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Dynamics of Social Harms in an Algorithmic Context

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Abstract

Growing evidence suggests that the affordances of algorithms can reproduce socially embedded bias and discrimination, increase the information asymmetry and power imbalances in socio-economic relations. We conceptualise these affordances in the context of socially mediated mass harms. We argue that algorithmic technologies may not alter what harms arise but, instead, affect harms qualitatively—that is, how and to what extent they emerge and on whom they fall. Using the example of three well-documented cases of algorithmic failures, we integrate the concerns identified in critical algorithm studies with the literature on social harm and zemiology. Reorienting the focus from socio-economic to socio-econo-technological structures, we illustrate how algorithmic technologies transform the dynamics of social harm production on macro and meso levels by: (1) systematising bias and inequality; (2) accelerating harm propagation on an unprecedented scale; and (3) blurring the perception of harms.

Keywords

Algorithmic technologies; social harms; zemiology; digital criminology; critical algorithm studies.

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Introduction

Social harm scholars have argued that many significant harms are not recognised as crimes and blameworthy harms in capitalist societies (Agnew 2011: 38) and remain normalised consequences of existing patterns of social organisation and modes of production (Boukli and Kotzé 2018; Hillyard and Tombs 2004). Critical algorithm studies, in turn, show that algorithmic technologies exacerbate societal biases and discrimination (e.g., Angwin et al. 2016; Barocas and Selbst 2016; Eubanks 2017; Sandving et al. 2016), violate fundamental rights (Citron and Pasquale 2014; Todolí-Signes 2019), increase inequality and destabilise our political environments (Gillespie and Seaver 2016; Tufekci 2015). Some scholars have also argued that algorithmic technologies have triggered changes in capitalism and its mode of accumulation (Suarez-Villa 2009; Zuboff 2019) and drive uneven participation in social life, posing a threat to social justice (Cinnamon 2017).

While digital criminology underscores the reciprocal nature of socio-technological relations underpinning crime and harm, the socio-econo-technological structures conducive to harm remain underexplored within social harm studies and zemiology. In this paper, we address the research gap by combining insights from social harm studies and zemiology with the findings of critical algorithm studies. To explore mechanisms of algorithmic harms, we analyse three cases using a social harm framework: (1) the failure of the Michigan Integrated Data Automated System (MiDAS), an automated adjudication and fraud detection system; (2) the 2010 financial market flash crash; and (3) the Cambridge Analytica (CA) election interference campaign. Each case highlights a unique dimension (social, economic and political) of the socio-econo-technological structures conducive to mass harms. More importantly, the events allow us to explore the opacity, diffuseness and intractability of algorithmic technologies that could facilitate harm production processes, undermine social harm claims and fuel the build-up of political helplessness in mediating and ameliorating mass harms. Finally, the cases have already been extensively scrutinised by critical algorithm scholars, confirming that they are representative of the dynamics of algorithmic transformation. Our analysis, conceptual in its nature, builds on previous studies from the field of critical algorithm studies, investigative journalists' reports, press releases and publicly available official documents. Expanding on previous theorisations of social harm, we explore how algorithmic technologies, once introduced into the complex, modern socio-technical environments, affect the system-level generation of mass harms.

The case studies suggest that the proliferation of algorithmic technologies will have fundamental effects on the dynamics of social harm generation. Algorithmic technologies will likely: (1) render social harms increasingly systemic and more difficult to counteract because they tend to centralise action; (2) amplify the harms because the interconnectedness of digital environments allows for faster propagation and dismantles potential human circuit breakers; and (3) make tracking and alleviating harms in increasingly complex, opaque and ambivalent environments harder. We argue that algorithmic technologies may not alter what harms arise but, instead, affect harms qualitatively—that is, how and to what extent they emerge and on whom they fall. Technologies modify socio-economic structures by creating affordances, mediating and distributing actions and power. Hence, social harm scholars should include a technology layer in their analyses of harm production at the meso (organisational) and macro (institutional and political economy) levels. Simultaneously, the focus on technologies and their significance can also be leveraged into social harm studies of non-algorithmic environments to mitigate structural harms, for example, by considering 'corporations' as 'technologies'. Therefore, social harm studies should broaden the understanding of harm aetiology from a focus on socio-economic structures to socio-econo-*technological* constructs.

Theorisations of Social Harms and Algorithmic Technologies

In our analysis, we combine insights from social harm studies with the findings of critical algorithm studies. Fusing these research strands offers a view into algorithmically mediated harm production patterns.

The social harm perspective emerged within critical criminology as a counterpoint to mainstream legalistic accounts that explained crime by focusing on individual agency, intentionality and immediate causality. Scholars who adopted the social harm perspective argued that the legalistic accounts failed to capture many harmful events and societal conditions. These harmful events and conditions slip through the mainstream analyses and intervention channels because they evolve over time, lack singular victimising events, defy attempts to pinpoint individual causes in time and space and often have no immediately observable effects or individual culprits (Alvesalo 2003; Hillyard and Tombs 2004: 19 et seq.). As a result, the inherent shortcomings of mainstream criminology effectively distort the societal understandings of harm production. In many mainstream accounts, mass harms are unintended consequences rather than intended outcomes (e.g., Friedrichs 2010), results of 'natural' processes that lie beyond the capacity for human intervention, the inevitable collateral damage of the market (Ruggiero 2013) or 'by-products' of beneficial social progress (Tombs and Whyte 2015: 14-15). As such, the harms are habitually deemed unforeseeable and unpreventable (Pemberton 2015: 3-5).

In response to the shortcomings of mainstream accounts, critical scholars have argued that these non-criminalised harms are embedded in systems of social relations and constitute inherent features of political economies (Pemberton, 2015). One part of a social harm approach is, thus, to explain the causes of harm at the macro and meso levels of analyses, reorienting the research focus from distinct 'moments of failure' and immediate interactions between specific actors (Tombs 2012) to social organisations, economic systems and modes of production conducive to harm. In line with those studying corporate, state-corporate and state crime, social harm scholars have argued that certain societal structures create and sustain 'chronic conditions' or 'states of affairs' that pervasively and deleteriously affect certain groups of people and their welfare interests (Hillyard and Tombs 2004: 21). Justified by neoliberal doctrines and the construed political helplessness of nation-states in the face of unstoppable global trends (Scott 2019: 7; Tombs and Hillyard 2004: 38), various social ordering practices (Whyte 2017) within and beyond crime control cause harm on a structural level. Given the harmful legacies of criminal justice, a part of the social harm agenda is to abandon criminal justice interventions and the field of criminology altogether for a separate field of zemiology (Hillyard and Tombs 2004). While striving to understand the ontology of harm, the ultimate zemiological value is to challenge and eradicate harm by developing novel modes of responsibility and accountability beyond criminal justice and through an alternative social organisation (Canning and Tombs 2021).

Notwithstanding the well-known tension between criminology, social harm and zemiology, addressing socially mediated harms requires a broader set of interventions directed at social change for social justice. In increasingly digitalised societies, this task necessarily includes a technological dimension. Critical algorithmic studies have demonstrated that algorithmic technologies have fundamentally transformed societal structures (Dencik and Kaun 2020; Mittelstadt et al. 2016), arguing, for example, that the proliferation of algorithmic decision-making signifies a qualitative and quantitative shift (Yeung and Lodge 2019), introducing unique algorithmic harms (e.g., Andrews 2019; Dave 2019; Future of Privacy Forum 2017; Tufekci 2015). For some, algorithmic decision-making constitutes an extension of neoliberal managerialism (Waldman 2019) or an exponential acceleration of neoliberalism (Završnik 2018). In that sense, algorithmic systems embody the latest manifestation of the long-term relationship between technologies, power and harm (Kanduč 2018). The use of algorithmic technologies creates a new relationship of power, enabling harmful 'casino capitalism' (Snider 2014) and prompting asymmetrical accumulation, in which users are dependent on technology providers without reciprocity (Cinnamon 2017). Regardless of the framing, digital transformation influences the ways in which social harms emerge and proliferate. Still, while social harm scholars have explored an array of social processes and institutional structures that facilitate mass harms, explicit analyses of algorithmic technologies and their effects on these structures are rare.

Some steps have been taken towards a broader understanding of the effects of new technologies on harm aetiology. Digital criminology (Smith, Moses and Chan 2017) embraces the inclusive perspective of social harm to expand the scope of conventional studies on computer crimes and cybercrimes towards a broader recognition of social harms, social justice, inequality and meaning-making in the digital society (Powell et al. 2018). Given the embedded nature of digital technologies in modern political and social life, digital criminologists reject the distinctions between virtual and embodied crime, offline and online, and instead conceptualise most contemporary experiences as digitally mediated (Stratton, Powell and Cameron 2017). To capture the mutually constitutive relationship between society and technology, digital criminologists draw on the dual concepts of 'digital society' and 'technosociality' (Powell, Stratton and Cameron 2018: 191, 199), calling for an exploration of socio-technological instruments, cultures and practices that are shaping crime, deviance, criminalisation, issues of justice, citizen participation and crime policy activism. Continuing from this line of thought to identify the determining context of harm production, Wood (2020: 628, 639) developed a 'stratigraphy of technology-related social harms', differentiating between four often-imbricated technology–harm relations: designed powers (utility) and emergent powers (technicity) of technologies, which both can serve as means to harm (instrumental) and inducers of harms (generative). He warned against conflating the social and the technological aspects of harm production. While this account is receptive to the pervasive nature and complexity of harm production in modern societies and acknowledges the effects of digital technologies, it predominantly focuses on the micro-level analyses of human–technology interactions. Even within digital criminology then, meso and macro analyses of harm production processes are relatively rare. Admittedly, studies on the role of big data in social and crime control (Završnik 2018), critical accounts of mass surveillance and predictive analytics in policing and criminal justice (Hayward and Maas 2021; Završnik 2021) align with the epistemological goals of social harm; however, without utilising a social harm framework.

Structurally oriented social harm studies would benefit from a stronger interdisciplinary engagement with these contributions of digital criminology and critical algorithm studies. Even though some explore the effects of state–corporate power dynamics on the design and development of new technologies (Snider 2014; Powell, Stratton and Cameron 2018: f 42), significant gaps remain. To shift the level of explanation beyond the individual (Canning and Tombs 2021) and explain the implications of technology for social ordering practices conducive to harm, we delve into the role algorithmic technologies play in facilitating system-level harm production and modifying its outcomes.

Effects of Algorithmic Technologies on Social Harms

In the three cases below, we explore how algorithmic technologies play a role in generating different types of harms frequently identified in social harm research: causing financial and economic, psychological (Tombs 2019), emotional and cultural harms (Alvesalo 1999); denying safety; and leading to misrecognision (Yar 2012), excluding and denying agency (Pemberton 2015). Our main goal is not to map algorithmically mediated harms but to highlight how algorithmic technologies transform the dynamics of social harm production. While not representative of every aspect of algorithmic transformation, the cases have each been the subject of public and academic scrutiny, proving their significance in the social harm context. The cases illustrate how algorithms enhance the dynamics of social harm production by systematising and automating bias and inequality (i.e., MiDAS), accelerating harm production and propagation on an unprecedented scale (i.e., flash crash) and diffusing the perception of social harms (i.e., CA).

MiDAS: Systematising Harm Production?

First, we explore how algorithms may intensify and automatise (Eubanks 2017) the production of social harms and inequality, potentially exacerbating the damage caused by privatisation, deregulation and other neoliberal policies explored in social harm studies. We use the failure of MiDAS system as an example while acknowledging that the case is not unique (e.g., Alston 2019; Chiusi et al. 2020; Noble 2018; O'Neil 2016). Digitalising social benefit provisions has resulted in similar debacles, for example, in the cases of Australia's Centrelink, the Netherlands' *Systeem Risico Inventarisatie* (System Risk Indication) and California's Employment Development Department.

Context

In October 2013, Michigan started using MiDAS for reviewing unemployment insurance claims. The initiative was part of an austerity-driven budget plan seeking to end the state's deficit (Richardson, Schultz and Southerland 2019) amid the Great Recession (de la Garza 2020). The goal was to enhance customer service accuracy, efficiency and responsiveness while reducing paperwork and operational costs (McFarlane 2013) by replacing a 30-year-old mainframe system and 400 employees who had previously reviewed the unemployment claims and investigated discrepancies (*Zynda v Zimmer* [ED Mich, Case No 2:2015cv11449, 21 April 2015] [*Zynda v Zimmer* 2015]). System development was outsourced to private vendors and covered by trade secrecy and intellectual property laws (Wykstra 2020).

Two years later, an investigation by the Michigan Unemployment Insurance Project discovered that the new system had upended the claims process. While denying unemployment insurance applications at a 13% higher rate than its manual predecessor, MiDAS also adjudicated twice the number of applications as fraudulent, clawing back a record of USD 56.9 million in 2015. However, the rate of false positive fraud findings was an estimated 85% (Shaefer and Grey 2015). The unprecedented spike in fraud charges drew public and federal reactions. Several lawsuits alleged that MiDAS fully automated the decision-making with no human review (*Bauserman v Unemployment Insurance Agency* [UIA] [2019] 503 Mich 169 [2019] [*Bauserman v UIA* 2019]; *Cahoo v SAS Institute Inc* [ED Mich, Case No 2:2017cv10657, Filing 137, 2 March 2017]; *Zynda v Zimmer* 2015) and that the system was rigged to seek and impute fraud charges without sufficient evidence (*Bauserman v UIA* 2019).

Social Harm Framing

In the aftermath, the UIA restored the human review for fraud cases, and Michigan enacted protective legislation to avoid similar algorithmic failures in the future. Still, the aborted MiDAS deployment had already caused significant social harms. The immediate harms were financial. Individuals falsely castigated as criminals had their tax refunds seized and wages garnished to repay the benefits they were, in fact, entitled to. In many cases, the accused had to lend funds to pay the fines, and, at times, the penalties led to foreclosures (*Bauserman v UIA* 2019). Indirectly, MiDAS inflicted autonomy harms because the false positives led to financial distress and bankruptcies (Richardson, Schultz and Southerland 2019), restricting the victims' abilities to fully participate in social relations (Pemberton 2015: 29). MiDAS also wreaked emotional havoc because the claimants of the unemployment benefits were placed under general suspicion. False accusations of fraud may also have led to misrecognition and exclusion from social networks by limiting access to housing, employment and credit (see de la Garza 2020; Wykstra 2020; *Zynda v Zimmer* 2015). Further, the harms were persistent. Due to a confusing appeals procedure, affected individuals sought redress less frequently than expected (Shaefer and Grey 2015). Those seeking redress became entangled in lengthy resolutions of legal questions and procedural issues at the state and federal levels. However, at the time of writing, the case filed in 2015 has still not been concluded (de la Garza 2020), thus, potentially intensifying feelings of misrecognition among the plaintiffs.

The collateral consequences and sustained harms (Richardson, Schultz and Southerland 2019) caused by the MiDAS debacle highlight the relational nature of social harms (Yar 2012) and their layered and synergistic effects (Tombs 2019). The existing zemiological framework is largely sufficient to conceptualise this debacle. MiDAS was an austerity policy measure, and it disproportionately affected marginalised groups, leading to social stratification (Hillyard and Tombs 2004; Mitchell, Pantazis and Pemberton 2019). However, we argue that the particular technological makeup of the MiDAS system changed the dynamics of social harm production compared to similar non-algorithmic systems and, therefore, ought to be studied separately.

First, the use of algorithms automated and systematised failure. Whereas similar manual systems undoubtedly generate unjustified decisions and false accusations, the MiDAS design apparently turned configuration mistakes and failures into pervasive features of the system and ensured that the entire applicant population was consequently subjected to systemic and pervasive mistreatment. Second, the sheer number of negative decisions and false fraud accusations overwhelmed the resources available for conducting appeal hearings, significantly increasing the time before a claimant could receive redress

(Shaefer and Grey 2015). Automation also effectively stripped prior process safeguards. By increasing information asymmetry between decision-makers and the subjects of the decisions, the fully automated MiDAS jeopardised the transparency of public governance and reinforced the accountability gap (Whittaker et al. 2018) between those benefiting from and those affected by algorithmic systems.

Flash Crash: Accelerating Harms Out of Control?

The MiDAS case indicates that the dynamics of algorithmic social harms differ from those that arise in human-dominated decision-making systems. The systematisation of actions and decision-making has the potential to re-entrench and systematise failures and, consequently, amplify harms. In the following, we discuss the 2010 flash crash as another example of how the speed and connectivity of algorithmic systems accelerate dynamics of social harm production and propagation.

Context

The flash crash took place on 6 May 2010, as the United States (US) stock markets suffered a sudden price collapse. Within 20 minutes, a major stock market index dropped 9% and then rebounded close to its previous level (David 2010; Easley, de Prado and O'Hara 2011; Menkveld and Yueshen 2019). What caused the collapse remains debated. Explanations range from human data input errors, speculative bets and market infrastructure failures of the high-frequency trading effects, malicious actors (Levine 2015) and inherent market brittleness. According to the US Commodity Futures Trading Commission and US Securities & Exchange Commission (CFTC and SEC 2010), the ultimate cause was the market itself. It had grown 'so fragmented and fragile that a single large trade could send stocks into a sudden spiral' (Lauricella, Scannell and Strasburg 2010: 1).

However, the chain of events was complicated. The CFTC and SEC (2010) reported that a firm had acquired a large position in the S&P 500 E-mini futures contract, a standardised financial derivative that allowed market participants to place bets on what the value of a stock market index would be at a set point in time in the future. The move was a hedge designed by the firm to eliminate general market risks in a portfolio of stock the firm owned and leave the firm exposed only to company-specific risks in the portfolio (CFTC and SEC 2010). A computer trading algorithm implemented the trades. The algorithm was programmed to take up 9% of available sell orders in the contract every minute, whatever the prices. Because the futures markets have limited liquidity, the algorithm, minute after minute, ended up paying more and more for the contracts (CFTC and SEC 2010: 2).

Futures contracts are the heart of financial markets. They are part of the infrastructure that weaves together the entire global economy, transmitting and processing information (Chen, Chung and Lien 2016) across geographies, industries and time (LiPuma and Lee 2005; Maurer 2002). Performing and enacting the efficient market hypothesis, futures contracts represent the entire economy. They constitute a shorthand to the market's appraisal of the future of all stocks. Any change in the contracts' prices indicates a collective reappraisal of the future of the market. Therefore, soaring prices in futures contracts indicate that market participants think that equity prices are about to fall.

With the contract prices soaring, the systemic effects of algorithmic technologies emerged. Future contracts sit at the crossroads of multiple markets. If stocks' future prices move, cross-arbitrage algorithms ensure that the price movements are transported into the index instruments (Menkveld and Yueshen 2019: 4473-4474). Because the prices suggested that a significant market decline was in the works, the changes triggered automated algorithmic responses across the board. Algorithmic trading agents started to sell off or hedge positions in a wide variety of equity and other instruments to stop and contain losses. The herding behaviours of similar algorithmic agents (Demirer, Leggio and Lien 2019) resulted in strange effects, driving some instruments to trade at close to zero and sending others soaring. The interconnectedness of algorithmic actions showed that its force was boosted by the speed at which the systems operate. The millisecond time scale of modern financial markets dominated by algorithmic high-frequency trading made human interventions impossible (Akansu 2017). Once the algorithms started to execute their pre-programmed but misguided scripts, no human could re-evaluate the strategies and break the circuits.

Social Harm Framing

The flash crash could have triggered a new financial crisis, further increasing the burden of austerity packages unleashed in response to the 2008 global financial crisis (Ruggiero 2015). However, it did not, leaving limited losses in its wake. Nevertheless, the case is emblematic of the devastating harm potential algorithmic systems may espouse. First, algorithmic technologies accelerate socio-technological processes (Rosa 2013) and, by extension, harms production. Because algorithmic actions take place in the millisecond time domain, harms will emerge at an increasing speed. The flash crash wiped out trillions of dollars of value in minutes.

Second, as speed combines with interconnectedness and systemic couplings, harms will increasingly propagate at a moment's notice across geographical and sectoral boundaries, making global catastrophic event cascades possible. In the flash crash, a single ill-advised trade had systemic repercussions due to the algorithmically mediated connectors across the markets and their herding behaviours. Acceleration and interconnectedness both contributed to systemic volatility.

Third, the market's brittleness was a function of algorithmic systems that had both facilitated the structure of the market and made it difficult to govern. High-frequency trading facilitated effective price discovery, but the technological assemblage that facilitated it fragmented the market. Fourth, the system-level economic harms from these kinds of failures seem likely to befall those who cannot put adequate defences in place. Due to the speed and complexity of the processes, implementing these safeguards requires significant foresight and resources. In the flash crash case many retail investors unable to engage in complex heading strategies, were left defenceless. While others simply might have never noticed the flash event before it was over.

Cambridge Analytica: Blurring Harms?

The flash crash illustrates the power of algorithmic technologies in facilitating the acceleration of harm production and their propagation. The speed and connectivity of these systems amplify the harmful potential of socio-economic domains. We will now move to our third case study and examine how algorithmic systems have diffused perceptions of social harms by blurring their causes and effects in the CA case.

Context

In March 2018, the news media was awash with alarming articles about Facebook's privacy breaches. The concerns gravitated around CA, a political consulting company. CA had acquired Facebook users' personal data without their explicit consent, fused the data with other data sets and, ultimately, used advanced algorithms to target ads and affect voter behaviour during the 2016 Trump presidential campaign, the United Kingdom's Leave.EU campaign and other smaller campaigns around the globe.

The company allegedly used a methodology developed by Kosinsky, Stillwell and Graepel (2013) to create psychometric profiles by fusing data from an online personality test with data on the respondents' Facebook likes. The created regression model was then used to predict users' personalities based on their Facebook likes. Because Facebook's privacy loopholes allowed the company to gain access to data on respondents' friends' Facebook likes, the company could soon claim it had 5,000 data points on 230 million US citizens. Given that Facebook had, in pursuit of engagement profit, set up its algorithms to employ 'the human brain's attraction to divisiveness', CA claimed it could manipulate voters and strengthen political division and extremism (Horwitz and Seetharaman 2020) by feeding the voters tailored content on Facebook.

However, it is unclear what the effects of CA's efforts were. It is not known how accurate the psychometric profiles were. Attempts to assess CA's claims have produced contradictory results. Sumpter (2018), for example, argued that CA's methodology was lacklustre, with its predictive accuracy at around 60%, and did not produce actionable insight into users' personality traits, changing few, if any, votes. Nevertheless, some contemporaneous accounts indicated that CA had changed the outcome of the election or had even had 'world-historical consequences' (Stark 2018: 221). Further, the general evidence on microtargeting is inconsistent. On the one hand, we know that microtargeting technologies do work and are widely used in other contexts (Tufekci 2015: 205; Zuboff 2019); however, a systematic meta-analysis of studies on how advertisement and campaign persuasions affect voter choices (Kalla and Broockman 2018) has cast a shadow on the effectiveness of voter manipulation efforts in general.

Social Harm Framing

Even if the CA case provides no closure on whether voter microtargeting and manipulation strategies are effective, the incessant use of big data algorithms in recommendation, personalisation and filtering engines is likely to shape both our understanding of the world and its concrete material structures. In line with the findings in critical algorithm studies (e.g., Cinnamon 2017; Mittelstadt et al. 2016; Tufekci 2015), a zemiological analysis of the harms caused by these algorithmic technologies would highlight that interfering with the content humans come across will, first, affect their ability to formulate choices and act on these choices effectively, causing autonomy harms. Systematic dismissal of and interfering with the wants, needs and concerns of certain groups amounts to the disablement of their attempts at self-actualisation (Pemberton 2015: 29).

Second, the harms to autonomy capacities are boosted by the threat of manipulation (even if unintended). Our autonomy may be compromised by stealthy choice architecture designs that nudge (Thaler and Sunstein 2008), 'hypernudge' (Yeung 2017) or 'sludge' (Thaler 2018) us to whatever ends the designers had in mind. The scalable subjects of surveillance capitalism are constantly in danger of being inconspicuously persuaded to move towards unknown ends while being completely ignorant of such manipulation (Stark 2018: 213). Third, the technologies may also give rise to cultural harms if, for example, algorithmic systems transform the material structures to privilege some cultural or socio-economic groups over others. These harms deny subjects access to the cultural, intellectual and informational resources generally available in any given society, robbing them of cultural safety (Alvesalo 1999).

Social harm studies should also note that the prevalence of recommendation, personalisation and filtering engines introduces a technological component to the harm production dynamics: the technologies may distort the visibility and perception of social harms. Algorithmic systems may create an illusion that harms arise from processes that lie beyond the capacity of human control, impairing our ability to discern harm generation mechanisms and, consequently, prevent certain harms. The asymmetry of data access and the power to influence the development and proliferation of modern technologies may allow systematic deception of the public and the creation of pseudo-public commons (Heawood 2018). The effects may be unnoticeable yet extensive, diffused and escalated via hidden personalisation on social media platforms. What is threatened here is the democratic society because algorithms escalate the risks of economic misdistribution, sociocultural misrecognition and political misrepresentation (Cinnamon 2017).

The CA case clarifies that technologies have the potential, if successful, to significantly undermine the private and public abilities to track and prevent harm production. It is easy to understand that along with CA's actions, Facebook's failure to properly oversee its data contributed to the creation of harms. However, because algorithms work in the shadows, nobody can definitively state how the different actors and platforms interplayed and caused the outcome known as an election interference scandal. Algorithmic systems are typically opaque, connected to informational infrastructures and propagate action everywhere within the infrastructure networks. Consequently, causation, involvement and effects will be increasingly difficult to predict ex-ante and disentangle forensically ex-post. If there is no information on how targeting or personalisation function, or when psychometric manipulation is deployed, the measurement of the effects becomes difficult, if not impossible. Thus, the proliferation of algorithms may further blur the alluded distinction between 'natural' and socially mediated harms.

Discussion

Critical scholars consider that technology is value-laden. In parallel, social harm scholars have explored the harmful dynamics of an array of value-laden societal structures (Wood 2020); however, in doing so, they have primarily resorted to structural explanations tinted by the political economy. Mass harms emerge as consequences of social organisations and structures, power relations and modes of production (Mitchell, Pantazis and Pemberton 2019). Wood (2020) argued that zemiology should reconsider its ontology of harm by acknowledging the embeddedness of technology into social structures and distinguishing between various types of harms arising at the interactional level of human–technology relations. While similarly concerned with the embeddedness of technology in social structures, our analysis instead focuses on the role that algorithmic technologies play in facilitating and shaping the dynamics of harm production on the meso and macro levels. Our examples have indicated that technologies, while possibly affecting what kinds of harms arise, more importantly, appear to have crucial effects on harm incidence in spatial and temporal dimensions, influencing harm intensity, extent and traceability. In short, technological aspects matter in harm production as much as social and economic aspects.

The MiDAS case indicated that, despite the optimistic narrative that hails algorithmic systems as capable of increasing the reliability and tractability of decision-making and adding to transparency and accountability, the opposite might be the reality. Using algorithms to allocate unemployment benefits and identify unemployment insurance fraud centralised decision-making and made all decisions dependent on a few instances of design choice. The choices became entrenched in the system and affected the whole applicant population, intensifying social exclusion (Yar 2012) and misrecognition (Tombs 2019) on a structural level. Thus, a key transformation that algorithmic systems bring about is their capability to systematise harm production. What before required great amounts of institutional work now take place at the flick of a switch. In addition, MiDAS stripped away many traditional human safeguards typically present in bureaucratic but, ultimately, decentralised human decision-making systems. The applicants seeking redress faced opaque algorithms that only experts could unpack. Consequently, the case suggests that algorithmic systems will intensify social harm production by systemising and homogenising decisions on a large scale. In addition, algorithmic processing can make seeking redress more onerous than in non-algorithmic decision-making systems, thus, having similar effects to what Eubanks (2017) calls the automation of inequality and bias.

The flash crash case, in turn, illustrated how algorithmic systems might accelerate the social harms produced inside the financial system and financial crashes (Ruggiero 2015; Snider 2014). The scalability, speed and interconnectedness of algorithmic systems have added new layers of complexity to market structures, increasing their systemic fragility and vulnerability to malfunctions. Further, the technologies have sped up the market processes compared to their non-algorithmic predecessors (Rosa 2013). Both tendencies, combined, destabilised the infrastructures. The flash crash demonstrated that because algorithmic systems are integrated into crucial infrastructure, the systems' technological makeup increases the likelihood that both internal and external shocks will propagate through and transmit between subsystems and spin out of control, causing significant social harms. Importantly, this social harm potential is derived from the creation of technological systems.

The CA case accentuated another important part of the changing dynamics of social harm production: the blurring of causes and effects. Algorithmic microtargeting and profiling technologies change our world when they afford actors unprecedented capabilities to manipulate opinions (Mittlestadt et al. 2016), limit the autonomy of data subjects and potentially distort democratic and political processes (Tufekci 2015), undermining solidarity and facilitating social fragmentation (Pemberton 2015). Importantly, unpacking how these algorithmic technologies affect social processes has proven difficult. The subtlety and diffuseness of algorithmic information manipulation and behavioural change tools make retracing and attributing the subsequent social harms to specific actors difficult, if not impossible. CA's efforts have evaded even advanced forensic analyses, apparently because they took place on private platforms using tools cordoned off from public scrutiny by intellectual property rights and arguments that private businesses bear no liability for the social harms that their technologies may afford their users to cause.

As is already well-known, social organisations and structures, power relations and modes of capitalism constitute important and compelling explanatory tropes in the aetiology of social harms. However, it seems evident that technology also plays a role, and analyses that do not incorporate and consider the effects that different technologies can have on social harm production will be incomplete in digital societies. Here, the technicity of technology, as Wood (2020) put it, comes to the forefront. In zemiology, as Wood argued, technologies should not be treated as mere extensions of their developers' and users' agency. Instead, technologies have an agency of their own in facilitating the unexpected and unintended. This technicity of technology in social harm production was evident in all three cases.

In the MiDAS case, the systematisation of harm production stemmed from the technological affordance algorithmic systems created to make decision-making automatic and dependent only on the pre-programmed non-human operation code. This harm production potential is not present in non-algorithmic systems. In the flash crash, algorithmic actions facilitated the emergence of a fragile market where a single trade could have destabilising consequences, threatening the entire market. Again, without the technologies, the harm potential would have been different. In the CA case, the confluence of data resources with new analysis and communication technologies allowed for novel political targeting. In all cases, technology acted as an indispensable booster and modifier for harm production that social harm scholars would explain solely by referring to social and economic structures (e.g., Mitchell, Pantazis and Pemberton 2019), possibly distorting the aetiology of these harms. This observation leads us to argue that harm production dynamics in modern societies should be analysed as being shaped by the socio-econo-technological composition of the environments in which the harms arise. Consequently, understanding and explaining harm production hinges on grappling with both social and technological structures and environments.

Accordingly, future research on social harms in environments affected by technological changes should consider how technological transformations affect harm production and be aware of the varying affordances for both harm production and alleviation that different technological configurations may have. This is crucial in digitalising societies where actions increasingly take place in highly technology-intensive environments. As technologies grow more complex, harm production may escape our efforts to explain, predict and, by extension, prevent social harms if we do not pay attention to how technologies affect our environment. Although the theme has been highlighted by radical scholars that, since the nineteenth century, explored the empowering potential of technologies and called for the development of new economies of free information, collaborative creation and non-hierarchical organisation (Gilbert 2017), the technological perspective is under-represented in social harm studies. The approach focuses on changing the social conditions in which the victims of social harms live or the organisational structures in which harms emerge, neglecting the potential that technological interventions could be created to alleviate harm. This was observable in both the MiDAS and flash crash cases.

In the MiDAS case, social harms were reduced by discontinuing the use of the algorithmic system. In the flash crash case, the market design was changed. Circuit breakers, seeking to halt the processes before they run out of control, were added. However, the CA case still awaits its technological fixes. The proliferation of artificial intelligence and algorithmic technologies has had and will continue to have an influence on the ability of nation-states to affect social harms. Pursuing a more just social world with fewer social harms requires consciously fostering and forcing the development of technologies that create affordances for harm alleviation. Consequently, zemiology can only serve its ultimate goal of alleviating social harms if it engages with the technological dimensions of social harm production and recognises technology as an explanatory factor similar to the more traditional components of the harm aetiology complex. In the algorithmic field, some requests for technology designs based on harm alleviation strategies are becoming available, for example, the artificial intelligence regulation framework in the EU (European Commission 2021)

Finally, we argue that the focus on technologies and understanding their significance can also be beneficial for zemiological studies of non-algorithmic environments. Our research highlights the importance of algorithmic technologies; however, the shift to *socio-econo-technological* explanation models might be useful for disentangling socio-economic processes more broadly. For example, a corporate form could be analysed as a technology consisting of an amalgamation of techniques, humans, skills, methods and processes that make corporations intricate information processing machines (Viljanen 2017). On an abstract level, algorithmic technologies and corporations work using an analogical logic: as algorithmic systems, corporations take in information, process it and produce outputs. Framing corporations as information processing entities allows the targeting of legal and extra-legal interventions to shape the information processing flows. Changes in the input or process level are likely to affect the output, such as potential social harms, regardless of the concrete form of the entity in question. This reconsideration of the technological aspects and logic by which those operate could open new avenues for harm amelioration.

Conclusions

The proliferation of algorithmic technologies gives rise to new configurations of power, prompting a new set of questions concerning the conceptualisation, control, prevention and study of algorithmically mediated mass harms. Critical algorithm and digital criminology studies expose and document the adverse effects of digital platforms, social media, big data and algorithmic decision-making (Chiusi et al. 2020; Whittaker et al. 2018). Building on these findings, we sought to understand how social ordering processes conducive to harms are facilitated in an algorithmic context. When combined, our case analyses suggest that algorithmic technologies fundamentally affect the dynamics of harm production and, therefore, should be considered as a separate aspect. The affordances of algorithmic structures subject new populations to harms that previously affected a smaller subset of the population. The interconnectedness of the digital environment renders our societies increasingly fragile and vulnerable to lightning-fast feedback loops and unintended consequences. The opacity, diffuseness and intractability of algorithmic systems are likely to obstruct and undermine social harm claims and fuel the build-up of the political helplessness of nation-states, undermining their (perceived) abilities to mediate and ameliorate mass harms (Tombs and Hillyard 2004: 38) and rendering many algorithmically mediated harms unpreventable. While we offer a peek into the dynamics of social harm propagation facilitated by the algorithmic context, future research should explore the technological layer of harm aetiology in more detail by expanding the focus from socio-economic to socio-econo-technological structures of harm production.

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