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Smoothing Out Smart Tech's Rough Edges: Imperfect Automation and the Human Fix

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Abstract

In this article, we take issue with an idea of autonomous and efficient automation that is upheld through the paradoxical conjunction of a flawed vision of the technological fix and the under-acknowledged human work required to fill in the gaps between machines and users. Our argument is based on two case studies that sit at opposite tails of automation processes: the front end of self-service checkouts and the back end of content moderation. This juxtaposition allows us to surface three themes on how the hype around automation is enabled by human interventions: the ad-hoc sociality in situated practices of automation, the capture of mundane expertise, and the inverted assistance of humans to machines. We argue that this human fix is not a temporary repair of malfunction, but a permanent and constitutive feature of automated systems.

Keywords: automation, fauxtomation, technological fix, content moderation, self-service checkout

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Introduction

Automation is everywhere. Hardly anything can withstand its allure. The substitution of manual processes and cognitive procedures by machine operations promises to obliviate tiresome and dangerous tasks; automation is said to be the beacon of economic revitalization and the fuel for exploding productivity (Andrejevic, 2019; Benanav, 2022). Unsurprisingly, automation has become a prominent feature of today's media infrastructures where it is believed to do, for instance, the heavy lifting in content moderation and the fight against hate speech in addition to absorbing communicative labor in customer care, help desk duties, and retail services (Hepp, 2020; Katzenbach, 2021).

The current hype, which only increased with the advent of automatic driving, domestic robots, and the new generation of chatbots like ChatGPT, has a long prehistory (Kang, 2011; Rifkin, 1995). The abiding enticement of life-like machines was propelled by technological advancements up to the dawn of algorithms and artificial intelligence (AI), yet at the same time it hinges on an ineradicable misconception: the fascination of automation implies to purposefully marginalize the human efforts that are required to perpetuate the illusion of seemingly self-maintaining automatons. "Seeing machines as autonomous, then, has historically meant not seeing certain kinds of labor and the people performing it," writes Jones-Imhotep (2020, p. 10). Thus, automation is not only an engineering problem but a sociomaterial fiction that requires the unseen but effective contributions from users, service workers, and facilitators. In order for automation to work, and to enchant public imagination, scientific inquiry, and commercial investments, it has to rely on their diligence as well as on the willful ignorance or obliviousness of those such imperfect automation was meant to cater for.

For sure, there are now myriad AI-driven applications of automated decision-making processes that showcase the power and potential of smart machines (Bassett & Roberts, 2019). In fact, they have come to serve as panacea to all kinds of social ills—as a *technological fix* (Johnston, 2018; Katzenbach, 2021). Here, automation tends to amaze when it seemingly blurs ontological boundaries, an operation that makes it difficult to tell apart humans and nonhumans. But even with the tremendous technological progress in computation and modeling, humans are still in the loop. They may not be like Jefferson's servants toiling behind magic dumbwaiters, yet automation still commonly rests on people assisting machines, not only the other way around. Today these are, for instance, remote operators of delivery robots, freelancers on Amazon's Mechanical Turk, moderators sifting through the user-generated content, or the customers asked to do the machine-assisted check-out themselves (Altenried, 2022; Gray & Suri, 2019; Posada et al., 2023; Smith, 2020).

In this article, we build on concepts from science and technology studies (STS), human-computer interaction, and mediatization research around the technological fix, the idea of humans in the loop, and ghost work, to scrutinize how a belief in effective automation is upheld through the paradoxical conjunction of a flawed vision of the technological fix and the under-acknowledged human work required to fill in the gaps between machines and users. We argue that the current enthusiasm for smart devices and services is driven not by technological progress alone. Instead, it is the decoupling of imperfect automation and operators that engenders the chimera of smoothly running and powerful facilities. We therefore follow the call to "rehumanise automation" (Pink et al., 2022, p. 3) by looking at

how apparently automated technologies are propped up by people. That turns the question from what automation does to people to what people do with automation. We tentatively call this the *human fix* which is not an analytical term but rather a *sensitizing concept* (Blumer, 1954) that helps us to emphasize the irreducible human part in maintaining automated processes.

Empirically, we revisit two case studies to illustrate the vital nexus of humans and machines. First, in self-service checkout, terminals have come to reconfigure the jobs of retail workers and customers alike. Second, in content moderation of social media platforms both increasing forms of automation as well as growing teams of human content moderators are tied together to fight harmful content and behavior. Based on these empirical illustrations, we engage with three key themes on how the hype around automation is enabled by human intervention: the ad-hoc sociality in situated practices of automation, the capture of mundane expertise, and the inverted assistance of humans to machines.

From the Technological Fix to the Human Fix

Arguably, automation encompasses not only functional and technological developments but a broader and more complex transformation that is inherently intertwined with media and communication. In many ways, the increasing automation of communication and media can be considered another stage of mediatization (Bolin & Hepp, 2017). It is the moment of "deep mediatization [. . .] in which all elements of our social world are intricately related to digital media and their underlying infrastructures" (Hepp, 2020, p. 5). Here, the communicative implications of algorithms and automation of data and AI turn into a key concern for contemporary societies.

Guided by the notion of a *deep mediatization*, the profound changes that come with the increasing datafication have been the focus of a mushrooming literature (Hepp et al., 2023; Kopecka-Piech & Bolin, 2023). For instance, Andersen (2018) has traced how search engines and their algorithms have become part and parcel of everyday life and shape routine cultural practices of searching, archiving, ordering, and filtering. In the same vein, Burgess et al. (2022) speak of *everyday data cultures*. Many of these efforts share sensibilities for the nonbinary relations between humans and machines in order to escape determinisms, both technological and social. This often happens in connection to traditions in relational sociology, microsociology, and STS and revolves around notions of figuration or arrangement (Couldry & Hepp, 2016). We particularly tie in with approaches that spell out how deep mediatization becomes both recognizable and is brought forward on the ground, though there is a lack of understanding with respect to the practical implications of automated media.

The turn to automation is not simply a change in the design and functionality of communication and media. Instead, it implicates a discursive turn in its own right (Katzenbach, 2021). Through this discursive turn, automation and AI are routinely positioned as catch-all solutions to vast areas of social problems ranging from hate speech and misinformation on social media platforms to service duties in public administration and customer care. We take our start from the apparent disconnect between the discursive enticements of automated cures on the one hand and the mundane practices and realities of the human efforts that are required to keep machines running on the other.

With this, we are not the first to depart from solutionist thinking. Indeed, it is no news that automation sputters and there is no smooth transition between situated actions and automated processes. Thus, Wynne (1988) for example already criticized the simplistic image of machine operations as following a rule which, he posited, "belies a far less clearly rule-bound and determined world of real technological practices" (p. 148). We do not line up to prove this true once again (Mindell, 2015; Pelegrin, 1980; Wajcman, 2017). Rather, despite the widespread awareness of the limitations of automation there is, on the one hand, still an emphatic—and it seems: inexhaustible—expectation of technological perfection; on the other, there is scant discussion of what happens in the meantime (i.e., how people cope with processes deemed automatic yet prone to get stuck or to require human decisions and intervention).

AI and the Technological Fix

The discourse around efficient automation builds on a long-lasting motif that has accompanied the stages of mediatization and technological development: the technological fix. Alvin Weinberg coined the term in 1965 in a mostly affirmative and even enthusiastic tone. Transforming social problems into technological ones, Weinberg (1965) argued, is a beneficial strategy as it reduces complexity, increases the speed of responses, and reduces costs. Weinberg himself pioneered the improvement of safety car engineering as a better solution than changing driving behaviors, but he also proposed fixes that may sound absurd today, for example "the use of air conditioning to cooling urban tensions" (Johnston, 2018, p. 13). Since then, businesses have been engineering their way into society by commercializing technological solutions that promise, for example, to save the environment (Katz, 1992), to help us overcome sociopolitical boundaries (Barbrook & Cameron, 1996), or put an end to our loneliness (Marston et al., 2020).

Particularly in the context of the US-dominated digital industry, the technological fix has become a key narrative of solutionist thinking (Daub, 2020). In that regard, Morozov (2013) describes how the industry offers ever new services and apps that promise to optimize processes and social interactions: "Recasting all complex social situations either as neat problems with definite, computable solutions or as transparent and self-evident processes that can be easily optimized—if only the right algorithms are in place!" (Morozov, 2013, p. 5). The rhetoric for AI solutionism is therefore twofold: we need to use faster and more high-level tools to face digital transitions; this is the opportunity to replace manual processes and cognitive procedures with machine operations to obliviate tiresome and dangerous tasks for laborers.

The turn to AI as a solution to social problems has been driven by the massively increased attention for the technology across all sectors since the mid-2010s. In media reporting on AI, new products and innovations, business actors and tech entrepreneurs clearly dominate the coverage (Brennen et al., 2018; Chuan et al., 2019; Fischer & Puschmann, 2021). It ventilates narratives that attribute magical properties to technologies, and specifically to AI (Bory, 2019; Cave & Dihal, 2019). Such "enchanted determinism" in the AI discourse, as Campolo and Crawford (2020, p. 1) call it, has also entered governmental strategies and regulation by positioning AI as an inevitable and massively disrupting

technological development with high economic opportunities (Bareis & Katzenbach, 2021; Zeng et al., 2022) and a solution for regulatory challenges (Katzenbach, 2021).

Humans in the Loop, Ghost Work, and Imperfect Automation

The vision of the technological fix sits uncomfortably with another recurring motive: that full-scale automation just does not work, that it is always imperfect. From the perspective of computer science and human-computer interaction (HCI), the notion of humans in the loop entails a wide range of literature discussing human-machine collaboration and interaction (Dickel, 2021; Gibbs et al., 2021; Johnston, 2018; Mosqueira-Rey et al., 2023). In the context of AI and automation, the phrase commonly refers to training data and integrating human domain knowledge at the service of machine learning in order to optimize, for example, accurate prediction models, ideally at low cost (Bansal et al., 2019). In a division of labor, humans may directly complete activities that are challenging for computers, and in the pipeline humans will give training data for machine learning applications (Bansal et al., 2019; Khashabi et al., 2022; Lee et al., 2022; Wu et al., 2022).

Yet, empirical research also shows that in such human-computer interactions humans tend to conform to affordances of the system, increasing the internal accuracy of task completion but decreasing unique human knowledge and thus complementarity between humans and AI (Fügener et al., 2021). For these reasons, scholars in the field of human-machine cooperation strive to identify factors of creating a beneficial collaborative environment between human and machine learning systems taking into account that contexts of AI and automation such as the stock exchange, industrial facilities, and airplanes are marked by uncertainty and dynamic changes that are beyond our control (Hoc, 2000). Consequently, degrees of freedom must be preserved so that both humans and machines can adjust to unanticipated developments; function allocation between humans and machines becomes a key issue (Flemisch et al., 2019; Hoc, 2000; Ishowo-Oloko et al., 2019).

Besides these debates, much of the buzz around automation clings to the expectation that it will replace human labor. To some, this comes with plenty of opportunities to unleash economic growth, provide unimaginable insights, and safe scarce labor (Brynjolfsson & McAfee, 2014). Others fear the loss of jobs, and anxieties to control the powers of automation prevail (Rifkin, 1995). In-between such scenarios, some have noted that automation is complementing human work, not replacing it (Pasquale, 2020). This is what Bainbridge (1983) has dubbed the "ironies of automation" (p. 775) where human discernment and intuition are required and cannot be substituted even by the most advanced machine-learning algorithms. In effect, automation is neither complete nor fully substitutive. It restructures divisions of labor, yet it does rarely nullify whole occupations; "automation replaces tasks, not jobs," as Smith (2020, p. 118) posits, and the decision to delegate a certain task to machines is often more complex than only driven by optimization and efficiency.

Against this background, it becomes ever more important to foreground the role and specifics of human labor involved in automation, specifically as there is a particular form of politics of valuation and discrimination involved. This then touches, Star and Strauss (1999) argue, upon the definition of what counts as work and what not, and yields the creation of nonpersons, a state of being where the work is visible but those performing it, their needs

and efforts, are overlooked. In this disembedding of work, workers themselves disappear and only their endeavors remain visible. Such "ghost work," as Gray and Suri (2019, p. ix) call it, often includes the human performance of automation; that is, actions are atomized into routine and repetitive tasks.

Imperfect automation, then, is not a momentary and, at a future point of time, vanquished state, but a lasting trait. It is not the opposite of perfect automation as that is ultimately a fantasy. Rather, the notion points us to the ways automated processes implicate humans and their work in order to run and deliver outcomes. "This is not simply a matter of using human labor for small tasks unable to be automated away," Munn (2022) highlights, "but instead a deeper enmeshment of machinic and anthropocentric work" (p. 23). Yet despite the constitutive texture of machine capacities and human capabilities, there is nevertheless the tendency to obfuscate the human part and maintain the mirage of perfect self-contained automation. It can degenerate to bare window dressing, for instance when some of Siri's more clever responses are pre-crafted by its engineers (Natale, 2021) or when a Tesla's allegedly autopilot maneuvers were in fact staged (Jin, 2023). More generally, that camouflage and under-appreciation of those sustaining machine-driven processes and smoothing out its rough edges contributes to the excitement around automation by concealing its limits, flaws, and inherent dependence. Consequently, Taylor (2018) refers to a "fauxtomation" that rests on the false belief into a technological fix.

In proposing the notion of the "human fix," we do not want to gloss over the profound differences of what technology does and what people do. The "human fix" is no analytical term and in fact the notion of the "fix," technological or human, is no precise reference that denotes a machine function or a human activity which can be neatly captured. Instead, the rhetoric of the "human fix" is gesturing to some sort of human intervention and it is exactly this imprecision and lack of scrutiny that facilitates the term's utility. Hence we use the omnibus term "human fix" as an intervention as it is indicative of the widespread indifference of those seeking to further implement it for the effort of the people confronted with automation with little to no training. The human fix enfolds and at the same time shrouds the subtleties of human tinkering which we seek to unpack here.

Case Sites: Studying the Human Fix From the Ends of Automation

As we have discussed, automation is not one process, but many. They are not confined to a self-contained machine that runs with little intervention or attendance but usually mediate between different actors. Hence, automation is not an end in itself but an increasingly pervasive mode of maintaining and ordering connections which is experienced quite differently depending on the part people come to play in these operations and the type of involvement and agency which become available from their position.

In communication, automated decisions and procedures structure the ways people interact with devices and services. On a more mundane level, they prefigure all kinds of digital communication by modifying, augmenting, or creating messages (Hancock et al., 2020). People have, for example, come to rely on auto-correct, predictive text prompts, and smart replies which form part of their routine communicative repertoire. The same applies

to controlling and moderating the thus generated mass of content with the help of automation (Gorwa et al., 2020; Roberts, 2019). All such instances, from colloquial everyday interactions to professional sequences of work, lend themselves to automation since they are to a great part conventionalized; they form patterns and follow templates.

With automation being such a vast phenomenon, we suggest approaching the automation of communication from two tails: On the one hand, we investigate the front end of interfaces where users come to engage with machine instructions and outputs. Our case site for this endpoint of automation are self-checkout systems in supermarkets. On the other hand, we observe the back end accessed by those tasked with managing and monitoring the streams of input. Our case site for this perspective is content moderation.

This juxtaposition of two ends of automation with the help of two separate case studies allows us to appreciate and surface the operators' tacit knowledge and mundane experience which often go unacknowledged. The comparison across differences captures a great many technologies and processes that in one way or the other are about machines running without human intervention—though the degrees of autonomy and the extent to which processes run independently vary a lot. Our examples are purposely dissimilar—we bring together two studies that take their start from two very different ends of automation. It is neither the same process nor the opposite ends of the very process. Rather, in their diversity, the two cases allow us to elucidate common aspects that pertain, we argue, to today's everyday automation that has left the factory workplace.

There is little spectacular about the cases—semi-attended customer-activated terminals, or SACATs, are an increasingly ubiquitous though overlooked feature of today's brick-and-mortar shopping whose beginnings date back to the 1960s (Andrews, 2018; Meuter et al., 2000); content moderation has co-evolved with the growth of user-generated content on social media platforms (Gillespie, 2018). While there are some technological features in place that ex ante check the upload of materials and the generation of content, the bulk of policing happens ex post. This has from the start been a mix of human sifting and machine inspection. Different to that, the introduction of terminals for self-checkout is in part propelled by ambitions to replace some human clerks. In both sites, well-known tropes of efficiency and speed accompany the roll-out of automated features, either for reshuffling retail around unpaid customer labor or as instruments for low-income content moderators (Mateescu & Elish, 2019; Roberts, 2019).

Both cases also epitomize a stage of "deep mediatization" (Hepp, 2020) where digitally networked media are not only pervasive features of all social sectors but where everyday communication and mundane affairs interlace with data collection and automated procedures. SACATs are the tangible elements of mediatized retail that are connected to vast infrastructures of transaction and information (Jacobson & Gorea, 2023; Turow, 2017). Content moderation, in turn, is indicative of a major long-term shift in which everyday conversations rely on digital services and thus become an element of surveillance and control (Gillespie, 2018).

Given the excitement around innovations in machine learning and modeling deemed to be at the heart of automation, these are in a way trivial sites where people are confronted with some more or less articulate and assessable service or device. However, rightly because of being somewhat pedestrian, this human element of automation risks to slide from view

when automation is reduced to advancements in technology. But these mundane realities of automated technologies, as Pink et al. (2022) argue, in fact "characterise the overwhelming majority of people's actual encounters with them" (p. 1). Despite the considerable differences between self-service checkouts and content moderation in social context, accessibility, the nature of activities, involved parties, and the skills needed, they both shed light on recurring patterns in how automation is made to function. However, this is not intended to be a comparative analysis; instead, the insights from these distinct case studies are employed to identify and give nuance to recurrent themes in human intervention and imperfect automation.

In order to achieve this, we worked with field notes, observation protocols, and transcripts of interviews from both studies using a coding procedure informed by Braun and Clarke's reflexive theme analysis (2019) and Glaser and Strauss's Grounded Theory (1967). Iterative steps of open, axial, and selective coding led to conceptualizations based on the empirical data. The analytical work included the tentative formulation of coding ideas and their subsequent discussion and adaptation, followed by the compilation of general categories. These were matched against the data and the evolving set of categories until they captured the theoretical essence and significance of the material (Strauss & Corbin, 1990), resulting in the identification of three shared themes in human-machine relations (cf. results section "Themes: Human Intervention and Imperfect Automation").

Case Site on the Front End of Automation: Self-Service Checkout

The study was conducted in 2019 and early 2020 and involved participant observation in two German supermarkets (Pentzold & Bischof, 2023). These observations were documented through field notes and repeatedly discussed in the team of researchers. Besides observation of customers using the SACATs and autoethnographic experimentation with the facilities by student researchers, the extensive visits to the field sites also included nine interviews with shoppers, usually upon completion of their purchase through self-checkout. Three of the interviews conducted in mid-2019 involved customers from 20 to about 35 years of age, thus capturing responses from young shoppers. Another six interviews were completed in January 2020 and involved older customers aged between 45 and approximately 85.

The eight questions which guided the post-shopping reflections revolved around the experience and frequency of using self-checkout terminals, the willingness to use them in the future, and the main advantages and disadvantages that customers associated with the devices. One of the supermarkets was in a downtown area of an Eastern German city mainly frequented by urban customers, while the other was located on its outskirts, with customers coming from the rural environs too.

Case Site on the Back End of Automation: Content Moderation

This study was conducted between 2021 and 2022. It included participant observation at a human moderators' social event, seven in-depth interviews, and one focus group. All these methods involved the same cohort of human content moderators who range in age from 23

to 37 years. The dominant language at a social gathering was Spanish, whereas interviews were run in both English and Spanish and the focus group in English. In addition, participants of the focus group spoke Spanish, English, German, and some of the regional and local vernaculars from the Spanish territory which contributed to understanding the complexity of the activity of moderation in terms of culture and content. The social gathering served to better understand the social dynamics between participants. Regarding the social gathering, the researcher was introduced at the beginning and encompassed notes and personal introductions that led to the series of in-depth interviews.

In-depth interviews took place between November 2021 and July 2022. They served to explore human reviewers' approach to their place of work, daily activity, sentiments about their workplace, and their relation to automated systems. Information was also gathered on how humans actively generate input for AI systems.

The focus group involved participants with 10+ years of experience in the industry. The conversations centered around the role of automated moderation, but also the long-term dynamics that automatization might imprint on the activity of moderation. Interviews were transcribed verbatim and names have been changed to protect informants. They all previously signed informed consent, and at all times the researcher was aware of their nondisclosure clauses; therefore, the interviews, focus groups, and transcriptions were navigated so informant jobs were not compromised. All processes followed ethical clearance.

Themes: Human Intervention and Imperfect Automation

In the following, we discuss three themes that we attribute to the quite different case studies. Following are the three common themes that characterize how the human fix operates both at the front end as well as the back end of automation that we discuss in the following sections: We surface the mundane and error-prone experiences and expertise of those handling machines and their pre-set courses of actions; we observe the genuinely social situations enfolding around acts of use and decisions prompted by system signals in contrast to the routine assumption of a single user facing machine interfaces; and we finally rephrase, in an ironic twist, machine assistance to denote humans in aid of deficient automation, not the other way round. We develop all three aspects along conceptual considerations and vignettes taken from the two case studies. In result, we show that the human fix is a core and fundamental practice in the automation of communication rather than the exemption in single cases of failure.

In our analysis, we do not want to re-stage the outdated dualism that puts automated technology on the one side and human communication and interaction on the other. Such dualism has been shed by mediatization research and connate approaches in STS for years in favor of relational and figurative conceptions. So our analysis follows Lipp and Dickel's (2022) invitation to take seriously the interfaces between humans and machines where "humans and machines are gradually rendered available for one another—by being held apart" (p. 2). Imperfect automation characterizes this relation that is not suspended for a more autonomous technological sphere or less human intervention.

Ad-Hoc Sociality and Sociotechnical Control

The first common theme that we have identified with regard to the relation between automation and humans in our case studies is about ad-hoc sociality and sociotechnical control. It responds to a shortcoming in much of the scholarship on human-computer interaction and specifically on human labor in automated processes that narrows its focus on solitary situations, with isolated single humans facing a screen or other kind of interface (Orr, 1996; Suchman, 2007). In contrast to this limited setup, we observed in both cases the spontaneous interaction and communication among human operators that were highly relevant for their engagement with the machine and the formation of the overall sociotechnical system.

In the case of self-service check-out, businesses and developers have envisioned and designed these terminals as one-to-one devices, with an isolated customer doing groceries and payment. Yet this conception is at odds with shopping being a fundamentally social and potentially public affair (Douglas, 1997; Mason, 1998). In the study, we repeatedly observed voluntary encounters and teamwork around check-out where this ephemeral social situation had a profound impact on the interaction with the machine. For example, when a machine was signaling errors or called for a clerk, which it did through lights and sounds, customers responded with two different, but both socially shaped patterns: they either embraced the situation and sought help and commentary by fellow customers; or they sensed uncomfortably the views of others, yielding moments of awkwardness and insecurity. Take, for instance, the conversation of two student shoppers, Tina and Valerie, during payment (speech protocol II, November 12, 2019, lines 25–36, our translation):

> . . .
> *Valerie: Where does the cash go now? Ahh.*
> *Tina: You have to choose cash first, right?*
> *V: Oh . . . no she (sic!) said: 'Introduce cash or choose payment method.'*
> *T: Ahh, okay.*
> *V: It sounds like this thing is shredding it.*
> *(Machine sound: Please take your change.)*
> *V: Oh gross . . . okay. Well, it is a bit funny.*
> *T: Yes, I think so too . . . especially she looks at us so already (nods to a nearby woman)*
> *V: Yes, she looks all the time as if you now . . .*
> *T: As if we want to steal.*
> *VC: . . . is a most evil criminal*
> . . .

In the case of content moderation, it was the office space that mattered as a social context. The everyday activity of moderation could not be brought home, even during the core phase of the pandemic companies stuck to that principle (Magalhães & Katzenbach, 2020). In general, human content moderators are grouped by teams who work together in open office spaces in cities such as Dublin, Miami, or Singapore, with teams usually organized by languages, not necessarily by regional or cultural expertise (Roberts, 2019).

Each human reviewer had a workstation with specific software provided by the company. The software consisted of queue systems with videos arriving in a specific order. Human moderators had access to two types of queues: the general queue in which all human reviewers worked, and a protected queue where the most complicated or high-profile pieces of content were piled up to be reviewed by team leaders or senior members of the client themselves. In their decisions on content items, interviewees reported that they routinely made use of the open office. They talked to each other about ensuing issues and looked out for immediate team support and advice. This proved especially valuable when operators like Ana (focus group, May 3, 2022, p. 3, lines 66–69) needed to make decisions on content items that spoke to contexts outside of her own expertise and culture.

> . . . and it also happens as well, in the market that I work in there are a lot of expressions from another country, that I don't know, even if I am Spanish I do not understand a lot of Latino American slang, so some of my colleagues, they say, ok . . . I might ask some of my colleagues . . .

Likewise, interviewees reported many examples and situations where their colleagues were discussing slang from Mexico, Iranian music, or obscure vernacular words from different regions in Spain in order to come to a decision.

In sum, both case studies foreground the oft-neglected ad-hoc sociality of human-machine interaction which has already invited a number of investigations (Pentzold & Bischof, 2023). Since Suchman's (1987) analysis of the frictions between plans and situated actions, numerous approaches have been gravitating around the forms of spontaneous interaction that emerge during use situations among co-present people. Yet despite the long-standing interest, interface design and use arrangements are still struggling to fully account for these encounters and the highly dynamic interactions they entail (Schubert & Kolb, 2021). Interacting with automated procedures is much more than a single human facing a machine, but it is situated in specific situations that were, in our cases, the office or the supermarket. These contexts were providing the vital settings for dealing with the prompts and requests generated at different points throughout the process.

Capturing and Marginalizing Mundane Expertise: The *Nothing* That Matters

The second theme that we have identified relates to the ambivalences of situated expertise. The discourse on automation and AI strongly foregrounds the high-level expertise of those involved in programming and installing systems, where it usually sidesteps expertise offered by those operating, supervising, and interacting with automated systems. Clickworkers are deemed to merely execute simple tasks and supervise the smooth operation of the system. In our case studies, this motif was interestingly both perpetuated and clearly challenged as it became evident that there is rich situated expertise needed for the functioning of those systems.

Looking at supermarkets, self-service check-outs are becoming a standard feature of shopping, within a much larger context of reorganizing and digitalizing brick-and-mortar

retail that, for example, envisions fully cashier-free stores as a next step (Ives et al., 2019). It is marketed as a service feature that will save time, increase comfort, and give shoppers more control. Yet in our observation and interviews, customers were less enthralled, and many tried to avoid the machines when possible. This resulted in overcrowded and ill-fitted cashier areas with people queuing in-between shelves while the machines took away much of the limited space.

In case people chose to use one of the machines, error was a taken-for-granted and ongoing occurrence. In consequence, human help and intervention were regularly needed; they were not the exception but formed part of the common experience. For sure, people get to know the machines and required procedures once they decide to use them more frequently. This, however, was not so much about mastering the protocol and producing less errors; it also meant to anticipate hiccups, learn to simply expect some sorts of alarm messages, and get accustomed to ring a clerk and recapitulate what made the process stop. Yet despite the essential role of such mundane expertise—both on the side of the clerks as well as the customers—this goes unacknowledged. Hence, shopkeepers have for example reported about their feelings of alienation with customers treating them as mere machine prostheses without really communicating to them; in turn, some shops refuse to assign clerks to the self-checkout areas resulting in constant back-and-forth between their other duties and customers in need of help (Mateescu & Elish, 2019). Meanwhile, customers are expected to get to know how to operate the devices on the spot without much guidance or introduction let alone time and testing.

In the case of content moderation, the initial understanding of human labor replicates the automation discourse: "To get in, you need nothing," Raul told us, "all I needed to know was the language, nothing else. You got the language, you get it, anyone can do it, even if you are from Norway but speak Spanish" (focus group, May 3, 2021, p. 2, line 4). So it is apparently nothing that one needs to offer to become a human content moderator. Yet upon closer inspection, it is clearly this *nothing* that matters. In the decision upon contested content, moderators strongly build on their own lived experiences and cultural knowledge. For the context of copyright, Ragavan (2001) has juxtaposed such traditional or public knowledge with codified and institutionalized knowledge. This type of knowledge includes understanding of slang language and local expressions, as well as ad-hoc awareness and knowledge of specific political situations. While it was evident for all people working in the office, that such kind of knowledge was fundamental for the smooth functioning of these systems, referring to this as *nothing* clearly signals that it was neither appreciated as an expertise nor was it valued in the labor relation between employees working on minimum wage and employers.

In sum, automated systems are strongly reliant on situated and contextual expertise on the spot. Usually, companies installing those systems are unable to capture this mundane expertise of operators thus leaving them without appreciation and remuneration. In effect, seeing machines as autonomous not only means "not seeing certain kinds of labor and the people performing it" (Jones-Imhotep, 2020, p. 10) but also not seeing, valuing, and compensating for their expertise. Although it is clearly essential for the success of those systems, it remains a *nothing* for everyone involved. A nothing that matters.

Humans Assisting Machines: The Irony of Human-Machine Assistance

The need for situated human expertise preludes the third and final theme of our analysis: as much as machines might be of assistance to humans in one way, these very machines are just as much in need of human assistance in another way. They need a human fix. For sure, most research on automation has abandoned the idea of a wholesale replacement of human labor, but there is nevertheless a dominant vision of machines assisting humans. For example, Tarleton Gillespie is suggesting in a critical piece on machine learning (ML) and content moderation that platforms should be "designing ML tools to support human teams rather than supplant them" (Gillespie, 2020, p. 4). In the vast area of human-robot interaction from elderly care to industry shop floors, robots are commonly treated as assistive technologies (Darling, 2021).

In one way, the reverse perspective put forward here—humans assisting machines—is about practical help and support. Automated processes are rarely self-contained and autarkic but implicate humans who intervene, take over, or step in. This can be a safety feature yet often it is the standard way of interlacing automated steps of procedure with interventions and stops that ask for human discernment or manual handling. In that sense, automation is imperfect as it implicates human operators, paid and unpaid, skilled and unskilled. The more automation takes hold in quotidian life and mundane encounters, the more essential the texture of machines and humans will become. Again, this is not about the usual bugs and malfunctions which require repair but rests to be an inevitable element of everyday automation.

More fundamentally, automation is built around human capacities to flexibly align our expectations and actions in a given situation. This tacit understanding of indexical meanings and gestures, that make sense in a particular spatio-temporal context, characterizes people as sociable and adaptive beings. Such capability is hard to be fully standardized and put into protocols. There is a gap and potential mismatch between plans and situated actions, as Suchman (2007) has it. To some, like Collins (2018), it will ultimately hinder automated technologies to get ahead of humans. Others have proposed more nuanced accounts of this entanglement where the at times enchanting eloquence and prowess of automated technologies is predicated on humans willing to condone and compensate for the evident limitations of smart machines (Natale, 2021).

For sure, in the assistive relationship between humans and machines, the context of interaction is key. It prefigures the resources, the technologies, and the abilities of those handling automated processes which come to bear upon a situation. Hence, manufacturing has been a pioneer in automation, where complex and extensive procedures are carried out by machines with little human intervention (Benanav, 2022). Another pertinent area has been the use of advanced technology for surgeries and medical operations, also at a distance (Schubert, 2006). Still, even in contexts of highly specialized automated procedures and skilled workers, like the advanced automotive sector or the handling of digital data, full automation remains a chimera (Altenried, 2022; Munn, 2022).

Arguably, the need to take a closer look at what automation involves and how it necessitates human intervention and assistance becomes more pressing with everyday automation: it threads through workplaces, also of seemingly low-skill jobs, and it appears in daily

routines like shopping. Compared to manufacturing, these situations are more spontaneous, less rigidly controlled by action protocols, and they afford more options for situated action (Pentzold & Bischof, 2023). In self-service checkout, humans were constantly assisting the devices that had a rather limited capacity; shoppers had to carry the complex task of identifying, weighing, and scanning items as well as channeling the payment procedures. All of these tasks were not completely assumed by the machines. Rather, their instructions and setup tried to guide customers through executing these steps. As stand-alone automatons, they could do little to nothing but predicated on customers following the course of stepwise tasks and requirements. So from the side of retailers, what was automated was the whole checkout process that would require no human cashiers, not the bulk of operations. As such, the terminals were no autonomously running devices which generated some outcome unattended. Instead, the whole restructuring relied on the indispensable intertwine of humans assisting machines.

In content moderation, automation is taking over the bulk of processing contested content. But with context and intention being key criteria for taking decisions on content, automated processes fail if they lack human advice. Context and intention are information that cannot be deducted from the piece of content itself, and are thus beyond the operative realm of automated systems. This is where human moderators came in. They analyzed the context of a post, its tone, and other factors to determine whether it would violate the platform's policies. It is ironic that human moderators make decisions based on information that is not embedded within the content. Instead, they rely on the moment *in-between* when users upload a post to the platform. This is where human moderation activity lies, as they interpret why the user uploaded the content and assess the post's appropriateness based on their understanding of the context.

This fundamental need for human intervention in content moderation has become particularly obvious when platforms companies sent home content moderators such as Joseph (key informant 4, February 2022, p. 4, line 33–36) during the pandemic without an option to work from home.

> During that time AI systems did the job, but when we return what we found were an incredible huge amount of reports by users who did not understand how or why pictures or comments were taken down, and they were right. The decision was taken by AI systems; we could see that (. . .) in fairness it relaxed me. I don't think we can be substituted.

The machines that are positioned to help people in fact need human help. This human assistance to the machine is much more fundamental than repair in case of malfunctioning or a human-in-the-loop position. It is a tight entanglement of assistance. As interactions necessarily generate moments of ambiguity and interpretative flexibility, everyday automation fundamentally rests on human labor and intervention for its smooth operation. This inversion also shifts the focus away from users framed as lacking an ability the machine should take over or help to compensate. In assisting machines, it is rather that users are asked to acquire new skills and abilities to properly use them. It is humans who not only assist the machine but also adapt their practices to the needs and affordances of technical systems.

Conclusion

In this article, we have taken issue with human labor and intervention in automation processes that are often overlooked or even actively obfuscated. We have turned the question from what automation does to people to what people do with automation, and shifted attention from the technological fix to what we call the human fix. The term functions for us as an intervention; it seeks to raise sensibilities to take a closer look at what automation involves in practice, and how it necessitates human intervention and assistance at a time where automation is becoming so tightly enmeshed in everyday lives. Conceptually, we have drawn on work in STS, HCI, and mediatization research to surface how the positioning of effective automation not primarily rests on technological progress, but much more on the successful decoupling of imperfect automation and precarious work.

In our empirical work juxtaposing two case sites from the front end and back end of automation, we have identified three key themes of how the human fix is operating in practice: in both supermarket self-service check out and in platforms' content moderation ad-hoc sociality emerges that distinctly shapes situated practices of automation; these situations are marked by the ongoing capture of mundane expertise, the nothing that matters, which is routinely marginalized both in the discourse about automation as well in labor relations; and we have reversed the dominant trope that machines are here to help, whereas humans are indeed needed to assist the machines in order to run smoothly. In contrast to the grand narratives, this human fix is an ongoing feature of automation in the tightly woven texture of machine capacities and human capabilities.

Taken together, our research and the review of cognate work make us aware that the hype and marketing around automation is enabled by human interventions where the costs of experimentation are unevenly distributed. Given our initial insights from revisiting the two highly different case studies, more systematic research and critical inquiry are needed to better understand the uneven entanglement between human operations and machines that increasingly rely on AI and ML. Perhaps our observations arise from a temporary moment of technological experimentation that will give way for much smoother interactions and smarter, fully autonomous machines. However, in light of the irresolvable complexities of tacit knowledge and indexical situations, it seems more important to examine how automation is a socio-material process that can neither be reduced to human users nor technological operations.

Given mediatization research's interest in long-term processes, this configuration of amazement and concealment can be traced back into the history of automata (Jones-Imhotep, 2020). Such a diachronic inquiry also casts doubt on heady visions of fully self-contained machine communication that is not only able to perform human-like but does so with minimal intervention or support. Imperfect automation is here to stay—instead of seeking and pushing for complete and perfect automation, we may focus more on accommodating imperfect automation as well on valuing the labor and mundane expertise needed to keep the systems (and our society) functioning. As such, imperfect automation seems an ineluctable condition of human-machine communication (Guzman, 2018; Natale, 2021). The technological fix is an illusion, the human fix is real.

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HUMAN-MACHINE
COMMUNICATION