


Please cite the Published Version

Serafinelli, Elisa  (2022) Imagining the social future of drones. *Convergence*, 28 (5). pp. 1376-1391. ISSN 1354-8565

DOI: <https://doi.org/10.1177/13548565211054904>

Publisher: SAGE Publications

Version: Published Version

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Additional Information: This is an Open Access article which appeared in *Convergence*, published by SAGE Publications

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Imagining the social future of drones

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Convergence: The International Journal of Research into New Media Technologies
2022, Vol. 28(5) 1376–1391
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DOI: 10.1177/13548565211054904
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Abstract

Despite the opportunities afforded by the growing use of drones, their civilian use causes concern as they can capture, share and store images of events and people following a set of norms still in development. The main challenges risen by drone usage relates mainly to existing gaps in regulation and the difficulty to enforce approved guidelines. Further changes and implementation of drone legislation will broadly affect current applications and future opportunities shaping the way civilians will be allowed to use drones. This article explores these issues qualitatively, analysing (i) civilian users' and developers' views on drone usage, (ii) their knowledge of relevant regulations and (iii) how they imagine its use should be regulated. In its conclusion, this article discusses the general concern of potential privacy infringements and the importance to take into account civilians' thoughts in further implementation of drone law in order to protect recreational practices.

Keywords

Drones, new technology, social imaginary, privacy, digital media, surveillance, mobile media, policy

Introduction

Drones are an increasingly important social phenomenon. They are widely understood as unstaffed aircraft, generally fitted with cameras that can be remotely controlled and used for recreational and commercial purposes (Howley, 2018). Alongside professional uses, the drone market found fertile ground with civilian fliers who show particular enthusiasm in the new visual opportunities they afford. In fact, they engage with viewing and capturing innovative visual content. Besides the interest in new visual perspectives, the widespread use of drones amongst civilians generates concern in relation to personal privacy, ethics, safety and security (Rao et al., 2016; Finn et al., 2014, 2016).

For example, when used by inexperienced or irresponsible pilots, they might cause potentially dangerous collisions. Drones are also able to fly above private properties collecting images that violate personal spaces. They can capture, share and store images with drones and videos of events

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and people without consent to do so. The posting and sharing of aerial images and videos across media channels and social media platforms rely on drone users' self-discipline. Legally, drone visuals are treated in the same way as any digital content captured with photo cameras, smartphones or other recording devices. However, in an environment where contexts and related policies change quickly and where there is an unclear understanding of suitable forms of regulation regarding data-driven camera technologies (McCosker and Wilken, 2020), the use and management of drone data and visuals is part of the problem of maintaining consistency between technological advancements and associated good practices.

Yet to date, not much attention has been paid to explore civilian users' perspectives and experiences of using drones. On the one hand, research to date has focused mainly on technical aspects (for example Yang et al., 2017) and the use of drones in war zones (for example, Agius, 2017). On the other hand, following studies conducted on the public perception of drone uses (Nesta and Flying High Challenge, 2017), policymakers have been focusing (and still are) on guaranteeing public safety and security (which represent the concerns that dominate the general public), and on enabling commercial work.

Despite the importance of these fields, it is also essential to acknowledge civilian users' thoughts, as they represent a significant part of drone buyers and users. In addition, drone developers themselves are fundamental actors in drone usage as they imagine the way in which the drones they develop will be used, and these imaginaries play a vital role in the eventual take up of these new technologies. Knowing their viewpoints matters to better understand and improve the match between technology and its users with a vision to further opportunities and potential challenges in drone applications from socio-cultural perspectives.

Drawing on literature from media studies and science and technology studies, this article fills this timely gap in research. To do so, this article brings together Taylor's concept of the social imaginary (Taylor, 2004) and Pink's (2013) notion of visual practices to form a theoretical framework that explores (i) civilian users' and developers' perspectives on drone usage, (ii) their knowledge of relevant regulations and (iii) how they imagine civilian drone use should be regulated. This helps to know more about the way users consume, change and domesticate technological developments and, in turn, the way users are shaped and transformed by technology (Oudshoorn and Pinch, 2003).

Drone usage as a social imaginary

Like other innovative technologies, drones are designed to introduce new ways of doing things. They have been already envisioned as a way of delivering goods, as additional monitoring systems, and creative tools in the film industry. These new uses include post-natural disaster evaluation and disaster aerial assessment (Ruiz Estrada and Ndoma, 2019), distributed modes and ways of seeing protests (Tuck, 2018) and the enhancement of the vision span of existing surveillance systems in crime prevention (Nair, 2020), as well as aerial monitoring of crops (Raeva et al., 2019), the facilitation of rescue operations (Pólka et al., 2017) and archaeological surveying of landscapes (Campana, 2017). Drones have also started to attract the attention of the cultural and creative industries, particularly tourism, journalism and filmmaking, for their capacity to reduce dramatically the cost of production, offer innovative visions (Santamarina-Campos and Segarro-Ona, 2018) and for their efficiency in witnessing happenings from a different angle (Gynnild, 2014; Tremayne and Clark, 2014). These are just some examples of the potential of drones to transform our views of the world, offering novel visual opportunities and uses. The common denominator of most (if not all) of these applications can be easily recognised in the possibilities offered by their embedded camera sensors.

With the proliferation of automated cameras and machine vision systems the way we make sense of seeing, vision and visibility has shifted substantially (McCosker and Wilken, 2020: 3), decentralising the role of humans in the process of observing. In their book *Automating Vision* (2020), McCosker and Wilken introduced the concept of ‘camera consciousness’ to further understanding on how machine vision technologies are not only formed by their technical components (e.g. artificial intelligence (AI) and machine learning) but also by the social relations that are produced around them. Therefore, thinking of drones, together with facial recognition, mobile phones, and self-driving cars (just to mention a few) as part of the different aspects of machine vision systems, helps us to make sense of and situate the impact that these new visual perspectives have in our societies and our visual imaginaries. This considers people working with this new visual material (as described above) and people experiencing it through various daily practices.

Despite the rapid expansion of the drone industry in recent years, research conducted with members of the general public reported that the general awareness of drone technology to be low or non-existing, in particular in relation to civic and commercial applications (DfT, 2016). Moreover, a study conducted in 2017 showed that only around 30% of members of the public felt they had a good understanding of drones and their uses (Nesta and Flying High Challenge, 2017). Nonetheless, according to the same study, the public recognised and trusted the use of drones in emergency services alongside their concerns for safety, privacy and accountability. These fears were followed by contentious opinions on drone deliveries and negative ones in relation to drones in war zones. In other words, the lack of accurate information and exposure to drone technology seems to be determining the publics’ uncertainty in current and future implementations.

Following the concept of social imaginary, drone innovative applications have the potential to affect the way societies operate like the arrival of the internet and the first smartphone did (Sarwar and Soomro, 2013). Considering that, it is important to reflect on people’s understandings, taking into account their imaginaries and their perceptions to investigate how these changes shape their social lives. To do so, it is helpful to trace the development of a distinct social imaginary following Taylor’s (2004) interpretative ideas.

For Taylor (2004), social imaginary refers to the ways people imagine their social lives, interactions and norms. His approach is therefore highly relevant for interpreting practices around drone development and drone usage in a way that incorporates the visual data that they capture. Social imaginary is what ‘enables, through making sense of, the practices of a society’ (Taylor, 2004: 2). Through this concept, Taylor (2004) contemplated the ways individuals imagine their social experiences, how they fit together with others, how things happen between them and others, and the normative notions and images that inspire social expectations. Specifically, Taylor (2004) theorised his concept of social imaginary through three main points. First, he adopted the term ‘imaginary’ to give attention to the way ordinary people imagine their surroundings. Often, this is not expressed in theoretical terms but is, instead, displayed in images and narrations, which is particularly suitable for the study of drone practices and their visuals. Secondly, contrary to social theory, social imaginary is interested in the experiences of large groups of people. In other words, it is interested in exploring the development of common practices and their related sense of legitimacy, which reflects the aim of this study. This article, indeed, explores the general perspectives of two big groups (civilian users and developers).

To implement Taylor’s (2004, 2007) reflections, it is worth mentioning the work done by Jasanoff and Kim (2015), which represents a relevant contribution to theorise societal transitions adding science and technology into institutional changes. Drawing on earlier work with Sang-Hyun Kim, Jasanoff defined sociotechnical imaginaries as ‘collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of

social life and social order attainable through, and supportive of, advances in science and technology' (p. 4). With this interpretation of society, [Jasanoff and Kim \(2015\)](#) acknowledged that science and technology shape our values and norms as much as we govern our way to make sense of things. Therefore, sociotechnical imaginary is also helpful to approach the study of drones as it draws together our capacity to establish new collectives through technological as well as social means.

Retracing the key concepts of surveillance and privacy theories in the digital age, in the following section I discuss how, despite advances in data collection (See [Jackson and Orebaugh, 2018](#)) and tracing apps (See [Bradford et al., 2020](#)), there is the widespread perception (as participants reported) that privacy is still a visual problem.

Drones in society: The problem of being watched

For a period of time broadcasters have favoured reporting on drones that emphasises their destructive use in war zones ([BBC, 2016](#)) and misuses near airports and in cities ([BBC, 2019](#)). In response, *DJI* wrote an open letter to the news director complaining about the negative pattern that the BBC was portraying around this new technology ([Duglas, 2019](#)). A survey conducted on the public perceptions of commercial drones reported that 89% of their participants gain knowledge about drones through media and online sources rather than official educational ones (less than 1%) ([Keilman, 2019](#)). This suggests that international news strongly shapes public opinion around safety, security, and privacy concerns. Even according to a recent survey conducted on the potential use of commercial drones in smart cities, privacy was reported as one of the major concerns ([Vattapparamban et al., 2016](#)). Arguably, due to built-in cameras, drones capture information that may occasionally violate people's privacy. This fear was confirmed by studies carried out in the UK ([Department for Transport, 2016](#)), Canada and US ([Vision Critical, 2014](#)) where security and information collection are felt as key issues of concern.

Following those concerns, [Finn and Wright \(2012, 2016\)](#) conducted extensive work on privacy, data protection and ethical challenges in drone usage as drones have been increasingly used for gathering multiple types of data through sensors and optical cameras. Surveying the European drone industry, regulators, and civil society organisations, one of their studies reported a fragmented environment in terms of regulations due to the difficulty to define an appropriate overarching legislative framework able to cover the use of drones by the three different categories. Indeed, drones equipped with cameras can capture images of people and this feature can carry private information, such as behaviours and physical characteristics. This information is often associated with the loss of control over the personal image as sensors can capture information about people's location (geographical data), health (temperature data) and home lives ([Finn et al., 2014](#)). Despite the range of information that drones can collect, the camera (and therefore visuals) remains the most popular payload to carry on a drone.

The relationships between control and vision are not a new dynamic. However, the constant introduction of new technologies seems to guide research to refresh and reframe this dichotomy. With the launch of the first smartphone with an embedded camera, people started to perceive the invasion of their personal privacy as an everyday problem since taking illicit photos became very easy ([BBC, 2004](#)). That showed a general identification of privacy issue in being tangibly observed. Before being worried about personal privacy being violated via the use of smart applications, mobile malware and geolocation data, smartphone users related their concerns with being photographed and/or recorded ([Serafinelli and Cox, 2019](#)) confirming an ever-present connection between privacy infringement with vision and visibility. Not surprisingly, one of the most discussed aspects of

civilian drones' development, from a societal and ethical perspective, was privacy and data protection (PDP) (Finn et al., 2014) where drones embody the actualization of advanced controlling systems.

Not all drones invade personal privacy all of the time. However, they all have the capability to be applied for a range of similar tasks and applications (Bracken-Roche et al., 2014) producing and articulating novel, multisided, complex, and varying types and forms of politics of visibility. Other than the traditional military uses, many versatile monitoring uses are growing within different sectors, such as: emergency services, critical infrastructure inspection, coastal security, search and rescue, transmission of meteorological data, for disaster events, and environmental monitoring (Vacca and Onishi, 2017). Due to the variation in monitoring and the ways they can collect data, drones present unique privacy challenges as, compared to more traditional controlling systems, they have remote vision and no on-board pilot, which gives greater possibilities to gather information (Bracken-Roche, 2016). Also, not all controlling practices are perceived as dangerous or unethical. For example, the use in domestic policing is strongly supported by the general public when related to search and rescue operations (94% supported) and less appreciated in the area of crowd management (47% supported) (Sakiyama et al., 2017).

In fact, drones are used in humanitarian actions (Bergtora Sandvik and Gabrielsen Jumbert, 2016), for the protection of communities and populations, as well as for the development of industry and commerce (Jacobstein, 2013). Despite a range of remarkable good purposes, the top-down structure used by governments, industries and manufacturers in setting drone regulations and rules of conduct is problematic because it does not acknowledge the ways in which the introduction of these technologies can lead towards eroding expectations of privacy and fundamental democratic rights. Taking this into account, it seems that the public is expected to accept these top-down mandates (McCosker and Wilken, 2020). These have the potential to intensify pre-existing tensions in society (Weizman, 2002), such as knowing that such observing can be carried out by privileged individuals, organizations and public agencies.

According to a European study on privacy, data protection, and ethical risks in civilian drone operations conducted in 2014 it emerged that the primary focus of CAAs was on safety rather than privacy or data protection. This study reported that even private actors such as corporations and journalists may use drones for corporate espionage, tracking celebrities, and other observation activities. It also emerged that some individuals envision the use of drones as a new tool for private monitoring activities including the protection of their property, as well as other voyeuristic pursuits (Finn et al., 2014). For instance, this can be seen through the implementations of high-tech sensors, such as thermal imaging cameras. These affect almost all types of privacy (bodily privacy, behavioural privacy, image and information privacy, and location and space privacy) and are easily accessible by a range of drone operators including government agencies, corporations, journalists and private users. Even if in the digital age the strict separation of private and public spheres does not seem to exist anymore, there is still the idea of a reasonable expectation of privacy (Mund, 2018).

Arguably, there is an inherent paradoxical relation between privacy and new technologies as people's ideas about privacy are often counterbalanced by their own desire for convenience and benefits (i.e. agreeing to 'terms and conditions' in order to get access to online services). In other words, their behaviours do not always mirror privacy concerns (Taddicken, 2014). This can be seen, for instance, comparing the surveys conducted on public opinions on commercial drones and the fast growth of the drone market discussed above. Indeed, despite the general fear of potential infringements of personal privacy the market of drones is growing rapidly suggesting that more

knowledge about perspectives on drone usage and the way it should be regulated is needed. This article fills this gap, exploring these issues qualitatively.

Methodology

The fieldwork for this study was undertaken primarily through computer-mediated qualitative interviews. A sample of 30 participants took part in this study: 20 civilian drone users and 10 drone developers. Civilian user participants were recruited from online platforms and communities, including DIYdrones.com (the leading community for personal use), Dronestagr.am (a social media platform where hobbyists share aerial photos and videos), [Travel by Drone](http://TravelbyDrone.com) (websites that allows drone pilots to share their geo-located content) and [Grey Arrows Drone Club UK](http://GreyArrowsDroneClubUK.com) (UK based club forum for drones' enthusiasts).

Civilian user participants were asked to respond to semi-structured questions and to show videos and photos they have captured with their drones to support their responses (if they wished). Even though debates around the use of drones by governments, Amazon and other big corporations are of clear public interest, this study focuses in particular on the visual material captured by civilian users. Developer participants were recruited from drone labs in Universities based in the UK. Likewise, developer participants responded to semi-structured questions. A call for participants was shared through social media platforms and across universities' mailing lists. The target population did not have restrictions in terms of gender, race, and education, but instead were selected because of their personal experience or knowledge of the topic under study. In the data analysis section, I have followed the most common form of participants' anonymization, which consists in assigning pseudonymous (see [Moore, 2018](#)) to maximise protection of participants' identities. All interviews were transcribed and then subjected to a detailed qualitative content analysis. This helped to identify patterns and recurring themes ([Vaismoradi et al., 2016](#)) with the aim of answering the three overarching research questions:

RQ1: What do users think about their uses of drones?

RQ2: How do developers imagine the drones they produce will be used?

RQ3: What do users and developers think constitutes acceptable drone use?

All interview data was organised and coded in Nvivo, according to pre-determined and emergent themes. This allowed an in-depth understanding of participant perspectives and visual practices by considering the relationships between their responses with findings discussed in previous studies. The study was exploratory in nature, focussing on civilian users' and developers' perspectives on drone usage, essential to open up future critical conversations that forefront socio-cultural perspectives.

In the following section, I discuss civilian user and developer participants' reflections on their current drone usage. Then, I discuss the widespread general concern about privacy infringement that the civilian use of drones might cause and civilian user and developer participants' positions about it. Ultimately, I consider participants' views on the current state of drone law and its further implementation emphasising civilian users' fear that future changes might limit their recreational practices. To do so, I employ [Taylor's \(2004, 2007\)](#) idea of social imaginaries to interpret the way participants envision future applications and uses of drones in society with particular attention on whether further rules will restrict civilians in exploring the novel recreational opportunities that these flying robots can offer. The concept of social imaginary is complemented by [Pink's \(2013\)](#)

argument that the study of visuals needs to consider how people produce images by thinking about the technologies they use to do so and how these relate to their existing personal experiences and knowledge. Through this approach, [Pink's \(2013\)](#) concept of visual practices helps to explore how the growth of civilian drone usage enhances an interest in aerial visuals and in viewing from a different perspective.

Users' and developers' thoughts on drones and their future

Drones and privacy issues. Considering the growing number of drone sales, participants shared the general feeling that the government will put in place further legislative restrictions to govern uses and misuses. Despite the government efforts to produce a drone regulation that aims to 'improve the safety of our airspace' ([House of Commons Science and Technology Committee, 2019: 3](#)) participants felt (from their own experiences) that most of the general public have negative views on drones as they relate these new technologies with harmful events such as drone strikes in war zones or other incidents (e.g. Between 19 and 21 December 2018, hundreds of flights were cancelled at Gatwick Airport (UK), following reports of a drone close to the runway). Together with practices that weaken people's safety, participants felt that the general public fears being spied on without consent. However, developer and civilian user participants find this an unjustified fear as nobody (they claimed) is interested in watching inside someone's bedroom or over neighbours' back gardens. For instance, Karl, a drone user in his 50s, blamed the UK media for saying that 'they have a lot to answer for when it comes to anxiety among the general public with drones'. In the past couple of years, he said he has seen many tabloids publishing dishonest articles accusing people of using drones to spy on other people.

For example, *Wired* in 2018 published an article about tricks to use to determine if a drone is watching you, implying that people might be using drones for watching over other people ([Greenberg, 2018](#)). In addition, *The Sun* in 2019 reported the story of a worried homeowner who called the police after a drone had been used to spy into neighbours' homes ([De Vaal, 2019](#)). Dave, a middle-aged lecturer, thinks that even when people use their cameras or mobile phones, they could potentially be spying on someone. 'What about dash cams on cars that spy on people without their permission?' he said, 'Nobody ever says anything about it!'. He continued saying: 'Actually, if you put a dash cam in your car and you draw up behind a car in front of you that's got children in the back, the camera is recording those children, and is that not spying or illegal?'. Dave's comparison between the use of camera phones and drones helps to reflect on the fact that drones are actually not different from other recording devices nowadays widely integrated in our everyday lives, like smartphones or AI technology.

Despite that, most members of the public fear that drones are now used to visually monitor people's private activities ([Vattapparamban et al., 2016](#)). Similarly, the use of a smartphone's camera has been widely associated with the 'paparazzi' style of photography ([McNamara, 2016](#)). Undoubtedly, the widespread ownership of such technology in Western societies and the spread of visual content on online platforms facilitated this idea of the visual invasion of personal space. What seemed to be an outdated problem – the physical infringement of privacy – re-emerges with the advancement of drones, which also brings new issues related to safety and security. Drone developer participants are aware that the invasion of privacy is often a concerning matter in the civilian use of drones. This concern comes mainly from the general fear of being spied on within private spaces (e.g. home and back garden). However, they are also aware that the use of drones in front of people's bedrooms would not go undetected mainly because of the noticeable noise they produce. Despite the general fear, drone developers are progressively refining this technology, but 'the creation of an

invisible drone with an embedded silencer and powerful lenses is not part of our near future', several participant developers claimed. Arguably, this fear to be watched and controlled may lie in the fact that drones resemble robot controllers in sci-fi movies. In a way, this fear seems justified by the capability of new optical zooms that are already built-in to other apparatuses (e.g. traditional DSLR cameras). However, as Joe, an American drone user, highlighted, privacy law is already in place and authorities should have the ability to enforce it either if someone uses a camera on the ground or a drone in the air. Yet, this seems difficult to enforce in practice.

Whilst members of the public might fear being watched, drone developer participants (but also some civilian user participants) feel that the main concern for future technological advancements will be related to the potential use of drones in delivery services. For example, since December 2016, Amazon has been testing air deliveries (service called Prime Air) in the Cambridge area in the UK using autonomous drones able to deliver parcels weighing up to 2.3 kg within 30 minutes from the order. Most developers see this (near) future implementation as one of the main problems in relation to personal privacy (only two developers did not report this concern). In fact, to be able to provide the service, delivery companies need to access personal data and metadata, as already happens with internet services (Couldry and Mejias, 2019). They are also very likely to get access to automated object detection, GPS surveillance and enhanced image resolution photographs. However, to date, Amazon's prospect of data collection usage from drones has not been disclosed. Alex, a drone user in his 40s, highlighted that companies like Amazon have already widely sold other devices (like Alexa and Echo) that could be monitoring people from inside their home. He thinks that there is already a range of devices on the market that invade people's personal privacy daily in a more invasive way than an ordinary drone would do. Regarding privacy invasions, developer participants feel that the general public does not consider the effects of data mining when it is in fact an important aspect to contemplate for further applications of drones in society.

Drone law and its gaps. Despite the initial unclear law, current drone regulation seems to develop a new set of rules that support safety and security. This includes restrictions in terms of where and how drones can be used and who can use them. According to participants, the basic rules related to distances to people, buildings and restricted areas are clear, accessible, and fair. Broadly, as said above, drone regulation rules two main groups: the use of drones for commercial (e.g. professionals) and non-commercial work (e.g. civilians). In the UK regulation, for instance, it is clear that civilian users are not allowed to fly in built-up areas, near airports, or beyond the visual line of sight. Flying drones (or model aircraft) between 250g and 20 kg is illegal if they do not show a valid operator ID and if they are not registered. Drone developers and all professionals should own a valid operator ID as these are necessary requirements to conduct commercial work. On the contrary, civilian users are not obliged to register their drone. They need to do so only if its weight goes above 250g. These rules appear very sensible for civilian users, Oscar, a middle-aged robotic engineer, commented. However, the big challenge is that enforcing these rules effectively is almost impossible. What complicates the enforcement of drone regulation is the fact that when buying a drone civilians are not (yet) forced by law to obtain a license or register their drone. This makes them less traceable if used inappropriately.

Oscar highlighted that the members of the government's drone committee come from commercial drone industries. Therefore, when discussing the development of drone regulations, they aim at having fewer restrictions, the possibility of flying wherever they can, and other rules that will allow them to increase their businesses leaving out the interests and concerns of civilian drone users and the general public. This justifies the concern that some of the civilian users have in imagining that further legislative changes will start to restrict recreational usage to facilitate businesses and

professional uses. In fact, the potential advancement of drone usage by delivery companies might cause two main problems: (i) the implementation of further personal data collection and storage and (ii) the development of further flying restrictions for recreational fliers. This would (inevitably) cause the request to limit recreational flights to protect airspace for deliveries. Also, the implementation of additional data mining procedures is a widespread concern that emerges from the experience with similar platforms. This potential direction was perceived by civilian user participants as a way to 'kill the hobby'.

Overall, participants had the feeling that the government might put in place further restrictions in addition to passing a theory test, getting a flyer ID, registering the drone with the local Aviation Authority, and getting an operator ID, which already felt overwhelming. Moreover, there is a general perception that training courses are too expensive and that the theory test is too complicated. 'You must be a plane pilot to pass it', many civilian user participants complained. However, unanimously, participants imagine the future of drones to be safe for the community and effectively controlled. They would be happy to see the development of new regulations that aim to also facilitate the protection of civilian fliers. Albert, an academic in his 40s, for instance, believes that the UK Civil Aviation Authority is doing a robust job in trying to develop regulations that make a clear difference between what is safe and what is not, even if, he added, there is almost no ability to enforce those laws. For example, if someone calls the police after having seen a drone potentially breaking the law, by the time the police arrive the drone pilot is probably no longer present, and in any case, it is very difficult to identify the pilot/owner. For this reason, Albert advised that wearing a reflective tabard/badge or having a little sign next to the pilot might help to reinforce responsible drone usage. This might also help the general public to be less afraid of recreational usage.

Three participants compared drones to cars claiming that people generally do not drive a car without a driving license and car insurance. As civilian participants reported, flying a drone is not an easy task and if 'things go wrong, drones can cause a lot of damage'. For instance, Rob, an American entrepreneur in his 50s, reported that in the US drones are required to be registered. He is happy with this rule as he believes that it will reduce their illegal or dangerous use. In the UK, the Civil Aviation Authority introduced a similar rule shortly after (5th November 2019) giving the confidence that bad usage could be banned. However, other participants believe that no matter how restrictive the rules are, the illicit use of drones will always exist as it does in relation to other objects, such as stolen or uninsured cars. 'If somebody wants to cause a problem at Gatwick Airport, they are not going to register their drone', Tom emphasised. Roman suggested that policymakers and regulatory bodies should move the attention from the object (drone in this case) to the intent of the action, and avoid making regulatory changes only based on technological developments.

Even if participants believe that registering drones for security purposes is fair, there appear to be unclear issues in relation to this. For example, the UK Civil Aviation Authority require a fee to be paid to register a drone. Alfie, a builder in his middle 30s, pointed out that there is not a clear explanation of what service this payment provides. He described his perspective saying: 'they are not providing me with anything. So, what am I paying for? You pay a TV license because you want to watch TV, you pay road tax because you want to use your car on the road. Are they going to send me a drone? You don't get anything'. He strongly believes that if people buy and use a drone for illicit purposes, they will not register their drones through the government scheme anyway. This is the reason why he expressed his disagreement toward this non-compulsory request that, as discussed above, is hard to enforce. Despite the good intentions of visualising what constitutes acceptable drone usage, participants believe that new regulations will not prevent certain people from using drones for wrong purposes. Instead, they believe that a new law will imply additional

restrictions that certainly will limit civilian uses. This translates into the reduction of opportunities for recreational fliers to experiment with this new technology.

Drone: New visuals and new developments. When reflecting on drone usage, civilian user participants showed a particular interest in the basic enjoyment of ‘making an object fly’ and in the potential of capturing aerial visuals (images and videos). Civilian user participants reported that their interest in drone technology started before they became widely available. Indeed, their interest in small helicopters and aircraft grew into a passion for drones. This highlights that their main interest in flying apparatus was not directly related to the fact that they might have a camera embedded. Instead, they described their interest in aerial photography and videography as something that the use of drones triggered later. This suggests that civilian user participants developed their interest in aerial visuals through the use of this new technology. A similar response emerged in a study on Instagram photosharing practices, which showed that Instagram users matured visual and compositional skills throughout the progressive use of the platform (Serafinelli, 2018). Similarly, in this study, civilian users reported that the progressive use of drones developed their piloting skills and their interest in capturing images of nature and landscapes.

In both activities, civilian users recognise the importance of having a built-in camera as it allows them to have a different experience of the flight. In fact, Civilian user participants admitted to being fascinated by the range of new visual perspectives they could capture and experience while using a drone. For example, Paul, a drone pilot in his 40s, admitted that now that he has a drone, he thinks about the light, the weather and all things that could let him capture visuals he considers ‘beautiful’. Now, every time he books holidays, he hopes he can take and use his drone to explore landscapes and capture new visual views. Civilian user participants recognise the potential of an affordable flying camera to capture perspectives that were not possible before. Although reporting a responsible use of drones in line with the official guidelines, often civilian user participants feel frustrated by flying restrictions as they seem to limit the possibilities of experimenting.

While civilian user participants are interested in the experience of flying and in capturing high quality aerial views, developer participants reported that their research in drone technology is moving toward the refinement of technicalities. All developer participants started their academic career in aerospace engineering. The first aircraft models they were working with were basic helicopters. Then, progression in aircraft engineering guided them towards the incorporation of drones in their research path. Even for developer participants the interest in drones was not (for some of them it is still not) related to the use of an embedded recording camera.

Together with the aim of developing sophisticated sensors and smaller cameras, most of their current research on drones prioritises primarily ‘autonomy’ (i.e. the capacity to act or accomplish a task without expert pilots) with a view of being able to make them cheaper, easier, and safer to operate. This has the aim to make drones progressively less reliant on human skills. In the UK, for example, research on autonomy seems to develop in contrast with the latest update on drone regulation published by EASA (European Union Aviation Safety Agency) in December 2020 that requires drones to be kept within the pilot’s line of sight. These advancements are thought to filter down into the civilian use of drones, meaning that the amount of training and practice that pilots need will be reduced significantly.

Developer participants admitted that their over-focus on improving technicalities leaves out a whole range of socio-cultural effects. Usually, the research conducted on drones in University labs is not designed to develop technologies specifically for amateurs and hobbyists, as they work in close proximity to manufacturers. Civilian users are often involved in public engagement events and open talks, as Ricky reported. However, they do not represent the intended target of developers’ research.

Although there is not a direct link between them (civilian users and developers), developer participants imagine that the majority of civilian users may be mostly interested in the potential of embedded cameras. They envision civilian users being interested in the top-down visual content that drones can capture. Even though drone technology is now used in various industries, drone developer participants feel that what fosters the most civilians' interest in drone technology is the equipped camera and the possibility of experiencing an aerial vision (only two civilian user participants did not report this interest). Despite the fact that civilian user participants and developer participants are different in terms of educational background and current profession, it is interesting to observe that both drone developers and civilian users share similar visions of what constitutes civilian drone usage.

Discussion and conclusion

This study drew particular attention to civilian users' and developers' perspectives on drone usage and drone visuals to explore how the advancements of these flying technologies is contributing to the way they envision future opportunities, challenges and applications in society. Specifically, it did so by adopting the concept of social imaginary (Taylor, 2004) with the aim of identifying the relationships between technological developments and their socio-cultural effects (Jasanoff and Kim, 2015). Through this approach, this article emphasised the importance of opening an interdisciplinary conversation about the ways technological advances contribute to influencing our visions, practices and understanding of the space in which we live. The qualitative content analysis of 30 interviews identified three main topics of interest, these are: personal privacy concerns, regulatory limitations for non-commercial work and drones innovative visual opportunities; all of which characterise the way the wider integration of drones in society is imagined.

To date the literature on drone technology has favoured predominantly the study of technicalities (for example, Yang et al., 2017), the use of armed drones (for example, Enemark, 2020), and their growing employment in commercial activities (Rao et al., 2016). Contrary to most published research on the topic, this article explored how this new technology, in its innovative applications, is affecting (and will) society from socio-cultural perspectives, which, so far, have not received substantial attention. Engineering research on drone technology, as developer participants reported, are working to focus on the refinement of drone performance, such as making them easier to manoeuvre and more precise (e.g. improving their sensors). This focus will place developers into conversation with manufacturers and governmental bodies, but not with civilian users or members of the general public. A range of these developments will make drones accessible (in terms of costs and usability) to a wide portion of civilians who explore their potential uses in a context where regulations are in progressive improvement (and not enforced effectively) and where privacy and public safety are considered its main challenges (Rao et al., 2016).

Literature in digital media and communication studies has widely discussed changes and effects on socio-cultural and economic dynamics that the use of new technology generates (for example, Hilbert, 2020). For example, the use of the internet facilitated the opening of a globalised market (Schiller, 1999), the use of smartphones changed the way we manage social interactions (Rotondi et al., 2017), the utilisation of smart applications reshaped young people's connections and their intimate encounters (Amichai-Hamburger and Etgar, 2016), and wearable technologies contributed to transform the experience of health and lifestyle (Kerner and Goodyear, 2017), just to mention a few. From past research, it seems evident that technological developments contribute to mark substantial changes to society and how we operate in it. This is the reason why this article inscribed the expansion of drones within this conversation.

To conceptualise whether and how the implementation of new technologies like drones will contribute to alterations in society, this article created a space in which developers and civilian users could talk about their views on drone practices, law enforcement and envision future developments in their own terms (Kennedy et al., 2017). This helped them to reflect on their current usage and the way they imagine their practices will change (Taylor, 2004). This approach took into consideration the range of factors that influence how developers and civilian users see drone usage and related rules within the perspective of imagining a future where permissions and licenses would be less restrictive for recreational practices. This collective idea represents a 'vision of desirable futures' (Jasanoff and Kim, 2015) in which civilian fliers wish to be able to use their drone freely and securely without being overwhelmed by the advancement of corporations' interests.

In relation to the general concern of an augmented invasion of personal privacy, the controversial employment of drones in war zones (Agius, 2017) or in terrorist attacks (Fisk et al., 2019) together with potential ethics and privacy issues (McKelvey et al., 2015; Finn and Wright, 2012) seemed to play a crucial role in determining the negative perspective about the further integration of drones in society. For most participants the fear that drones will be used to observe, record and capture images or videos of people (only three participants did not report this view) obscures the fact that even other digital technologies are able to collect data (and metadata) and, therefore, personal information about people's bodies and everyday lives (Lupton, 2018). This demonstrates that the existing fear of being physically watched overpowers the growing expansion of other pervasive controlling techniques, such as smart cities infrastructure in threats relating to information security and the management of personal data (Ismagilova et al., 2020). However, from participant responses the reason behind that did not emerge clearly, but it could be reconnected to the way the media pictured the coming of drones.

Although this study did not intend to focus on privacy specifically, this issue emerged strongly from both developers' and civilian users' responses. The future of drones in society seems filled with the fear of being observed and violated. This is not a new condition and it confirms Kennedy et al's (2017) idea that the general public lacks awareness of how platforms and technologies work in the digital society to provide services. As discussed above, the introduction of drones in industry (unsurprisingly) will lead to an increased collection, use and storage of personal data and metadata from businesses and professionals (for example Caillouet et al., 2019 and Ben Ghorbel et al., 2018). Civilian user and developer participants sense the general fear towards the growing use of drones, even if both groups believe that the negativity drawn around this new technology is not concretely contextualised and justified. For example, a range of studies that discussed the use of drones in war zones highlighted how new challenges started to be set to traditional and ethical standards on armed conflicts (Boyle, 2015). This, according to participants, will not be perceived as problematic as neighbours playing with their toy drones in the back garden. Despite the fact that companies are now starting to use drones (and collect data) for business purposes, civilian user and developer participants feel that this does not seem to fall into most people's worries.

Previous research that explored the relation between visuals and privacy concerns on social media showed that users' ideas of freedoms, beliefs, ownership and vulnerability depends of users' age, sex and education but also on the level of trust they have on the platform/device (DeHart et al., 2020). This means that users customise their behaviours according to the platform they use. As witnessed with the introduction of other innovative technologies, the new dynamics and rules they carry create a general state of insecurity that is often replaced by the idea of 'contextual integrity' (Nissenbaum, 2009), in which the protection of personal privacy is normed by the adequate collection and dissemination of information in relation to specific contexts, as it happens with smartphones or other internet services. This will provide a standard for acceptability in the flow of

personal information, and what civilian user and developer participants labelled as ‘common sense’. This leads to the idea that people might understand and approach further integrations of drones in society in the same way they do with other existing technologies, that is, by relating drones to other smart devices.

Regarding future law implementation, civilian user and developer participants perceive the invasion of personal privacy in visual terms, together with regulating the co-presence of commercial and con-commercial drones, is very likely to generate a number of legislative changes that will considerably restrict non-commercial uses. On the contrary, most civilian users and developer participants’ imaginaries, drone cameras are the feature that will set a new range of (visual) opportunities and applications for the implementations of services for the public good: security, monitoring, rescue operations, firefighting operations, wildlife conservation, disaster management, aerial photographing, VR entertainment and filming, just to mention a few.

The interest in the new visual opportunities drones will be able to offer are not only imagined in industry and commercial services. In fact, all participants reported strong fascination towards the creative perspectives (e.g. top-down vision and bird-eye view) drones can capture in non-professional contexts. This shows the urgency to acknowledge civil user and developer participants’ views and concerns as they feel they should be factored into the implementation of future policies and good practices. Considering that participants reported their strong interest in the new visual perspective drones can offer, further developments in the research urge the need to investigate also these creative opportunities and whether and how the use of these flying robots will contribute to mark significant changes in social practices.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was funded by British Academy; SRG18 R1\180618.

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