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"Nothing is useless in nature": Delhi's repair economies and value-creation in an electronics "waste" sector

Abstract
This paper follows the return of electronic waste back into commodity circuits through widespread processes of reuse, repair and remanufacturing across Delhi, India. Tracing the movements of 'waste' from the scrap shop back into secondary use industries, I situate e-waste in India as operating primarily within economies of reuse and repair, rather than waste and recycling. Instead of managing waste, India's broad reuse industries are production-based, maintaining and making new things out of a diversity of new and used materials. The production of value from used things is dependent on the e-waste trader and the repair worker, who see the potential for seemingly unlimited trajectories of multitudinous conditions and configurations. This view of e-waste from the repair shop (and even the scrap shop) rather than a recycling factory offers a very different rendering of e-waste and particularly informal e-waste labor in the Global South than is presented in policy and popular media. Building on scholarship on vibrant waste economies, I demonstrate that India's electronic 'waste' sector is in fact a powerful source of value (and product) creation and call into question e-waste as a definitive "waste" product and its management in a "waste" economy.

Keywords
Electronic waste; reuse and repair; remanufacturing; informal economy; computers

The mother and her teenage son brought their Dell laptop to Kavita's[i] Nehru Place repair shop in south Delhi, India for an urgent repair. The screen's hinge was broken, and they were having a hard time opening and closing the laptop. Each time the laptop was opened, it got worse, and the plastic body near the screen was buckling from the bent metal hinge and threatening to break in half. The mother and son stood in the hallway in front of the shop, watching with the owner as her repairman inspected the laptop. The narrow shop had two small work spaces: the front counter that was placed at the entrance to the shop and a worktable in the back, outfitted with a soldering iron, a variety of screwdrivers, tweezers and replacement parts,

among other things. Praneet, the repairman, explained that in order to reach the part of the hinge that was broken, everything near it had to be removed, and he proceeded to disassemble the laptop.

It was then laid open and empty on the front counter so he could examine the frame. The laptop (is it still a laptop, without its insides?) was now a metal and plastic body with empty spaces of different shapes and sizes, its circuit board resting on top. The glass screen reflected its exposed and barren frame, and the countertop's white linoleum was visible through where the keyboard should have been. All its unattached parts were arranged on both the front counter and back worktable. As a colleague and I sat down to have a cup of chai with Kavita, Praneet took the laptop frame to the back table and soon returned with it, the hinge working perfectly. He hadn't replaced anything but had worked the hinge back into its proper position and shape and then secured it; this took about ten minutes.

Praneet then had to put the laptop back together again. On the front counter, he spread out around 30 little screws of different sizes, all saved from the computer's initial dismantling, and the various parts to reconnect. Over the course of around 20 minutes and without consulting any diagrams or notes, we all watched as he reattached the processor and the disc drive, connected the motherboard to the power cable, the power cable to the screen, the thin antennas for the wireless card (which run along a little track in the plastic frame), and the touch-sensitive mousepad to the motherboard. Every component had just enough space for itself, a belt here, some wires there, each getting connected in overlapping layers. Reposition the motherboard, secure everything, reattach the keyboard itself, do a final check, and then restart the computer. The entire process took around an hour and cost the mother and her son less than 500 rupees ($8).

After many visits to electronics repair shops in New Delhi, India, I became accustomed to seeing things *get fixed.* The ease and regularity with which everyday things in Delhi are repaired always struck my American self as exceptional, and I regularly commented to repairers that this rarely happens in the US – that in fact, repair was so uncommon and cost-prohibitive that it was often cheaper to buy a new device. Repairers and scrapers in Delhi were rarely surprised; an electronics scrap-dealer named Anuj was the first of several people to inform me that America was a "use and throw *desh*," or "use and throw nation" ("use and throw" was an English term I heard regularly from Hindi speaking waste dealers). Anyone dealing with electronic waste knew that waste from the Global North was thrown out much earlier than when they would consider a legitimate end-of-life, and it was easily inferred that very little repair work took place in the US.

In the context of global production networks and complex supply chains, work that revalorizes used and possibly non-working things can seem insignificant and thus easily overlooked in questions of value creation[ii]. Repair work in particular is often taken as part of a general culture of craftwork and juxtaposed to the more significant scale of industrial production (Carr and Gibson, 2016). In comparison with advanced manufacturing, the work of repair and resale of used goods can appear to be low-skilled or just old fashioned, like a sewing machine repair shop on Main Street: a relic from a time when people had less, and thus more deliberately participated in the maintenance of their things (Strasser, 1999)[iii]. Like the aforementioned broken computer, repair also suggests the management of small-scale and individual problems, not a bustling economy built on the repair, resale and manufacturing of used electronic devices and IT systems commonly subsumed under the term "electronic waste", or e-waste. Following Carr and Gibson's (2016) assertion on the importance of repair and efforts to re-inscribe such labor into larger practices of "making," along with Graham and Thrift's (2007) theorization of the city as

made through repair, and based on almost 2 years of research on India's e-waste sector in Delhi, I situate e-waste in India as grounded in and driven by economies of reuse and repair, rather than waste and recycling. This view of e-waste from the repair shop (and even the scrap shop) rather than a recycling factory offers a very different rendering of e-waste and particularly informal e-waste labor in the Global South than is presented in policy and popular media.

In rapidly spreading legal frameworks, policy reports and media exposes, e-waste has gained worldwide notoriety as a hazardous waste that is increasing at rapid rates, with its growth observed and predicted through reams of government and private data (Schluep et al., 2009; Chaturvedi and Bhardwaj, 2013). The presence and ubiquity of lead, cadmium, brominated flame retardants and other toxins in e-waste is clearly cause for concern about the management of these products after usage – what is often simplified to be their disposal (Iles, 2004; Agarwal et al., 2003). At the center of debates around the hazards of e-waste is the assertion that it is being handled predominantly by informal recyclers in cities like Delhi, Accra and Dhaka in the Global South, causing the migration of hazards and pollution to poor urban communities and contributing to the pollution of their local environments. The inferred cohesion and thus slippage between electronic waste and hazardous waste is based on the widely reported hazards of extracting metals from printed circuit boards using "backyard" informal processes, primarily acid baths and burning (Agarwal and Wankhade, 2006). The widely cited ubiquity of global trade in e-waste along with health and environmental dangers due to informal recycling have led e-waste in the global South to be framed as an environmental injustice[iv], with waste flows characterized as politicized "geographies of responsibility" (Walker, 2009) and the e-waste trade as "garbage imperialism" (Pellow, 2007). With the vast majority of India's e-waste work categorized as outside the formal economy – a widely agreed upon estimate is that the informal sector handles

over 90% of e-waste (Kandhari and Sood, 2010) – all work with used electronics has been easily overdetermined by this larger discourse on e-waste as a global "matter of concern" (Latour, 2004).

A growing body of incisive research on e-waste economies and global trade (Lepawsky and Billah, 2011; Grant and Oteng-Ababio, 2012; Reddy, 2013; Tong et al., 2015; Lepawsky et al., 2015; Gregson and Crang, 2015) complicates the now well-traveled discourse on e-waste as a hazardous environmental injustice, what Furniss (2015) calls "the neocolonial geographies of inequality paradigm." Scholars have pointed to changes over the past two decades in global trade relationships (Barrientos et al., 2016) and the nature of e-waste recycling (Lepawsky, 2015; Furniss, 2015) along with the continued over-reliance on a well-circulated but out-of-date narrative from the early 2000s, first set into motion by an American NGO, the Basel Action Network and its international partners. In particular, scholars (among them Lepawsky et al., 2015; Tong et al., 2015; Reddy, 2015) have noted that one Basel Action Network report, "Exporting Harm: The High-Tech Trashing of Asia" (Puckett, 2002), has been consistently cited in reports on e-waste in the Global South, and the now 15 year old report frequently provides the basic narrative on e-waste as a polluting injustice. Instead, recent critical scholarship on e-waste has endeavored to draw attention to the "disjuncture between this narrative of e-waste as primarily a hazard contrasted to the lively afterlives of e-waste" (Reddy, 2015, 168), focusing on the ways in which e-waste is part of vibrant waste economies that remake this 'waste' into new products, from metal locks to plastic DVD cases (Lepawsky et al., 2015). What has variably been called the "afterlives" of waste (Gidwani and Reddy, 2011) the waste-value dialectic (Gidwani and Maringanti, 2016), waste mining (Labban, 2014), global destruction networks (Herod et al., 2014), ongoingness (Lepawsky and Mather, 2011) and "the shit end of capitalism" (Gregson and

Crang, 2010: 1029) are all ways to connect waste to global circuits of capital and explain what happens to our waste, particularly our used commodities, after they are discarded. How is their value transferred, reinvented, or condemned, and what happens to their material bodies? How do their movements in space, value and identity shape cities, laws, and politics, and how do these in turn shape the waste?

In emphasizing the vastness of Delhi's extended *used electronics economy* and not its electronic waste sector, I argue that what is commonly known as India's informal e-waste economy is actually driven by vast reuse and repair industries that defer and reverse the transfer of used electronics into e-waste. Rather than being composed of peripheral labor processes feeding off the detritus of the formal economy – what is often understood as part of life at the urban margins (Lancione and McFarlane, 2016) – this article demonstrates that India's electronic 'waste' sector is in fact a powerful source of value (and product) creation. This approach necessitates distinguishing waste and its 'management' after death (including recycling, along with burning and landfilling, all of which occur in tandem with reuse industries in India and across the world) from different labor processes that facilitate its reuse and repair, rather than its wasting.

While reuse (in which I include repair, resale and reassembly of used devices and appliances) is sometimes casually referred to as "recycling" in the broader sense of "using again," and reuse is often included in broad definitions of waste management, I contest this categorical emphasis on *waste*. From a technical perspective, recycling consists of materials recovery processes through which a thing's original use and value are rendered insignificant and it is reduced to its constitutive materials (for example, plastic and metals) to become a raw material again – processes with very different material, political and economic meanings and

effects than those of reuse and repair work (Liboiron, 2016). This slippage between reuse and recycling, and in general the discussion of reuse as related to handling waste, is regularly reflected in scholarly and policy literature as well as waste management regulations, and is often difficult to escape. From the confines of the waste management hierarchy (which places reuse towards the middle in a hierarchy of waste management ideals, between the less preferable options of recycling and landfilling, and the more desirable waste minimization) to efforts to transcend waste beyond something to be managed, ordered, and rendered invisible, "reuse" is often something than can be done to "waste." For example, even as Gregson and Crang (2010: 1026) direct attention to the materiality or "stuff" of waste and argue that waste's common subsumption into discussions of management causes "the matter of waste [to become] fixed and limited," reuse remains stuck within the confines of debates on waste. Instead, through my study of reuse and repair, I call into question e-waste as a definitive "waste" product and its management in a straightforward waste economy, emphasizing processes of *making* electronics in place of their common categorization as electronic *waste* (Ingold, 2013). I contend that what is broadly called "e-waste" is only notionally waste, as it can exist in starkly different conditions and be enlisted in a variety of different labor processes. "E-waste" can be a high-quality working but used electronic device ready for resale; it can be composed of parts in various states of working or non-working condition that may be reused or repaired; or it can represent the most common understanding of e-waste: a device that contains within it different materials to be extracted through recycling processes (or headed to a landfill). E-waste is not static, and within its body it always possesses the potential to be something else, from the individual parts to the device itself.

In the following sections, I illustrate how what has been broadly called an electronic

'waste' economy in India - and, arguably, the entire world - rests on a relatively static understanding of waste and its supposed undeviating transfer into some form of waste industry – most significantly, the recycling industry. I follow stories of e-waste that accentuate the broadness and depth of work with used electronics, the diverse ways that e-waste is moved back into repair and manufacturing networks, and the processes of commodity production and manufacturing in what is supposed to be a "back-end" waste industry. Through examples of the reuse, storage, manufacturing and repair of things known as electronic waste, I show the material and temporal flexibility of e-waste and its embeddedness in non-waste production. This flexibility – the ability of electronic waste to become valuable again, to shift forms and become new products, to arise from its 'death' – is always mediated by inventive and resourceful workers whose labor is central to e-waste's becoming non-waste. The production of new value from used things is dependent on the e-waste trader and the repair worker, who can see the potential for seemingly unlimited trajectories of multitudinous conditions and configurations.

Revaluing rubbish electronics

In Michael Thompson's seminal work *Rubbish Theory*, "rubbish" is an impermanent and fluid cultural category and things are constantly "on the move" between categories, never comfortably resting in a state of rubbish or value. Rubbish is part of Thompson's (1979) trio of cultural categories, durables, transient and rubbish,[v] which separate things according to different values and lifespans. For Thompson, the flexibility of categories and regular movement of things between them is a necessary outcome of existing in a world with "socially unrealizable… combination[s] of…world views" between individuals and communities, in which things are differently valued and this difference is regularly confronted (90). Indeed, he argues that

negotiation of social difference within and between societies depends on the ability for objects to switch categories, and for the logics undergirding their categorization itself to be flexible. This is markedly different from Mary Douglas's (2002) more commonly cited approach to waste, which understands pollution as an expression of disorder or contamination for which social rules are developed. For Thompson, "rubbish" is not necessary negatively valued, and he barely dwells on the potentially socially-polluting nature of rubbish. Instead, social interaction consists of regular confrontation between different understandings of how things are valued and ordered, what Thompson (1979: 90) calls "world views," in which "[t]he survival of a world view can be ensured only by eliminating, rejecting, or ignoring these intrusive and dangerous elements that preclude the continued coexistence of differing world views. The elements that elicit such responses constitute the cultural category 'rubbish'". In other words, rubbish is an inevitable element of living amongst others and is the natural consequence of accepting constant contradiction in how we understand things and categories.[vi] Thus, Thompson's cultural categories of rubbish, transient and durable are fluid categories that not only allow for mobility of things between categories, but are relied upon for regular transfers. By basing his rubbish theory on following the movements between culturally determined material and temporal categories (instead of the common waste-related discussions of pollution, disposal and management in both cultural and material contexts), Thompson focuses on the regularity and necessity of transfers between categories, and their relationship to economic valuations. Rubbish theory is the act of recognizing the boundaries as well as movements between them to account for the "social malleability of things" (88).

According to Thompson (1979), the most common transfer between categories is the transfer of things from transient to rubbish, as everyday things are used and become waste. These

transient things slowly decrease in value over time, until they reach the end of their life and cross the threshold into valueless rubbish. The opposite movement, from rubbish to transient, is "theoretically impossible," since it requires an item with a "value and expected lifespan" of zero to regain life and move into a category worth more than nothing, but not priceless (like the shift of something old to becoming an "antique," thus moving from rubbish to durable) (106). While the transfer from rubbish to transient is theoretically impossible, as it seems to move the rubbish back in time to a point when it still possessed value, Thompson recognizes that these transfers do indeed occur. Transfers between categories are not unilinear: not only is a thing's consignment to a category not permanent, but it does not always move in one direction or according to one logic.

Not all people recognize the fluidity of social categories or unusual transfers of things across membranes assumed to be secure; revaluing rubbish is not a common occurrence and the potential for rubbish to become un-rubbish is arguably willed unseen by most people. Rubbish taking a return trip to non-rubbish categories is part of the negotiations of both economic value and social power, and happens due to certain people facilitating the transfers. Transferring rubbish back into value is facilitated by "the dealer…the rag-and-bone man, the Gypsy and the scrap-dealer," in which "the successful dealer operates by manipulating the value and expected life-span of an item: by depressing them in one transaction and elevating them in the subsequent transaction" (Thompson, 1979: 106). To these characters, I would add the repairer, a person of certain skills who can see what others cannot or will not: the potential for manipulating something's lifespan and value through repair and reinvention.

In India, repair and remanufacturing workers regularly move e-waste from waste or rubbish to a valuable product in a variety of different but broadly related reuse industries. These industries are composed of people that see life and value in used commodities otherwise called

"waste", and who collectively use their considerable skills to repair and reinvent electronic commodities. Everyone connected to these industries possesses a similar understanding of the potential for waste to be moved back into categories of use and value through diverse labor processes that rework used materials. While recycling does, arguably, return rubbish to a material of some value, the reworking of e-waste through reuse industries unequivocally transfers e-waste from rubbish to non-rubbish.

India's reuse industries can be broadly divided into three categories: maintenance and repair; resale and refurbishment; and reassembly and remanufacturing.[vii] *Maintenance and repair practices* range from the repair of individual devices to maintenance of large-scale data centers and anything in between, which begins with testing the non-functional systems to diagnose which component is not working. While sometimes no replacement parts are required (like when reconnecting circuits), maintenance and repair processes often rely on a mixture of new and used parts sourced from the wider used electronics and new electronics imports sectors (e.g. soldering replacement chips onto motherboards or replacing broken components deemed unworthy of repair themselves). These practices allow for the continual use of devices and appliances as well as continued functioning of IT systems at companies across India. *Resale and refurbishment* involves the sale of used electronics either in "as-is" condition or with minor upgrades and changes (e.g. RAM upgrade or installation of a different optical drive). Used electronics come from both national and international (and formal and informal) sources, including local small-scale use, national and international corporations based in India and the international scrap trade[viii]. *Reassembly and remanufacturing* produce new products made of both locally collected used parts and new parts imported from China, sometimes sold under a local brand. Remanufactured electronics are sold in local markets, often with local warranties, as well as sold

in bulk to businesses. These extended reuse processes are intimately related to, but functionally distinct from, e-waste *recycling*[ix], which recovers raw materials such as metals, plastics and glass from electronics. Things from the reuse industries deemed useless are sold to recyclers and eventually end up in the relatively well documented recycling industry,[x] but the reverse movement is also common: things at the recyclers' shops and warehouses are regularly revalued and returned to the reuse industries. Instead of managing waste, India's broad reuse industries are production-based, maintaining and making new things out of a diversity of new and used materials.

Beyond recycling: transferring e-waste into Delhi's value circuits

In India's National Capital Region (NCR), which includes Delhi and its environs, electronics reuse industries have amassed in several markets and neighborhoods spread out across the city, each specializing in different aspects of the process, including trade, dismantling, warehousing, repair, and refurbishing.[xi] These businesses emerged in part from older, well-established manufacturing and machine industries in India, that have grown and adapted as the technological terrain and manufacturing economy has changed. Before e-waste ends up at the recycler (and sometimes after that!) each device and part is assessed and sold on to a related used electronics-based industries. All extended reuse industries, from repair to remanufacturing, depend on the accumulation and movement of these supplies, and devices and parts assessed as valuable or useful in some way are constantly sorted, traded and repaired across the city. In South Delhi's Nehru Place, a major electronics market in India (and arguably the biggest in South Asia), one can see almost every step of the revaluation process. Besides the many authorized retailers for global electronics brands, Nehru Place also features a dense and well-

networked array of repair and resale shops, specializing in computers and related electronics and selling reassembled and remanufactured electronics.

An integral part of Nehru Place's extended used electronics industries is the market's scrap shops. In India (and more broadly South Asia and much of the Global South), most waste and recyclable material is managed not by municipalities or private companies but through locally established waste management networks considered part of the "informal" sector (Demaria and Schindler, 2016). These businesses focus primarily on recyclable waste, such as paper, plastic, glass and metal, which is differentiated from mixed waste and called "scrap" in English, "kabaad" in Hindi. Arguably, the use of the term "scrap" articulates its usefulness as a material, i.e. scrap metal to be reused in industrial processes, as opposed to "recyclables," which connotes a form of waste disposal (even if the outcome – reentry into raw materials markets – is the same). "Kabaad" shares a similar recognition and prioritization of value in the materials that the term "recyclables" does not necessarily connote. While these networks are informal (meaning that they are not government authorized), they are well-organized and made up of many local businesses that excel at efficient collection of recyclable materials, as they make money by selling recyclables on to recycling companies (Minter, 2013).

While most *kabadi ki dukan* (scrap shops) in India deal in common recyclable materials (similar to recycling programs in the west),[xii] some shops and scrappers specialize in electronic waste. Positioned on the so-called back end of Nehru Place, both spatially and socially, are around ten *kabadi ki dukan* that specialize in waste electronics produced by the 'front,' the market's electronics shops. However, in contrast to the normal movement of waste from consumer to scrapper to recycler, in the electronics scrap shops plenty of people come not to dispose of waste, but instead to buy things *from* the scrap man, or *kabadiwala.* In one Nehru

Place scrap shop located in an out-of-the-way back alley, the owner Javed kept aside any components and devices that looked to be in working order. Instead of selling this "waste" to an electronics recycler, Javed sorted and stored different electronic components in case a repairman[xiii] would stop by in search of that very thing. Neatly lined up and stacked on densely packed shelves along the walls of his shop were hard drives, sorted separately into laptop and desktop varieties; another shelf had different optical drives, from CDs to DVD writers. Nehru Place's repair shops all depend on the e-waste scrap shops for useful supplies, and at any given time that I sat in Javed's scrap shop, a repairman (or three) would be rummaging through the scrap shop's many electronic waste wares.

Even though a cell phone or computer's arrival at the scrap shop meant someone (or several people) had already evaluated it and decided it was worth only its value as scrap, that assessment is almost endlessly impermanent. Once it has been dismantled, its individual parts can often be reused or repaired. Even the parts of parts, for example the individual chips on a circuit board, are saved for repair of other circuit boards. A common purchase from the scrap shop was a range of circuit boards to keep at the ready in repair shops. All repair shops in Nehru Place have at least a shelf or two of used circuit boards, lined up side by side, standing on their ends like books waiting to be taken off the shelf and thumbed through. Each one has been carefully inspected at the scrap shop and saved (in other words, not sold on to the recycler) because someone determined that it offered salvageable and often high quality parts. In the electronics scrap shop, the rapid movement of materials, supplies and repairmen in and out, the constant negotiation of prices and discussion of something's usefulness, the testing of batteries and power supplies: it can feel more like a supply shop than a site of waste disposal.

In India, conventionally the scrap shop and people who work with waste are held at a

distance from 'respectable' people, who assiduously avoid waste's rich symbolic universe of contamination. Waste-based work and neighborhoods that specialize in waste can induce an almost frantic fear of social and religious contamination, which several upper-caste Hindu men, thinking themselves helpful, went to great lengths to protect me from through warnings about scrap areas and the men who work there.[xiv] One consistent exception, however, seemed to be the purchase of things from the electronics scrap shop. If I went to purchase a part for a repair, visiting the scrap shop would be understandable as the site of a necessary business transaction. At the electronics scrap shop, there is something about the matter's potential for revaluation, for remaking, and the shared knowledge of this possibility, that makes e-waste so much less about waste and instead about mutual recognition of everyone's search for value. This redemptive quality of certain types of materials has been observed by Gill (2010), who argues that plastic as a profitable and modern material has helped to "refashion" lower-caste categories and support the increasing respectability of castes that work with newer and more profitable waste materials. In this way, the electronics scrap shop is an open recognition of the potential for waste to be not-waste, as the movement of used electronics and electronic scrap back into repair and resale provides the necessary supplies for India's non-corporate (and often informal) electronics industries.

Supplying the industry: collections of used electronics

While there is plenty of data indicating the immensity and growing quantities of e-waste in India and across the world, there is almost no data on used electronics and their related industries, and all work with used electronics tends to be classified as "e-waste" (Gidwani and Corwin, 2017). Repair and resale in particular can seem like niche markets, offering small

quantities of low quality electronics to lower-income individuals. In one of our first conversations together, a well-connected used electronics businessman named Akash immediately made clear the immensity of an industry based on what would be called, in another context, "e-waste". He explained that his company primarily dealt in bulk computer orders and that one of their big clients was a major Indian mobile phone company, which has around 8000 desks for their rotating call center employees. Those call centers don't need expensive, state-of-the-art computers ("they don't need to be shining," he said), all they need are desktops that provide them with customer information and call logs. Another common bulk customer for used IT was start-ups, which were mentioned regularly in interviews with used computer shop managers. "Start-ups" (a term used by both Hindi and English speakers) provided a regular cast of new customers in need of computers right away but without the capital to invest in a newly outfitted office. Akash's company was one of many who also had a booming used computer leasing business, in which he leased bulk computer set-ups to start-ups, who paid by the month for the use and maintenance of their computer systems. For new entrepreneurs without the security to invest in office facilities long term, the option to buy or lease used computers at approximately a quarter of the cost of new computers meant IT equipment was more readily available to diverse sizes and types of businesses and start-ups.

The supplies for these used computers are based in networks of warehouses: vast stores of used electronics that provide the material for entire refurbishment-based industries. Later that day, I accompanied Akash on a trip to his used electronics warehouse, a 20-minute drive from his shop in Nehru Place. As I descended the steps into the warehouse, I was confronted with floor to ceiling stacks of desktop computers, filling the entire ground floor. Within these densely stacked computers were narrow paths, barely wide enough to walk through, and I continued

through these connected labyrinthine computer-walled alleys, going deeper and deeper as it got darker and darker, until I reached a dead-end of more computers leaning against the concrete wall. The stacks of desktop computers blocked out the florescent ceiling lights and swayed ever-so-gently, like the rustle of tall grasses in a breeze. The density of these electronics was awe-inspiring, capturing the meaning of "awe" as both an awesome and awful sight, evoking fear and wonder at the sheer quantity of materials and their potentially dangerous, tightly-packed storage. While most reports of e-waste, both from academic and media sources, understandably emphasize the danger of these work places and the informality of related business arrangements, instead I would like to attend to the warehouse's dense accumulation of e-waste not just as depicting hazardous workspaces in the Global South[xv] but as emerging from and surviving through capital's on-going discards. Walking amongst the stacks of computer towers, the walls of computers seemed unending and it felt as if the warehouse would continually reveal more and more walls of stuff. And so it would: every day, some of these computers were transported to the store for sale and recently collected ones were delivered to the warehouse, where they are tested, sorted, upgraded and stored – a testament to the "unsettling materiality" of global electronics production as well as the e-waste warehouse's "disruptive interaction with capitalist regimes of value" (Thoburn, 2010: 9).

Gille (2007) argues that "materials are not 'born' to be waste: they are transformed into waste by identifiable material and social processes" (18); following Thompson, the corollary is that waste can also be transformed into non-waste again, either as commodities with value or just the stuff of the dealer and collector, an in-between phase of potential. The e-waste warehouse as collection offers the promise of latent value redeemable through some combination of things and knowledge of reuse practices. Like Benjamin's collector, it is in the collection that things have

value, as each individual item or device is nothing without the collector and outside the collective. The "excessive materiality" of the e-waste warehouse frees things from "the imperatives of expedience and production" without relegating it to the excesses of waste (Thoburn, 2010: 6). In the electronics warehouse, there is no pressure for any one thing to be useful or valuable as a part of the collection; it is no longer rubbish but is not yet valuable: it is waiting, moving through the membranes of rubbish to transient. The used electronics collector and trader, the repairperson and the remanufacturer together recognize what can be remade with these parts.

In Akash's warehouse, one high shelf was filled with an array of video projectors, collecting dust. The projectors, Akash told us, were in storage for the foreseeable future. They were all missing light bulbs and new ones were costly, so he was holding onto the projectors until used but working bulbs came along. For the time being, the projectors were in an indeterminate state, neither rubbish nor valued, waiting for the used bulbs that would return them to their previous position as an expensive and highly coveted device. Akash explained that his business model was to collect almost everything offered to him, and this strategy was depicted in both the regular movement of things in and out of the warehouse as well as the dust-covered items awaiting rebirth as commodity. His open collection strategy was based in two mutually beneficial business strategies that amounted to assuming the impermanency of anything as "rubbish". First, to continually invest in good trade relationships with regular e-waste traders, Akash openly accepted all available goods regardless of initial assessments of their value. Second, his business depended on having the widest variety of stock that he could, with as many parts and devices available; thus he would be able to offer any product and provide any parts needed. Akash's unabashed accumulation of things reflected the indeterminate and flexible

nature of commodities, in which a thing instead becomes part of a collection, its individual body overtaken by the sheer density of its collective brethren. His used electronics warehouse - one of several I saw during fieldwork, and both a normal and exemplary one - was a collector's dream world. Akash's vast collection of devices and parts enabled his workmen to create seemingly endless computer combinations and configurations and to constantly improvise and improve upon them as 'new' stock arrived – that is, 'new' stock rooted in the discards of the rapidly evolving global electronics industry.

The many lives of used electronics in Delhi: reassembly and remanufacturing

In the used electronics warehouse, e-waste is no longer 'waste' but has not yet reached its revaluation as 'new' electronic commodity. Used electronics traders provide the parts and materials to enable the making of new things, from an individual computer to larger-scale re-manufacturing units. For computers, the most common way that e-waste is unmade ontologically is not through recycling but instead through the reanimative labor of refurbishing and remanufacturing, and in particular the making of reassembled computers using previously unrelated parts, like making little computer Frankensteins. While for the average consumer of electronics, we purchase a computer or other electronic appliance fully formed and perceived by the user as a unitary device, these devices can be easily separated into their many constitutive parts and recombined to make other computers. A reassembled, or "Frankenstein," computer is just that: it contains a hard drive taken from here, a wireless card from there, its necessary parts assembled until a complete computer is made. These computers are made, or assembled, in shops according to a customer's specifications, as the repairperson is "equipped with the sensibilities and disposition to conceive of things-at-hand as only ever temporary gatherings of matter and

idea, which can disperse and be reassembled elsewhere in new combinations" (Carr and Gibson, 2016, 10). For example, if Akash got a shipment of 1000 identical desktop computers from a corporate office that is upgrading their hardware, they are computers and also an amalgamation of separate parts. There are 1000 computers, but they are also a collection of 1000 hard drives, 1000 DVD drives, 2000 RAM cards,[xvi] etc., all of which can be reorganized for specific customers' orders. Perhaps those used computers will be sold as is. Perhaps they will be given a basic upgrade: their RAM increased, or an optical drive changed. Perhaps they will enter the inventory as individual parts, combining in entirely new configurations and arrangements. This collection of parts and devices forms the basis for the used computer and repair industry. Anyone can come into a shop and make an order for computers without being constricted to the exact things that have already been used together in one computer.

But what if that laptop part does not become part of another laptop, but instead is a resource for a wholly different thing, maybe a child's toy or a mobile battery back-up? The creative production of re-manufacturing, in which new products are made using the parts of old often unrelated devices, demonstrates another realm through which to see both the vastness of the used electronics industries as well as the inventive ways in which value is created out of "waste". I first learned about the extensive world of remanufacturing while sitting at the scrap shop, where I saw bulk purchases of parts for use in manufacturing another product.

The cathode ray tube (CRT) computer monitor is one of the more recent electrical devices being quickly phased out of usage; most offices in India now buy flat screen computer monitors (either new or used), and there is an abundance of heavy and bulky CRT monitors in India's e-scrap. In the west, the CRT TV and computer monitor are one of the most problematic pieces of e-waste to recycle:[xvii] cathode ray tubes and the glass screens include lead, and when broken for

recycling, not only can the lead become airborne but it is difficult to separate the lead from the glass. In India, however, as the boxy CRT monitors were being swapped out, everyone in Delhi's used electronics trade knew that they were not being recycled or more generally disposed of, but instead were being used as the principal manufacturing materials for the making of cheap TVs. Their sale into the re-manufacturing industry meant that they had a relatively high set value in the *kabadi* market: depending on their size, the *kabadiwala* sold each screen to a re-manufacturer for between 700 and 1100 rupees (approximately $10-16). The TVs are produced under local brand names and sold in local electronics markets, providing a cheap alternative for people unable to buy flat panel TVs. These inexpensive remanufactured TVs are quite popular, and I regularly noticed them in small shops across Delhi, sitting on top shelves near the cash register for entertainment on slow days. These local manufacturing units are emblematic of an extended repair economy that remakes used electronics, or notional e-waste into "new" products.

The re-manufacturing process is done by different companies in separate steps, beginning with the collection of used computer monitors and ending at a small, urban remanufacturing factory, where the newly made TVs were installed in new black plastic casings and packaged in locally-branded cardboard boxes for sale. Each part of the manufacturing process relies on used materials, but with a gesture to the new, like the installation of new speakers on the old screen. In the driveway of a CRT factory in East Delhi, which converts the monitors to TV circuitry, the CRT computer screens were stored in neatly stacked boxes, having already been collected, processed and readied for their conversion. In addition to changing the circuitry, the factory workers buffed the glass screens to reflective perfection and applied protective plastic sheeting on the screen before it was re-boxed and sent to the next factory. Watching men apply the thin plastic film to fit the newly buffed screens prompted an immediate tactile memory: the

excitement of peeling off the plastic on your newly bought electronic device, pulling against the little bit of resistance from its static-cling. New owners of these remanufactured TVs would get that same feeling when opening their new (old) TV.

Conclusion: Nothing is useless in nature

The diversity and depth of used electronics industries points to the value of used goods and illustrates the basic foundation upon which India's e-waste industry rests: that the value of something as a device, as a part, as a machine, is always more than its value as a bundle of recovered raw materials.[xviii] This is not lost on recyclers, both government-authorized "formal" recyclers and informal players across all scales, from major e-waste traders to street sellers of e-waste in Nehru Place market, and indeed formal recyclers derive much of their income from contracts for data and hardware destruction, rather than from materials recovery (Lepawsky et al., 2015). This basic economic logic produces a substantial disjuncture between India's regulations on e-waste management and the functioning of actual electronic "waste" markets. While reuse has always been more lucrative than recycling, this economic reality has become even more significant with the global fluctuations of commodity prices, which all traders repeatedly lamented had dropped in the past few years (for example, in 2016 the price of copper had dropped almost 50% from its height in 2011). Recycling is dependent on global commodity prices, and even petty scrap dealers in Delhi follow the ups and downs of the London Metal Exchange from local business newspapers and discuss the perils of metals trading and global prices. At the electronics scrap shop, the frequent transfer of things back into reuse, from rubbish to value through reuse labor processes, is openly understood as an integral part of everyday business.

While less openly acknowledged, it does happen at the authorized recycling plant, too. For at least the past year, a major formal recycler in Bangalore, E-Parisaraa, had been making their profit primarily from their "assets recovery" factory while their recycling sector was just breaking even.[xix] The "assets recovery" industry consists of what the informal electronics reuse sector has been doing for decades: repairing, reconfiguring and reselling electronic devices and appliances. However, their assets recovery processes are dictated, and often constrained, by individual contracts with corporate customers as well as adherence to India's e-waste management laws. Many customers require that all their material be shredded and recycled for various reasons (mainly to protect copyright or prevent leakage into informal sectors), and sometimes company representatives come to observe the initial shredding and ensure compliance. By most accounts, E-Parisaraa operated legally and according to its contracts and state regulations. Not all formal recyclers were afforded that trust.

Attero, another corporate Indian recycler based in North India, has been the subject of dispute in the industry as well as in environmental circles. In 2010, a well-publicized undercover sting operation conducted by a prominent environmental magazine, Down to Earth, exposed Attero's regular e-waste sales to the informal sector (Kandhari and Sood, 2010)[xx]. The article suggested that Attero was selling to anyone willing to pay, and emphasized the recycling plant's primary function as the *sale* of electronics rather than their recycling, describing it as "nothing short of a supermarket" with its products "neatly stacked in columns with their names labelled on signboards" (Kandhari and Sood, 2010). Amongst the environmental NGOs and government regulators, this disclosure prompted further conversation on the need to better regulate e-waste management, to enable a seamless flow of e-waste to recyclers and stop "leakage" to the informal sector.[xxi] However, used electronics scrappers, traders, repairers and remanufacturers

alike saw this exposé differently. Everyone knew that anything that could be reused would be: a trader, Rajan, said of the industry: "if it is a little bit usable, no one will recycle it".[xxii] Akash, the used computer salesman in Nehru Place, explained that if an e-waste collector takes a shipment of waste, they may sell it to a recycler but that somewhere along the way it will end up back in the reuse market. "Recycling…" he paused for dramatic effect and continued with a knowing half-smile, "…doesn't happen" ("*recycling nahi hota*").[xxiii] I was told multiple times by different traders and scrap dealers, only half joking, that even I, as a white American woman, could go to Attero's factory and purchase some *maal,* or stuff. Ahmed Bhai, an informal sector e-waste dealer, described Attero's factory as "*dikhane ke liye*" or "just for show" and said definitively "*nahi chalta*": it doesn't actually run.[xxiv] Evidence of Attero's trade of e-waste back into informal reuse economies exposed an open secret amongst those in the industry: that no one would throw away (or recycle) something with latent value; instead, the sting operation showed how formal recycling companies could break the law and operate with impunity while petty dealers feared for their small businesses.[xxv] Anuj summed it up perfectly: "in nature everything can be used again, absolutely nothing is useless – except for people."[xxvi]

Informal repair workers, manufacturers and traders of used electronic goods all coexist in a mutually acknowledged system based on hindering and reversing the transfer of things into rubbish. While Thompson (1979) poses the movement of a valuable thing into a category of non-value (rubbish) as normal, reuse and repair workers throw such social norms into question. Following reuse and repair work emphasizes how the most common form of social relationships with things is the *making* of rubbish. This transfer between categories of transient to rubbish is part of what Thompson calls the "unquestioned current paradigm" (101). Changing the normative nature of such value movement requires an epistemic break, facilitated by the scrap

dealer, a person "whose activities run counter to the ideal properties of the system" (106). These workers, harnessing improvised yet deeply skillful means through which they return things to value, possess knowledge which "confers upon the holder the possibility of a wider and stronger control over time and space than that available to those without such knowledge" (Thompson, 1979: 102). The time-space of an e-waste worker is malleable, working across decades and continents as well against the ideal property of a thing as something that gradually devolves into universal rubbish. As their work fashions the supposedly impossible leap from rubbish back to value, they reassess the notion of things and their time as an inescapable trajectory of commodity production, use and disposal.

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Notes

[i] I have used pseudonyms for all interlocutors and do not include any identifying characteristics; however, I have kept religious markers consistent (specifically, the pseudonyms continue to reference religion) in order to highlight common religious divisions in the e-waste and electronics industry.

[ii] For example, even as Herod et al. (2014) aim to reemphasize labor in discussions of value in recycling industries, they focus solely on the original productive labor in their emphasis on congealed labor in used electronics, which, however inadvertently, I argue neglects the skilled labor and creation of value by reuse and repair workers.

[iii] See also Bond, DeSilvey and Ryan (2013) for a photo essay on traditional repair practices in England.

[iv] For more on environmental justice in India, see Williams and Mawdsley (2006). In the context of the Indian postcolonial state, they note that environmental and social injustices take different forms than how they are commonly understood in the West, in part due to different relationships with legal systems, land use, and state interventions, and argue against a direct translation of environmental justice into the South Asian context.

[v] Durables have an increasing value and lifespan; transient objects are declining in both value and lifespan, while rubbish things are valueless and with no further lifespan.

[vi] Thompson's (1979) overall argument is regarding relativist and universalist positions, which he wants to show are both false: rubbish theory, he argues, allows one to see the boundaries between viewpoints and the movements between them in order to understand the existence of social difference.

[vii] While I have divided the labor and industry processes into separate categories for ease of understanding the variations in work, I want to stress that these categories are in practice always overlapping and are useful only to understand the overall industry. The realities of many small firms and family businesses working with used electronics would continue to complicate these divisions. King et al. (2006) offer similar categories for closed-loop electronics management in Europe: repair, recondition, remanufacture, recycle.

[viii] The frequency of international trade in e-waste to countries in the Global South is widely debated, and these rates change based on trade restrictions, global commodity prices, etc. (Lepawsky, 2015; Furniss, 2015). Personal correspondence with traders and e-waste buyers indicated that while international trade in e-waste to India does continue through discrete business connections, it has significantly reduced due to Indian laws restricting the import of used goods as well as international trade restrictions, and thus international supplies may represent a miniscule source of India's e-waste; certainly, India's corporate and IT industries provide a vast quantity of e-waste to fuel the used electronics sector.

[ix] Current Indian law, the E-waste Management Rules of 2016, focuses solely on recycling as an outcome of e-waste management. The law divides the industry into three separate regulatory categories: collection, dismantling and recycling. India's extended used electronics economy does not map well onto these categories, but for most of the reuse industries to exist, electronics must be collected and to some extent dismantled.

[x] In particular, environmental NGOs have produced detailed reports on the informal e-waste recycling industry in India, including Centre for Science and Environment and Toxics Link, both based in Delhi (e.g. Agarwal et al., 2003; Toxics Link, 2014; Sambyal and Sohail, 2015).

[xi] While accounts of e-waste recycling, specifically acid baths and burning for metal extraction, indicate that circuit board recycling did occur in Delhi, local industry as of 2016 appeared not to include any e-waste recycling processes. There is an informal e-waste recycling industry located either at the border or right outside Delhi city limits in the neighboring state of Uttar Pradesh (Mahesh et al., 2014).

[xii] In contrast to recycling programs in the West, in India the scrap dealer pays households and companies for recyclables, based on their value as raw materials.
[xiii] I am using the gendered terms "repairman" and "scrap man" during ethnographic descriptions when it accurately represents my interactions in the field. In general, the repair and scrap electronics industries are remarkably male with few exceptions. After much searching, I met only one woman in the repair industry ("Kavita"), who owned a repair shop and employed repairmen to work for her. I never witnessed a repairwoman come to the scrap shop, and other than women waste pickers (who would come to the shop to sell recyclables), I never saw another woman in the scrap shop area besides my research assistant and myself. I did, however, see women involved in business and repair during visits to people's homes, where work sometimes occurs.
[xiv] In several cases, the men's efforts were to 'protect' me from Muslim neighborhoods and emerged from straightforward anti-Muslim sentiment, which was often socially acceptable within Hindu spaces. Waste work, particularly scrap collection and recycling, is frequently done by Muslim communities, and in Delhi Muslim scrap workers and traders dominate much of the electronic scrap industry. There are also more traditional, caste-based hierarchies regarding work with waste, which I personally encountered less because electronic waste is considered less socially contaminating than work with mixed and "wet" waste (which includes organic waste or anything that decomposes readily). Historically, *Dalits*, the formerly untouchable communities, have (and continue to) manage human and household waste (Prashad, 2001). Those who avoid the world of waste – people and the materials themselves – can be generally assumed to be Hindu, upper caste, middle class, or some combination of these categories.
[xv] I do not mean to detract from concerns regarding worker safety and occupational hazards in informal work spaces. To complicate matters, I would note that informal production spaces are often lumped together and that the range of "informal" spaces in terms of occupational hazards is quite broad. For example, in Delhi I also visited highly organized used electronics warehouses which depended on heavy equipment like forklifts and are managed akin to industrial facilities in the U.S., which have a different subset of occupational hazards and are likely assumed to be safer workspaces (or at least, they are not associated with hazardous workspaces).
[xvi] RAM is commonly installed in sets of 2.
[xvii] Often municipal and corporate recyclers in the United States charge fees to take CRTs for recycling.
[xviii] King et al. (2006) similarly recognize this in their study of waste in the UK.
[xix] Interview, Bangalore, 13 July 2016.
[xx] Attero defended itself by saying that they were permitted by some contracts to sell e-waste into reuse circuits (as E-Parisaraa does in their assets recovery section). The regulatory lines here are blurry: government-authorized e-waste recyclers can receive permission for e-waste sales from the Central Pollution Control Board, but at the time, Attero's authorization had expired. I do believe it's important to note that authorized recyclers can receive such permissions, while the informal sector's performance of the same reuse labor would be illegal, or at least in a legal grey zone.
[xxi] Interview with Ministry of Environment and Forests employee, Government of India, 19 May 2015. While it is widely recognized that in practice once e-waste enters the informal sector it will most likely be reused, the importance of the environmental regulations is to redirect e-waste streams into formal, or government-authorized, recycling units that are supposedly complying with environmental and labor laws.
[xxii] Interview, Delhi, 10 September 2015.
[xxiii] Interview, 11 November 2015. To clarify, he did not mean literally that recycling doesn't happen at all, but that most of the materials called "e-waste" destined for recycling would return to the reuse sector and not be recycled.
[xxiv] Interview, Delhi, 21 July 2016. Similarly, I did not take him literally that Attero does not recycle anything, but that the primary goal of recyclers is to return things to use rather than to recycle them.
[xxv] Interview with government authorized recycler who began his work in the informal sector, Bangalore, 12 July 2016.
[xxvi] Interview with an informal kabadiwala, or scrap man, in Delhi, 14 May 2015. The quote was originally in Hindi: "*prakriti mein koi bhi cheez useless nahi hai, dubara istemal ho sakta hai, aadmi ko chorke*."