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SPECIAL ISSUE PAPER

The social construction of algorithms: A reassessment of algorithmic management in food delivery gig work

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Abstract

Algorithms are usually regarded as fixed objects. In contrast, the article conceptualises and analyses the (social) construction of algorithmic management. By means of interviews, ethnography and analyses of chats, two allocation algorithms in platform-mediated courier work are examined. Different levels of algorithm construction are identified and a conceptual framework is developed to analyse the connections between the workers' technological frames, theories and practices. It is shown that the couriers develop theories about the algorithms' mode of operation based on their assumptions and experiences, and that their practices are guided by these theories. As a result, it becomes apparent how workers develop false theories about the algorithms' mechanisms due to their opacity, which effectively disciplines their actions. However, the paper further describes how the ontogenetic nature of algorithms gives workers limited but existing agency in their interactions with technologies.

KEYWORDS

algorithmic management, food delivery, platform labour, social construction

INTRODUCTION

Asked what happens when a moving cyclist drops a ball, many people erroneously believe it falls to the ground in a straight line. Instead, it will fall in a parabolic arc. This means many have a non-Newtonian theory of motion. This is an example of naïve physics, which maybe originates in the influential cartoon physics of Wile E. Coyote falling straight off many cliffs or more likely in a perceptual illusion, whereupon objects dropped while moving are perceived as falling straight down (McCloskey et al., 1983). This demonstrates how people intuitively construct mental models of their environment based on their experiences and beliefs. The trajectory of the ball is not influenced by this, but the actions of the individuals are, because they are not guided by the laws of physics, but by people's assumptions and expectations. These mental models do not have to be correct to be reflected in actions, because '[i]f men define situations as real, they are real in their consequences' (Thomas & Thomas, 1928, p. 572). For example, if a child assumes a monster is under its bed, it will act accordingly and feel genuine fear.

Newtonian laws of physics can be looked up at any time. The same does not apply to algorithms. These are deliberately designed as black boxes such that their users cannot adapt their corresponding mental models to reality. Instead, they are stuck with their experiences and assumptions. Accordingly, the article asks what significance mental models have, how they emerge and develop and how they influence the effects of algorithms in labour processes. It focuses on algorithmic management and specifically on a comparison of the algorithms' objective constitution with the workers' subjective interpretations. The result is a realistic analysis of the effects of algorithms on the labour process. A key argument of the paper is that algorithms are ontogenetic. They only become effective through the application of their users and are thus also socially constructed. Since these practices are based on both individually and collectively generated mental models, algorithms are also socially constructed.

The article examines two algorithms of the food delivery platforms Foodora and Deliveroo which are used for the automatic distribution of incoming orders to couriers, so-called riders. Platform-mediated food delivery is a testing ground for algorithmic management and there is consensus that these new technologies control the riders' labour process comprehensively (Cant, 2019; Griesbach et al., 2019; Heiland, 2021, 2022; Huang, 2022; Ivanova et al., 2018; Shapiro, 2018; Sun, 2019; Veen et al., 2019). The objective mechanisms of algorithms are thus known, as is their role as part of control regimes. However, algorithms are commonly regarded as objective entities and their social construction is ignored. As will be shown, these constructions and their effects on the riders' practices make a crucial difference. The article thus follows an 'algorithms in everyday labor' approach, which attempts to explore 'how algorithm processes are experienced and reacted to at the level of everyday experience' (Beer, 2017, p. 6).

Based on a multimethod research design, the article makes three contributions. First, it provides a theoretical framework for analysing the interplay between the social contexts in which algorithms are applied, the users' theories about their operating principles and the practices in which these interpretations are applied. As a result, and secondly, a nuanced perspective on algorithmic management can be developed. According to this, the latter controls the labour process not only through algorithmic monitoring and instructions, but also through its opaqueness, which is met by the workers with anticipatory obedience—identified as *black box power*. Despite this, the riders are sometimes able to influence or circumvent algorithmic decisions. Third, by using interviews with different actors and various forms of ethnographic

investigations, the article offers an example of how the epistemic challenge of analysing otherwise opaque algorithms can be addressed.

ALGORITHMIC MANAGEMENT AND FOOD DELIVERY GIG WORK

Algorithms are regulatory structures which produce autonomous results based on automated systems for processing data and given parameters. In ‘critical algorithm studies’, algorithms are identified as technologies that control and monitor people and (re)produce social inequalities (Beer, 2017; Eubanks, 2018; Gillespie, 2014; Kitchin, 2017). Usually, the focus is on consumption algorithms which seek to encourage people to consume products, information or social relationships. Furthermore, algorithms have become increasingly important in the field of work (Heiland, 2018; Kellogg et al., 2020). With algorithmic management, ‘human jobs are assigned, optimised, and evaluated through algorithms and tracked data’ (Lee et al., 2015, p. 1603). Algorithms ‘direct workers by *restricting* and *recommending*, evaluate workers by *recording* and *rating*, and discipline workers by *replacing* and *rewarding*’ (Kellogg et al., 2020, p. 367). Taylor (1947, p. 94) noted in 1903 that ‘almost all shops are under-officered’ and ‘the number of leading man is not sufficient to do the work economically’. Algorithmic management eliminates this lack of control over the labour process. It extends the management’s influence to potentially all individual actions of workers, diminishing zones of uncertainty and autonomous agency even of mobile workers (Heiland & Brinkmann, 2020, p. 129; Levy, 2015).

Platform labour is an avant-garde and testing field for algorithm-based management of labour processes. Only through algorithms is it possible to efficiently realise and control these forms of labour, as workers are scattered throughout space and mainly perform small and simple tasks: ‘The time you spent looking at the e-mail costs more than what you paid [the workers]. This has to be on autopilot as an algorithmic system’ (Irani, 2015, pp. 229–230), explains a platform manager. This is especially true for courier work. In the past, couriers were organised by a dispatch office via radio and operated autonomously in urban areas. Platform-mediated food couriers are GPS-tracked and carry out many small orders that are automatically assigned by algorithms. The platforms promote the algorithms as significant innovation. For example, Deliveroo states it uses a ‘super smart algorithm’ ‘made up of machine-learning technology’ and a ‘powerful predictive technology’ that is able to efficiently distribute orders in a self-learning manner. In addition to logistics, algorithms control the entire labour process via an app and dispatching only enters the loop in the event of problems. As a result, food delivery work is identified as comprehensively algorithmically controlled (Heiland, 2021, 2022; Heiland & Brinkmann, 2020; Huang, 2022; Ivanova et al., 2018; Shapiro, 2018; Sun, 2019; Veen et al., 2019; Author 1). Accordingly, an ‘algorithmic despotism’ is described, which reproduces the tyranny of bosses via algorithms (Griesbach et al., 2019, p. 9) or a surveilling ‘algorithmic panopticon’ (Veen et al., 2019; Waters & Woodcock, 2017, p. 388). Next to this research and its detailed understanding of algorithmically controlled labour processes, a growing body of literature has recently focused on the sociomateriality of algorithms. In this context, algorithms are not understood as objective entities, but rather as ‘a systematic and integrated assemblage of human and algorithmic actants’ (Wood, 2021, p. 12) or as ‘sociotechnical process’ (Jarrahi et al., 2021, p. 2). It is shown how Uber drivers try to make sense of opaque algorithms (Möhlmann et al., 2023), how crowdworkers act towards them with anticipatory compliance

(Bucher et al., 2021; Rahman, 2021) and how food delivery couriers discuss the algorithms in chats and develop resistant strategies (Yu et al., 2022). This co-constitution of algorithms is examined further in the following.

THE CONSTRUCTION OF ALGORITHMS

Like data (Gitelman, 2013), algorithms are constructed. This construction takes place on four levels. First, an algorithm is planned. For example, the management of a company communicates its needs which an algorithm should meet. On the second level, and usually primarily in focus, an algorithm is programmed. Programmers ‘place a particular philosophical frame on the world that renders it amenable to the work of code and algorithms’ (Kitchin & Dodge, 2011, p. 247). Third, algorithms are curated. People act as ‘data janitors’ who communicate algorithmic decisions to users, correct errors or intervene in the decision-making process (Kellogg et al., 2020, pp. 387–388). Fourth, and less considered, the users themselves participate in the construction of the algorithms. This is based on the assumption that algorithmic decisions only become effective through their application in practice. The users implement these decisions individually and thus contribute their personal interests and subjectivities.

On all four levels of their construction, algorithms are exposed to interests and practices which might be antagonistic to each other. This does not mean that these levels are symmetrical and have an equal influence on the results of algorithms. However, it emphasises that technology in general and algorithms in particular are not a simple object, but complex social processes that should be analysed as such. This is a basic assumption in the sociology of technology and is evident in the field of work. Here it becomes apparent in particular that technology is a ‘reification of social interests’ (Haraway, 1991; Rammert, 1983, p. 62) making the social context of production and its use decisive for its content and results. Algorithms for analysing X-ray images (Hosny et al., 2018) have a different rationality than ‘Frank’, the algorithm of the delivery platform Deliveroo which is examined below and which is responsible for the distribution of orders to drivers.

Usually, algorithms are understood as instruments of power that operate in a top-down process. However, power does not work unilaterally and must be established in practice. Oudshoorn and Pinch (2003, pp. 1–2) emphasise that technology comes with interpretative flexibility: ‘[T]here may be one dominant use of a technology, or a prescribed use, or a use that confirms the manufacturer’s warranty, but there is no one essential use that can be deduced from the artifact itself’. Technology develops its effects in practice and can to some degree be ‘redesigned’ by the users. However, it must be taken into account that algorithms restrict deviating practices far more than, for example, a dishwasher. Nevertheless, ‘users matter’. After all, there is no guarantee that the instructions and controls conveyed by algorithms are implemented unfiltered (Heiland, 2020a).

As a result, it can be stated that algorithms are ontogenetic. First, especially their more complex and self-learning forms are always in the making and never static. Second, algorithms without data are ineffective, and those data change constantly and so do the algorithmic decisions. Third, algorithms are socially ontogenetic and performative since they only take effect in practice and thus in contact with other actors and in specific contexts. Because of their influence on these same actors and contexts, the result of an algorithmic decision is never identical with a previous one. Contrary to their ontogenetic character algorithms are usually

reified and treated as objective entities and the fact that they are socially constructed is neglected. They are analysed only as such and without the social relations connected with them and behind these artefacts, which is tantamount to fetishisation.

To influence a technological artefact, an understanding of its mechanisms is required, which is difficult when confronted with opaque algorithms. Besides, users must develop an awareness for algorithms in the first place. Consumption algorithms are usually not explicitly addressed by the companies using them in order not to call into question the veil of objectivity of their performance and thus become part of the ‘technological unconsciousness’ (Thrift, 2004). As a result, the users’ ‘algorithm awareness’ is limited as well as distributed unevenly and limits the critical and conscious handling of the provided content (Eslami et al., 2015; Gran et al., 2020). This is different for labour algorithms. Their usage is usually explicitly communicated without making their operating principles transparent. Workers are largely aware of algorithmic management and regularly exchange information about it to be able to anticipate its requirements and align their own actions accordingly. For example, Uber drivers discuss the mechanisms of algorithmic management in online forums (Reid-Musson et al., 2020; Rosenblat, 2018) or YouTube Vloggers engage in ‘algorithmic gossip’ (Bishop, 2019) to learn how to influence the success of their videos. Although workers do not have any reliable information about their mechanisms, they do develop ‘folk theories’ (Eslami et al., 2016), ‘algorithmic imaginaries’ (Bucher, 2017), heuristics (Bolin & Andersson Schwarz, 2015) and interpretations (Myers West, 2018). These different terms refer to the identical phenomenon of the user’s construction of mental models of various algorithms. And these models guide the user’s efforts to make specific aspects of their actions visible to the algorithms and others invisible to them and thus influence the algorithms’ decisions. Thus, users of work algorithms—the workers—are located on the last and most heteronomous level of the construction of algorithms. They cannot intervene in the algorithms themselves, but can solely interpret their instructions within narrow corridors, as already described regarding computer games: ‘To play the game means to play the code of the game. To win means to know the system. And thus, to interpret a game means to interpret its algorithm’ (Galloway, 2006, pp. 90–91). To analyse these interpretations, or mental models, and their results, a theoretical conceptualisation is discussed below.

TECHNOLOGICAL FRAMES, THEORIES AND PRACTICES

To process information, people need cognitive structures (Bandura, 1986). These are interpretative schemes or scripts by means of which social reality can be meaningfully interpreted (e.g., Giddens, 1986; Gioia et al., 1989). Gioia et al. (1989, p. 507) define these as a ‘mental representation of sequences of events that guides our own behaviour and our interpretation of others behaviours in similar situations’. They can be applied in any situation (e.g., a falling ball)—especially in interactions with digital technologies (Payne, 2003). To be able to include technologies in actions, people develop scripts about them based on their experiences and assumptions—either to estimate when the washing machine will be ready or to anticipate the decisions of algorithms. With reference to the interpretative flexibility of technologies outlined earlier, questions arise whether there is only one interpretation or whether different social groups arrive at differing conclusions, what role cognitive structures play and how both affect users’ practices.

To answer these questions, the concept of ‘technological frames’ by Orlikowski and Gash (1994) will be adapted in the following. It focuses on the social generation of meaning in connection with technologies. According to Orlikowski and Gash, mental models do not emerge in a social vacuum, but are framed specifically. These frames are based on assumptions, experiences and knowledge, and guide reactions to and interactions with technologies (Orlikowski & Gash, 1994, p. 176). Technological frames are no cohesive theoretical system, but can be inconsistent and contradictory (Orlikowski & Gash, 1994, p. 181). Analogous to the different levels of algorithm construction identified earlier, distinct groups have distinct framings. These can be congruent or incongruent with each other, for example, if employees do not share the management’s intentions for implementing new technologies (Rice, 1987). This can result in conflict or, in the case of congruent expectations, increased integration (Orlikowski & Gash, 1994, p. 180).

The concept of ‘technological frames’ has received wide attention and application (Davidson, 2006). For the analysis of algorithmic management, it must be adapted and refined. In contrast to more trivial technologies such as an assembly line, algorithms are nontransparent. Hence, a distinction must be made between the technological frames and the theories about how the technology works: ‘Obviously, the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to an artifact’ (Pinch & Bijker, 1987, p. 46). In addition, the practices by means of which algorithms unfold their effect are relevant. Thus, three steps in the construction of algorithms by users can be differentiated (Figure 1), ranging from macro- over meso- to micro-structures.

First, there are technological frames as precursory ‘sense-making’ propositions. Regarding this, Scott (1999, p. 41) writes: ‘Individuals do construct and continuously negotiate social reality in everyday life, but they do so within the context of wider, pre-existing cultural systems: symbolic frameworks, perceived to be both objective and external, that provide orientation and guidance.’ Accordingly, technological frames are mental macrostructures in which experiences with technologies can be integrated. Subjects encounter them in their everyday experience and their perception of various discourses—for example, in films or newspapers. For example, Treem et al. (2015) demonstrate how social media can influence the alignment of technological frames. And Poole and DeSanctis (1992) show how pre-existing norms determine the use of technologies. Thus, frames are general interpretive structures that exist in social discourse and

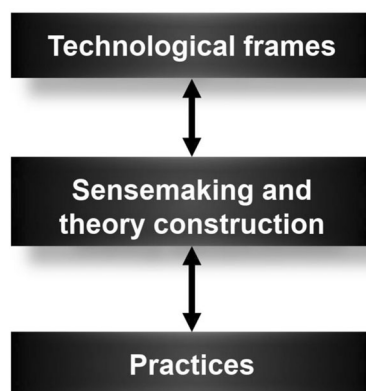


FIGURE 1 Three steps of the construction of algorithms by users.

are made plausible by users with lifeworld experiences, for example when workers under algorithmic management gain experience with algorithms beyond their work.

Second, subjects develop theories by structuring and interpreting technologies. Following Silverstone (2006), this process is domestication, whereby opaque and potentially threatening technologies are transformed into familiar objects. In the course of this ‘taming’, meanings are developed, projected onto the artefacts and applied in interactions with technologies. This sense-making takes place in interpretative corridors defined by the underlying technological frames. The resulting theories about technologies are intersubjective interpretations of medium range, related to specific artefacts. They are located on the meso level and are based on the individual experiences of the subjects (see below) and on users’ discussions. For example, Orlikowski (1992), Rice and Aydin (1991) and recently Simon et al. (2022) show that employees engage in frequent conversations about new technologies and how the attitudes and interpretations they develop influence the way they use them.

The third step follows the practical application of the interpretations, which are often omitted from analyses (Leonardi, 2009; Orlikowski, 2000). At this level, the effects of algorithms become manifest and are realised through the subjects’ actions. Workers’ everyday practices and interactions with algorithmic management are guided by their theories about algorithms. Thus, those who assume that specific factors are relevant to algorithms’ decisions will specifically focus on, emphasise or conceal these aspects.

All three steps are interrelated. For example, new experiences of users with algorithms can both influence the theories and lead to a change in the technological framework and vice versa. Like Lévi-Strauss’ *Bricoleur* (1973, p. 30), workers gather information the algorithms offer them. They interpret this in a way which is structured by technological frames and exchange information with colleagues. As they do so, they construct mental models of the algorithms not on the basis of the code they cannot access, but with the cues and experiences available to them. While management has the whole range of the toolbox at its disposal, bricolage works with ‘second qualities’, that is, ‘by using the remnants of events’ (Lévi-Strauss, 1973, p. 35).

RESEARCH CONTEXT AND METHODS

Since 2014, there are platforms in Germany which deliver food. It is the most important exponent of platform labour in Germany (Heiland, 2019). Between February and October 2018, two case studies were conducted regarding the major platforms at the time, Foodora and Deliveroo. Foodora hired riders and paid them hourly rates just above the minimum wage plus performance-related bonuses. Deliveroo worked with self-employed couriers who were paid around five euros per completed assignment. Thus, for riders of both platforms, the algorithmically organised allocation of jobs was particularly relevant—both for work intensity and income.

Digital technologies and especially algorithms are an epistemic challenge. As described above, they are mostly opaque and inaccessible as well as ontogenetic and performative. The best way to understand their source code would be to directly analyse it; which usually is impossible. If it is possible, however, it is insufficient and unreliable (Kroll et al., 2017, pp. 6–12). Such an approach conceptualises algorithms as isolated and objective technologies described above. Beyond that, the interplay of algorithmic control, the riders’ assumptions about its logic and their practices in working with the algorithms must be analysed. For this purpose, a multimethod research design was applied. Thirty-five semistructured interviews

were conducted with riders in seven different German cities and with managers of the platforms. On average, these lasted 80 min. Five of the interviewees were female, eight had no German citizenship, the average age was 27, and the majority had at least the university entrance qualification. This reflects the social structure found in a quantitative online survey (Heiland, 2019). The interviewees were recruited according to a continuously updated theoretical sampling with the aim to develop subject-related theoretical concepts (Glaser & Strauss, 1967). The interviews with managers provided insights into the algorithms' mechanisms. And in the interviews with riders their experiences, practices and theories with and about the algorithms were collected.

Additionally, more than 500 h of ethnographic work were conducted. So far, only basic concepts exist for the ethnographic analysis of algorithms (Christin, 2020; Heiland, 2020a; Lange et al., 2018; Seaver, 2017). In the case presented here, participatory observation and observational participation were conducted. As part of participatory observation (Marcus, 2010), riders were accompanied to their work and meetings with colleagues. In this way, the riders' interactions with the apps and their algorithms could be followed directly.

Furthermore, auto-ethnography was used as a form of observational participation (Burawoy, 1998; Wacquant, 2009). In contrast to the endeavour of analysing practices as uninvolved third parties, this offers the opportunity to intervene actively. Thus, targeted stimuli were tested on the technology, which corresponds to a 'sequence of experiments that continue until one's theory is in sync with the world one studies' (Burawoy, 1998, pp. 17–18). For example, different interactions with the algorithms were tested in identical situations (A/B-testing). The findings from both the observational participation and the participating observation were recorded in field diaries. To control regional differences, the ethnography was conducted multisited in five different cities.

Additionally, online ethnography (Skågeby, 2011, p. 414) was used for the analysis of six of the riders' chat groups. These were especially important for the otherwise individualised couriers. Five of these chats were accessible by invitation only. Half of these communication channels were supra-regional, the other three were restricted to individual cities. In all chat groups, the author's role as rider and researcher was made transparent and the data have been anonymized. Following the criterion of theoretical saturation, all investigations were stopped as soon as conceptual representativeness was achieved (Saunders et al., 2018). The transcripts of the interviews, the field notes and the chat transcripts were evaluated using computer-aided qualitative content analysis (Kuckartz, 2016).

ANALYSIS

In the following, the actual mechanisms of the algorithms and how they control the labour process will be explained first. Then the riders' technological frames will be analysed and, subsequently, the resulting theories and practices.

Constitution and relevance of the algorithms

Influencing algorithmic decisions was common among riders from the beginning. One of the first riders of Deliveroo in Germany described that in the beginning, it was 'a stupid algorithm. Simply the next available rider was taken'. Another interviewee, who first worked as a rider and

then as a manager at Deliveroo, explained that in the beginning there were only a few riders who waited together at a central place for orders and used the geo-localisation of the algorithm: ‘When a rider returned, he sat down on the other side of the group, so that the probability was highest that the others would leave from the opposite side. ... You could really build something like underground individuality and solidarity’. From the management’s point of view, a former member described: ‘It was not: “We are trying to create a system of oppression out of it.” It was just trial and error’, which also allowed ‘individual case treatment’ which stopped when ‘it became just too big’.

In early 2018, Deliveroo introduced a new self-learning algorithm called ‘Frank’. One of the former managers described Frank as

the implementation of another algorithm on the old one, which pre-calculates where the courier is, where does he have to go with his delivery, how long will it take him on average, and can he take the next order right after that. And then this next order, although another courier may be free, this order is reserved for this courier, because he is closer to it afterwards. And that depends on the expected load [amount of orders] within the next 30 min. This has become a much, much more complex system.

According to riders who also have worked on the management side, Foodora’s distribution of orders worked identically. One of them identified automation and lack of transparency as the algorithms’ guiding logic: ‘It is based on the idea that the drivers should be extra stupid and therefore as much logic as possible is packed into the system and not to the driver.’ This can also be seen in statements by another Foodora rider:

We only get information about the next destination. We cannot choose it. [...] We only see it as a cryptic number, if we don’t accept it, we get it again. Until we accept it. Then we see which street it is, which restaurant is behind it. Then we just have to drive there. But the head office makes the route, because also double orders are possible. That means you have food in your backpack, but you get a second meal from a second restaurant. And you can’t choose which customer you go to first.

In addition, the apps and the labour process constantly evolved: ‘It is always changing. It is still a very new platform and they are looking for the best system. They are testing all the time’ described a courier. Many riders reported recurring frustrations due to the algorithmically controlled labour process: ‘[As a rider] you are at the bottom. ... You are motivated and also feel like riding fast and doing a good job. Only, then such orders come in and you just ride 5 km pointlessly through the area; it’s not about efficiency here, so I don’t need to work efficiently’. Correspondingly, in an accompanying survey, 63% of the riders interviewed said that they very often or often felt being at the mercy of the technology, which only was true for 39% of German employees in general (Heiland, 2019, p. 302).

While mainly similar, the platforms’ algorithms differed in details related to the respective employment model—self-employed at Deliveroo and employed at Foodora. An A/B-test of the various algorithms showed this in its reaction to a delayed confirmation of the completion of an order. During the observational participation, it happened that an order was accepted but not started afterwards. Deliveroo’s algorithm did not react even after 15 min. Foodora, on the other

hand, called with an automatic announcement after a short time, asking to contact the dispatching department in case of problems.

Technological frames: Irrationality and mistrust

Due to the relevance of the algorithms for the riders' everyday work, their mode of operation was a recurring theme: 'To understand how this kind of job works takes a lot of guessing' described a rider. And therefore, there were numerous different and often contradictory theories among riders, for example, that cars were preferred to bicycles, that the riders' speed influenced the number and distances of the jobs, or that bad performance or protest was sanctioned. As explained above, technological frames determine the direction of such interpretations. Among the riders, two of these cognitive frames prevailed in particular: The first assumed the algorithms' neutral irrationality and the second was characterised by a pronounced distrust of the platforms and their technologies. Since technological frames are not mutually exclusive and are not necessarily used consistently, both could sometimes be found in the statements of single individuals.

The first frame assumed that the algorithms were either poorly programmed or far less smart than claimed. This frame was connected to nonwork experiences with other algorithms, as one rider wrote in a chat: 'Facebook also shows me ads for winter tyres, even though I don't have a car. Why should Foodora's algorithms be smarter?' Regarding courier work, an interviewee specified: 'The algorithm is more stupid than we actually think. You can also see that from these logistics, which doesn't work at all.' This manifested in long waiting times at restaurants, delays in deliveries and the organisation of double orders: 'The double orders are sometimes really crazy. I recently had one and had to drive in the opposite direction. I had to pass the same restaurant again', was one chat comment. Another example was a rider with an order that was supposed to be close, but due to a closed bridge turned out to be far away. This closure was a data point unknown to the algorithm: 'Take the route you like, cause the algorithm does not work. Algorithm out of the order', a colleague advised in a chat. These examples demonstrate that even the supposedly simple labour process of courier work depends on human intelligence to be able to react in complex situations. Furthermore, situations in which the riders were forced by the apps to take actions they seemed to be irrational—for example, the arrangement of double orders—fed the riders' previously described strong feeling of being at the mercy of technology. Riders who assumed the algorithms' irrationality did not identify the platforms as a structural opponent. They also made them less responsible for work-related problems, as one of them put it in an interview: 'Of course it's not the best job ever. But where should it come from? We deliver food. You can't assume top pay and top working conditions.'

More widespread was the second assumption according to which the platforms used the algorithms to control, monitor and sanction noncompliant behaviour in detail. Riders who followed this frame assumed antagonistic interests, blamed the platforms for poor working conditions and derived their mistrust from the platforms' stipulations: 'Why don't we see the customer's address right away? Why do we only get it when we leave the restaurant? You can only assume that they are ripping us off or think we are cheating', wrote one rider in a chat. This framing was also based on general discourses in society and everyday experiences:

We're under constant surveillance anyway. It's not like we can get out of the matrix. Google uses our movements to optimise its route planning, always knows where I am and what I'm doing. This chat is analysed by WhatsApp. Deliveroo is no different and monitors us and records everything.

Accordingly, there were doubts about the platforms: 'Foodora could do a lot for us riders, but they don't want to', said a courier. As a result, riders from both platforms accused them in interviews and in chats of hiding behind the algorithms, i.e. agency laundering: 'My favourite excuse is: We can't help it, that was the system. Or the algorithm.' In fact, a senior rider with managerial responsibilities described how the new algorithm limited the scope for dispatching. The latter was required not to assign riders to other delivery zones at their request: 'They can do it, but it's bad for the algorithm. [...] This is a wrong input for the algorithm. That's not how it learns.'

Theories and practices of the riders

It was well-known and obvious to the riders that their proximity to the restaurant was a central factor in the distribution of orders via algorithms. The riders used this knowledge to influence the work intensity: 'If you don't have an order at the moment, you can decide that you can get one faster by going into restaurant dense zones.' Another rider explained:

There is an announcement that you should drive to the centre of the zone. ... And often it makes no sense. Experienced riders know approximately what goes on at what time, which restaurants are highly frequented. They are not always in the [zone centre]. So, sometimes it makes more sense to drive somewhere else.

Provided with the necessary knowledge, the riders sometimes acted against the algorithmic instructions to increase their number of orders. Such use of geo-location was particularly relevant for Deliveroo riders who were paid per order. Employed Foodora couriers used such strategies as well since a large volume of delivered orders was relevant for the earning of a bonus and early access to the shift system. Contrary, some Foodora riders used the same knowledge to 'hide from orders'. Chat groups were regularly used to inform in which areas no orders were received, for example, because there were few restaurants nearby. For example, a rider asked: 'Hey guys, where in [delivery zone] do you not get orders?' Furthermore, the knowledge about dead spots, which prevented the transmission of orders, was widely shared. And some riders used fake GPS apps to change the geolocation of their mobile phone and conceal their position to 'control at least a little bit where you work', a rider described (Heiland, 2021).

However, many riders doubted that only geo-location was used to assign orders. One rider wrote half-seriously: 'Maybe they have a special algorithm for unpopular riders? Everything is possible'. Regularly they discussed potential further influencing factors:

Like, what is the algorithm? ... They say, the nearest rider gets the order. But when three riders are in the same spot? I think they are collecting some data for sure. Like, how long are you working, probably your average speed, or your statistics how many shifts you attended, how many you cancelled.

At Foodora, the riders received regular reports describing their performance in various areas such as speed, time with customers, number of deliveries or delays. As explained above and as tested in the ethnographic surveys, none of these parameters influenced the assignment of orders. However, as the platforms communication in this respect was ambiguous, riders suggested that performance determined the allocation of orders. A rider in a chat group wrote: ‘Do you really think they collect all this data, send them to us regularly and use them only to “inform” us? I’m 100% sure we get the orders according to our performance.’ A similar discussion took place among riders from Deliveroo. Here, as soon as a new order was offered, a field with an ‘order acceptance rate’ appeared, but without giving a value. As a manager explained, the reason was that Deliveroo used one app in different countries. As a result, German riders were also shown features only relevant for other countries—such as the ‘order acceptance rate’. Since this was not communicated, the riders discussed it vigorously and considered it in their actions:

They say to you on the app that your choice of accepting can go against your performance statistics. When you get the message of a pending order and you choose to accept it or not it has a little phrase written over the cancel button. I would not say I reject every order, you know, maybe I reject one out of four or three, but maybe when you sit there and reject and reject and reject, then it could probably be like, ok, something could happen to you. (see also Veen et al., 2019, p. 11)

However, a former manager emphasized riders could ‘reject as much as they want’ without consequences, and testing during the observational participation confirmed this. Nevertheless, the lack of transparency of the algorithmic decision had a sufficiently disciplining effect for most riders, even without actually sanctioning the rejection.

In addition, especially orders with long distances drew the riders’ attention to the algorithms. The platforms announced that orders should generally not be longer than 2.5 or 3 km, but this was not always the case: ‘Now I’m at almost 4.5 km. Nobody told me that I suddenly have to drive 2 km further’, said a courier. That the app calculated the distance as the crow flies was only known to few riders. Screenshots of long distances were regularly posted in the chat groups. Again, some assumed the algorithms’ irrationality: ‘Their “automated planning” is just crap. Investing in better algorithms would help us all.’ Others, however, mistrusted the platforms: ‘It’s pure harassment’ wrote one, which was shared by many others and regularly discussed. The doubts about the algorithms were fuelled by recurring reports from riders who received closer orders following complaints: ‘I once asked for a redispach in December, because they wanted to send me from [southern district] up to [northern district] within 3 min. And et voila, an order a few metres away.’ Another driver answered: ‘Look, I’ve done this more than once. ... I have felt that 75% of the time I have always got something close to me after complaining.’ Among self-employed Deliveroo riders it was also discussed that

the new algorithm also keeps drivers busy. It is uncomfortable for drivers to wait for a long time in a restaurant, because they then have the feeling of losing time. So, they give him a distant order and when he arrives, the order is already ready. Then the restaurant has more time and the driver has to wait less and starts moving.

Many riders identified speed as the reason they get long-distance assignments: ‘I know of many riders, especially those who are more experienced, who say “if you go fast, you get long distances”. I don’t ride fast anymore. I ride as I like’ described a courier. In response to a similar statement, another Foodora rider answered in a chat: ‘I understand. But this is rather short-sighted. Because then you have no chance of the bonus. And when your contract extension is up for renewal, you were slower and had fewer orders than the average. Do you think you will be renewed then?’. Deliveroo drivers also assumed that their speed influenced the number of orders: ‘I think the app tries to calculate how fast a delivery is delivered. So, they know that if someone is faster or closer, they have a better chance to get that order.’ Riders of both platforms were thus faced with the contradictory interpretation that a high average speed could result in both the unpopular longer distances and more orders. During the participating observation a rider adjusted his speed to the probability of follow-up orders. When asked, he said: ‘With few orders, I ride faster to increase my chances for more orders. When there is a lot going on, I save my strength.’

However, as confirmed by former managers, the algorithm did not take into account the riders’ speed. This could be confirmed by an A/B-test during the observational participation. After working particularly slowly at first on both platforms and particularly fast 1 month later, the number of orders did not change. Despite this, and although the platforms did not communicate that speed is a central parameter, the apps gave the impression of urgency, as one of them described:

We do not have the pressure to be very fast. You can also drive around slowly. No problem. But then you have this psychological pressure, this expectation. If the app tells you that you’re already 5 min late, that tempts many people to drive very fast and very dangerously.

Many riders tried to influence the allocation of orders. For example, a courier from Foodora said that he refused to accept assigned orders:

I have often simply pressed “accept” and then “delivered” and then wrote that I don’t drive to [street]—get that out of my system. And they did that in the beginning. But then at some point I had to do [these orders]. I refused. I threatened to press “accept” and “delivered”, and they said: “You can’t do that”, I said: “But I can’t get any new orders otherwise.” So, I pressed “accept” and “delivered” a few times again. ... By pressing delivered the order is gone. The customer has to be contacted and asked what he has ordered and everything has to be reordered. For them this is a big extra effort.

Such a strategy proved to be successful in some cases and established the possibility to ask the dispatching department for an alternative order in case of an unsuitable assignment. However, this could also result in warnings, which, if repeated, could lead to termination. On the other hand, the silent withdrawal from the app was a more subtle and less confrontational form of refusal: ‘You turn off your internet for an hour, write to the dispatcher after an hour: “Had technical problems”’, described a rider. This strategy was only relevant for hourly paid Foodora riders. To deal with this issue, it was recommended in chats to take screenshots of the mobile phone desktop at different times in the event of a network failure so that they could be used on other occasions and sent to the dispatcher as justification.

DISCUSSION AND CONCLUSION

More than 20 years ago, Jürgen Habermas (1998, p. 69) stated that '[t]he technologically saturated structures of the lifeworld...still require of us laymen a philistine handling with apparatuses and systems we do not understand, a habitualised trust in the functioning of "inscrutable" technologies and circuits'. With this statement and algorithmic management in mind, the question arises whether 'it is not the worker who employs the conditions of his work, but rather the reverse, the conditions of work employ the worker' (Marx, 1976, p. 548). As the article shows, algorithmic management leads to workers' heteronomies. But at the same time, instead of 'habitualised trust', the users both mistrust and try to influence the technology. Focusing on the users' 'philistine handling', the article offers three central insights concerning (1) the construction and influence of algorithms, (2) the interplay between technological frames, interpretations of algorithms and practices, and (3) the forms of control through algorithmic management.

First, in accordance with recent socio-technical analyses of algorithms (e.g., Bucher et al., 2021; Jarrahi et al., 2021; Möhlmann et al., 2023; Rahman, 2021), the article argues that algorithms do not work unilaterally, but are ontogenetic and produced interactively in practice, thus providing users with (limited) agency. Algorithms are constructed on different levels and are therefore exposed to different interests. They are not static and an algorithmic ego needs a human alter. Accordingly, interactions with algorithms are situations of double contingency. Algorithms act on assumptions about the riders' actions and anticipate possible deviations. Vice versa, the riders develop assumptions about the algorithms' operations, anticipate these and adjust their actions accordingly—similar to the way computer gamers develop a mental image of the computer model and adapt their actions to it (McGowan & McCullaugh, 1995, p. 71). However, in contrast to nondigital technologies, the 'technological flexibility' of algorithms is limited. They define narrow corridors in which the workers can act and they do not tolerate deviations. Since users cannot influence the code of the algorithms, they do not have equal agency. However, since algorithms depend on the users' participation, workers can at least partly act autonomously.

Second, the article goes beyond previous analyses and shows not only the sociotechnical nature of algorithms, but also how this co-constitution takes place and which factors and processes affect it. It uses the technological frames approach (Orlikowski & Gash, 1994) and adapts it to the analysis of the social construction of algorithms. It is shown that this process is an interplay between (a) technological frames, (b) individually or collectively produced theories about algorithms and (c) practices of users. Since algorithms are black boxes, users develop theories about how they work and apply these in their everyday practices. The theories are framed by the assumptions users have about the meaning and intention of algorithms. Given the constant changes of managerial algorithms, this construction process is continuous and interrelated, so that new experiences with the algorithms and the exchange with colleagues lead to changes in the riders' technological frames, theories and practices.

As shown, some riders assume an irrationality of the algorithms. Apart from that, the 'structured antagonism' of platforms and workers, the opacity of the processes and the poor working conditions lead to a technological frame characterised by 'hermeneutics of suspicion' (Sedgwick, 1997). Accordingly, the riders' theories on algorithms assume that the assignment of orders is connected with work performance and compliance. As shown, these theories are objectively wrong and are a 'myth information' (Winner, 1984). However, if algorithms are ontogenetic and socially constructed, they do not follow the

laws solely of physics, but also of social processes. Thus, and as outlined in the introduction, experiences and beliefs, such as the riders' interpretations, can be effective even though objectively incorrect.

Moreover, technological frames, interpretations and the actual interaction with the algorithms depend on the nature of the working relationships. Deliveroo's self-employed riders influence the algorithms to obtain more orders. Foodora's riders strive for the same, but on the other hand they discuss how to hide from orders and reduce the work intensity. Furthermore, there are incongruencies between the technological frames of the platforms and those of the riders. While the former, at least as far as the allocation algorithms are concerned, primarily aim at an efficient organisation of the labour process, the riders assume comprehensive performance control, when they are assigned orders. Such different expectations regarding the role of technology can lead to dissatisfaction and conflicts (Orlikowski & Gash, 1994: p. 180). Both are evident in the riders' high fluctuation and their pronounced willingness to protest, as the many collective actions prove (Heiland, 2020b, pp. 3–034). Moreover, the different frames and critical stances towards the algorithm—irrationality and mistrust—refer to different sources of critique and legitimacy claims as identified by Menz (2021) in other work contexts.

Third, with regard to algorithmic management, the relevance of the opacity and the workers' agency that exists despite this opacity must be taken into account. The findings show that the effectiveness of algorithmic management is not only based on the automated organisation and control of the labour process, but also on the opacity of the automated decisions. This lack of transparency leads to uncertainty among riders and the described misinterpretations of the algorithms. Similar to crowdworkers (Bucher et al., 2021), the riders react with anticipatory obedience to a presumed but not real control of their work performance. These obvious misunderstandings work in the interest of the platforms and are not corrected by them. The opacity of the algorithms is therefore a control instrument on its own, which can be described as *black box power* (Heiland, 2022).

Contrary to the one-dimensional thesis of an all-encompassing algorithmic control, however, it is evident that the riders are not without agency. Based on their theories about the algorithms, workers are at least partially able to anticipate, circumvent or even influence the algorithmic decisions. However, the workers cannot influence the algorithms' code, but only the data input. The riders' practices can be defined as a management of visibility, by which riders try to influence what is and what is not recognised by the algorithms. While they try to hide some practices, they try to gain the attention of the technology through others—for example by influencing their GPS signal, regulating their speed or disabling the connection to the platform.

A final and general insight concerns the methodological challenge of analysing algorithms. If algorithms are socially constructed, it is not the algorithms themselves, but the praxis of which they are the central part that must be the anchor point of analyses. By means of the applied multi-method approach the construction of the algorithms can be analysed on their different levels (here especially management, dispatching and riders) as well as regarding the different user aspects when dealing with algorithmic management. Interviews with users are therefore necessary and those with former managers are especially valuable. Furthermore, ethnographic research in terms of participatory observation, observational participation and online ethnography in chat groups has proved to be particularly relevant for analysing the practices and discourses of riders in actu.

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REFERENCES

- Bandura, A. (1986) *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs: Prentice-Hall.
- Beer, D. (2017) The social power of algorithms. *Information, Communication & Society*, 20(1), 1–13.
- Bishop, S. (2019) Managing visibility on YouTube through algorithmic gossip. *New Media & Society*, 21(11–12), 2589–2606.
- Bolin, G. & Andersson Schwarz, J. (2015) Heuristics of the algorithm: big data, user interpretation and institutional translation. *Big Data & Society*, 2(2).
- Bucher, E.L., Schou, P.K. & Waldkirch, M. (2021) Pacifying the algorithm—anticipatory compliance in the face of algorithmic management in the gig economy. *Organization*, 28(1), 44–67.
- Bucher, T. (2017) The algorithmic imaginary: exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society*, 20(1), 30–44.
- Burawoy, M. (1998) The extended case method. *Sociological Theory*, 16(1), 4–33.
- Cant, C. (2019) *Riding for deliveroo: resistance in the new economy*. Polity.
- Christin, A. (2020) The ethnographer and the algorithm: beyond the black box. *Theory and Society*, 49, 897–918.
- Davidson, E. (2006) A technological frames perspective on information technology and organizational change. *The Journal of Applied Behavioral Science*, 42(1), 23–39.
- Eslami, M., Karahalios, K., Sandvig, C., Vaccaro, K., Rickman, A. & Hamilton, K. et al. (2016) First I “like” it, then I hide it. In: Kaye, J., Druin, A., Lampe, C., Morris, D. & Hourcade, J.P. (Eds.) *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, CHI’16*. San Jose. ACM, pp. 2371–2382.
- Eslami, M., Rickman, A., Vaccaro, K., Aleyasen, A., Vuong, A. & Karahalios, K. et al. (2015) I always assumed that I wasn’t really that close to [her]. In: Begole, B., Kim, J., Inkpen, K. & Woo, W. (Eds.) *Proceedings of the 33rd Annual ACM Conference*. ACM Press, pp. 153–162.
- Eubanks, V. (2018) *Automating inequality: how high-tech tools profile, police, and punish the poor*. New York: St. Martin’s Press.
- Galloway, A.R. (2006) *Gaming: essays on algorithmic culture*. Minneapolis: University of Minnesota Press.
- Giddens, A. (1986) *The constitution of society: outline of the Theory of Structuration*. Cambridge: Polity Press.
- Gillespie, T. (2014) The relevance of algorithms. In: Gillespie, T., Boczkowski, P.J. & Foot, K.A. (Eds.) *Media technologies*. Cambridge: MIT Press, pp. 167–194.
- Gioia, D.A., Donnellon, A. & Sims, H.P. (1989) Communication and cognition in appraisal: a tale of two paradigms. *Organization Studies*, 10(4), 503–529.
- Gitelman, L. (Ed.) (2013) *“Raw data” is an oxymoron*. Cambridge: MIT Press.
- Glaser, B.G. & Strauss, A.L. (1967) *The discovery of grounded theory: strategies for qualitative research*. Chicago: Aldine.
- Gran, A.-B., Booth, P. & Bucher, T. (2020) To be or not to be algorithm aware: a question of a new digital divide? *Information, Communication & Society*, 24(12), 1–18.
- Griesbach, K., Reich, A., Elliott-Negri, L. & Milkman, R. (2019) Algorithmic control in platform food delivery. *Work Socius*, 5(4), 1–15.
- Habermas, J. (1998) *Die postnationale Konstellation: politische Essays*. Frankfurt am Main: Suhrkamp.
- Haraway, D.J. (1991) *Simians, cyborgs, and women: the reinvention of nature*. New York: Routledge.
- Heiland, H. (2018) Algorithmus = Logik + Kontrolle: Algorithmisches Management und die Kontrolle der einfachen Arbeit. In: Houben, D. & Prietl, B. (Eds.) *Datengesellschaft: Einsichten in die Datafizierung des Sozialen*. transcript: Bielefeld, pp. 233–252.
- Heiland, H. (2019) Plattformarbeit im Fokus: Ergebnisse einer explorativen Online-Umfrage. *WSI Mitteilungen*, 72(4), 298–304.
- Heiland, H. (2020a) Die Praxis der Plattformarbeit: von der Relevanz ethnographischer Analysen digitaler Arbeitskulturen. *Berliner Blätter*, 82, 17–28.
- Heiland, H. (2020b) Workers’ voice in platform labour: an overview. *Düsseldorf. WSI-Study*, 21.

- Heiland, H. (2021) Controlling space, controlling labour? Contested space in food delivery gig work. *New Technology, Work and Employment*, 36(1), 1–16.
- Heiland, H. (2022) Black box power: zones of uncertainty in algorithmic management. In: Armano, E., Briziarelli, M. & Risi, E. (Eds.) *Digital platforms and algorithmic subjectivities*. Düsseldorf: Westminster, pp. 75–86.
- Heiland, H., & Brinkmann, U. (2020) Liefern am Limit: wie die Plattformökonomie die Arbeitsbeziehungen verändert. *Industrielle Beziehungen*, 27(2), 120–140.
- Hosny, A., Parmar, C., Quackenbush, J., Schwartz, L., & Aerts, H. (2018) Artificial intelligence in radiology. *Nat Rev Cancer*, 18(8), 500–510.
- Huang, H. (2022) Algorithmic management in food-delivery platform economy in China. *New Technology, Work and Employment*, 38(2), 185–205.
- Irani, L. (2015) Difference and dependence among digital workers: the case of Amazon mechanical turk. *South Atlantic Quarterly*, 114(1), 225–234.
- Ivanova, M., Bronowicka, J., Kocher, E. & Degner, A. (2018) *The app as a boss? Control and autonomy in application-based management*, Frankfurt (Oder). Work in Progress interdisziplinärer Arbeitsforschung: 2.
- Jarrahi, M., Newlands, G., Lee, M., Wolf, C., Kinder, E. & Sutherland, W. (2021) Algorithmic management in a work context. *Big Data & Society*, 8(2), 1–14.
- Kellogg, K.C., Valentine, M.A. & Christin, A. (2020) Algorithms at work: the new contested terrain of control. *Academy of Management Annals*, 14(1), 366–410.
- Kitchin, R. (2017) Thinking critically about and researching algorithms. *Information, Communication & Society*, 20(1), 14–29.
- Kitchin, R. & Dodge, M. (2011) *Code/space: software and everyday life*. Cambridge: MIT Press.
- Kroll, J.A., Huey, J., Barocas, S., Felten, E.W., Reidenberg, J.R. & Robinson, D.G. et al. (2017) *Accountable algorithms*. University of Pennsylvania Law Review.
- Kuckartz, U. (2016) *Qualitative inhaltsanalyse*. Weinheim: Beltz Juventa.
- Lange, A.-C., Lenglet, M. & Seyfert, R. (2018) On studying algorithms ethnographically: making sense of objects of ignorance. *Organization*, 13(2), 1–20.
- Lee, M.K., Kusbit, D., Metsky, E. & Dabbish, L. (2015) Working with machines: the impact of algorithmic and data-driven management on human workers. In: Begole, B., Kim, J., Inkpen, K. & Woo, W. (Eds.) *The 33rd Annual ACM Conference*. Seoul, pp. 1603–1612.
- Leonardi, P.M. (2009) Why do people reject new technologies and stymie organizational changes of which they are in favor? Exploring misalignments between social interactions and materiality. *Human Communication Research*, 35(3), 407–441.
- Lévi-Strauss, C. (1973) *Das wilde Denken*. Frankfurt am Main: Suhrkamp.
- Levy, K.E.C. (2015) The contexts of control: information, power, and truck-driving work. *The Information Society*, 31(2), 160–174.
- Marcus, G.E. (2010) *Ethnography through thick and thin*. Princeton: Princeton University Press.
- Marx, K. (1976) *Capital*. Penguin Books.
- McCloskey, M., Washburn, A. & Felch, L. (1983) Intuitive physics: the straight-down belief and its origin. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 9(4), 636–649.
- McGowan, C. & McCullough, J. (1995) *Entertainment in the cyber zone*. New York: Random House.
- Menz, W. (2021). Normative claims toward Work, crises of legitimation and mobilisation. In: Kupfer, A. (Ed.), *Work appropriation and social inequality* (pp. 123–145). Wilmington: Vernon Press.
- Möhlmann, M., Salge, C.A.L. & Marabelli, M. (2023) Algorithm sensemaking: how platform workers make sense of algorithmic management. *Journal of the Association for Information Systems*, 24(1), 35–64.
- Myers West, S. (2018) Censored, suspended, shadowbanned: user interpretations of content moderation on social media platforms. *New Media & Society*, 20(11), 4366–4383.
- Orlikowski, W.J. (1992) The duality of technology: rethinking the concept of technology in organizations. *Organization Science*, 3(3), 398–427.
- Orlikowski, W.J. (2000) Using technology and constituting structures: a practice lens for studying technology in organizations. *Organization Science*, 11(4), 404–428.
- Orlikowski, W.J. & Gash, D.C. (1994) Technological frames. *ACM Transactions on Information Systems*, 12(2), 174–207.

- Oudshoorn, N. & Pinch, T.J. (2003) Introduction. In: Oudshoorn, N. & Pinch, T.J. (Eds.) *How users matter: the co-construction of users and technologies*. Cambridge: MIT Press, pp. 1–25.
- Payne, S.J. (2003) Users' mental models: the very ideas. In: Carroll, J. (Ed.) *HCI models, theories, and frameworks*. Amsterdam: Morgan Kaufmann, pp. 135–156.
- Pinch, T.J. & Bijker, W.E. (1987) The social construction of facts and artifacts: or how the sociology of science and the sociology of technology might benefit each other. In: Bijker, W.E., Hughes, T.P. & Pinch, T.J. (Eds.) *The social construction of technological systems*. Cambridge: MIT Press, pp. 17–50.
- Rahman, H.A. (2021) The invisible cage: workers' reactivity to opaque algorithmic evaluations. *Administrative Science Quarterly*, 66(4), 945–988.
- Rammert, W. (1983) Technisierung der Arbeit als gesellschaftlich-historisches Projekt. In: Littek, W., Rammert, W. & Wachtler, G. (Eds.) *Einführung in die Arbeits- und Industriesoziologie*. Campus, pp. 62–75.
- Reid-Musson, E., MacEachen, E. & Bartel, E. (2020) Don't take a poo!': worker misbehaviour in on-demand ride-hail carpooling. *New Technology, Work and Employment*, 35(2), 145–161.
- Rice, R.E. (1987) Computer-mediated communication and organizational innovation. *Journal of Communication*, 37(4), 65–94.
- Rice, R.E. & Aydin, C. (1991) Attitudes toward new organizational technology: network proximity as a mechanism for social information processing. *Administrative Science Quarterly*, 36(2), 219–244.
- Rosenblat, A. (2018) *Uberland: how algorithms are rewriting the rules of work*. Berkeley: University of California Press.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B. et al. (2018) Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*, 52(4), 1893–1907.
- Scott, M. & DeSanctis, P.G. (1992) Microlevel structuration in computer-supported group decision making. *Human Communication Research*, 19(1), 5–49.
- Scott, W.R. (1999) *Institutions and organizations*. Thousand Oaks: Sage.
- Seaver, N. (2017) Algorithms as culture: some tactics for the ethnography of algorithmic systems. *Big Data & Society*, 4(2).
- Sedgwick, E.K. (1997) Paranoid reading and reparative reading; or, you're so paranoid, you probably think this introduction is about you. In: Sedgwick, E.K. (Ed.) *Novel gazing*. Durham: Duke University Press, pp. 1–38.
- Shapiro, A. (2018) Between autonomy and control: strategies of arbitrage in the “on-demand” economy. *New Media & Society*, 20(8), 2954–2971.
- Silverstone, R. (2006) Domesticating domestication: reflections on the life of a concept. In: Berker, T., Hartmann, M., Punie, Y. & Ward, K.J. (Eds.) *Domestication of media and technology*. Maidenhead: Open University Press, pp. 227–248.
- Simon, H., Brinkmann, U. & Paulitz, T. (2022) „Wir haben keinen plan B“: chronik einer gescheiterten digitalisierung. *Arbeit*, 31(4), 355–375.
- Skågeby, J. (2011) Online ethnographic methods: towards a qualitative understanding of user engagement and communication sharing. In: Daniel, B.K. (Ed.) *Handbook of research on methods and techniques for studying virtual communities*. IGI Global: Hershey, pp. 410–428.
- Sun, P. (2019) Your order, their labor: an exploration of algorithms and laboring on food delivery platforms in China. *Chinese Journal of Communication*, 12(1), 308–323.
- Taylor, F.W. (1947) *Scientific management*. Westport: Greenwood.
- Thomas, W.I. & Thomas, D.S. (1928) *The child in America: behavior problems and programs*. New York: Knopf.
- Thrift, N. (2004) Remembering the technological unconscious by foregrounding knowledges of position. *Environment and Planning D: Society and Space*, 22(1), 175–190.
- Treem, J.W., Dailey, S.L., Pierce, C.S. & Leonardi, P.M. (2015) Bringing technological frames to work: how previous experience with social media shapes the technology's meaning in an organization: bringing technological frames to work. *Journal of Communication*, 65(2), 396–422.
- Veen, A., Barratt, T. & Goods, C. (2019) Platform-capital's 'app-etite' for control: a labour process analysis of food-delivery work in Australia. *Work, Employment and Society*, 34(3), 388–406.
- Wacquant, L. (2009) Habitus as topic and tool: reflections on becoming a prizefighter. In: Puddephatt, A.J., Kleinknecht, S.W. & Shaffir, W. (Eds.) *Ethnographies revisited: constructing theory in the field*. New York: Routledge, pp. 137–151.

- Waters, F. & Woodcock, J. (2017) *Far from seamless: a workers inquiry at deliveroo*. Available from: <https://www.viewpointmag.com/2017/09/20/far-seamless-workers-inquiry-deliveroo/>
- Winner, L. (1984) Mythinformation in the high-tech era. *Bulletin of Science, Technology & Society*, 4(6), 582–596.
- Wood, A. (2021) *Algorithmic management: consequences for work organisation and working conditions*. Brussels: European Commission.
- Yu, Z., Tréré, E. & Bonini, T. (2022) The emergence of algorithmic solidarity: unveiling mutual aid practices and resistance among Chinese delivery workers. *Media International Australia*, 183(1), 107–123.

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