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Taking togetherness apart: From digital footprints to geno-digital spores

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Abstract

Increasingly, the lines of our lives are prescribed, mediated, drawn and knotted together by digital technologies. It has been argued that 'digital footprints', as a trail of user data points collected from online communities and networks, can assist in better understanding human behaviour and social interaction, initially focused on mainly real-time and retrospective analysis. In our attempts at sense-making of togetherness in a COVID-19/post-COVID-19 world, we believe it may be an oversimplification to conceptualise our daily data trails as 'digital footprints'. The nature of our interaction with these technologies as well as their interaction with us have changed deeply ever since the rapid growth of digital connectivity. The character of these symbiotic relationships has been accentuated even more by our global experience of 'connected disconnection' during the pandemic's lockdowns. Against this background, we expand the concept of 'geno-digital spores' as a more appropriate metaphor for the manner within which data and technology combine in new ways to create (or fracture) lines of togetherness.

Keywords

COVID-19, digital footprint, digital technologies, geno-digital spore, surveillance

Separando la unión: de huellas digitales a esporas geno-digitales

Resumen

Cada vez más, las líneas de nuestras vidas están prescritas, mediadas, trazadas y anudadas por las tecnologías digitales. Se ha argumentado que las "huellas digitales", como un rastro de puntos de datos de usuarios recopilados de comunidades y redes en línea, pueden ayudar a comprender mejor el comportamiento humano y la interacción social, inicialmente centrados principalmente en análisis retrospectivos y en tiempo real. En nuestros intentos de dar sentido a la unión en un mundo COVID-19/post-COVID-19, creemos que puede ser una simplificación excesiva conceptualizar nuestros rastros de datos diarios como "huellas digitales". La naturaleza de nuestra interacción con estas tecnologías, así como su interacción con nosotros, ha cambiado profundamente desde el rápido crecimiento de la conectividad digital. El carácter de estas relaciones simbióticas se ha acentuado aún más por nuestra experiencia global de "desconexión conectada" durante los bloqueos de la pandemia. En este contexto, ampliamos el concepto de "esporas geno-digitales" como una metáfora más apropiada de la forma en que los datos y la tecnología se combinan en nuevas formas para crear (o fracturar) líneas de unión.

Palabras clave

huella digital, tecnologías digitales, espora geno-digital, vigilancia

Introduction

Increasingly, the lines of our lives are prescribed, mediated, drawn and knotted together by digital technologies as our governments, policymakers, innovators and citizens are all grappling with the emergent reality of planetary-scale

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computation (Bratton, 2015). More than 50% of the 7.7 billion people on earth are leaving digital footprints in increasingly interconnected digital databases by their interaction with digital technologies (ITU, 2018). Through their interaction with convergent technologies (both digital and biological), billions of real-time (or very-near real-time) data trails are created, captured, analysed and used to predict.

It has been argued that 'digital footprints', as a trail of user data points collected from online communities and networks, can assist in better understanding human behaviour and social interaction, initially focused on mainly real-time and retrospective analysis (Golder and Macy, 2014). In literature, the term 'digital footprints' has become commonplace in various fields, including for example Communication Studies (Thatcher, 2014), Privacy Studies (Vervier, 2017) and Management Studies (Hinds and Joinson, 2018; Önder et al., 2016); it has also been used to nuance the digital divide (Micheli et al., 2018). It has been appropriated by, for example, the Internet Society (Internet Society, 2019), European Commission (Ferrari, 2013), the Pew Internet Center (Madden et al., 2007) and the International Standards Organisation (Bird, 2017). The concept of 'digital footprints' has also entered the lexicon of sociology (Golder and Macy, 2014) and anthropology, for example (González, 2017).

Our captured 'digital footprints' may be very revealing about our identity and its constituent elements (Hinds and Joinson, 2018), but in our interaction with ubiquitous (increasingly invisible) technologies around and even within us, we hardly notice our digital trails anymore. Similarly, in our daily walk through our lived reality we hardly ever reflect deeply upon every footstep we take.

In our attempts at sense-making of human togetherness in a COVID-19 world, we believe it is an oversimplification to conceptualise our daily data trails as 'digital footprints'. In this paper, we argue for the adoption of the term 'geno-digital spores' instead. 'Geno-digital' data are digital and/or biological/genetic data points about our human identity that are digitally created or captured and used for prediction through digital means. These types of data points, such as digitally captured patient-health data, social media interactions and COVID-19 tracking and tracing data, are interlinked, interdependent, time and context sensitive, inevitably incomplete, and of increasing interest to those in power. 'Spores' replaces the concept of 'footprints'.

The original meaning of the word 'spore' in Ancient Greek referred to both seed and the act of sowing, something that can grow and take on a life of its own. Footprints may be ephemeral, but spores are much better adapted for both dispersal and survival, often over very long periods of time and despite seemingly unfavourable conditions. Spores can be activated into life, taking on an instantiated identity, by a range of mechanisms ranging from violent actions (imagine a fungus being kicked and releasing millions of spores in the process) to very subtle changes in environmental factors (such as barely observable variations in temperature, acidity, or light triggering release).

We expand on the definition and characteristics of data as geno-digital spores in the sections to follow. We apply it as a concept in the thematic frame of societal togetherness, a concept defined in subsequent sections. In this text, we make frequent use of COVID-19-related scenarios as a way of presenting the concept of geno-digital spores in action, but also to add meaningfully to the conversation of 'connected disconnection' (Hesselberth, 2018) of how our use of technology has influenced our togetherness during a pandemic that forced us apart. Against this background, we expand the concept of 'geno-digital spores' as a more appropriate metaphor for the manner within which data and technology combine in new ways to create (or fracture) lines of togetherness between us.

Defining geno-digital spores

In recent work (Grove et al., 2019), we coined the term 'geno-digital' to denote a characteristic of human-related data: An integrated dual-structure (a double helix of sorts) of technologically visible digital and/or biological facts about our human identity that is created, collected, extracted, stored, transformed, analysed and used for prediction of behaviour by digital means. The dual identity of geno-digital data points, or 'spores', is of particular interest at this time of COVID-19, as human-related health data are now digitally captured in increasing volumes and with increased velocity.

In nature, fungal or bacterial spores develop into organisms or structures that can be beneficial or pathogenic and sometimes both (Venkova et al., 2018). As stated by Fisher et al. (2020): 'Bacteria are not only considered the cradle of Life, but as revealed by history and centuries of scientific interest, they are the living organisms that affect us, the Humans, most'.

The fungal kingdom, which includes at least 6 million eukaryotic species, is remarkable for its profound impact on global health, biodiversity, ecology, agriculture, manufacturing and biomedical research (Fisher et al., 2020). Our understanding of these contributions of fungi and bacteria to our life and health is still not understood in all its complexity. Similarly, our understanding of how fast developing new forms of geno-digital spores is (re-)combining, or fracturing, to inform our identity and our actual or perceived togetherness in the sensing eyes of technological systems is still not well understood.

We further define geno-digital spores – digital data points with embedded human and/or biological facts – as structures with agency, and as entities that can function as agents of mediation. Whereas footprints contain no (or very limited) biological and genetic information about an individual and cannot facilitate action, in nature spores contain either DNA or RNA, within its code. Footprints have very little agency, whereas in nature each spore within its DNA or RNA

contains the inherent potential to develop into full and complex organisms under the right environmental conditions. Geno-digital spores contain the base elements and code connecting those elements to be used to reconstruct our identity (or incomplete snippets thereof, as we will argue).

The process of datafication refers to the rendering of previously unquantified aspects of the world into data (Kennedy et al., 2015). Within the context of COVID-19, datafication intensified and accelerated, and the pandemic also served as an ex-post justification for the deepening entrenchment of Big Data in regulation, governance, surveillance and subjectification processes (Leszczynski and Zook, 2020).

Our thoughts on the materiality of geno-digital spores and its actant potential have been inspired in part by actor network theory (ANT; Latour, 1996, Latour, 1999, 2005).

In our view, society can be understood as the outcome of networks of connections among human, agents, technologies and objects, but our perspective on these connections is a nuanced view. This view is well described by Stalph (2019) stating that

> (*t*)his symmetry is not 'the establishment of some absurd "symmetry between humans and non-humans"' (Latour, 2005: 76) but the refusal of a priori distinctions and conjectures as to causalities and categorisations—not to study the one and the other but both of them as they are connected within an assemblage.

It is our contention that geno-digital spores may increasingly need to be understood as *mediators*, within the context of ANT, and not mere *intermediaries*.

We therefore view geno-digital spores as having not necessarily an a priori capacity to act, but we argue that, as technology-sensing capabilities increase, the actant capacity of geno-digital spores may probably increase. Materiality has been defined as the arrangement of an artifact's physical and/or digital materials into particular forms that endure across differences in place and time and are important to users (Leonardi, 2012: 34). It is our contention that the characteristic of geno-digital spores to endure across time and place that makes it a more appropriate metaphor than 'digital footprints'.

Geno-digital data as spores

As digitally connected populations all over the globe (knowingly and/or unknowingly) are sowing billions of data points every day, possibly for the first time in human history, advances in technology are enabling the harnessing and control over these geno-digital spores. There are increasingly powerful capacities to automatically and at scale extract these spores, for example the recently announced programme of the US Military to crawl through 350 billion social media messages (Norman, 2019). The creation of the Common Identity Repository (CIR) with the EU will, for example, aggregate both identity records (i.e. name, date of birth) and biometrics (facial scans and fingerprints) of over 350 million people (Cimpanu, 2019) into a digital database.

In Kenya, President Uhuru Kenyatta is pushing through legal amendments that will require citizens to provide DNA samples and GPS coordinates of places of residence, amongst other data required (Mosoku, 2019). In the world's largest democracy, India, the creation of the Aadhaar biometric database, the largest in the world (Safi, 2018), has been subjected to scrutiny not only as result of its ambition and scale, but also as a result of its struggles to secure the data of citizens (Goel, 2018; Hays, 2019). Power also derives from an increasingly long list of surveillance technologies capturing spores, such as gait and facial expression.

The convergence between the fields of behavioural economics, geno-economics, artificial intelligence and data science is furthermore creating a vast new set of tools to leverage geno-digital spores. For the first time in history, powerful actors (both state and non-state) have the unprecedented ability to map, manage and control population behaviour in near-real-time and at scale, using data. They are doing so with increasing velocity. To use the terminology of Scott (1998), powerful government and/or techno-commercial actors (with its power extended by its deep – and often obscured – relationships and dependencies on the geno-digital powers mainly held within large technology firms) are able to permanently settle the perennial state project of making society '*legible'* and addressing '*mobile peoples'*. It has now become possible as never before, for example, to have cities that are not partially blind – now, we have a city that increasingly knows more and more about its (data) subjects (Erwin, 2015; Vanolo, 2014).

The encroachment of surveillance technologies in our everyday lives takes place on multiple levels, ranging from secret drone flights over cities in the US (Hambling, 2020), increases of 1900% between 2010 to 2019 in surveillance-related government procurement in China (Butler, 2020) or the usage of facial verification in national ID schemes in Singapore (Abbugao, 2020). It is also prevalent in workplaces with screen monitoring, for example, being used to monitor productivity from home during the COVID-19 pandemic (Christian, 2020). Surveillance also largely ignores geo-political boundaries, for example the alleged large-scale surveillance of US, UK, Australian and Indian citizens by Chinese military-linked agencies (McGregor, 2020). In the Philippines, police was alleged to have used social media monitoring in enforcement of COVID quarantine rules (Reuters, 2020). Within the context of COVID-19, these technologies have also been appropriated to capture data through public health surveillance programmes, communicate health risk status, trace contacts and inform authorities or others of the potential health risk we may pose to our close contacts or society at large (Gasser et al., 2020; Newlands et al., 2020; O'Neill, 2020; Sandvik, 2020).

Our emerging technological dependency, so deeply exposed through the COVID-19 pandemic, relies on complex, dynamic socio-technological assemblages (social media, digital platforms, artificial intelligence, etc.) with progressively more powerful tools of data-driven prediction (e.g. Kitchin and Lauriault, 2014; Leszczynski and Zook, 2020; Milan, 2020; Poom et al., 2020). The base-element making this possible is the geno-digital spore, extracted and collected by increasingly sensitive sensing technologies, stored in vast databases that are often interconnected and under the control of powerful actors, both state and non-state.

The example of 'immunity passports' (WHO, 2020) further comes to mind. Simultaneously, more and more we rely upon online representations of others and ourselves to make decisions to connect, date, chat, follow, collaborate, friend and unfriend. These tools are used to construct representations of individuals from their geno-digital spores that, increasingly from both a law and governance perspective, becomes the 'real' selves of citizens.

However, the reliance upon 'big data' may present a false sense of objectivity and risks of *ahophenia* (seeing patterns where none actually exist, simply because of the volume of potential connections that may be made in very large datasets) (boyd and Crawford, 2012). Togetherness should be understood as being more than simply the collection, observation and analysis of large volumes of geno-digital spores.

Data mining techniques may lead to spurious connections being made by analysing very large datasets. In one notable example quoted by boyd and Crawford (2012: 668), Leinweber (2007) demonstrated that data mining techniques could show a strong but spurious correlation between changes in the S&P 500 stock index and butter production in Bangladesh.

The combination of different types of spores cannot necessarily be combined into meaningful analytical pictures, despite its quantitative richness. As stated by boyd and Crawford (2012: 670), '(b)ecause large data sets can be modelled, data are often reduced to what can fit into a mathematical model. Yet, taken out of context, data lose meaning and value'.

Data vary across the dimensions of space in various ways and particularly important is who may be included or excluded from datasets and data collection processes, but also who has access to access to data to conduct analysis, manipulation and (re)presentation (Thatcher, 2014). Cognisance must be taken of the *big data divide* and the complexities it introduces into the application of, and reliance upon, predictive technologies (Andrejevic, 2014). In a discussion with Thatcher, it was emphasised that Critical Data Studies must create space for a recursive dialog between theoretical depth and robust empiricism and 'in so doing, avoid the hubris of pseudopositivism and technological determinism, in favor of the nuanced and contingent' (Dalton et al., 2017: 1).

It is our argument that the concept of geno-digital spores may present a useful addition to the lexicon of this endeavour, especially as it is more nuanced than the one-dimensional notion of 'digital footprints'. In the section to follow we discuss characteristics of geno-digital spores, whereafter we will focus on aspects of geno-digital spores that relate more specifically to togetherness.

Characteristics of geno-digital spores

Geno-digital spores signal intention. These data snippets are signalling individual interests, opinions, intentions, wishes, fears, relationships and our most intimate thoughts. In contrast to this, the notion of a footprint simply provides an indication of direction and speed of movement at a particular time. Our digitally captured genetic spores that live in ever growing (and interlinked) digital and genetic databases go even further by predicting (or claiming to be able to predict) our future abilities, possible imperfections, correctable flaws and our eventual probability of making a 'successful' contribution to society. It signals how people are connected, how they organise around common interests, opinions, intentions and fears and, crucially, it signals with increasing granularity how they spend almost every moment of their attention. It signals how their weaknesses and strengths are related, grouped and segmented and can be used to award, for example, 'a "polygenic score" to individuals, summarising the genetic patterns that correlate to outcomes found in a group' (Ward, 2018).

However, big data-driven profiling and targeting is still far from being able to provide exact predictive power (Moore, 2021). There seems to be a disconnect between commercially driven sales narratives (or 'socio-technical imaginaries') and actual technological capabilities. The increasing influence of these corporate imaginaries on society and policy may have significant implications for citizens and the ability of counter-imaginaries to gain traction (Mager and Katzenbach, 2020).

Geno-digital spores show who you are and who you are going to be. Depending on the concentration of geno-digital material being acted upon by sensing and prediction technologies, it can be reasonably inferred who you are going to be at some time in the future, for multiple possible horizons, whereas footprints may show where you were and it can be inferred where you are going only for a particular horizon, with limited relation to your identity.

The geno-digital data captured in each spore will be determined by various factors. These may include what questions were asked when data is captured/extracted. Who collected or extracted the data? For what purposes? For what context in space and time? Under what conditions of extraction/volunteering were data obtained? Did the volunteers (e.g. citizen scientists) know where their data would end up? In contrast to this, the notion of a footprint denotes an

observable, measurable artifact in more simple dimensions only, for example length, width, and depth.

There is a duality embedded in each spore. Each spore can be used for good (such as genomic surveillance that can play a key role in fighting malaria (Aniebo, 2019) and yet the same data can also be used to harm (i.e. exclude vulnerable populations from medical or insurance cover (Shi and Wu, 2017). The marginal value of any geno-digital spore will be influenced, for example, by how it is stored, transformed to make sense of it, recombined to create new insights and the cost of destroying it in comparison to the cost of storage. The phenomenon of 'dark patterns' is well-known in design contexts (e.g. Gray et al., 2018), and it utilises manipulative aspects of user experience design to extract personal information that users would not necessarily have provided otherwise. The fact that manipulative (or even forceful) extraction of geno-digital spores can take place at scale if these types of 'dark pattern' techniques such as nagging, forced action, obstruction of options are applied is concerning. The collection or extraction of small snippets of personal information may be easily coaxed out of users as it may result in some perceived short-term benefit. Users however may be less aware of the potential for these data snippets to be reconstructed and used as proxies for the whole of our identity. In contrast, footprints are not perceived as something that can be forcefully extracted.

Spores are independent yet entangled. Spores are genetically identical, except if they mutate over time. Every spore carries all of our genetic-digital instructions ('DNA' or 'RNA'), yet our identity will always be more than the sum of our geno-digital spores. Extraction of geno-digital data, by means of capture of an individual unknowingly walking past a known drug syndicate kingpin in a facial recognition CCTV system database, will inevitably create an incomplete snippet of data, possibly devoid of context. By means of the process of modelling of geno-digital spores, more geno-digital spores are produced. Footprints, by contrast, are independent with very little entanglement.

Each spore uses different schema for identity construction (e.g. Facebook's model of likes, sad faces, etc.) and the obvious risk to identity-forming and application of the 'geno-digital material' in the spore for that purpose is that spores collected under one schema are applied and analysed according to another. This can lead to distorted reconstructed identities emerging. Each spore may be plotted according to different addressing protocols and may therefore (re)create different identities on different maps. Lines between different contexts, times, relationships and spaces may become blurred, crossed, tightly or loosely knotted without the citizen having any knowledge or control of this. The metaphor of footprints denotes a more simplistic schema of construction based only on its observable dimensions.

The geno-digital spore may be used to reproduce a representation of your identity. This may however only be based on the captured/extracted geno-digital material hosted in that particular spore or collection of spores. By means of geno-digital spores, we continuously give up some (often longer-term and broadly impacting) elements of our identity that may be used to construct sufficiently robust approximations of our identity in future to transact, claim rights and act as representative of us within the urban context. This recasting is increasingly being done automatically by artificial intelligence and often without the awareness, informed consent and willing permission of citizens. An example of this is the controversial 'immunity passports' that have been discussed to facilitate international travel during the COVID-19 reality (WHO, 2020). Whereas a spore, with its DNA or RNA may provide enough information to reconstruct a complete organism given the right technology tools, footprints can only be used to reconstruct a limited amount of information (such as the expected weight of a person based on the depth of footprint).

Your identity becomes the weighted sum of predictions made by technological systems about your geno-digital spores. This calculation is based only on what is visible at that moment in time (and their visible interactions and inter-relationships) to whoever (or whatever) has the power to collect, analyse and infer from that data the answer only the *question or questions they are asking*. If the spore/s does not activate into visibility or activity or sufficient quantity or format to be visible, your identity will not be re-constructed by that particular actor at that particular time to answer any specific question that needs to be answered. Therefore, in the eyes of the observer, if no inference can be made based on visible geno-digital spores, you will not be identified. Stated in terms of COVID-19, without the required 'immunity passport', as captured in a digital database, the freedom of a citizen to connect to others may be curtailed, regulated or prescribed according to certain rules. The metaphor of footprints, in contrast, carries much less inherent predictive value.

Each spore is, from the eyes of external observers (specifically digital platforms with commercial goals, as well as government-industry data sharing platforms or projects), viewed as an adequate approximation of our real selves. Digitally stored approximations of our real selves such as, for example, an approximation of a full fingerprint is often viewed as adequate for the purposes of commercial exploitation or the allocation of/removal of rights, for example giving rights to access to your own phone, or to your home or work premises, or your social support grant. It has been found that platforms such as Facebook, despite their denials in congressional hearings in the US, are collecting data and creating so-called 'shadow profiles' even of people that have never signed up for or used their platform or consented to the profiling (Garcia, 2017; Quodling, 2018). The ubiquity of digital platform usage enables *leaky privacy* (Garcia, 2017) that may lead to the use of data given by users of an online service to predict the personal information of non-users.

Whereas we may be largely unaware of the value of our digital footprints (therefore we contribute it easily), users seem to be blissfully unaware of the multiplicity of ways in which their geno-digital data is being captured, extracted and stored. Our excessive faith in automated systems can lead us down a dangerous path (Hao, 2021). The phenomenon of the *privacy paradox* details how, even though we may be concerned about our privacy, our behaviour often seems to trade privacy for relatively small rewards (Kokolakis, 2017). Our awareness of the extraction or capture of our geno-digital spores does not seem to translate to behaviour that effectively protects against unwanted exploitation, or the potential thereof.

Every geno-digital spore will have an address, whether it wants it or not. The dominance creatures of the geno-digital panopticon,[1] as the map makers, have the power to not only assign boundaries, but also to assign addresses that transcend the boundaries of space as well as of time. There have been various examples of the application of large-scale digital identity programmes by governments to entrench their power to exercise control of populations. An interesting recent example is a Venezuelan digital ID system (based on exported Chinese technology) enabling government monitoring of aspects such as personal finances, medical history and voting activity (Berwick, 2018). In order to create lines between us, the geno-digital address as fixed point on living maps, is a critical anchor that we need to understand, in order to understand the new knotting of relationships in our COVID-19/post COVID-19 world. Footprints, in contrast, are perceived to be ephemeral, more easily destroyed, obscured or camouflaged. Footprints are perceived to be temporary marks of address, whereas spores denote a longer term (potentially permanent?) location in space and time appended to the contributor's identity profile.

Geno-digital spores can be created both by and for non-humans. Every digital interaction, whether by an automated sensor embedded in a product, a captured image in a surveillance camera, or a user decision mediated by an internet-connected digital technology, creates an entry or entries in digital databases. This may or may not be with the explicit knowledge of the user. These processes may also be autopoietic, such as the automated flagging of 'suspicious' gait patterns of a person in a crowd, leading to predictive intervention by law enforcement officials (Brunton and Nissenbaum, 2015).

Legally valid 'addresses' have already been allocated to non-humans, such as the case of Saudi Arabia that granted legal citizenship to Sofia (a robot) but asks various questions of law and government (Abbass, 2017). The process of creation and allocation of each geno-digital spore to an address is largely invisible, automated and designed to minimise user friction. For example, more than 80 countries already issue ePassports with embedded chips and photos particularly suitable for facial recognition systems (Lockhart, 2017). More than 32 countries already use these biometric databases for entry/exit border control (Lockhart, 2017). The Australian government is planning for 90% of travellers to pass through passport control without human help by 2020 (BBC News, 2017). These same types of integrated biometric systems using facial, iris and other types of biometric identity are also increasingly used in anything from humanitarian processing to government access to services (Lockhart, 2017). These technologies are also applied intensively within public health management contexts. In contrast, footprints are more naturally thought of as being created by human or biological agents, such as animals.

The fact that a citizen has left a geno-digital spore does not mean that they have access to it, knowledge of it or control over it. Geno-digital spores may currently be invisible but may become visible as sensing technologies develop over time. At the same time, it may mean that everyone, selected people or no one, may have access to it. It may be visible, only in certain jurisdictions and only at certain points in time. This may change over time, as technology systems upgrade or degrade. It may change over time as new territories are drawn by new technologies, suddenly becoming more valuable or useful, or it may lose its value altogether. The marginal value of the geno-digital spore/s to yourself or others may increase or decrease over time, may remain stable or may become very volatile (driving speculative actors to act on their increasing sensing capabilities). Owners of data often underestimate its value and notions complementing existing frameworks such as the EU's General Data Protection Regulation such as *the right to know the value of your personal data* have been advanced; however, this is unclear whether that will result in more effective empowerment of users (Malgieri and Custers, 2018). A further complicating factor is so-called 'ownerless' forms of big data that may potentially still be utilised to reconstruct identifiable personal data despite application of techniques such as anonymisation or pseudonymisation (Andrew and Baker, 2021)

In contrast, the footprints metaphor presupposes knowledge of the fact that you have created it. Footprints are only created in the same geographical area which you visited, whereas geno-digital spores may cross geo-boundaries with both ease and invisibility.

Insights about our geno-digital property is often licensed to others. Even though we have the right to ownership of geno-digital data that we are both volunteering and/or contributing by (often forceful or deceitful) extraction, we are often incentivised (or forced by law) to license insights about or usage of our own geno-digital property. A recent case in point is *23andMe* and its operating model of packaging and commercially selling geno-digital data or sharing it with government agencies (Molteni, 2018; Robitzski, 2019).

Citizens have very little power to protect themselves against uncontrolled dispersal of geno-digital spores. In nature, very high levels of internal pressure cause spores to fire (Trail, 2007). The walls of the spores need to be strong

enough to stop uncontrolled blowout and dispersal. With regard to geno-digital spores, the reality at present is that the power differential between powerful platforms and other power actors and citizens are just getting bigger. Though there are various initiatives enabling citizen empowerment through, for example, inclusive innovation (Heeks et al., 2014) values sensitive design (de Reuver et al., 2020) the colonisation of the lifeworld or citizens by means of control over data is of concern (Couldry and Mejias, 2019; Heyman, 2015). Various strategies for defeating increasing digital surveillance have been suggested, for example, obfuscation (the deliberate addition of ambiguous, confusing, or misleading information to interfere with surveillance and data collection) (Brunton and Nissenbaum, 2015). However, the all-encompassing surveillance infrastructure characteristic of platform businesses, often adopted as well by government actors, leads to deepening of information asymmetry with 'opting out' becoming more and more challenging to effectively achieve. The notion of geno-digital spores better denote this reality than 'digital footprints'.

Unlike footprints, spores are tough and can survive for long periods of time. It has been claimed that spores can survive for very long periods without water or nutrients. They can survive extensive external shocks, for example bacterial spores can survive meteorite impact (Horneck, 2006). Spores have tough outer shells to protect them against external environmental changes and forces and they can reawaken if conditions become favourable. Some scientists have claimed (controversially) that they have been able to resurrect 25-40-million-year-old bacterial spores from the abdominal content of bees (Cano and Borucki, 1995). A more human example of such geno-digital longevity is the capturing in 2018 of the 'Golden State Killer' in 2018 based on tracing through free online genetic database technologies for 12 unsolved murders and at least 45 rapes that were committed throughout California from 1976 to 1986 (Guerrini et al., 2018).

Whereas 'digital footprints' do not create new structures and living organisms, spores do. An example of the fungus *Armillaria gallica* extends over more than 37 hectares of forest floor and is at least 2500 years old. Even though it has persisted in a particular place, it has been shown to be remarkably resistant to genomic change (Anderson et al., 2018). Similarly, geno-digital structures can be large, complex and 'fungible' and hardy like bacteria. These structures can manifest underground, invisibly growing only to become known once they are very large and often much older and hardier than what we expect. Evolution in cities seems to take place faster (Johnson and Munshi-South, 2017); we therefore postulate that geno-digital spores will also mutate faster in urban contexts because of the number of sensing technologies and data-capturing technologies present, as well as the higher number of lines of connection between people. In contrast, even though footprints of dinosaurs have been found that are thousands of years old, those footprints cannot be use used to extract genetic material and reconstruct the identity of the complex organisms that left them.

Geno-digital spore dispersal may blind and obscure. In nature, another effect of large-scale spore dispersal is the fact that it may create clouds of billions of spores that can blind and obscure. It may be that any meaningful communication in the middle of such a cloud becomes a game of the blind leading the blind. This may have interesting parallels in, for example, the use of social media in current populist politics and the flood of fake news observed during COVID-19. In contrast, footprints are thought of as being harmless artefacts with little actant potential.

Taking 'togetherness' apart

We frame our move from 'digital footprints' to 'geno-digital spores' within the concept of togetherness as proposed by the anthropologist Ingold (2015, 2017). Ingold assumes our understanding of the social is premised on the experience that people's lives are joined. He rejects the idea that this join is best understood as a blob (which depicts social life as discrete and externally bounded entities) and instead proposes what he terms 'an overture to social life', which starts from 'the premise that every living being should be envisaged as a bundle of lines' (Ingold, 2017: 4). He also suggests that in 'joining with one another, these lives of lines comprise a meshwork, in which every node is a knot, and in answering to one another, lifelines co-respond' (Ingold, 2017: 4). We use this rather than the social network metaphor, which is useful in understanding who and what connects to produce knowledge in stakeholder engagement research (Klenk, 2018). Rather, the idea of meshwork explains more the entanglement of individuals who are full of loose ends and always on the move, thus 'becoming' rather than being fixed in time. Thus, Ingold's (2017) work on meshwork aligns with the discourse on geno-digital spores and the ideas around entanglements that go with this. From the perspective of geno-digital spores, even though our togetherness in the digital age may look like a 'blob' at first glance, upon closer inspection it reveals very deeply integrated, interrelated networks of millions, if not billions of computationally drawn connecting lines between geno-digital spores captured from our every digitally captured moment of digital interaction.

Thus understood, humanity's 'togetherness' has surely been transformed by COVID-19. Critical questions resonate as the virus and our digitally mediated interactions with it imposes new trails and inscriptions in the 'meshwork' of the social, with lockdown reconfiguring the bundles of lines and tracing our 'new' humanity. Ingold argues that weather and geography can wipe out lines. If that is so, COVID-19 has a hurricane effect, wiping out familiar traces just as new togetherness forges unexpected new lines that now entangle our lives. Empty airports and planes, trams, trains mimic interruption of everyday lives, with intimations of possibilities for new ecological/human togetherness as COVID-19

changes the markings of humans. We uncover spaces and create 'meshworks' through (Zoom, Skype, WhatsApp, Teams, etc.) rather than in places (parks, restaurants, bars, cinemas, shebeens). Global North/South boundaries are redefined. COVID-19 exposes strengths and weaknesses of nation states and regions in which places which were considered strong, such as Italy, Spain, Germany, the UK, and the US. bend and bow to the ravages of the virus blurring ideals of vulnerability and resilience and creating new science-society borders as we contemplate the prior (ab)normal and the new (not) normal.

Yet, we should be very wary of utilising geno-digital spores as a proxy for 'togetherness' as each of these captured or extracted units of identity are never value neutral. They are deeply enmeshed within the technological rules and limitations that guided their collection. The collision between the large-scale use of geno-digital data and the technologies of prediction has four major effects (Grove et al., 2019). It recasts the citizen as data subject; it enables the unprecedented ability of authority (power) to map, manage and control population behaviour; it is characterised by concentration of control; and regulators and mediators are simultaneously transforming and being transformed. When citizens are reduced to numbers useful for prediction and geno-digital datapoints are controlled by powerful commercial and state actors harnessing vast computing power, the complexity of this emerging reality is difficult to fathom. Bratton (2015) refers to the emergence of an accidental mega-structure of planetary-scale computation. This leads to increasingly difficult trade-offs that citizens must make in their interaction with each other, those in power and with both digital and biological technologies. Often though, citizens are not in fact aware that they are interacting with (increasingly opaque and even invisible) technologies.

Social connection and geno-digital spores

Our connectedness and level of societal inclusion and association, or our 'togetherness' as described in the next section, is increasingly determined by our reconstructed digital identity (Cross et al., 2010; Mellmer et al., 2014) using our quantifiable dimensions (as well as quantifiable dimensions inferred from our geno-digital data) as measurable coordinates on a dynamic map (Van Hoff and Breunig, 2016). Our sensed self-identity, and by extension our relationships, becomes the weighted sum of predictions made by technological systems about our data, our geno-digital spores. Our distance from others (and ourselves) on these dynamic maps is increasingly being algorithmically determined and mediated behind opaque systems with blurring boundaries between public and private, free and commercial, far and near, shared and exploited.

As digital sensing technologies become more advanced (i.e. quantum computing), the mechanisms by means of which togetherness may be mediated by technology will not only become more prevalent, but also more invisible (i.e. deep fakes, virtual reality, Zoom video call backgrounds). These technologies will also increasingly be able to reach back into the history of geno-digital spore colonies captured in ever-increasing data lakes and make 'sense' of our digitised selves, our relationships and our collective records thereof. The base unit of analysis making these identity-proximity calculations possible is the geno-digital spore. This may take place across the boundaries of geography, of space and time. The metaphor for digital connection of humans as rows of intersecting digital footprints is thus no longer sufficient to describe how technology is pushing us together and moving us further apart.

Mapping the encounter between geno-digital spores, inclusion and power

To control the COVID-19 pandemic, many governments have instituted temporary or indefinite technological efforts to single out infected individuals or maintain quarantines. The numerous and varied public and academic debates around the use of apps to trace COVID-19's spread and community risks have been characterised by tensions between centralised and decentralised approaches, with the underlying assumption that proximity to data is advantageous, but centralised data brings advantages of more nuanced analysis, and may be more attractive to power.

Many of these efforts compromise privacy and human rights. The most common form of surveillance is the use of smartphone location data and/or Bluetooth data – some governments are using smartphone apps to offer coronavirus health information. South Africa for example, announced a mobile app developed by the University of Cape Town in partnership with the Council for Scientific and Industrial Research (CSIR) (Covi-ID, 2020; Krige, 2020) yet it is highly unclear how many users would be required for this app to become effective. The app was seemingly developed using a top-down approach. Unsurprisingly, even in India, being the largest democracy in the world, citizens have been forced to download tracking apps (O'Neill, 2020). For a non-exhaustive list of further examples, see for example, MIT Technology Review's COVID Tracing Tracker (O'Neill et al., 2020), as well as (Covi-ID, 2020; Duncan, 2020; French and Monahan, 2020; UCL News, 2020; Veale, 2020).

These technologies can be positioned in a typology of proximity and contact tracing, symptom monitoring, quarantine control and flow modelling tools (Gasser et al., 2020), and each of these tools introduces context-specific risks, cross-sectional issues, and ethical concerns (Gasser et al., 2020).

The absence of digital skills or digital connectivity can cut the line between a citizen and their ability to carry the 'immunity passport' suggested in various jurisdictions (WHO, 2020) or their obtaining of access to obligatory mobile applications (O'Neill, 2020). Skills deficits can also

very negatively affect the ability of citizens to participate and contribute to the very citizen-science initiatives designed to empower them. The price of togetherness (and, in the age of COVID-19 relationship-risk mediation) is being tracked – contributing geno-digital spores.

The complexities around COVID-19 and inherent uncertainty and unpredictability requires a more interactive and creative view on knowledge encounters and the transmission of 'facts' and how to convert inequality and the more than ever uneven balance of power for a more just and ethical society. It is our contention that geno-digital spores may present a useful addition to the analytical lexicon in this regard.

Conclusion

Our increasing interaction with digital technologies and the convergence of the biological data collected and/or extracted from us and its continuous capture in digital form and use for predictive means, led the authors to conceptualise data trails as 'geno-digital', and as entities with agency. The geno-digital spore, as unit of identity, carries within it the base elements that are increasingly used to draw (often invisible) lines between us, impacting both our online and offline worlds.

In this paper, we introduce and define the term 'geno-digital spore' and describe its character. We translate each characteristic of geno-digital spores within the notion of 'togetherness' – where our initial question about the nature of digitally captured human data trails started. We demonstrate the value of conceptualising data trails as geno-digital spores by narratively explaining COVID-19-related human-technology interaction scenarios and their effects on our togetherness as being results of the nature of our data trails. The COVID-19 pandemic significantly raised our collective awareness of the role of digital technologies in connecting our everyday lives and in mediating our interaction with those in power, be that government or non-state actors. Some were able to articulate their sense of 'connected disconnection', yet second order questions – such as how technology interaction influenced family and work dynamics – were more challenging to answer if data is defined to be mere trails of facts about past actions.

We argue that by conceptualising these interactions as mere 'digital footprints', we may inadvertently be perpetuating a techno-utopian vision of billions of data-points being collected and/or created without having agency. This would be inaccurate. When we are conceiving policy interventions or regulatory remedies to manage our interactions with and through digital technologies, we need to adapt our underlying assumptions. We need to take care not to perceive only 'digital footprints' – the reality seems to be more complex than that and we need to adapt our metaphor accordingly.

To unlock the public value of digital technologies as mediators of interpersonal connection in these pandemic times, we need to be cognisant not only of the ways in which this pandemic is disrupting lines between us, but also how our geno-digital spores are being reconstructed automatically by technological systems often unbeknown to us. The value of design friction (Forlano and Mathew, 2014) in our mutual human endeavour to address challenges through design of new technologies will become more and more important in ensuring connection results in meaningful human togetherness. By making our interactions with technological interfaces more visible to users, we are creating more space for deliberative reflection. We are enabling users and designers to engage in Daniel Kahneman's *system 2* 'slow thinking' that is more calculated and requires more active attention than *system 1* automatic thinking (involving little rationality and control) (Kahneman, 2011).

These moments of contemplative friction are needed in a world where future imaginaries around digital technologies, its making and its governance, are increasingly dominated by technology companies that 'partly absorb public institutions' ability to govern these very futures with their rhetoric, technologies and business models' (Mager and Katzenbach, 2020).

In our endeavours to design meaningful technologies, we would need to sometimes deliberately mark the lines of our togetherness, in order to signal their visibility, to emphasise and test their strength and to ensure that our connections with citizens are real. In our mutual human endeavour to address challenges through design and use of new technologies, viewing our captured and extracted data trails as having agency will become more and more important in ensuring connection results in meaningful human togetherness. In conceptualising the lines that connect us to each other and to our increasingly complex data and socio-technological assemblages, we could benefit from adopting a more organically inspired metaphor such as geno-digital spores.

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Note

1. The panopticon concept has caught the imagination of many researchers, for better or worse. The prison architecture invented by the Bentham brothers but elaborated by Jeremy Bentham became the crucial 'diagram' for Foucault's work on surveillance. Interestingly, it encapsulated both an emphasis on self-discipline as the archetypical modern mode, supplanting previous coercive and brutal methods, and a focus on the classificatory schemes by which sovereign power would locate and differentiate treatment of the variety of prisoners (Lyon, 2006).

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