which means that their absence is guaranteed every month, at least for a day. I have at least four to five students who regularly miss school for PDS biometrics. We cannot penalize them because their families have no option so we permit them to skip class and help them catch up later."

Adolescents were very vocal about their dissatisfaction. P-55, a 15-year-old boy studying in Grade 10 had been waiting for 3 hours for his turn. He said,

"I hate skipping school because I have to take my school leaving exams this year and the authentication cuts into my study time. I can't even study here as it is too chaotic."

For some children, being elected to perform the biometric authentication was a contentious issue with their siblings. P-37, a mother of two boys aged 10 and 12, said,

"My boys generally don't complain when they have to graze the goats, but they fight among themselves and go into long sulks about whose turn it is to accompany me for biometric authentication. It takes a long time and they have to miss school. These are monthly squabbles at our home and it cannot be helped."

Thus the value conflicts that children experience stems from the anxiety around the authentication act as well as being unable to adequately represent and advocate for their interests with adults both within and outside their families.

DISCUSSION

The biometric authentication process in the PDS invites value scrutiny owing to the central role it occupies in enacting the social and morally just cause of providing food security to the poor. Discussing the notion of justice, Sen argues that the choice of institutions and rules that are put in place to realize social justice goals cannot be evaluated merely on the

rational merits of their structures. Equally, the arrangements also need to account for the kind of world that emerges from these institutions and how people experience their lives within these arrangements [43]. Sen uses two Sanskrit terms - *niti* and *nyaya* that both mean justice, but still differ in the kind of justice they represent, to illustrate his argument. While *niti* represents formal organizational arrangements, *nyaya,* takes a broader and inclusive view to assess the nature and characteristics of justice and fairness that emerge from the *niti's* institutional base [43]. Also overlapping with Sen in evaluating the moral values of actions to resolve issues of hunger, the philosopher Onora O'Neill, argues that the principle of non-coercion should be a prominent value when deciding hunger solutions for the poor and the vulnerable. She writes that since the poor are more easily coerced owing to their great need to alleviate hunger, it is important that the conditions for aid allow them room for maneuvers [34].

Seen in the light of Sen and O'Neill's arguments, the findings from this study show that the *niti* of the technological design of the PDS biometric system that is based on claims to governance values such as targeted delivery of entitlements and prevention of corruption, leads the administration to mandatorily implement biometric systems even in conditions where there is a clear lack of supporting infrastructural values such as reliable Internet connectivity. The privileging of the fingerprint biometrics as an infrastructural value that has to be mandatorily performed and authenticated every month by beneficiaries is also experienced by people in particularly harsh ways that are indifferent to their bodies' realities as well as the routine demands of their lives. Thus, having to perform the biometric authentication every month for food security does not always result in a sense of *nyaya* for the PDS beneficiaries owing to the coercive and unstable nature of the authentication process.

As a form of infrastructural arrangement, the biometric authentication process recognizes only the bodily information of the beneficiaries. Not only do beneficiaries' values find no place in the way they are 'seen' and 'read' by the infrastructure, but they are frequently forced to be in conflict with these values. These conflicts also lead them to experience a sense of being rendered residual and orphaned [45, 46] by the infrastructure with little immediate recourse to any alternative or remedial *nyaya* that would alleviate their conflicts. Instead, it even draws their children to be a part of the system and in the process, compromises children's interests too. The emphasis on the biometric authentication process as a non-negotiable part of the PDS process creates value conflicts that adults unhappily cope with or seek to avoid by passing them on to their children under duress.

Given that the biometric authentication process represents an instance of human-computer interaction, it prompts this paper to ask if the authentication process that seeks to uphold the social justice goal of food security, can equally be deemed to be a process of *humane*-computer interaction for beneficiaries? In asking this question, this paper urges examination of the conditions in which biometric authentication processes are deployed as a 'humanitarian technology' in welfare and aid schemes. Both infrastructural conditions and the inherent uncertainty of bodies in producing biometric identification can not only compromise the humaneness of the process, but also leave beneficiaries bereft of aid itself. In the PDS, for instance, a recent survey of 1,36,120 beneficiaries shows that the exclusion rates owing to Aadhaar authentication failures were pegged at 4.7%. While 3.2% of beneficiaries were able to get their entitlements through alternative means, 1.5% of beneficiaries were left without access to their food entitlements [1, 33]. Hence, this paper joins other work on the PDS, to urge the exploration of suitable alternatives to the current mandatory enforcement of the monthly biometric authentication for food [2]. While the question of humane-computer interaction was arrived at independently by the author, the paper acknowledges its previous use in HCI [4].

As contributions to HCI research, this study extends the observations that Singh and Jackson make to provide a value oriented and social justice context in which beneficiaries perform the constant negotiation for inclusion in the PDS system [45]. Second, children have scarcely featured as subjects of interest both in the discourse and the design of biometric infrastructures in general, as well as their role in the PDS process. This paper takes cognizance of their very visible presence in the PDS biometric authentication process and the value conflicts it creates in their lives. Third, it also seeks to broaden the nature of privacy discussions around biometric systems to draw attention to the performative nature of authentication that contributes to the beneficiaries' unease about their dignity and privacy. Lastly, it draws on Amartya Sen's arguments of *niti* and *nyaya* to argue that technological design that seeks to advance social justice should also be mindful of translating into a fair and just experience for users.

CONCLUSION

This paper adopts a value oriented inquiry of beneficiary interactions around the biometric authentication process of a food security program in India. It finds that adults experience intersecting value conflicts around time, dignity, and privacy. They are therefore, compelled to turn to their children for assistance who in turn, experience anxiety and interruptions in their education and playtime.

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