

# Biographies of Biometric Devices: The POS Machine at Work in India's PDS

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## ABSTRACT

The centrality of the biometric point of sale (POS) machine in the administration of food security in Indian's public distribution system (PDS) invites scrutiny for its primacy as a non-negotiable artifact in the monthly PDS process. In this paper, I critically examine how the POS machine emerges as a site for varying imaginaries of a technologically-mediated welfare system for the three primary stakeholders of the PDS, consisting of the beneficiaries, dealers, and state administrators. Drawing on ethnographic fieldwork, the paper traces the histories of interaction and portraiture that the three stakeholders bring to their description and interpretation of the POS machine. It shows that an active POS machine provokes the stakeholders in the PDS to view it as an artifact that invites engagement on practical, moral, and knowledge dimensions. The varying 'biographies' that stakeholders narrate of the POS machine, collectively reveal the design, disposition, and functioning of a social justice infrastructure that rests on the compulsions of biometric technologies to improve inclusion and deter corruption in welfare delivery.

## CCS CONCEPTS

• Human Centred Computing; • Empirical Studies in HCI;

## KEYWORDS

Food security, Infrastructure, Aadhaar, Biometrics

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## 1 INTRODUCTION

Every month, when states in India begin distributing subsidized food entitlements as part of the country's public distribution system (PDS), people and processes begin coalescing around a specific technology artifact that commands attention owing to its centrality in the distribution process. Popularly called the 'machine' by stakeholders of the PDS, this artifact is the biometric point of sale (POS) device (henceforth referred to as POS machine or machine).

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It governs the functioning of PDS shops (also called as fair price shops) where food aid is distributed to beneficiaries through the PDS dealers. Equipped with a biometric reader, the POS machine is a non-negotiable entity in the PDS. It sits between the dealer and the beneficiary to mediate the ritual of the fingerprint authentication that beneficiaries must successfully clear before they can claim their entitlements.

On the field, the most evident function of the POS machine is the interactive interface it provides for the beneficiaries to authenticate their fingerprints. The machine then communicates with the Aadhaar database—India's biometric identity system, to determine the success or failure of the authentication attempt. Failure to find a match, results in repeated trials for authentication, dialogues, and negotiations around the POS machine until the beneficiary either succeeds in authenticating their fingerprint and collects their entitlement or gives up to return another day [42, 44, 54, 69, 71–73]. While the beneficiaries and the dealers interact directly with the POS machine on the field, state officials rely on it to capture the transactions of dealers and beneficiaries in their distant offices through a management information system (MIS) that displays a variety of PDS transactions in real time. Other than providing an interface for the biometric authentication of beneficiaries, a functional POS machine also operationalizes a range of other data in the PDS for the state. This data includes information on the offtake of food stocks, the names of beneficiaries performing biometric authentication along with the date and time of their transactions, the number of failed and successful transactions, and the active and inactive status of the POS machines.

The PDS functions invested in the POS machine are obligatory and non-trivial, and bestow on it the status of a compulsory artifact in the disbursement of food entitlements. As an infrastructural translation of the welfare state, it offers a critical point of entry to examine how technology design and practice unfolds within the bureaucracy of a social justice program that argues for the use of biometric technologies to further its welfare goals of food security. In its agenda, the POS machine represents a contemporary iteration of 'scientific charity' arguments [17] that has routinely expressed faith in technology to bring efficiency in the administration of welfare programs. However, as Virginia Eubanks observes, the expected precision that technology ostensibly brings to welfare as an unprejudiced, neutral, and objective arbitrator of processes is very often punishing and exclusionary for the poor [17]. With the global discourse on biometric-based technologies establishing itself as a 'humanitarian technology' [26, 27, 65] that checks fraud and delivers inclusive aid to the needy, studying the POS machine broadens the analytical lens of inquiry on welfare to include the discourse about its design and use by state authorities, the politics of machine deployment that intermediary dealers navigate, and the

consequences it has for beneficiaries seeking inclusion in a digital welfare state.

Viewed through the lens of HCI and CSCW scholarship [6, 7, 21, 57, 59, 60], the POS machine becomes salient as a boundary object of public policy and governance for the beneficiaries, dealers, and state representatives - the three primary stakeholders in the PDS. Not only do these stakeholders inhabit different social worlds, but they also engage with the POS machine in very different ways. The interpretations, motivations, rationalizations, tensions, and negotiations that each of these stakeholders bring to their encounters with the POS machine are equally, representations of how welfare and inclusion itself is shaped, articulated, executed, and experienced between the motivations of the state, the intermediaries, and its beneficiaries.

The paper's invocation of 'biographies' to frame the three stakeholder's responses and discussions to the POS speaks to the varied actions and reactions that the POS machine provokes between multiple actors in the PDS. It is also inspired by the way the machine additionally invites attention to its supremacy by asserting its authority on the field through speech. Consisting of pre-programmed audio prompts, the POS machine directs beneficiaries to perform the all-important action of placing their finger on the sensor and announces the success or failure of their biometric authentication. Inspired by this anthropomorphic quality of the machine, I argue that while the machine appears to possess a voice of its own, its responses are limited to delivering prompts that have been baked into it, which limits its ability to narrate its own story of eminence in the PDS.

Writing about the cultural biography of things, Kopytoff observes that objects are not merely produced materially, but they also culturally come into being as a certain kind of thing [33]. As they move through different contexts, scenarios of use, and people who interact with them, they accumulate sets of biographies that reveal the collective understandings of the social system that the object speaks to and on which it rests [5, 33]. Inspired by Kopytoff, in CSCW and STS scholarship, Pollock and colleagues [24, 45] propose the 'biographies of artifacts and practices' (BOAP) framework to argue for a strategic, multi-sited, ethnography of complex technical objects that will yield more robust understandings of technology artifacts by engaging with multiple locales and contexts. They note that scholarship on technology is usually divided between technology design and technology implementation leading to an incomplete and partial analysis of complex objects [24].

In presenting the analysis of the POS machine as a biography of things [24, 33, 45], I draw attention to the variety of situated 'epistemological, semiotic, technical, political and material' connections [22, 23: 403] that together produce hierarchies of practices, interests, and morals in the way a welfare program functions.

## 2 THE POS MACHINE

The POS machine entered the PDS bureaucracy with reforms carried out as part of the National Food Security Act (NFSA) that came into force in 2013. The NFSA mandates food security for 2/3<sup>rd</sup> of the country's population, with 75% of the rural population and 50% of the urban population, eligible for subsidized food grains through the PDS shops. Seeking to strengthen the food security infrastructure,

the NFSA recommended the use of the Aadhaar biometrics database. It aimed to both enhance the targeted inclusion of beneficiaries in the PDS and introduce transparency in transactions by tracking the supply and distribution of food grains to curb leakages and corruption in the PDS supply chain [1, 40].

While Aadhaar's viability as a centralized biometric identification system and subsequent implementation in various welfare programs such as the PDS was fiercely contested legally and in public discourse, the Supreme Court of India ruled in 2018 that Aadhaar would be mandatory to access any welfare entitlements provided by the state [49]. The state of Rajasthan, where the fieldwork for this study was conducted, began introducing biometrics in its PDS from late 2015. The PDS transitioned from a paper-based system, where dealers would manually list the monthly disbursements that they made in a book, to a technology-mediated action that centred on the POS machine. It introduced a culture of hardware and software contained within the POS machine that was wholly alien to the PDS ecosystem at the field distribution level.

As the sole representation of the new biometric regime governing the ration disbursement in the field, the POS machine was a literal manifestation of the break with the old paper-and-pen order of the PDS and it was toward the POS machine that the dealers and beneficiaries first directed their ire to express resistance to the new system that was now called the e-PDS. News reports about the vandalizing of the POS machines were common [3, 70] as were incidents of dealers striking to protest against the POS machines [3].

Additionally, it was only through the POS machine that the possibilities and the limitations of the new infrastructural method became visible. For instance, people learnt about internet network and server connectivity issues as necessary conditions to receive their entitlements, without which the POS machine would not work. Similarly, beneficiaries learnt about their biometric successes or failures only when it was called out by the machine's audio prompts or by the machine's visual cue. Thus, although the POS machine works in tandem with other crucial, fragile, and equally non-negotiable systemic components such as availability of Internet connectivity and the Aadhaar database [14], it is the only visible representative of the e-PDS technics for both the ration shop dealers as well as beneficiaries.

While in states like Andhra Pradesh, the POS machine is replaced or supplemented by a biometric iris scanner at some PDS shops, it is the fingerprint POS device that is widely deployed in Rajasthan because of its more affordable cost. Given how central touch is to the authentication process, several states suspended the biometric process in the PDS in the wake of the COVID-19 global pandemic caused by the SARS-CoV-2 virus. In Rajasthan, the biometric authentication procedure was halted in April and May 2020 and reinstated in June 2020. For two months, the biometric authentication was replaced by a one-time password (OTP) authentication procedure sent to the beneficiaries' phone numbers that was linked to their Aadhaar number or the state Bhamashah ID that enabled food distribution.

However, the suspension of the biometric authentication procedure did not diminish the role of the POS machine. It continued to be the primary intermediary in the PDS process and the PDS dealers continued routing all the other steps in the transaction



**Figure 1: A POS machine used in the PDS in Rajasthan.**  
Image: © Preeti Mudliar

process such as entering the beneficiaries ration card number and tracking of the available and disbursed stocks being routed through the machine.

## 2.1 The POS machine script: Hardware and software

In planning the transition from the PDS to the e-PDS, the Rajasthan state administration invited tenders in 2015 for both the hardware as well as the software components that would together constitute the POS machine. According to interviewees who were involved in the transition, designing the e-PDS began with a requirement gathering phase that involved understanding various nuances and components of the PDS process such as the nature of entitlements for different beneficiary segments, the frequency of transactions, and how it affected the movement and count of stocks. The requirements of the PDS process were then used to design both the client software that runs on the POS machine as well as the backend software that supports the reporting system for the MIS that is used by various PDS administrators.

For the hardware components, the design conformed to various guidelines that had already been centrally mandated for Aadhaar-based devices by the Unique Identification Authority of India (UIDAI) and the National Informatics Centre (NIC) that administers the ration card database for the PDS. According to UIDAI rules, every biometric device deployed for Aadhaar use in the country has to be registered with their database. Hence, every POS machine

is assigned a unique registration device number that allows them to communicate with the Aadhaar server. Once the POS machines were ready, the state administration held camps for the PDS dealers to train them in its use.

The POS machine is a handheld micro ATM with a fingerprint scanner to enable biometric authentication. For internet connectivity, it is both WiFi enabled and also has a SIM slot for mobile internet that dealers use most commonly to connect to the internet. The machines that were first distributed to the dealers in 2015, supported mobile internet up to 3G speeds and it is these machines that continue to be in use. Every terminal is unique to a dealer as it is seeded with data specific to their ration shop. This data includes the ration shop number, ration card number of every family on the PDS list, and the names of every member of a family who have linked their Aadhaar numbers to their ration cards. The machine is also seeded with the supply limit that the dealer is entitled to and it updates the distributed stock and the available stock after every transaction. Thus, dealers cannot borrow or use any other terminal for the distribution of supplies in case of machine breakdowns.

The machine is powered by a lithium ion battery and is composed of a glass sensor that records the biometric intersection points of a fingerprint. This sensor also has a backlit component that provides a visual cue about the machine's readiness for the authentication process by glowing red. Every device has a touch screen with a stylus (that dealers usually replaced with a pen or their keys to input entries), a QWERTY keyboard, and a 24 pin column thermal printer that issues receipts after every successful authentication. The receipt contains details such as the date, time, name of beneficiary, quantity of ration issued, the shop code where the transaction was conducted, and the amount of money paid by the beneficiary. Machines have an inbuilt speaker and its software is programmed with standardized audio prompts in a woman's voice in Hindi that walk the dealer and beneficiary through every step in the authentication process. This feature had been included to increase transparency in the process for the beneficiaries. Some of the audio prompts include:

- Apna ration card number daalein (Enter your ration card number)
- Krupaya apni ungli sensor pe lagayein (Please place your hand on the sensor)
- Prakriya jaari hain, krupaya prateeksha kijiye (The process is on, please wait)
- Aapka Aadhaar sahi hain (Your Aadhaar is correct) –this signals a successful biometric authentication
- Aapka Aadhaar sahi nahin hain (Your Aadhaar is not correct) – this signals a failed biometric authentication
- Ration prapt karein (Collect your ration)

To begin the authentication process, the dealer enters the beneficiary's ration card number on the touch screen and the machine displays the details of the family members who are a part of the ration card from the PDS database. The dealer then selects the name of the person who will be authenticating their biometric identity. Once the biometric details are submitted, the machine sends the details to the UIDAI server which returns the result in

the Boolean logic of 1 and 0 or ‘yes and no’. This result is displayed on the POS screen and declared by the audio prompt as a successful or failed authentication attempt. The machine’s speakers often break down, but other than the loss of the audio prompts, it does not hamper the functioning of the machine. Nor do beneficiaries express any significant information or interactional loss at its absence.

The POS machine works on GPRS connectivity and every transaction size is around 400 bytes. It records details of each transaction, which is uploaded to an MIS that is accessible to relevant government officials. Details of some of these transactions are made available to the public on the food department website for Rajasthan.

The entire framework of action available to the dealer and the beneficiary is vested in these details of the POS machine and the dealer is constrained from overriding any part of this script to issue food grains.

### 3 RELATED WORK

#### 3.1 Producing the Aadhaar infrastructure; producing welfare

Owing to its ambitious undertaking of building a centralized biometric identification database for the citizens of the world’s second most populous country, Aadhaar has invited a range of commentary and analyses in Information and Communication Technologies for Development (ICTD), Human-Computer Interaction (HCI), and Computer Supported Cooperative Work (CSCW) scholarship even as some argue for more sociological analyses of Aadhaar [32].

When the Unique Identification (UID) project, as Aadhaar was earlier known, began gaining ground in India, it invited observations on the qualities of its digital infrastructure [56] with research noting that unlike past mega infrastructure projects such as railways and dams, Aadhaar did not have a tangible technological artifact in an imposing material or physical form, which made it harder for the project to gain symbolic legitimacy in the country. Hence, for its image construction, the UID relied on the reputation of its designers as technologists and businessmen. It created materiality for itself by transforming into a brand with a new name – Aadhaar, a physical card, and a logo, and drew linkages to existing welfare schemes such as the National Rural Employment Guarantee Act (NREGA) to evangelize the different benefits that Aadhaar would bring ranging from social inclusion, national integration, reducing corruption, and plugging leakages [56].

Interviews with the designers of the Aadhaar infrastructure and the field practices of enrollment agents collecting citizen biometrics on the ground reveal the mediating role that ideas about data played in aligning the goals and visions of the two different stakeholders as they worked on enrolling citizens and building the Aadhaar database [28]. Another ethnographic enquiry situated among the designers of Aadhaar shows how members described their work using the metaphoric expression of an hour glass to reimagine state-citizen interactions in terms of creating data bureaucracies and platformized governance [55]. Similarly, commentary on Aadhaar as an apparatus of governmentality using biometric technology, evaluates its implications for citizenship, e-governance, and citizen-state relationships in India [9, 11, 46].

Owing to Aadhaar’s claims of improving welfare delivery and easing access to benefits through targeted inclusion of beneficiaries, there is also a growing body of work researching Aadhaar’s administration of welfare programs, especially the PDS. Singh and Jackson [54] explore how inclusion is achieved in the Aadhaar-administered PDS and note that the Aadhaar infrastructure is overlaid on top of pre-existing infrastructures such as the PDS database, resulting in several seamful spaces that require patching to be functional. They observe that beneficiaries often find themselves at the interstices of these interconnected, but disparate infrastructures and have to engage in a constant and careful negotiation at the boundaries and seams to ensure their inclusion in the PDS [54].

Drawing on value-based frameworks in HCI scholarship another study reveals how adult beneficiaries experience value conflicts in complying with the compulsory biometric authentication to receive their PDS entitlements. These value conflicts have repercussions for the children who are drawn into fulfilling the authentication responsibilities for their families [42]. Other studies on Aadhaar and the biometric authentication process in welfare programs note the role of human intermediaries in stabilizing the technical infrastructural elements [10] and the crafting of biometric bodies by beneficiaries to meet the demands of authentication [48]. Additionally, developmental economists too have studied the infrastructural challenges that beset the Aadhaar-administered PDS such as inadequate internet connectivity and biometric failures [e.g. 13, 15, 30, 31, 39].

The analytic point of departure for most of these studies has usually centered on examining the general idea of Aadhaar as an infrastructure or specific procedures around it such as the enrolment process or the biometric authentication procedure, to examine how Aadhaar affects the experience of the citizen-beneficiaries who depend on it for their entitlements. In this paper, I observe that while Aadhaar provides the larger infrastructural framework that governs and mediates the welfare programs within which beneficiaries are placed, it is the specific artifact such as the POS machine that represents and translates Aadhaar into a rooted, visible, and lively infrastructure on the field. This is especially true of a food security program like the PDS that requires the monthly performance of biometric authentication from its beneficiaries for their entitlements. Tracing the POS machine’s interaction with different stakeholders thus permits a broadening of the analytical landscape of Aadhaar-based welfare programs that have hitherto focused on the arguably more abstract representation of the Aadhaar database as an infrastructure.

#### 3.2 Infrastructural objects and devices

Materials, devices, and infrastructure [58] have regularly inspired scholarship to critically reflect on the ‘world of things’ that act as constituting or organizing forces for social processes around them [38]. As Larkin argues, apart from their technical capabilities, infrastructures are equally carriers of semiotic and aesthetic elements that address the desires and fantasies of people and reveal the political constitution of infrastructures [35]. Drawing particular attention to devices, Amicelle et al note that the etymology and the range of meanings attributed to the word ‘device’ by the Oxford English Dictionary includes division, difference, and disposition that reveals the simultaneous and heterogeneous meanings that

devices host [4]. Their critical scrutiny of various security-related technologies such as biometrics, body scanners, algorithms et al show that these security devices contain within them a multitude of competing conceptions, controversies, goals, interests, and values between various actors engaging with the devices [e.g. 4, 68]. Similarly, in her study of the water meter in South Africa, von Schnitzler notes that an ethnography of the assembling and reassembling of technical devices permits the political to be studied in newer conceptual and methodological ways and expands the way the political is imagined and produced. She argues that the very design of infrastructural artifacts carries within them specific expectations and targets that does not allow them to be mere neutral tools to achieve ends [70].

As an instrument of public policy and governance, the POS machine is an artifact that operates in the public space. HCI and CSCW literature has directed considerable attention towards the design of infrastructures and artifacts oriented towards the public, serving a range of purposes, especially in global south contexts. Recent examples include, but are not limited to Karsula and Kumar's critical examination of the artifact of panic buttons on mobile phones [29]. Work on WiFi hotspots in the public parks of Havana present design learnings for people experiencing the internet for the first time in low resource settings [16] while a feminist HCI lens interrogates the publicness of public WiFi infrastructures in India to show how women's access and use of public spaces is rarely considered in their design and implementation [41]. A design intervention exploring conversational speech probes in the public spaces of low income communities in Mumbai demonstrates opportunities for community learning through publicly accessible speech probes [50]. Closer to the concerns of this paper, Talhouk et al study the electronic voucher system that Syrian refugees use for food aid in Lebanon and suggest a redesigning of the food aid technology to account for power and information asymmetries as well as collaborative values and practices that inform refugee communities in their quest for food security [64].

Similarly, this paper's infrastructural inversion [7] of the POS machine, situates it as an artifact of public interest that operates in the public space while producing a certain imagination of a social justice program that strives for inclusivity. Additionally, its analysis of the POS machine is not limited to a single set of users or designers, but engages with the embodied narratives, interpretations, motives, and experiences of multiple stakeholders who collectively work on the machine to produce the PDS every month. It acknowledges Marathe and Chandra's argument that while end user beneficiaries have typically been the focus of HCI4D and ICTD scholarship, government officers and other bureaucratic actors have been underrepresented as technology users and designers of new forms of technology, which has limited HCI contribution to design practices in state initiatives [37].

Presenting a simultaneous analysis of the three primary stakeholders of the PDS, my analysis borrows from Akrich and goes, "back and forth between the designer and the user. . . between the world inscribed in the object and the world described by its displacement" [2, p. 208-209] to present a situated view [62, 63] of the interactions and perceptions that three different stakeholders bring to bear on the POS machine and what they reveal about the functioning of the PDS.

## 4 METHOD

### 4.1 Data Collection

The data reported in this study consists of interviews and observations conducted with beneficiaries, dealers, and state government officials engaged with the PDS in rural Ajmer, Rajasthan. As described in an earlier paper [42], the fieldwork for this study is rooted in the communities where agricultural activities were the predominant source of livelihood. The data was mainly conducted during the winter and summer months between March 2017 – June 2019. Some of the fieldwork coincided with the harvesting season and during this time, beneficiaries reported more challenges in authenticating their fingerprints owing to cuts and injuries on their fingers as a result of their manual labors in the field [42]. Interviews with beneficiaries and dealers were conducted before, during, and after transactions. State representatives working for the PDS were interviewed both at the district as well as the state levels and occupied different ranks in the administration hierarchy. Follow up conversations with state officials about the pandemic-induced changes were conducted in August 2020.

The kind of information I received from interviews with the state representatives differed depending on their place in the hierarchy. For instance, interviews with people working at the district supply office (DSO) in Ajmer would be limited to their own job roles within the PDS whereas people working at the state departments at Jaipur were usually able to discuss the history as well as the broader design and implementation details of the e-PDS for Rajasthan state. To protect the anonymity of the state representatives, their job designations and hierarchical ranks are not reported owing to the specialized nature of their roles and positions.

Together, the data reported in this paper consists of interviews and observations of 178 beneficiaries performing biometric authentications, 14 PDS dealers, and eight state representatives. The interviews were also supplemented by informal conversations and 'hanging out' in the waiting areas of various government office spaces related to the PDS.

### 4.2 Field access

The kind of access and ease in interaction I was able to forge with the different stakeholder groups was a varied experience. While the fieldwork for this specific study was conducted from March 2017, I first visited one of the villages in the district in June 2016 as part of a study on the National Optic Fibre Network (NOFN) that was rolled out as a pilot test in the region. In that study [41], I discuss the significant challenges that I faced during fieldwork on account of being a woman and while some of these challenges continued even during the fieldwork for this study, my long engagements on the field deepened the social ties I was able to build with people and I mostly shared an equation of comfort with the beneficiaries and the PDS dealers.

As an outsider to the state of Rajasthan, I was not conversant with the commonly spoken language of Marwari. However, Hindi is widely spoken and understood in the state since it is also the official language of communication in Rajasthan and this aided my communication with the dealers and the beneficiaries. In the early days of fieldwork, I approached dealers through my social contacts and explained to them that I was interested in understanding the

biometric authentication process in the PDS. Dealers were mostly eager that I witness the challenges that they faced in conducting biometric authentication owing to poor infrastructure. Hence, I did not face significant challenges in gaining access and permission to observe the PDS process and conduct interviews with beneficiaries on the premises of their shops. Since the dealers' motives in allowing me access to their shops were shaped by their resistance to the e-PDS, I sought to minimize snowballing biases in the sample by also soliciting suggestions from government officials about their recommendations for 'honest' dealers in the district as well as scouting for dealers on my own. The beneficiaries at all PDS shops also willingly shared their experiences with the POS machine, not least because of the long wait times that they experienced while awaiting their turn for authentication. To minimize any discomfort the beneficiaries may feel about sharing their thoughts on the PDS in the dealers' presence, I also visited and interviewed them at their homes.

Access and interviews with the state representatives was often challenging. While most district officials in Ajmer would readily grant interviews, getting access was not always straightforward with the state officials in Jaipur where the officers displayed a fair degree of ambivalence to my presence. For initial meetings with the officers, my self-introduction would contain details of my work as a professor at a tech school in Bangalore who was studying the PDS and doing fieldwork in Ajmer district. Although some officers were forthcoming with information, it was also common for responses to interview requests to be slow or absent, requiring multiple follow up emails and phone calls to secure an appointment. To assure me of their cooperation in case of delays, officers would cite their busy schedules while also naming civil society representatives such as right to information and food security activists to underscore that they worked with them regularly and incorporated their feedback to strengthen transparency and voluntary information disclosures of the e-PDS data on the government websites.

During fieldwork, I also used the right to information (RTI) act to access age-related details of the beneficiaries conducting biometric authentication since I was observing the very visible presence of children conducting biometric authentication for their families that would sometimes lead them to miss school [42]. Seeking details through the RTI invited the annoyance of some officers, which they expressed to me during our meetings and I succeeded in receiving partial data only after multiple applications and hearings.

### 4.3 Data Analysis

The interviews were recorded in various formats ranging from audio and video recordings with beneficiaries and dealers as well as handwritten and typed notes with government officers. I transcribed all the recordings myself. Since the data collection lasted over two years, analysis was an on-going process, which included multiple codings of the transcript and field notes. The analysis process included frequent and close reading of the transcripts in conjunction with my field notes both during data collection as well as after returning from the field. There were also significant gaps between reading the transcripts to allow for analytical distance in my interaction with the data.

In keeping with the emergent design of ethnographic fieldwork and the principles of theoretical sampling [12, 61], the analysis and memos from the transcripts guided lines of interrogation for subsequent rounds of fieldwork as well as research questions to frame paper writing. For this paper, the transcripts were analyzed using a process of open coding to identify concepts that participants were employing in their descriptions and interactions around the POS machine. A part of the data has been reported in earlier work that describes the value conflicts that adult and child beneficiaries face in the biometric authentication process [42] and advances the concept of 'broken data' [44] to describe the repair attempts of beneficiaries to groom their fingers and pass authentication. This paper reports specifically on the data and analysis that centered on the POS machine.

## 5 FINDINGS

I use the biography framework [24, 33, 45] to report the findings. I argue that the three stakeholders interact with the POS machine along practical, knowledge, and moral axes that differed in very meaningful ways for each of them. I observe that the POS machine has a practical narrative to its biography that is marked by considerable labor and work practices that the three stakeholders variously bring to bear on the machine to perform and produce the PDS every month. I present that the discourse of corruption within the PDS foregrounds the POS machine as a moral agent for the stakeholders who engage with its stated ability to eliminate fraud and increase welfare inclusion in qualitatively different ways. Lastly, I show how the POS machine is designed to create knowledge and transparency in the PDS for the state and the beneficiaries, but greatly differs in the relevance and utility that such knowledge has for its stakeholders. In presenting a simultaneous analysis of the POS machine through their practical, moral, and knowledge biographies, I account for how welfare design & delivery is enmeshed with competing claims, aspirations & priorities that complicate the inclusion and delivery of welfare to people seeking protection against hunger. I discuss each of these biographies below.

### 5.1 The practical biography of the POS machine: Between inconvenience and achievement

Engagement with the POS machine for beneficiaries, dealers, and the state involves different kinds of effort, labor, work practices and infrastructural competencies [51] that are essential for the PDS transaction process to function. In line with Gerson and Star's observation, state representatives, dealers, and beneficiaries engage in articulation work [18] to make the POS machine work for the PDS. The articulation efforts for the dealers revolve around what Gerson describes as local articulation [19], which describes efforts to ensure that essential local resources and conditions are in place to support infrastructural functioning. For the dealers, local articulation work involves carefully calibrating conditions to get their POS machines to function in response to infrastructural challenge of connectivity, which they commonly refer to as '*tower ki samasiya*' or the tower problem. Their labor of articulation revolves around the deployment of the high gain antenna that they received from the state after repeated complaints about Internet connectivity. Dealers reported



that attaching the high gain antenna did improve the signal reception on the POS machine, but it did not guarantee uninterrupted signal, leaving them to improvise solutions that reconfigured their relation to time and space.

For instance, a dealer who received weak to zero Internet connectivity, sometimes began his authentication process early in the morning starting from 7 am, since he was assured of reasonable connectivity until 10 am, after which the internet signal vanished. In another village, a dealer showed how the internet signal strength displayed on his POS machine dropped every few minutes in the networks of all the three service providers whose SIMs he rotated to maximize signal availability from whichever service provider he could best reach at that time. This meant that the dealer repeatedly switched between different SIMs to be able to continue with the authentication process, which increased the time taken to process every transaction.

Another common local articulation tactic that dealers employ is to prioritize biometric authentications first and begin the wheat distribution process only after completing the authentication procedures of all beneficiaries who are present on that day. This often results in crowding at the shops and long wait times for beneficiaries whose discomfort becomes more pronounced in shops that do not have sufficient seating space or ventilation. Dreze et al note that separating authentication processes from the distribution can often encourage corruption [15]. However, no beneficiary reported receiving or at least being aware of receiving less than their entitlement share. In several dealerships where the dealer was the sole person overseeing the PDS process, beneficiaries often weighed the quota of their entitlements themselves under the dealer's supervision.

The portability of the POS machine was another characteristic that dealers frequently leveraged for local articulation work by taking the machine to spots where they could get reasonable connectivity to conduct transactions. One dealer who reported chronic connectivity issues carried the POS machine up two flights of stairs that was unsupported by safety railings to conduct authentications on the open terrace of his building. However, this elevation was also insufficient so he further extended the high gain antenna by hoisting it on to a long stick that he planted on his terrace. The dealer had also purchased a longer length of wire to be able to extend the antenna even higher. However, the wire did not fit neatly into the POS machine's slot and so in order to conduct authentication, the dealer had to walk a fine line between waiting for the POS machine to indicate that it had sufficient signal strength and then begin the authentication process by holding the wire tightly in place with his other hand to maintain the connection. The dealer also complained that since the actual distribution process of weighing and distributing the wheat was being conducted in the basement of the shop by his employees, he was apprehensive that they may be siphoning the grains in his absence. He said,

*"Dealers like me who have severe connectivity issues have to work hard to ensure that the POS machine functions as a result of which other work processes of our dealership suffer. I lose out on both efficiency as well as control over the distribution process because I have no alternative but to sit upstairs with the POS machine. Since the distribution process requires physical labor to*

*move sacks of grains and weigh the appropriate entitlements for beneficiaries, I delegate that to my helpers. I can't exchange tasks with them."*

For the disabled and senior citizen beneficiaries attached to his dealership, having to conduct authentications on the terrace was also a precarious undertaking as they needed assistance to climb the stairs. An 85-year old woman who was the sole living person on her family's ration card performed authentication after being supported by two members of her extended family up the terrace. Her companion said,

*"The dealer would have brought the POS machine to our home for authentication given her advanced age, but his terrace is the only place where some internet signal is available so we have no choice but to help her up the stairs every month."*

According to the dealers, the POS machine also contributed to an increase in the time they spent on processing the entitlement of each beneficiary. One dealer noted,

*"I have 500 ration cards attached to my shop. Even if I experience no infrastructural disruptions and every beneficiary's fingerprint authenticates on the very first try, which is almost never the case, I can still only process around 60 people every hour, at one minute per beneficiary, on an average. Earlier, I would finish the distribution in two days. Now, it takes me seven to 10 days to finish the same process with the machine."*

Other factors such as disruption in electricity supply also caused dependencies for dealers who either suspended disbursement until electricity was restored and the machine's battery could be charged. Alternatively, they would coordinate with other institutions in their villages such as the milk cooperatives and dairies who owned inverters to conduct the authentication on their premises before returning to the PDS shop to distribute the rations.

The infrastructural challenges that the dealers faced, contributed equally to articulation work that the beneficiaries had to undertake in terms of time and effort to collect their entitlements. As previously reported [42, 44] infrastructural disruptions either translated towards long wait times for authentication and receipt of entitlements or resulted in beneficiaries having to make repeated trips whenever the 'tower' was reported to be functioning again. The extent of work this required from the beneficiaries depended on various factors such as the distance of the shop from their homes, availability of vehicle to commute to the shop, and availability of other family members who could authenticate for the entitlements at another time. Beneficiaries complained of economic costs such as loss of wages and repeated transport expenses that had to be borne by them to visit the shop to get their entitlements.

In addition to long wait times, beneficiaries also engaged in articulation work to groom their bodies to enable the POS machine to biometrically recognize them as a valid claimant of the entitlements [42, 44]. The beneficiaries learnt of this articulation work from dealers and from information pamphlets that the state distributed to them when the POS machine was introduced in the PDS. A state representative said,

*“We held camps to educate the dealers on using the POS machine. At that time, we also distributed pamphlets to spread awareness among beneficiaries about cleaning their fingers if they had trouble authenticating. We asked them to use salt to scrub their fingers and wash them with soap and water so that they would pass the fingerprint authentication process.”*

Beneficiaries engage in various kinds of labor to be able to complete authentication that conflicted with the routines and values of their life [42] as they worked towards producing a biometrically accepted body [47, 48]. A common method was to squat and rub their fingers in the earth and wash them with the water that dealers made available to beneficiaries. Sometimes, beneficiaries would also rub their fingers on each other's scalps to clean the ridges of their fingertips. Moreover, children were often sent to perform the authentication process by the adults in the family whose fingers either failed authentication or because they could not afford to spend long hours waiting to complete the authentication process [42]. Women beneficiaries reported facing additional challenges in attending to household chores and spending long wait hours for authentication as well as feeling very vulnerable and embarrassed with having to groom and ‘repair’ their fingers in public when faced with biometric failures, a vulnerability that male senior citizens also mentioned [42].

In contrast, the articulation work that the state representatives performed on the POS machine and how they perceive their work, differs in very meaningful ways from the local articulation work performed by the dealers and beneficiaries. The state representatives consisted of engineers who were a part of the software design and maintenance of the POS machine as well as technicians who were employed by the POS machine vendor to attend to the hardware repair and maintenance of the machines. In their articulation labor, the state representatives accounts align with Gerson's description of ‘metawork’ [19] that consists of the overall work flow process that guide the POS machine's functioning and which is independent of localized conditions and situations.

The technicians who oversee the repair and maintenance of the hardware of the POS machines are posted at jurisdictional blocks of villages for handling minor technical queries such as connectivity and antenna issues. For all major repairs such as malfunctioning batteries and damage to different machine components such as touch screens, keyboards, and speaker, the machines have to be brought to Ajmer city and submitted to the district coordinator of the technicians by the dealers. Between 2017-2019, I observed how the space that the district coordinator occupied in the DSO office in Ajmer grew from one table in a shared room, to a room exclusively devoted to him to accommodate the increase in repair and maintenance work of the POS machines. The technicians took great pride in their work and considered themselves indispensable in keeping the PDS working since a functional POS machine was essential for PDS work. They also saw their work as crucial to curbing corruption in the PDS practiced by the dealers and spoke of working long hours to enable the PDS. One technician said,

*“I did not receive any training in the repair of these machines beyond the orientation workshop that the company conducted. I trained myself by watching YouTube*

*videos for issues related to the machine's battery, speakers and the motherboard. I often take the machines home and repair them after work hours because of the work load. If I don't do it, people will not get their rations, but I don't mind this at all. It is because of the POS machine that the dealers are prevented from cheating the poor of their entitlements so I feel very proud of playing a role in maintaining the machines. In the early days of the transition, the dealers used to deliberately break the machines because they did not want to implement the biometric system. The government would replace these machines for free, but we have now begun charging the dealers so the incidence of deliberate damage has decreased.”*

Along with hardware articulation, the state was also responsible for software articulation work that was performed by engineers working in Jaipur. Interestingly, for the engineers, the POS machine itself was not an object of interest. One engineer said,

*“The POS machine is more like a client server based model and any machine which runs the client server in the field is okay for us. We are more interested in the data that is traveling rather than the hardware it uses.”*

The articulation work that engineers performed on the POS machine was mainly centered around software enhancements and maintenance to ensure that the data was regularly updated for the National Informatics Centre (NIC) to manage the MIS. For instance, following the pandemic, the POS software had to be modified to switch from biometric authentication to OTP authentication. Next, it had to be tweaked to accommodate multiple food commodities that were included in the PDS for pandemic relief distribution. Another modification that the engineers made was to program the machine to send reminder alerts to the dealers to maintain social distance and use a hand sanitizer after every biometric authentication procedure. An engineer who was involved in the transition to the e-PDS from the very beginning said,

*“The software requires constant maintenance by way of enhancements that we make in response to feedback, requirements that we receive from different government officers, or in response to state legislature or parliamentary questions on PDS data. Having the POS software work in this way is a big achievement for us. When we began designing it, nobody was aware of how it should look like and we spoke to a lot of people in the PDS. We also undertook field visits to see the offline PDS transactions to design the software. I have grown up seeing and hearing about corruption in the PDS and it is very satisfying to see how we have changed it. We have built the software from scratch and are very proud of the way we are responsive to the way the system evolves in accordance with the needs of the PDS.”*

The pride and satisfaction that the state representatives took in the e-PDS is also on visible display in their offices. The workstations of the state representatives often had clippings of old news reports from 2016 that detailed the efforts and success of the government in successfully implementing the POS machines across Rajasthan. In their interviews, the state representatives also agreed that they



were emotionally invested in their work they included the designing, implementing, and maintenance of the project. They considered the transition to the e-PDS, a successful achievement in fighting corruption for which they could claim credit.

## 5.2 The moral biography of the POS machine: Between rights and wrongs

The practice of corruption by dealers continues to be a regular and prominent discourse in the PDS and is often invoked by state representatives to defend the POS machine, which now mediates as a 'referee' [3] between the beneficiary, dealer, and the government. Most dealers who participated in this study were unhappy on some count with the introduction of the POS machine in the PDS process owing to infrastructural challenges and longer working hours. It is also why I faced very little resistance from dealers when I requested access to their PDS shops for interviews and observations. They dealers would urge me to write about the infrastructural breakdowns that obstructed the disbursement process and listen to the beneficiaries' complaints about the POS machine.

The resistance to the POS machine from the dealers was so pronounced that in one instance, early during the fieldwork, a dealer even staged a pretend breakdown of the POS machine by claiming that the high gain antenna was not fitting into the machine and hence he would not be able to process any transactions. The waiting beneficiaries grew vocal in their complaints and disappointments over the POS machine and agreed with the dealer that this was a frequent occurrence. However, the dealer's subterfuge that was staged for my benefit, was revealed when the POS machine technician with whom I had previously arranged to meet for an interview at the shop, arrived and fixed the issue immediately. The dealer continued to underscore that this repair work too resulted only in a weak, fluctuating Internet signal that was still insufficient to process transactions. The technician revealed to me in private that the dealer had removed a screw which hindered the high gain antenna from fitting into its slot in order to show me how the POS machine hindered the PDS process.

As Dreze et al note, dealers arguably have a negative view of the POS since it makes it harder for them to cheat [9]. This is also echoed by state representatives who say that dealer non-cooperation is a prime reason why the POS functionality is hindered. Several officers in their interviews mentioned the vandalism and damages that the dealers had inflicted on the POS machines when it was first introduced in the PDS. One state representative recalled,

*"We had an incident in which the dealer had immersed the POS machine in a barrel of kerosene to damage the machine. In another instance, a dealer said that the machine sparked and burned itself, but when we visited his shop we saw that the table on which the POS machine was placed was intact with no sign of burning. It was clear that he had set fire to the machine somewhere else and then placed its remains on the table. Dealers mislead beneficiaries about facing connectivity issues so that beneficiaries face challenges and will protest against the machine."*

These incidents that state representatives witnessed during the early days of the e-PDS transition have also primed them to take a

very unsympathetic view about the infrastructural challenges that dealers continue to report even four years after the POS was first introduced. One officer said,

*"We had identified around 120 villages in 2015 that were located in 'shadow areas' where no internet connectivity was possible and POS machines could not be implemented. We permitted these dealers to continue with offline transactions. The shadow villages are now down to 68 and we will be ensuring they get connectivity by October 2020. Most of the complaints from dealers is actually just non-cooperation in the guise of connectivity challenges."*

The experiences of the state representatives with the dealers resistance to the POS machines colors their reaction to the infrastructural challenges that dealers face in authenticating biometric transactions. Although no village where this fieldwork was conducted was identified as a shadow village by the state, the infrastructural challenges that I observed during the two years of fieldwork were still significant, which was brushed aside by the state representatives as deliberate attempts by the dealers to create discontent against the POS machines.

Ultimately, it is the beneficiaries who bear the brunt of the moral ambiguity and suspicion that exists between the state and the dealers, with even biometric authentication failures not viewed with any particular sympathy by the officers. State representatives frequently expressed that it was only a matter of washing their hands, which the poor were not mindful about. One officer said,

*As far as biometric authentication failures are concerned that happens because people do not clean their fingers properly so these failures are bound to occur. We have educated them about washing their hands with soap and if they do that there should not be a problem. In any case we have now permitted beneficiaries with genuine authentication challenges to enter their names in a bypass list and they don't need to deal with the POS machine any more."*

Even as they found themselves on the receiving end of the state's suspicion, the dealers interestingly also had moral opinions on the POS machine's functionality that critiqued the state. Several dealers commented on the overt political branding of the POS machines by the ruling political party in Rajasthan. When the first round of fieldwork was conducted in March 2017, the Bharatiya Janata Party (BJP) was in office in Rajasthan. In their interviews, dealers objected to the BJP government branding the POS machines in saffron, which is the BJP's party color. The dealers also objected to the BJP's party symbol of the lotus being branded on the POS machine and on the printed receipts that were given to beneficiaries once they successfully completed authentication. One dealer said,

*"Government schemes should be free of political branding. Even the Bhamashah state ID cards given to us (a financial inclusion program) have Vasundhara Raje's (the former chief minister) photograph. This is wrong and should not be permitted because this is also corruption. Who will track this?"*

By December 2018, the BJP had been voted out of office and the Indian National Congress party who formed the government, replaced the lotus symbol on the POS machine and receipts with an image of wheat stalks to represent food security. This was a move that most dealers approved.

Although in a minority, there were also dealers who were in favor of the machine. These dealers had equally strong moral reasons for their support, despite their own hardships and dissatisfaction with the POS machines. One dealer said that the machine represented governance by a rule that had been enforced in national interest by the Indian prime minister, Narendra Modi. This dealer self-identified as a “*desh bhakt*” (patriot) and a die-hard supporter of the prime minister’s digital India initiatives that including his sudden move in 2016 to demonetize high value currency notes. He said,

*“Routing transactions through devices like the POS machine means that there is a strong rule in place to govern things. These machine are like the strong rule of Modi ji. He is a satyavad (honest) man and he is increasing the use of machines like the POS everywhere by doing things like demonetization. These machines are about becoming digital so they are also going to make the country stronger.”*

Surprisingly, this dealer faced severe and chronic internet connectivity issues that caused him immense trouble in distributing ration. Referring to the extra time and labor he had to put in, this dealer equated his longer working hours as a form of service to the nation. He said,

*“I don’t mind the time it takes to distribute the ration and I don’t think the beneficiaries should complain about the inconveniences either because this is the right thing to do for the country.”*

This dealer’s point of view was almost unanimously shared by all the state representatives I interacted with for this study. They frequently invoked references to the prime minister’s Digital India campaign and said that the POS machine would be able to track every transaction and eliminate corruption. An officer who walked me through a presentation on the PDS showed me several news reports from local newspapers on dealers giving up their shop licenses since it was no longer possible to profit from food grain diversion and hence they did not find it worthwhile to persist with their PDS dealership.

On their part, while no dealer admitted to their involvement in corruption in the interviews, they were vocal in their opinion that it was no longer possible for them to sustain their families on the PDS commission that they received. They said that this was because of reasons such as a decrease in the number of beneficiaries receiving entitlements because of biometric authentication failures, which adversely impacted their commission. The dealers frequently planned protests against the POS machines on their WhatsApp groups and they would sometimes show me the messages that they received on their planned meetings with the state authorities. Their efforts ultimately led the government to concede a nominal hike in the commission after which their protests stopped. While the dealers denied engaging in corruption, public perception about their own morals led some of them to express grudging satisfaction with the POS machine because they felt that it improved their image. While

complaining about the connectivity and authentication failures that increased his work load, one dealer said,

*“In one way I am glad that the POS machine is now tracking the transactions. Earlier, people would always whisper about the alleged corrupt practices of PDS dealers. I am sure people thought the same about me too even though I am an honest man. At least with the POS machine now there won’t be any loose talk about my morals.”*

The beneficiaries on the other hand, did not share commonality with the state’s view of the moral values that the POS machine enforced on the PDS process. Their primary concern remained the inconvenience it caused them in getting their entitlements. Even people who faced no authentication challenges opposed the machine because of the extra time that it now took for them get their quota of food aid. One man whose mother was ill and was the sole beneficiary on her ration card after his father passed away said,

*“The POS machine does not allow me to collect my mother’s share of wheat. She is unable to personally come to the shop and authenticate her fingerprints since she is bed ridden. How can a system like this be good for anyone?”*

The beneficiaries who were challenged by authentication failures often made references to their poverty and expressed their anger at the machine being indifferent to their suffering. A common refrain among the beneficiaries as noted previously [42] was, “*yeh machine garib logon ko pareshaan karti hain*.” (The machine troubles poor people). Other sentiments that beneficiaries expressed included, “*dukhi karti hain, yeh machine*” (This machine makes us sad) or “*bandh kar do machine ko*” (Shut down the machine). Beneficiaries would often refer to the audio prompts of the POS machine to complain about it. Their characterization of the machine would include statements such as “*galat bolti hain machine*” (The machine utters incorrect things) and “*machine kuch bolti hi nahin*” (The machine does not say anything).

### 5.3 The knowledge biography of the POS machine: Between transparency and opacity

While the most prominent functionality of the POS machine on the field is its facilitation of biometric authentications, the machine is particularly valued by the government administrators for making every transaction transparent to them in real time. During the course of our interview, one officer opened the MIS and expressing praise for the POS machine, read out the statistics of the PDS transactions that were being recorded and updated through the POS machines even as we were talking. The state representatives argue that the data from the POS machine brings transparency to the government while also empowering beneficiaries. A point frequently stated by the officers was that biometric transactions allowed beneficiaries to retrieve details of any transaction on the PDS website. Moreover, the POS machine also provided printed

receipts with details about their transaction every time the beneficiaries completed authentication that ensuring accountability of dealers to the beneficiaries and the government.

However, the instances that officials cite as empowering and transparent for the beneficiaries are of little use to the beneficiaries themselves who instead find the POS machine procedures, a very opaque process. For instance, since the dealers are able to operate the POS machine only by turning it towards themselves, the beneficiaries cannot read the small screen display that remains visible only to those who are directly bending over it. Even with the audio prompts, the transaction process remains a mystery to the beneficiaries, with very few being able to adequately explain the procedure and the steps that the dealer performs on the POS machine to authenticate their fingerprints. Beneficiaries often do not know that the dealer enters their ration card number and selects their name from the list of family members who are displayed on the machine. A common explanation by beneficiaries who are below the poverty line is that they are illiterate and understand nothing about what the dealer is doing with the machine. When asked to explain the POS transactions, even the literate and educated beneficiaries, shrug and say that they just listen to the audio prompts or depend on the dealer to tell them what to do. This can sometimes lead to transaction errors that could be easily fixed if the beneficiaries were aware of the transaction process.

In one instance, a 13-year-old girl and her parents were puzzled by the repeated failure of all of her ten fingerprints that the POS machine declared as failed authentications. I asked the dealer to walk me through the process from the very beginning and we soon discovered that he had incorrectly selected the girl's sister's name for authentication and neither he nor the girl's parents had checked to see whose name from the family had been selected for authentication. Thus the transparency that the audio prompts bring to the transaction process is only partial and of little use to the beneficiary if a mistake is made since it does not provide them with the relevant information that they could use to check the process—such as the name of the person entered by the dealer to perform the biometric authentication or a confirmation of the quantity of food grains that is weighed for them at shops where the beneficiaries depend on the dealer to weigh their entitlements for them.

When asked if they found the receipts that the POS machine printed for them useful, beneficiaries often said that once they collected their ration, they did not really care about the receipts and they often discarded them on exiting the PDS shops. Some would ask me if I would like to save their receipts to help in the writing of my report. Beneficiaries who had stable mobile numbers that were correctly linked to the Aadhaar and PDS database would also receive SMS alerts after collecting their entitlements and while some of them expressed satisfaction at receiving a text message, they did not find it useful information that they could use in any meaningful manner since they received the messages after they had already successfully authenticated and collected their rations.

State representatives' emphasis on the extent of public transparency that the POS machine has brought to the PDS is also more amplified than what public records reflect. The details of failed biometric authentications or the number of trials that a person undertook in order to be successfully authenticated are not available on the PDS website. The state representatives are particularly wary

about displaying the biometric failure rates to the public although the MIS captures all details and these numbers are readily available to officers themselves. When asked about why biometric failure rates are not displayed on the website along with other transaction details, one officer said,

*"The biometric failure rates are not relevant to the beneficiaries. We are giving them details about their own transactions, which is what is important to them. Statistics are misleading and can often hide more than they reveal. If we display this data to the public, who knows how they will twist it and what they will say about the PDS process. If I share the data with you, I will not know what you will write about it."*

I asked the officers to comment on the biometric failure rates that was often cited by civil society activists who opposed the introduction of biometrics in the PDS and he said,

*"The number of POS devices currently deployed in Rajasthan are 26,737. More than 40 crore transactions have been routed through POS since we transitioned to the e-PDS and we average around 1.2 crore transactions every month now. The POS uptime is at 98.83% which means that if more than 50 transactions are done in a month, the machine is considered functional. These are huge figures from a bird's eye view. If in this scenario, a few people face authentication failures then does that mean the system is a failure? I would say no, since the aggregate figures are satisfying to me. In any case, if a beneficiary is facing trouble authenticating their fingerprints, we have created a bypass mechanism that they can now use to petition us and get their name added to a list, which will not require them to authenticate their biometrics anymore. As of now only around 40 thousand people have been added to the bypass list, which means that the system is still working for everybody else."*

The bypass list that the officer was referring to was created by the state in response to complaints that the elderly and the ill faced in authenticating their fingers and they are now excused by the state from complying with authentication requirements [42]. Since the PDS is not universal and only covers 2/3<sup>rd</sup> of the country's population according to eligibility criteria as determined by the NFSA [1], there is a steady stream of people awaiting inclusion in the food security program. Officers revealed that they remove beneficiaries from the PDS if there is no record of them having claimed their entitlements for more than three months in a row as that was one way to make place for new beneficiaries in the PDS.

Given the challenges in performing biometric authentication, beneficiaries stand to lose their food security if their authentication fails for three months in a row. Therefore, getting on to the bypass list is crucial for beneficiaries whose authentications are prone to failure. Getting on to the bypass list and staying on it is dependent on the examining state authority's conviction about the beneficiary's inability to complete authentication. Officers said that they examined the beneficiaries' fingers to ascertain if they were worn out owing to age, labor, or illness of any kind or if the beneficiary had sufficient reasons for limited mobility. Once these

conditions were satisfied, they approved the beneficiary for inclusion on the bypass list. However, the inclusion of beneficiaries on the bypass list was not permanent and had to be renewed by them by appearing before a state authority and securing approvals every year [42].

## 6 DISCUSSION

The POS machine represents a field translation of the Aadhaar infrastructure's biometric implementation in the PDS to ensure the targeted inclusion of beneficiaries and to deter corruption. In its narrative, the machine finds itself embedded in three different and complex biographies that speak to the practice, morals, and knowledge dynamics surrounding PDS welfare delivery. The biographies stem from the POS machine's design and functioning in the field as well as the experiences of the beneficiaries, dealers, and state authorities who engage with it in different capacities. Their elaborations on the machine offer insights on the way welfare inclusion is situated and achieved within the motivations and compulsions of the three stakeholders along with the infrastructural conditions and bodily limitations that complicate the biometric authentication process.

That tensions around the POS machine exist is not surprising. Past studies acknowledge that the design and real world deployments of infrastructures are riven with frictions arising from the partial and uneven overlaps between heterogeneous infrastructural arrangements [34] that producing seamful spaces [69]. Singh and Jackson observe that for the PDS beneficiaries, inclusion is a constant work-in-progress owing to frictions arising from seamful spaces between the PDS database and the Aadhaar infrastructure [54]. Extending their observation, this study shows that infrastructural seams in the Aadhaar-based PDS system can equally arise within the boundaries of a single infrastructural artifact such as the POS machine and its design is consequential for how welfare inclusion is achieved.

Even as the state claims the twin goals of targeted inclusion and fraud elimination as motivations for introducing the POS machine in the PDS, the design considerations of the machine are motivated primarily by the state's own requirements for data rather than a participatory approach of artful integration [62] that would integrate the compulsions and experiences of the end user beneficiaries and dealers in its design. As Suchman writes, assessing the objects in the environments of their intended use should be central in evaluating the adequacy of its design [62]. However, the PDS beneficiaries and dealers concerns are absent or minimized from the design decisions around the POS machine. In this, the design of the POS machine, interestingly, mimics the way that end users were observed to be absent in the design workflow of the Aadhaar infrastructure itself. Much like the production of the PDS depends on the articulation labor of the dealers and beneficiaries, the creation of the Aadhaar database too, ultimately depended on the inventiveness and resourcefulness of agents whose articulation labor during the enrollment process ensured the eventual data quality of the biometric database [28].

Correspondingly, it is also useful to examine what the state considers as successful in the working of the PDS. Officers claim both satisfaction and pride in offering aggregate figures of transactions

and uptimes of POS machines as proof of the success of the PDS. Similar to how matters of scale assume centrality in the building of Aadhaar [55], the state representatives working on the PDS too express gratification in amplifying the mammoth proportions of the project. In foregrounding the scale at which the PDS is managed through the POS machines, they define its efficiency in terms of the large numbers of authentication transactions that the PDS successfully processes. Within this framework of evaluation, complaints about authentication challenges and failures are dismissed as outliers or aberrations in the larger scheme of things. The struggles and labors that beneficiaries and dealers face in grooming their bodies and engaging in local infrastructure articulation work for the PDS remain unacknowledged and lost.

The work of human infrastructures in holding together and stitching seamful spaces to ensure the successful implementation of technology initiatives, is well acknowledged in HCI scholarship [8, 20, 54] and emerges as an important consideration when designing for welfare delivery in low resource environments. The functional scale of POS machine operations can conceal the challenges of human infrastructural work that beneficiaries and dealers undertake to work for inclusion. Recognizing the residual and orphaning experiences that beneficiaries face when confronted with biometric authentication failures and the challenges that dealers face in patching infrastructural failures is crucial in designing field infrastructures for welfare programs such as the PDS [42, 44, 59]. Echoing Amartya Sen's social justice conceptualization of *niti* and *nyaya* that was discussed in a previous paper [42, 53], it is useful to reiterate that values such as morality, human rights, and ethics emerge as equally forceful considerations in determining how social welfare goals such as food security are accomplished [42, 52, 53]. These values need to be fully accounted for in the design of welfare delivery by recognizing the user experiences of beneficiaries who are the targets of inclusion in the PDS and the dealers who mediate the process between the state and the beneficiaries.

The state representatives' perspectives on scale is also revealing of how beneficiary inclusion gets counted in welfare programs. In its present form, the state operates with a narrow view of inclusion. It considers the receipt of entitlements that is recorded by the POS machine at the very end of the PDS disbursement process as an adequate measure of beneficiary inclusion. The PDS can benefit from a broadening of how inclusion is conceptualized by moving the point of inclusion to the beginning of the design process rather than at the end of the PDS process. A starting point to rethinking inclusion would be to acknowledge that beneficiary complaints with the POS machine are rooted in real world infrastructural challenges arising from infrastructural and bodily limitations that do not always accurately reflect the state's perspective on hygiene and morally suspect dealers. An inclusive view of inclusion will also allow the state to play a fruitful role in the imbrication of seams in the PDS [54] by proactively addressing the needs of other stakeholders in their design decisions instead of the beneficiaries and dealers alone bearing the burden of performing articulation work.

In this context, the perspectives of the state engineers and technicians who are engaged in the practical work of design and repair and maintenance of the machine, makes for an interesting commentary on the conditions of their work on the POS machine. In their interviews, state representatives in different roles and at

different hierarchies frequently expressed pride in their work on the POS machine and interpreted it as an opportunity to perform good citizenship behavior. They positioned their labor as an important contribution in eliminating corruption and their way of contributing to nation building. Similar to observations made by Irani [25] the state representatives in this study too did not explicitly speak of citizenship, but perceived their work on the machine as “doing their bit” [pp. 60] by situating it within the larger discourse of their membership and labor toward making the country stronger.

It is noteworthy that the state representatives who constantly articulate on the POS machine's hardware and software, accomplish their work within the boundaries of professional skills and the job roles that they have been hired to perform. Their interactions with the POS machine are bookended either at generating and designing functions for the POS machine as engineers or repairing and maintaining the machine as technicians in case of breakdowns. They do not interact with the POS machine when it is actively processing biometric authentications on the field and they do not share similar experiences of the machine with the dealers and beneficiaries. The state representatives are hence organically able to align their professional work on the POS machine within the larger discourse of the country's progress and claim a sense of intrinsic satisfaction and achievement in resolving the country's problems. In contrast, the dealers and beneficiaries labor at improvising, generating, and enacting local infrastructural competencies and personalized body grooming activities in order to meet the demands of the machine to produce the PDS and ensures inclusion in the welfare system. Therefore, they find this articulation labor incompatible and hostile to their contexts and values of work, life, and infrastructural conditions [42, 44].

The knowledge that the POS machine generates and which is made public by the state to claim transparency, often has scant relevance to the beneficiaries on the field who are usually unconcerned about the POS machine data and what it reveals about their transactions. They find little transparency in their own transaction process with the machine and continue to rely on the dealer who processes their authentications. The beneficiaries remain ignorant and oblivious to errors that the dealer may be making in the steps to process their transactions since they are unable to see the machine's display and the information issued by the audio prompts do not contain useful information that is customized for their transactions. While the POS machine satisfies the state's need for information, it remains selective in what it makes available to public and essential information on the details of the biometric authentications remain hidden.

Ultimately, just like the audio prompts that enable the POS machine to speak and make itself heard on the field, the kind of biography that is written and read about the POS machine in the present functioning of the PDS, foregrounds and privileges the state's practices, moral imperatives, and knowledge requirements to administer the system. Through the POS machine, the state is able to speak to its welfare citizens, inform them about its evaluation of their bodies' biometric suitabilities, but its design is unable to listen to their responses. In its present iteration, the PDS is yet to incorporate the field biographies of the POS machine that are generated by the dealers and beneficiaries, which limits the POS

machine biography from being an inclusive account of welfare design and delivery.

## 7 LIMITATIONS

While the paper is concerned with the way inclusion is embedded and performed in the technology design of a biometric welfare artifact, it presently does not report on caste considerations that may be influencing the design of the POS machine and its role in the biometric authentication process. Given that the Hindu caste system's influence is not limited to Hindus alone and determines inclusion and exclusion in various contexts depending on the position an individual occupies in the caste hierarchy, this can be an important analytical category for future work examining design considerations in welfare contexts in India. The absence of an explicit caste analysis in this paper is because beneficiaries themselves did not report their caste identities playing a role in the success or failures of their biometric authentication. Instead, people from all castes pointed to their advancing age or engagement in manual labor as a reason for experiencing authentication failures.

Since social proximity and touch is very central both to authentication as well as caste interactions, as seen in the practice of untouchability, I did not directly observe explicit caste-based discrimination playing out in the authentication process on the POS machine. The biometric authentication process is a public process that is marked by long queues and beneficiaries huddled closely together while awaiting their turn at authentication. As described in previous work, beneficiaries often examine each other's hands while waiting for authentication and sometimes even rub their fingers on other's bodies and scalps to clean their fingers while performing authentication [42]. I also did not find direct evidence of beneficiaries refusing to perform authentication on the POS machine if members of another caste had touched the machine before them. Dealers too did not clean the machines after every authentication transaction to address any caste-based objections of having a common touch point.

However, as noted by Vaghela et al, [67] the nature of contemporary caste in India manifests in different ways in urban, semi-urban, and rural settings and my unfamiliarity with the caste positionality and dynamics of the rural beneficiaries and rural Dalits who seek inclusion in the PDS may occlude a nuanced reporting of caste concerns that shape the design and the working of the POS machine in the PDS. Additionally, as reported in other studies on the PDS, Dalit beneficiaries themselves may have internalized oppressive caste views and practices that do not allow them to fully recognize the role caste plays in their exclusion or because they fear violence and boycott in retaliation for expressing caste discrimination against them [66].

Drawing from fieldwork, I offer reflections on caste and the larger compulsions of touch in the fingerprint authentication process in speculative work [43] and future studies could incorporate these considerations in their fieldwork.

## 8 CONCLUSION

This paper reports an ethnographic investigation of the biometric POS machine that is used to administer the PDS, a food security welfare program in India. Using the biography framework, it offers

a multi-sited and embodied perspective of three primary stakeholders in the PDS, the state representatives, the dealers, and the beneficiaries, who engage with the POS machine to accomplish welfare inclusion. It finds that the stakeholders engage with the POS machine on practical, moral, and knowledge terms that reveals the tensions and frictions in the functioning of the PDS. The paper contributes to HCI scholarship by including the perspectives of bureaucrats and government representatives who are usually understudied as end users. It surfaces the ways in which the design of the POS machine prioritizes the needs of the state in determining how inclusion is determined and achieved in the PDS. Biometric technologies implemented in welfare programs like the PDS, seek to champion fiscal advantages by advancing arguments about the targeted inclusion of beneficiaries and a reduction in corruption, however the beneficiaries themselves do not figure as end users in the design of infrastructures that are meant to uphold the welfare agenda. Even as larger debates on the appropriateness of biometric technologies continue [36], designing for welfare inclusion and beneficiary rights would be well served by acknowledging the multiple, situated biographies of field artifacts such as the POS machine that enables the PDS.

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## REFERENCES

- [1] National Food Security Act. 2013. The Gazette of India. Retrieved from [http://www.egazette.nic.in/WriteReadData/2013/E\\_29\\_2013\\_429.pdf](http://www.egazette.nic.in/WriteReadData/2013/E_29_2013_429.pdf)
- [2] Madeleine Akrich, 1992. The De-Scriptio of Technical Objects in Bijker and Law (eds.) Shaping Technology/Building Society: Studies in Sociotechnical Change
- [3] Syed Intishab Ali. 2016. Fair Price Shop Dealers Intensify Protest for More Commission. The Times of India. Retrieved from <https://timesofindia.indiatimes.com/city/jaipur/Fair-price-shops-dealers-intensify-protest-for-more-commission/articleshow/51630348.cms>
- [4] Anthony Amicelle, Claudia Aradau, and Julien Jeandesboz. 2015. Questioning Security Devices: Performativity, Resistance, Politics. *Security Dialogue*. 46.4, 293-306. <https://doi.org/10.1177/0967010615586964>
- [5] Arjun Appadurai. 1986. Introduction: commodities and the politics of value. In *The Social Life of Things: Commodities in Cultural Perspectives*. Ed. Arjun Appadurai. pp. 03-63. Cambridge University Press.
- [6] Kristin Boehner, Janet Vertesi, Phoebe Sengers, and Paul Dourish. 2007. How HCI Interprets the Probes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1077-1086. New York, NY, USA: Association for Computing Machinery. <https://dl.acm.org/doi/10.1145/1240624.1240789>
- [7] Geoffrey Bowker and Susan Leigh Star. 2000. *Sorting Things Out: Classification and its Consequences*. Cambridge, MA: MIT Press.
- [8] Rajesh Chandwani and Neha Kumar. 2018. Stitching Infrastructures to Facilitate Telemedicine for Low-Resource Environments. In *Proceedings of the 2018 SIGCHI Conference on Human Factors in Computing Systems*. New York, NY, USA: Association for Computing Machinery. <https://doi.org/10.1145/3173574.3173958>
- [9] Bidisha Chaudhuri and Lion Koenig. 2018. The Aadhaar Scheme: A Cornerstone of a New Citizenship Regime in India? *Contemporary South Asia*. 26: 2. 127-142. <https://doi.org/10.1080/09584935.2017.1369934>
- [10] Bidisha Chaudhuri. 2019. Paradoxes of Intermediation in Aadhaar: Human Making of a Digital Infrastructure. *South Asia: Journal of South Asian Studies* 42 (3). 572-587. <https://doi.org/10.1080/00856401.2019.1598671>
- [11] Bidisha Chaudhuri. 2020. Distant, Opaque, and Seamful: Seeing the State through the Workings of Aadhaar in India. *Information Technology for Development*. 1-13. <https://doi.org/10.1080/02681102.2020.1789037>
- [12] Juliet Corbin and Anselm Strauss. 2008. Theoretical Sampling. *Basics of Qualitative Research*. Sage Publications.
- [13] Jean Dreze and Reetika Khera. 2015. Understanding Leakages in the Public Distribution System. *Economic and Political Weekly*. 1:7. 39-42.
- [14] Jean Dreze. 2016. Dark Clouds Over the PDS. The Hindu. Retrieved from <http://www.thehindu.com/opinion/lead/Dark-clouds-over-the-PDS/article14631030.ece>
- [15] Jean Dreze, Nazar Khalid, Reetika Khera, and Anmol Somanchi. 2017. Aadhaar and Food Security in Jharkhand. *Economic & Political Weekly* 52: 51.
- [16] Michaelanne Dye, David Nemer, Laura R. Pina, Nithya Sambasivan, Amy S. Bruckman, and Neha Kumar. 2017. Locating the Internet in the Parks of Havana. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 3867-3878. DOI: <https://doi.org/10.1145/3025453.3025728>
- [17] Virginia Eubanks. 2018. *Automating Inequality. How High-Tech Tools Profile, Police, and Punish the Poor*. St. Martin's Press. New York.
- [18] Elihu Gerson and Susan Leigh Star. 1986. Analyzing Due Process in the Workplace. *ACM Transactions on Information Systems*. 4:3. 257-270.
- [19] Elihu Gerson. 2008. Reach, Bracket, and the Limits of Rationalized Coordination: Some Challenges for CSCW. In *Resources, Co-Evolution and Artifacts*. Springer London (2008), 193-220.
- [20] Xinning Gui and Yunan Chen. 2019. Making Healthcare Infrastructure Work: Unpacking the Infrastructure Work of Individuals. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 3867-3878. DOI: <https://doi.org/10.1145/3290605.3300688>
- [21] Meghan K. Halpern, Ingrid Erikson, Laura Forlano, and Geri K. Gay. 2013. Designing Collaboration: Comparing Cases Exploring Cultural Probes as Boundary-Negotiating Objects. In *Proceedings of the 2013 Conference of Computer Supported Cooperative Work, 1093-1102*. CSCW'13. New York, NY, USA: Association for Computing Machinery. <https://dl.acm.org/doi/10.1145/2441776.2441900>
- [22] Donna Haraway. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge
- [23] Donna Haraway. 2000. Morphing in the Order: Flexible Strategies, Feminist Science Studies, and Primate Revisions. In *Primate Encounters: Models of Science, Gender, and Society*. Eds. Shirley Strum and Linda Fedigan. University of Chicago Press.
- [24] Sampsa Hyysalo, Neil Pollock, and Robin Williams. 2019. Method Matters in the Social Study of Technology: Investigating the Biographies of Artifacts and Practices. *Science and Technology Studies*. 32.3. 2-25. <https://doi.org/10.23987/sts.65532>
- [25] Lily Irani. 2019. *Chasing Innovation: Making Entrepreneurial Citizens in Modern India*. Volume 22. Princeton University Press. <https://escholarship.org/uc/item/3239b1qv>
- [26] Katya Lindskov Jacobsen. 2015. Political Violence and Humanitarian Technology. Retrieved from <http://politicalviolenceataglance.org/2015/05/04/political-violence-and-humanitarian-technology/>
- [27] Katya Lindskov Jacobsen. 2017. On Humanitarian Refugee Biometrics and New Forms of Intervention. *Journal of Intervention and State Building*. <https://doi.org/10.1080/17502977.2017.1347856>
- [28] Aditya Johri and Janaki Srinivasan. 2014. The Role of Data in Aligning the 'Unique Identity' Infrastructure in India. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*. pp. 697-709. <https://doi.org/10.1145/2531602.2531687>
- [29] Naveena Karusala and Neha Kumar. 2017. Women's Safety in Public Spaces: Examining the Efficacy of Panic Buttons in New Delhi. In *Proceedings of the 2017 SIGCHI Conference on Human Factors in Computing Systems, CHI'2017*. pp. 3340-3351. <https://doi.org/10.1145/3025453.3025532>
- [30] Reetika Khera. 2011. Revival of the public distribution system: evidence and explanations. *Economic and Political Weekly*. 36-50.
- [31] Reetika Khera. 2011. The UID Project and Welfare Schemes. *Economic and Political Weekly*. Vol. 46. 9. 38-43.
- [32] Reetika Khera. 2018. The Aadhaar Debate: Where are the Sociologists? *Contributions to Indian Sociology*. 52 (3). 336-342. <https://doi.org/10.1177/0069966718787029>
- [33] Igor Kopytoff. 1986. The Cultural Biography of Things: Commoditization as a Process. In *The Social Life of Things: Commodities in Cultural Perspectives*. Ed. Arjun Appadurai. pp. 64-91. Cambridge University Press.
- [34] Martha Lampland and Susan Leigh Star. 2009. *Standards and their Stories: How Quantifying, Classifying, and Formalizing Practices shape Everyday Life*. Cornell University Press, Ithaca
- [35] Brian Larkin. 2013. The Politics and Poetics of Infrastructure. *The Annual Review of Anthropology*. 42:327-43.
- [36] Shoshana Magnet. 2011. *When Biometrics Fail. Gender, Race, and the Technology of Identity*. Duke University Press.
- [37] Megh Marathe and Priyank Chandra. 2020. Officers Never Type: Examining the Persistence of Paper in e-Governance. In *Proceedings of the 2020 SIGCHI Conference on Human Factors in Computing Systems CHI' 2020*. <https://doi.org/10.1145/3313831.3376216>
- [38] Noortje Marres and Javier Lezaun. 2011. Material and Devices of the Public: An Introduction. *Economy and Society*. 40 (4). 489-509.

- [39] Sneha Menon. 2017. Aadhaar-based Biometric Authentication for PDS and Food Security: Observations on Implementation in Jharkhand's Ranchi District. *Indian Journal of Human Development*. 11:3. 387–401. <https://doi.org/10.1177/0973703017748384>
- [40] Silvia Masiero. 2015. Redesigning the Indian Food Security System through e-Governance: The Case of Kerala. *World Development*. 67: 126–137.
- [41] Preeti Mudliar. 2018. Public WiFi is for Men and Mobile Internet is for Women: Interrogating Politics of Space and Gender around WiFi Hotspots. In *Proceedings of the 2018 ACM Human-Computer Interaction*. 2, CSCW, Article 126. <https://doi.org/10.1145/3274395>
- [42] Preeti Mudliar. 2020. Whither Humane-Computer Interaction? Adult and Child Value Conflicts in the Biometric Fingerprinting for Food. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. (CHI '20). Association for Computing Machinery, New York, NY, USA, 1–12. DOI: <https://doi.org/10.1145/3313831.3376564>
- [43] Preeti Mudliar. 2020. In Mangal's New World. In *Twenty-Four: Utopias for a Digital Society*. Ed. Benedikt Fecher. pp. 79–87. Alexander von Humboldt Institute for Internet and Society, Berlin, Germany.
- [44] Preeti Mudliar. 2020. Broken Data: Repairs in the Production of Biometric Bodies. In *Lives of Data: Essays on Computational Cultures from India*. Ed. Sandeep Mertia. pp. 89–98. <https://networkcultures.org/wp-content/uploads/2020/12/LivesofData.pdf>
- [45] Neil Pollock and Robin Williams. 2010. E-infrastructures: How Do We Know and Understand Them? Strategic Ethnography and the Biography of Artefacts. *Computer Supported Cooperative Work*. 19:521–556. <https://doi.org/10.1007/s10606-010-9129-4>
- [46] Ursula Rao. 2013. Biometric Marginality. *Economic and Political Weekly* 48, 13: 72–77. Retrieved from <http://www.epw.in/review-urban-affairs/biometricmarginality.html> 44.
- [47] Ursula Rao and Graham Greenleaf. 2013. Subverting ID from above and below: The uncertain shaping of India's new instrument of e-governance. *Surveillance & Society* 11, 3: 287–300.
- [48] Ursula Rao. 2018. Biometric Bodies, or How to Make Electronic Fingerprinting Work in India. *Body & Society*. 24(3): 1–27.
- [49] Samanwaya Rautray. 2018. Aadhaar Verdict: Legal, but Limit Use to Government Benefits, Says Supreme Court. *Economic Times*. Retrieved from <https://economictimes.indiatimes.com/news/politicsand-nation/aadhaar-verdict-legal-but-limit-use-to-government-benefits-says-supremecourt/articleshow/65973337.cms?from=mdr>
- [50] Simon Robinson, Jennifer Pearson, Shashank Ahire, Rini Ahirwar, Bhakti Bhikne, Nimish Maravi, Matt Jones. 2018. Revisiting "Hole in the Wall" Computing: Private Smart Speakers and Public Slum Settings. In *Proceedings of the 2018 SIGCHI Conference on Human Factors in Computing Systems CHI' 2018*. pp. 1–11 Association for Computing Machinery, New York, NY, USA.
- [51] Steve Sawyer, Ingrid Erickson, and Mohammad Hossein Jarrahi. 2019. Infrastructural Competence. In *Digital STS: A Field Guide for Science & Technology Studies*. Eds. Janet Vertesi and David Ribes. Princeton University Press.
- [52] Amartya Sen. 1988. Property and Hunger. *Economics and Philosophy*, 4, pp 57–68 doi:10.1017/S026626710000033X
- [53] Amartya Sen. 2009. The Idea of Justice. Harvard University Press.
- [54] Ranjit Singh and Steven J Jackson. 2017. From Margins to Seams: Imbrication, Inclusion, and Torque in the Aadhaar Identification Project. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 4776–4824. <https://doi.org/10.1145/3025453.3025910>
- [55] Ranjit Singh. 2019. Give Me a Database and I will Raise the Nation State. *South Asia: Journal of South Asian Studies*. 42: 3. 501–518. <https://doi.org/10.1080/00856401.2019.1602810>
- [56] Janaki Srinivasan and Aditya Johri. 2013. Creating Machine Readable Men: Legitimizing the 'Aadhaar' mega e-infrastructure project in India. In *Proceedings of the Sixth International Conference on Information and Communication Technologies and Development*. ICTD' 2013. Pp. 101–112. <https://doi.org/10.1145/2516604.2516625>
- [57] Susan Leigh Star. 1990. Power, Technology and the Phenomenology of Conventions: On Being Allergic to Onions." *The Sociological Review* 38, no. 1\_suppl (1990): 26–56.
- [58] Susan Leigh Star. 1999. The Ethnography of Infrastructure. *American Behavioral Scientist*. 43:3. 377–391.
- [59] Susan Leigh Star. 2006. Orphans of Infrastructure: Engendering, Commodifying, and the Making of NonPeople. Stanford University Event Calendar. Retrieved from <http://events.stanford.edu/events/97/9744/>
- [60] Susan Leigh Star and James R. Griesemer. 1989. Institutional Ecology, 'Translations' and Boundary Objects. *Social Studies of Science*. Volume 19, No. 3. pp. 387–420 <https://www.jstor.org/stable/pdf/285080.pdf>
- [61] Anselm Strauss. 1985. Work and the division of labor. *The Sociological Quarterly* 26, 1 (1985), 1–19. 40.
- [62] Lucy Suchman. 1993. Working Relations of Technology Production and Use. *Computer Supported Cooperative Work (CSCW)* 2, 1: 21–39.
- [63] Lucy Suchman. 1995. Making work visible. *Communications of the ACM* 38, 9 (1995), 56–64.
- [64] Reem Talhouk, Lizzie Coles-Kemp, Rikke Bjerg Jensen, Madeline Balaam, Andrew Garbett, Hala Ghattas, Vera Araujo-Soares, Balsam Ahmad, Kyle Montague. 2020. Food Aid Technology: The Experience of a Syrian Refugee Community in Coping with Food Insecurity. *Proceedings of the ACM Human Computer Interaction*, Volume 4, CSCW 2, Article 134 <https://doi.org/10.1145/3415205>
- [65] Martina Tazzioli. 2019. Refugees' Debit Cards, Subjectivities, and Data Circuits: Financial-Humanitarianism in the Greek Migration Laboratory. *International Political Sociology*. 13-4. pp. 392–408. doi: 10.1093/ips/olz014
- [66] Sukhdeo Thorat and Joel Lee. 2006. Dalits and the Right to Food – Discrimination and Exclusion in Food-related Government Programmes. *Indian Institute of Dalit Studies*. Working Paper Series. Volume 1: 3. <http://www.dalitstudies.org.in/download/wp/0603.pdf>
- [67] Palashi Vaghela, Ramaravind K. Mothilal, and Joyojeet Pal. 2020. Birds of a Caste? How Caste Hierarchies Manifest in Retweet Behavior of Indian Politicians. In *Proceedings of the ACM Human Computer Interaction*, Volume 4, CSCW 3, Article 212. <https://doi.org/10.1145/3432911>
- [68] Govert Valkenberg and Irma van der Ploeg. 2015. Materialities Between Security and Privacy: A Constructivist Account of Airport Security Scanners. *Security Dialogue*. 46:4. pp. 326–344.
- [69] Janet Vertesi. 2014. Seamful Spaces: Heterogeneous Infrastructures in Interaction. *Science, Technology & Human Values* 39, 2: 264–284.
- [70] Antina Von Schnitzler. 2013. Traveling Technologies: Infrastructure, Ethical Regimes, and the Materiality of Politics in South Africa. *Cultural Anthropology*. 28: 4: 670–693.
- [71] Anumeha Yadav. 2016. Rajasthan presses on with Aadhaar after fingerprint readers fail: We'll buy iris scanners. *Scroll.in*. Retrieved from <http://scroll.in/article/806243/rajasthan-presses-on-with-aadhaar-after-fingerprint-readers-fail-well-buy-iris-scanners>
- [72] Anumeha Yadav. 2016. In Rajasthan, there is 'unrest at the ration shop' because of error-ridden Aadhaar. *Scroll*. Retrieved from <https://scroll.in/article/805909/in-rajasthan-there-is-unrest-at-the-ration-shop-because-of-error-ridden-aadhaar>
- [73] Anumeha Yadav. 2016. Identity Project. *Scroll*. Retrieved from <https://scroll.in/tags/38792/identity-project>