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Domestic drone futures

Article

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DOMESTIC DRONE FUTURES

ABSTRACT

We are in the midst of a global turn to the drone. In the context of the 'unmanning' of contemporary life, this article explores urban drone futures as they are speculated through the under-examined sites of patents and speculative design. Approaching the drone as it is anticipated, it examines the role of speculative visualizations in the fostering and constitution of urban drone imaginations and futures. While recognising growing scholarly attention to the drone as it manifests in increasingly diverse more-than-military contexts, it argues that there remains a need to expand the methodological toolkit employed in the drone's study. Through the lenses of patents and speculative design, it calls for the diversification of both the sites through which the drone is approached, and the temporalities engaged in its critical accounting. Collectively, this article pursues an alternative political geography of the 'domestic' drone as it is actively imagined. It explores both the capabilities with which the anticipated drone is imbued, and the potential implications of dronified social relations and everyday life. Attending to patents and speculative design as anticipatory drone sources offers contribution to both drone geographies, drone methodologies, and political geographies of the robotic more widely.

Key words: Drone, unmanned, future, anticipation, visual

INTRODUCTION

In July 2018, a patent filed by Amazon Technologies, Inc. describing an 'airborne fulfillment center using unmanned aerial vehicles for item delivery' was published. The patent details an airship operating at around 45,000 feet and designed as a base from which drones, laden with consumer-ordered goods, can be deployed to 'user designated locations' (USPTO, 2018, p.1). The patent continues to describe the blimp-like warehouse floating 'above a metropolitan area', aloft for 'extended periods of time' and 'navigating to different areas' (USPTO, 2018, p.17, 16). In its description of drones (dis)embarking this floating craft to 'satisfy' a customer's order 'within minutes', Amazon's speculative patent acts to envision a future that 'may, i.e. has to the potential to' re-imagine last-mile delivery via the drone (USPTO, 2018,

p.17, 16), while bringing together the 'making easier' of consumption with its own commercial and spatial expansion (Parks and Kaplan, 2017, p.2).

Such visions of urban drone futures at once resonate with the assertion that we live in a 'drone age' or 'zeitgeist' (Rothstein, 2015; Coley and Lockwood, 2015), and recognise that we can 'spot' drones both in the air and as they are imagined (Rothstein, 2011). Following Rothstein's (2011, n.p) notion of 'drone ethnography' as that attentive to 'glimpses' of the 'drone-mythos', this article foregrounds and critically engages with speculative visions of the drone as they are crafted and anticipated in the under-examined sites [i] of the patent and speculative design. It understands each as sites through which techno-futures are actively imagined and fostered, and particular desires and social relations both promoted and elided (Jackman and Jablonowski, 2021).

In so doing, this article engages a growing body of scholarship attentive to the drone's complex geographies, agencies, and power. Following an established literature on the 'dronification' of contemporary warfare (Gregory, 2011; Shaw, 2016; Williams, 2011), scholars have begun to explore the drone's growing deployment beyond the battlefield in increasingly diverse applications 'at home' (Kaplan and Miller, 2019, p.419). While cognisant that the drone's 'domestication' remains 'born of militarized technologies and ways of knowing' (Schnepf, 2019, p.749), scholars are interrogating the drone across more multiple applications, contexts, and users. Approaching the drone 'ecosystem' as one comprised of diverse platforms (Jackman, 2019), they have critically traced the drone's 'ascendancy' (Jumbert and Sandvik, 2017, p.1) across varied contexts, including policing (Klauser, 2021; Shaw, 2016a; Wall, 2013, 2016), commercial applications (Crampton, 2016; Klauser and Pauschinger, 2021; Richardson, 2018; Jackman and Brickell, 2022), and conservation (Millner, 2020; Fish and Richardson, 2021). Further, in spotlighting citizen drone-use, scholars have highlighted the drone's malleability as a device open to repurposing, subversion, and the infliction of harm (Bradley and Cerella, 2019; Jackman, 2019; Kaplan, 2020). Collectively, calls have been made for the articulation of a "specifically domestic drone theory" (Bradley and Cerella, 2019, n.p; Jackman and Brickell, 2022) and the telling of diverse and 'contradictory drone stories' (Jablonowski, 2015, p.13).

While important steps in building a critical drone project, it remains that drone scholarship demonstrates several lacunae. First, while drone geographies offer an increasingly rich exposition of the more-than-military drone, there remains a need to expand the

methodological toolkit employed in the drone's study. For example, while fruitful, existing methodologically-focused drone scholarship largely explores the drone as it visualizes (Garrett and Anderson, 2018; Birtchnell and Gibson, 2015; Fish et al., 2017), rather than as it is visualized, visually represented across diverse media. Here we can draw lessons from work exploring both the wider visual cultures of the military drone (Grayson and Mawdsley, 2019), and the role of the drone's visual representation in select media in the forging of drone imaginations (Stahl, 2013; Jackman, 2021). Following the notion that 'not only power shapes the visual field, but the visual field executes power' (Mitchell in Maurer 2017, p.142), scholars have explored different and 'competing ways in which drone warfare is made sensible' (Van Veeren, 2013, n.p), contending that visualizations act to 'normalize' the drone in important ways (Jackman, 2021). Extending such analysis, this article approaches the more-than-military drone through the under-examined sites of the patent and speculative design, interrogating their role in anticipating, compelling, and propelling particular techno-urban drone futures. In so doing, it brings drone scholarship into dialogue with geographical work attentive to urban and transport futures and the role and politics of visualizations in their envisioning and 'enacting' (Bissell and Fuller, 2017, p.2478; Degen et al., 2017; Leszczynski, 2016, 2019; Melhuish et al., 2016; Wigley and Rose, 2020). Therein, it argues that patents and speculative design are under-examined 'terrains' (Jumbert and Sandvik, 2017, p.2) that act to imagine and forge techno-futures, while remaining spaces for critical reflection of the worlds and relations anticipated therein.

Second, this article recognises an enduring temporal focus of existing scholarship upon the drone as it 'functions' and is airborne, interrogating its operational deployment and the implications of this (Klauser and Pedrozo, 2015). Taking inspiration from work attending to the (military) drone at alternative temporalities (Chandler, 2020; Hall, 2016), this article instead foregrounds the more-than-military drone as it is anticipated. Understanding anticipation as a form of drone 'making', it responds to calls for further attention to diverse knowledges and ideas as they 'emerge and crystallise' in the drone's development (Klauser and Pedrozo, 2015, p.290). In so doing, it engages 'future geographies' on how potential futures 'become present' and are 'animated in the contemporary condition' (Anderson and Adey, 2012, p.1529, 1532). Exploring 'anticipatory' practices through which potential futures are crafted and '(re)born' (Anderson and Adey 2012, p.1531; Anderson, 2010), scholars have unpacked a range of discursive and visual 'techniques of imagination' (Kinsley, 2012, p.1559, 2011). Such 'artefacts' are understood as both 'performative' in their speculation of

(techno-)futures (Kinsley, 2010, p.2271), and enacting a 'politics of anticipation' therein (Bissell and Del Casino, 2017, p.439). This article engages the sites of patents and speculative deign, drawing attention to drone futures as they are anticipated therein.

Lastly, while scholars have variously explored the more-than-military drone in 'domestic settings' (Jensen, 2016, p.68), the term 'domestic' has been deployed in particular ways. In exploration of 'domestic security', Wall (2013, p.32) argues that police drones represent an 'importation (or boomeranging) of military and colonial architectures into the routine spaces of the homeland'. In this vein, scholars have rejected 'separations between domestic and foreign', foregrounding the blurring of 'military and civilian, battleground and homefront' (Wall, 2016, p.1123; Kaplan and Miller 2019, p.419). Such work has been accompanied by calls for a 'mapping of the political geographies of our domestic dronescape' attentive specifically to the "complex ways in which civilian life is lived with, through and against the drone" (Bradley and Cerella, 2019, n.p). Here, an opportunity to consider different scales of analysis emerges. Thinking with work approaching the military drone through a feminist lens (Williams, 2011; Clark, 2018; Parks and Kaplan, 2017), so too can we re-approach the more-than-military drone through a feminist analytic attentive to everyday and lived experiences as the drone is encountered and envisioned in and above domestic homes (Jackman and Brickell, 2022). Here we can bring together both the interests of feminist geographers in 'redefining what counts' as (geo)political through diversifying the actors and scales of analysis (Massaro and Williams 2013, p.567; see also Hyndman, 2007; Williams and Massaro, 2013), and growing attention to 'drone capitalism' as it is 'increasingly entangled in daily life, impinging on bodies' (Richardson, 2018, p.79). To this end, scholars have explored the dronification of domestic airspace in the Global North, as approached at the scale of the home. Articulating the concept of 'everyday droning' to refer to the 'honing and homing of military technology and drone capitalism', Jackman and Brickell (2022) demonstrate the value of attending to a 'growing range of non-state actors multiply mobilising, experiencing, and subject to' the domestic drone. This article builds on such work through attention to how urban futures, as they are speculated in the under-examined sites of patents and speculative design, might contribute to the '(re)production of power and extant sociospatial inequalities' along particular lines (Elwood and Leszczynski, 2018, p.630).

The article proceed as follows. First, it outlines the methodology underpinning the article's critical visual analysis of patents and speculative design. Second, it approaches the anticipated drone through the site of the patent. Emplacing the drone within the context of the

corporatisation and surveillance of the everyday (Richardson, 2018; Zuboff, 2019), it explores commercial desires to drone-gather contextual data to both offer 'targeted' product recommendations to consumers, and to act as targeted 'neighbourhood watch' for consumers. It thinks critically with the domestic drone's 'sorting' work (Lyon, 2007), unpacking its potential 'performance of power relationships' unevenly targeting and subjugating citizens in its midst (Monahan, 2011, p.495). Third, the article explores the drone as it is anticipated in speculative design, a design practice whereby alternative techno-futures are imagined and imaged without the confines of budget and regulation. Here, attention is focussed to changing drone morphologies in the contexts of urban surveillance and the drone-equipped home. In exploring the drone's potential 'reshaping and shifting of power relations' (Del Casino et al. 2020, p.606) therein, I reflect on both shifting notions of covertness in urban life and space, and uneven social relations within such futuristic forms of techno-dwelling and co-habitation. Such examples collectively act as under-examined 'sites' through which the drone is both accessible, and particular futures are 'disclosed', normalized and 'legitimized' (Anderson 2010, p.777). The analysis that follows is thus underpinned by critical questions of whom such anticipatory drone futures are designed for, by, and to what end.

Methodology: Approaching speculative drone futures

In re-approaching the domestic drone through the anticipatory lenses of patents and speculative design, this article offers contribution to emerging debates around drone methodology. In researching the military drone, scholars note that while associated with illumination, drones are opaque - difficult to 'empirically ground' and access (Klauser and Pedrozo, 2015, p.289; Coley and Lockwood, 2015). Nonetheless, scholars have forged avenues of access, examining the 'in-theatre' military drone through interviews with operators (Clark, 2018; Williams, 2011), analysis of operator testimony (Allinson, 2015; Bentley, 2018), and analysis of military and government drone programme documentation (Boyle, 2015; Shaw, 2017), while also tracing deeper histories of the US drone programme through archival work (Chandler, 2020; Hall, 2016).

In exploration of the more-than-military drone across a range of applications and contexts, scholars have adopted a dual focus on understanding both how the drone sees (drone vision), and how the drone is seen (visions of the drone). In exploring the former, scholars have foregrounded the drone's ability to 'generate and visualize data' (Leszczynski, 2019, p.1150),

reflecting on its 'ungrounded' position, 'free' manoeuvres, and visual-sensory capacities (Choi-Fitzpatrick, 2019, n.p; see also Birtchnell and Gibson, 2015; Fish et al., 2017; Garrett and Anderson, 2018; Garrett and McCosker, 2017; Munck Petersen, 2020; Jackman and Squire, 2021). In so doing, they unpack both the 'sensorium' and 'rendering visible' the drone enables, and its ability to challenge 'conventional perspectival space' (Gahrn-Andersen, 2020, p.273; Christiansen, 2020, p.286). In this vein, scholars have developed '(post-)phenomenological readings' of amateur drone pilot First Person View in tracing the 'embodied' dimensions of 'drone vision' (Jablonowski, 2020, p.344). Alongside methodological interest in how the drone *sees*, scholars have also explored how the drone is *seen*, namely how it both perceived and represented. Here, scholars have undertaken interviews and surveys with commercial, police, agricultural, and conservation drone users (Klauser and Pauschinger, 2021; Millner, 2020; Pauschinger and Klauser, 2020). Turning attention to how the drone is represented, building upon work exploring military drones (Maurer, 2017; Stahl, 2013; Van Veeren, 2013; Jackman, 2021), scholars have explored how more-than-military drones are represented in both popular culture and commercial promotional videos and patents (Graae, 2020; Jackman and Jablonowski, 2021). As Graae (2020, p.331) writes of speculative drone swarms in sci-fi series 'Black Mirror', the future drone enacts 'different modes of sensation' therein.

While rich contributions, such analyses collectively demonstrate a temporal focus on the drone as it flies and functions, unpacking practices, capabilities, and implications (Klauser and Pedrozo, 2015). There remains, then, a need for further attention to the range of sites and practices through which the drone is imagined, envisioned, and compelled – that is culturally 'made' (ibid, p.285). Further, while existing analyses are attentive to visualisations of the drone, these are presently largely confined to military drones and depictions of drones within select media. Working at the intersection of this lacuna, this article re-approaches the more-than-military drone as it visually encountered and speculated in patents and speculative design. It understands these anticipatory sources as both 'material projects of future-ing' (Leszczynski, 2016, p.1691), and under-examined 'domains and sources of authority, expectation and beliefs' in and through which drones are 'made' and 'normalised' (Klauser and Pedrozo, 2015, p.290; see also Van Veeren, 2013; Jackman, 2021). In recognition that 'images are not just passive entities…they change the way we think, see and dream…bringing new criteria and desires into the world' (Mitchell 2005 in Bissell and Fuller, 2017, p.2485), this article employs a critical visual analysis of both the diagrams within

commercial delivery drone patents, and visual computer-renderings of urban and domestic drone futures by speculative designers.

Critical visual analysis analyses visual materials with a consideration of both 'the cultural significance, social practices and power relations in which [they are] embedded' and the 'power relations' they articulate and are 'articulated through' (Rose, 2001, p.3). In discussion of critical visual analysis, Rose highlights 'four sites in which the meaning of an image is made', those including the 'site of production' (origins and processes), the 'site' of the image (content and context), the 'site of circulation' (mobility and materialization), and the 'site of audiencing' (Wigley and Rose, 2020, p.160). Rose (2001, p.17) further identifies three 'modalities' therein, namely the 'technological' (image production), 'compositional' (content, conventions, and style), and 'social' (the 'social, political and economic relations, institutions and practices surrounding an image and through which it is seen and used'). While recognising their entanglement, in pursuit of an interest in the 'feminist politics of the urban everyday' (Leszczynski, 2020, p.191), this paper's analysis foregrounds the 'site' of the speculative image, and the question of the 'social' therein. In addition to attention to each as digital 'sites' (Rose, 2016), it approaches patent and speculative design imagery as 'world-makers' (Bissell and Fuller, 2017, p.2478) with 'their own effects' (Rose, 2001, p.11). Responding to the assertion that 'little has been said' about the visual 'materials used to garner support' for urban mobility and techno-'fixes' (Bissell and Fuller, 2017, p.2477), it recognises 'visioning' as a 'technique' both bringing markets and potential user bases 'into being' (Wigley and Rose, 2020, p.158), and through which technological legitimation is 'produced and promoted' (Woodward, 2005, p.729). In unpacking what these speculative images 'do', the article explores 'particular visions' of drone futures (Rose, 2001, p.16) and their 'indication' of the 'values, peoples, and behaviours' that may be both 'legitimated' and 'marginalized' therein (Wigley and Rose, 2020, p.156).

At site 1, this article turns to the patent. The filing of a patent is a practice documenting an invention to protect it as intellectual property. If granted, a patent enables its filer to act as owner of this intellectual property within a defined area and time-period, during which they can make, use, and sell the invention, while excluding others from doing so. While recognised as both 'integrated' into global economies and 'central techniques of accumulation in contemporary capitalism', there nonetheless remains a dearth of critical patent-centred analysis (Kang, 2015, p.29, 30; Jackman and Jablonowski, 2021). As such, this article approaches the patent as an under-examined site and 'articulation of possible

futures', working both to shape and 'condition' understandings, and to the garner and build support and 'confidence in them' (Kinsley, 2019, n.p). In other words, patents are both an 'essential' part of corporate 'thinking and anticipating the future' bound to and 'saturated' with 'private interests' (Urry, 2016), and an important commercial 'action' through which drone markets are created (Crampton 2016, p.138). As such, patents are approached as an anticipatory site through which visions of drone futures, and the 'logics driving them', are at once encountered and 'woven into' imaginations and environments (Bissell and Del Casino 2017, p.439; Del Casino et al. 2020, p.611).

In its investigation, this article foregrounds e-commerce giant Amazon's delivery drone programme 'Prime Air' and the patents both underpinning its growth and fuelling wider imaginations around shifting airspace in the drone age. Filing patents at a comparably 'faster rate than any other company working on drone technology today', Amazon Technologies, Inc has both filed over 60 drone-related patents while hiring patent lawyers as part of their team (Holland Michel, 2017, p.1). Amazon's patent applications span 'aircraft designs, safety and security systems, methods for transferring goods from the air to the ground, and hive-like fulfilment [warehouse] centers' (ibid). In terms of sourcing patents, applications filed in different countries feature in different databases. Examples include the United States' US Patent and Trademark Office (USPTO), enabling you to search full US patents published since 1976, and the European Patent Office's (EPO) 'Espacenet', allowing you to search published patents in over 100 countries. While each provides guidance, in basic terms users can freely conduct 'quick' or 'advanced' searches, entering details such as application number, city filed in, application type, or search terms of interest. For this article I undertook searches related to 'Amazon' and 'UAV' (returning 50 results in the USPTO search and 192 in the EPO), focusing attention to drone patents related to the domestic home therein.

Regarding the online documents themselves, patents feature both structured textual description (abstract, background, and description) and visual figures (diagrams depicting the components of that filed). Like computer-generated images, patents too can be understood as 'laboriously crafted' imagery (Degen et al., 2017, p.3). Diagrams render visible the invention while providing clues into the future environment it is anticipated to function in. Diagram imagery are both 'abstracted' 'schematic presentations', and 'generative' 'projections' shaping 'what might happen' (McCormack, 2009; Latham and McCormack, 2004, p.708). Diagrams are thus understood as 'a technique for inhabiting possible futures' (McCormack, 2009) and a space in which we can interrogate socio-technical relations therein. While

diagrams ‘convey information’ in ways that exceed ‘the limitations of text’ (McCormack, 2009), patents also rely upon text for the provision of invention context and capability description. Text is also an important component in the wider articulation and ‘ascendancy’ of the so-called the ‘good drone’ (Jumbert and Sandvik, 2017). Alongside ‘existing as a physical entity’, the drone is also ‘made up of narratives incorporating abstract values’ (ibid, p.11). As such, the patent’s text is a ‘space’ through which to ‘contemplate’ both the ‘imaginative geographies’ of the drone, and the potential ‘future spatialities’ therein (Kitchin and Kneale, 2001, p.19).

In site two, the article re-approaches drone futures as they are visually imagined in speculative design. Speculative design is a practice whereby designers ‘speculate futures’ by drawing upon both ‘contemporary systems and product lineages’ and ‘fiction’ in the ‘imagining’ and ‘presentation’ of alternative future ‘products, systems or worlds’ (Auger, 2013, p.12, 11; Dunne and Raby, 2013). In its analysis, the article engages with speculative design ‘concepts’ (computer-rendered imagery) produced by Canada-based designers ‘Imaginactive’. The non-profit think-tank publishes hundreds of concept designs of future urban vehicles, with a number covered in international media. In its analysis of several urban and domestic drone concepts, this article engages geographical work on ‘digital-visual methods’ (Leszczynski 2019, p.1143). In particular, it engages work exploring computer-generated imagery (CGI) of future urban redevelopments ‘yet to be built’ (Rose et al., 2014, p.386; Degen et al., 2017), recognising such imagery not as ‘disembodied’ but rather as crafted and seeking to craft particular future environments and relations (Degen et al., 2017, p.5). As such, in examining the ‘site’ and ‘social’ of speculative design imagery, I remain attentive to both its ‘codes and conventions’ (Bartram, 2010, p.132) and the (uneven) social relations anticipated therein.

Lastly, in the article’s collective interest in anticipatory imagery of domestic drone futures, it is important to note that speculative visualisations are approached in a particular way throughout. The article is concerned not with whether or not the drones discussed will become actualised or ‘turn out to be useless’ (Kang, 2015, p.30), but rather with the capacities of speculative visualizations as ‘value-generating devices’ (Bissell and Fuller, 2017, p.2492), forging and normalising particular drone imaginations, relations and co-habitations (Jackman and Jablonowski, 2021). In this vein, Harvey (2003, p.3) reflects critically on technological ‘fetishism’, namely the ‘endowment of technologies with power’ to ‘move and shape the world in distinctive ways’. Harvey (2003, p.12,17) argues that

‘representation and communication’ play a key role in the ‘production’ of the ‘belief in technological fixes’. In urging further interrogation of this ‘fantasy production’, Harvey (2003, p.5) encourages us to ask: ‘what is it that gets embedded and embodied in particular technologies?’. In its examination of domestic drones, this article thus critically traces both the commercial and capitalist logics, and potential social implications, embedded in speculative visualisations.

Site 1: The patent

The city is understood as a “plurality of urban actuality and expectation” (Olson, 2018, n.p). Given that the drone market is ‘actively performed by interested actors in material and discursive ways’ (Crampton, 2016, p.141), this section approaches the drone as it is anticipated through the patent. The delivery drone is a staple of the evolving drone imagination; drones are increasingly fielded, trialled, and anticipated as ‘last mile’ solutions, re-imagining the final stage of goods delivery from warehouse to customers’ homes (Kellerman et al., 2020; see also Jackman and Jablonowski, 2021). Proponents celebrate delivery drones as “potential disruptors” reducing labour costs and road congestion, while increasing delivery speed (Aurambout et al., 2019). Popularised by programmes such as Amazon’s ‘Prime Air’ and Google X’s ‘Wing’, at least 26 nations are “trialling, planning to test, or have established drone delivery operations” (Unmanned Airspace, 2019, n.p). While many have ‘not yet progressed to viable mass-market offerings’ (Stankov et al., 2019, p.808), delivery drones continue to actively anticipated.

Given their domination of global headlines, this section foregrounds e-commerce giant Amazon’s delivery drone programme, ‘Prime Air’. Driven by an ethos of convenience, Amazon is re-imagining its established delivery chain to include drones. Launched in 2013, ‘Prime Air’ comprises ‘a future delivery system designed to safely get packages to customers in 30 minutes or less using drones’ (Amazon, n.d.). As Richardson (2018, p.84) writes, Amazon’s project marks a dual ‘enfolding of the contemporary consumer’s desire for immediacy with that to ever-expand the drone-world’. Amazon continues to actively craft and legitimate a delivery drone future, undertaking research and development, trials, and wider advocacy efforts. A global project, significant milestones included a 2016 trial in Cambridge, UK, wherein a drone delivered a parcel to a rural customer in 13 minutes, and the 2020 awarding of a Part 135 certificate from the US Federal Aviation Administration. While

cognizant that Amazon's programme is a multifaceted and multi-sited endeavour, this section approaches the drone via one avenue through which it seeks to form, protect, and advance its visions – the patent.

Data topologies and expansive intimacies

It is argued that the drone's 'increased mobility and aeriality' affords 'visual surveillance new possibilities' (Bracken-Roche, 2016, p.169). Amazon embraces this sentiment, as evidenced in its growing litany of drone-patents. In September 2015 Amazon filed a patent (then published in July 2017) entitled 'Trigger agents in video streams from drones'. The patent describes both desires and techniques to collect and analyse 'data while delivering an item' to a customer via a drone (USPTO, 2017, p.1,12). Outfitting delivery drones with 'data capturing devices (e.g. video cameras, cameras, microphones, audio sensors) as permitted', such data collection would focus on 'interesting or unique properties associated with the delivery location' (USPTO, 2017, p.12) (Figure 1).

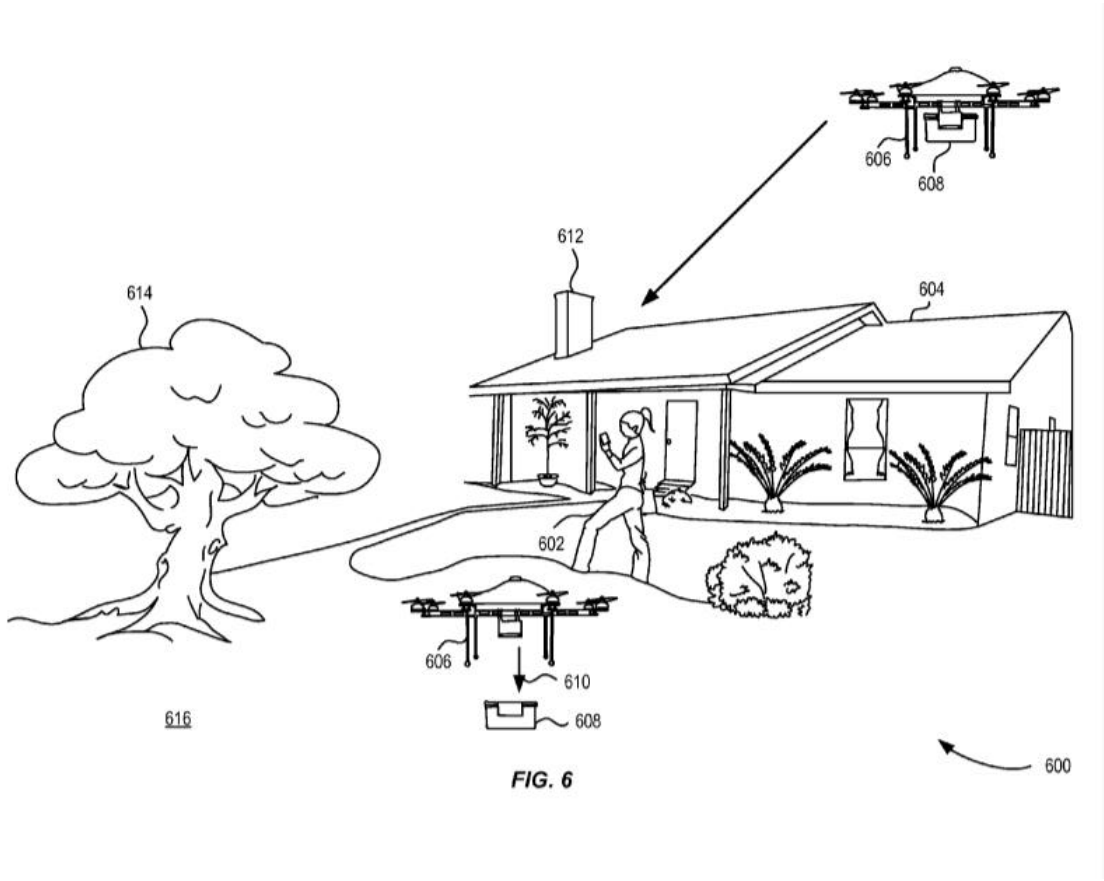

Figure 1: Amazon Technologies, Inc. patent, 'Trigger agents in video streams from drones' (USPTO, 2017, p.7)

The patent describes an example of a delivery drone identifying a ‘roof in disrepair’, data enabling Amazon to make a ‘recommendation to the customer… offering an item or service that is appropriate’ to fix it (USPTO, 2017, p.12) (figure 2). Such anticipations of the delivery drone constitute a ‘sensorially attuned form of contextual targeting’ in which the consumer’s wider lifeworld is rendered visible to the drone while fuelling targeted advertising to/at them (Jackman, 2017). Here the drone is at once concerned with “capturing” and ‘controlling activity’ (Richardson, 2018, p.93), and working at the scale of the home – imbricating itself into our domestic habits, routines, odd-jobs left incomplete. As such, Amazon’s anticipated drone resonates with the growing presence of ‘social robots’ within and ‘intervening in the spaces of everyday life’ (Lynch, 2021, p.1; see also Jackman and Brickell, 2022). Sold on a promise of making domestic life more convenient and efficient by ‘freeing up time’ (Macrorie et al., 2021, p.206), such ‘dronified labour’ raises critical questions of both the expansive and individuated data capture therein (Richardson, 2018), and the potential impact of the ‘drone workforce’ on both labour and social relations within domestic home volumes (Jackman and Brickell, 2022).

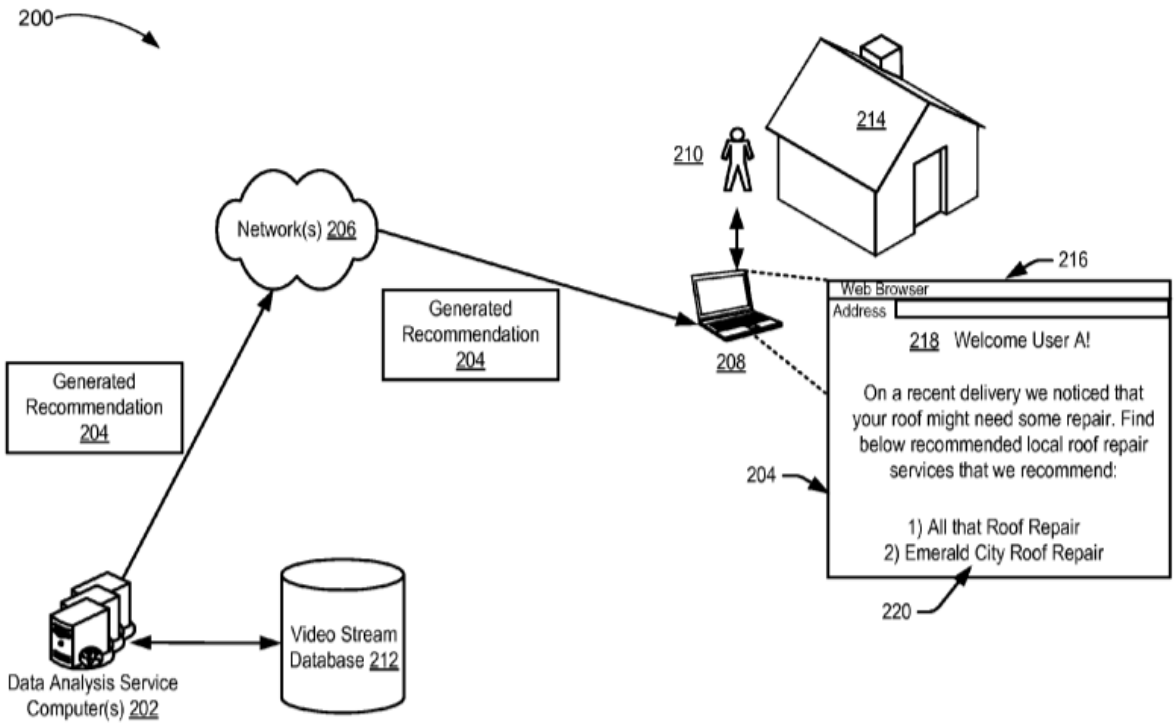

Figure 2: Amazon Technologies, Inc. patent, ‘Trigger agents in video streams from drones’ (USPTO, 2017, p.3)

For example, in alternatively approaching the ‘dronification of the home’ (Richardson, 2018, p.91) through the lens of the patent, we can consider the social worlds evoked in its diagrams. Approaching them as ‘techniques of abstraction’ that selectively represent only ‘certain processes’ (McCormack, 2009), we can reflect on what is both made visible and excluded in their envisionings. In figure 1, a customer is shown in her garden, waiting for a delivery drone to land. The house is a detached, low-rise property featuring a large back garden - no adjacent properties or neighbours are shown. As Degen et al. (2017, p.19) write of CGIs of potential urban futures, there remains a ‘problem’ with ‘visualising the future social life’ of the imagined ‘development’. The authors get at the challenges of visually conveying social relations in imagery focused upon technology-centred futures. In Amazon’s patent we can however discern hints at particular socio-spatial relations. While Amazon articulates a goal to “deliver packages in a variety of operating environments” (Amazon, n.d.), the patent images – mirroring videos of its UK trial – suggest that large garden spaces are required for landing. Alongside reminding us of the need to attend to how drones may shape suburban and rural spaces ‘just as much as the urban, albeit in different ways’ (Klauser, 2018, p.370), this prompts wider questions of to whom Amazon’s services will be accessible. Just as Del Casino et al. (2020, p.611) write of robotic technologies ‘creating complex and evolving socio-spatial realities’, so too are they exacerbating existing socio-spatial inequalities. The garden is, after all, ‘iconic’ in signifying both the ‘idealized’ home and 'status, cultural capital and social difference' more widely (Crouch, 2009, p.289; Blunt and Dowling, 2006, p.7). In its depiction, Amazon’s imagery thus at once ‘depends on and (re)produces social inclusions and exclusions’ (Rose, 2001, p.15), while evading ongoing challenges surrounding drone navigation in complex and congested aerial environments (Duvall et al, 2019).

Thinking further with whom Amazon’s delivery drone imaginary serves, we can also examine not just that depicted, but that elided. Choi-Fitzpatrick (2019, n.p) writes that drones ‘require fresh theorizing of the verticalization and colonization of the ground, sky, and subterranean’. In developing vocabularies of the domestic drone, scholars have engaged the concept of ‘enclosure’ to interrogate the ‘imprisoning of life inside nonhuman apparatuses’ (Shaw, 2016, p.47). Writing of enclosure ‘inside dronified environments’, they have reflected on (potential) police drone futures, foregrounding the ‘logics of permanent manhunt’ (Shaw, 2016a, p.21; Wall, 2016) while noting the simultaneous ‘twin imperative to secure and profit’ (Shaw, 2016a, p.21). In exploring attempts to commercialise and privatise the atmosphere, scholars have unpacked the drone’s enaction of ‘capitalist enclosure’ (Crampton, 2016;

Richardson, 2018; Shaw, 2017a; Jackman and Brickell, 2022), arguing that the drone, and desires to 'prioritise' corporate over citizen access to the 'public resource' of the sky, represents a potentially 'radical reshaping' of airspace (Garrett and Fish, 2016, n.p). This is because, unlike manned aircraft, drones remain at once more accessible, deployed by a greater range of actors vying for different aerial desires, and (often uncritically) narrated as quieter tools enabling an easing of urban congestion (Jackman and Jablonowski, 2021).

While enclosure is a valuable framework to account for shifts in drone-punctuated and anticipated airspace, there remains a need to further diversify accounts of the occupants of airspace volumes (Jackman and Squire, 2021). After all, the site of the speculative can be engaged to understand non-human relations (Galloway, 2013). For example, returning to figure 1, while trees are present, wildlife remains absent. Thinking about airspace presented as empty and uninhabited, I returned to the question 'what would happen if territory scholars were forced to start with birdsong?' (reviewer cited in Jackman et al., 2020). Drones are of course not the only occupants of airspace. Rather, animals are both 'interlocutors and actors', '(re-)making' spaces and lives in important ways (Oliver et al., 2021, p.2,3). For example, Morris (2018, p.305) notes that starlings congregate in the sky, adopting murmuration formations that 'undulate, expand and contract, swoop and turn'. Just like drones, birds too navigate in and as volume (Jackman and Squire, 2021). In addition to considering the 'physical intrusiveness' of the drone on humans below (Thomasen, 2020, p.3), further thought is needed to the multi-faceted and multi-sensory effects of drones upon birds. For example, acoustic ecologist Paine (2019, n.p) calls for a reflection of drone disruption that thinks beyond human 'ears on the ground', noting that birdcalls crucial to species communication may be under threat in 'high pitched' delivery drone futures. In this vein, researchers have demonstrated the disruptive effects of drones on bird flight and animal stress levels, arguing that the drone's 'chronic' effects are not yet adequately understood (Ditmer et al., 2015, p.2278; Mulero-Pázmány et al., 2017). While recognising agential animals that, 'unwilling to cede their territory to the drone' also 'rip' at drone-frames to down the craft (Gibbs, 2019, n.p), future robo-geographies must make and 'claim space' for diverse human and nonhuman life (Del Casino et al., 2020, p.605). In 'questioning the anthropocentric view of urban futures' (Pollastri et al., 2021, p.24), there thus remains scope for further engagements at the intersection of the urban techno-future and the non-human animal (Leszczynski, 2019).

Such an exercise could valuably learn from and extend existing geographical work interested in the 'affective politics of drones' (Crampton, 2016, p.144). Approaching the drone through the lens of 'algorithmic governance', Crampton (2016, p.137) argues that accounts of the drone should exceed a focus on 'capacities', reflecting also upon 'their effects and affects'. Crampton's work can be valuably re-sited/scaled to consider commercial drones as they are anticipated to alternatively monitor and 'police' the peripheries of the domestic home. Here, a further example of an Amazon patent is beneficial. Just as the first patent (figures 1 and 2) goes on to describe data capture that could identify 'anomalies, inconsistencies and irregularities' from roof tiles to 'smoke coming from a building…and/or audio data that indicates gun shots, cries for help, or breaking glass' (USPTO, 2017, p.13), later Amazon patents describe further secondary data collection capabilities ascribed to their anticipated delivery drones. For example, a 2015 Amazon patent (published in 2019) entitled 'image creation using geo-fence data' introduces a drone 'performing a surveillance action at a property of an authorized party' (USPTO, 2019, p.1) (figure 3). Here Amazon describes the 'leveraging' of delivery drones 'to perform secondary tasks' including 'surveillance' fly-overs of consenting homes (USPTO, 2019, p.14). Therein, data captured would be reviewed to determine whether there was a 'surveillance event' – such as 'a garage door being left open, a broken window, detection of graffiti, or a fire', adding that a 'police/fire alert may be generated for certain events' (USPTO, 2019, p.14, 24).

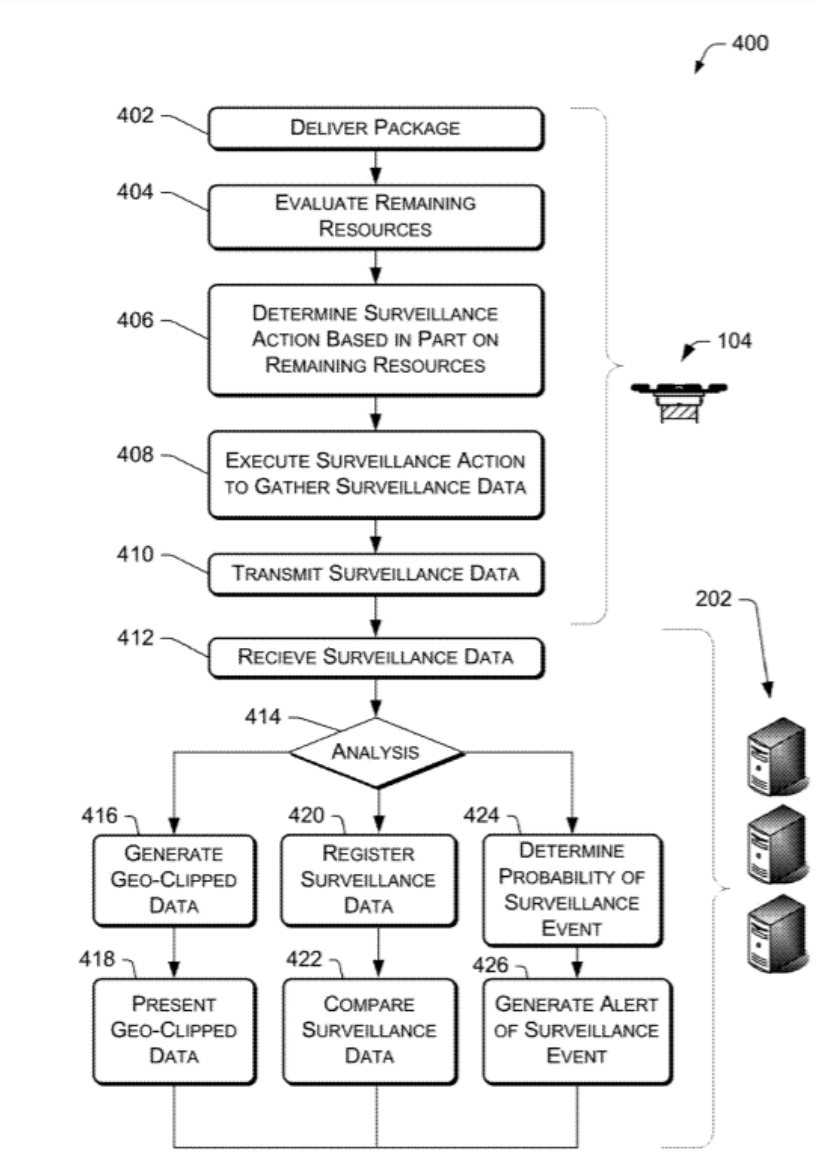

Figure 3: Amazon Technologies, Inc. patent, 'Image creation using geo-fence data' (USPTO, 2019, p.6)

Guided by 'economy and efficiency' as key legitimating discourses of the 'good drone' (Jumbert and Sandvik, 2017, p.8), Amazon's drones are here multiply and re-purposed as *neighbourhood-watch craft*. This secondary surveillance, however, raises a number of questions. Emplacing drones within the wider robotification of the 'spaces, politics and subjects of security' (Del Casino et al. 2020, p.607), scholars argue that we are witnessing the robotic 'taking up new roles as both collectors and interpreters of data' (Del Casino, 2016, p.848; Jackman and Brickell, 2022). As such, they argue it is pertinent to understand who or what is apprehended as 'anomaly' or 'insecurity scenario' (Jumbert and Sandvik, 2017, p.6; see also Leszczynski, 2016), namely who is subject to the drone as 'social sorter'. Writing of

the ‘coding and categorization’ of individuals via ‘personal information’, Lyon (2007, p.162, 161) describes the proliferation of ‘social sorting’ in ‘everyday life’. Recognising such surveillant practices as ‘performances of power’ that act to ‘amplify social inequalities’, researchers have highlighted unequal experiences, ‘differing by population’ (Monahan, 2011, p.497,495; Thomasen, 2020). In this vein, scholars have raised critical questions of the racialized and gendered ‘assumptions, biases’ and ‘values encoded’ into such systems (Walker et al. 2021, p.206; West et al., 2019). Given that ‘pattern recognition and machine vision’ are ‘two defining features’ of the drone’s sensory capacities and datafication (Braeunert 2020, p.259), further attention is therefore needed to both the ‘triggers’ of a ‘surveillance action’, and the potentially uneven implications of this action upon subjects in the drone’s crosshairs.

Section 2: Speculative design

We are in the midst of a ‘robotization of urban services’ (Macrorie et al., 2021, p.201). Following the notion that to ‘foresight to the year 2050’ is to ‘imagine drones as commonplace in the aerial of smart cities alongside birds’ (Birtchnell, 2017, p.232), in this section I engage with a further site through which drones are actively anticipated. Speculative design encompasses diverse practices spanning different disciplines, together sharing an interest in techno-futures and their spatial, infrastructural and social ‘possibilities’ (Lukens and DiSalvo, 2012, p.25, 27).

This section engages as its example ‘Imaginactive’, a non-profit based in Montreal, Canada. Launched in 2013, the organization develops ‘futuristic concepts’ of the ‘vehicles of tomorrow’ (Imaginactive, n.d). Revolving around ‘the future of mobility’, its concept imagery focuses on the ‘ideation phase of product development’ – namely brainstorming technologies that could ‘come next’ (Imaginactive, n.d; Uniting Aviation, 2019). Each concept is designed by the organization’s founder Charles Bombardier, often in collaboration with ‘industrial designers from around the world’ (Imaginactive, n.d), and features digital imagery accompanied by a textual description. In exploring ‘constructions of futurity’ (Kinsley, 2012, p.1554) therein, this section explores three designs and engages with correspondence with their leading designer.

As a visual practice, speculative design is centrally concerned with imagining alternative spaces and lifeworlds. Echoing this ethos, when asked about how a particular design fit with

his wider approach, Charles Bombardier stated, “I create concepts based on problems I notice in everyday life. Right now I have lots of pieces of a puzzle that could be assembled together to create the city of tomorrow” (personal correspondence, 2017). He continued that his aim is to then “let people pick-up from there and carry the idea forward" (personal correspondence, 2020). To this end, an important facet of speculative design is that concepts are ‘designed to circulate’, both presenting possible futures and prompting discussion of ‘issues of accessibility, elitism, populism, sophistication’ therein (Dunne and Raby, 2013, p.139). In this vein, Imaginactive’s designs (numbering over 350) have been featured in and commissioned by global press outlets. When asked about ‘target audience’, Charles added that the designs are for ‘anyone interested’, as much to “inspire future generations” as for current ‘policy-makers, the public, and industry’ (personal correspondence, 2020). To this end, the organisation does not patent concepts but rather sees them as tools ‘to inspire and attract attention’ from and beyond ‘potential developers’ (Uniting Aviation, 2019).

Speculative surveillance: whisper

The first Imaginactive example is Whisper (figure 4), a concept depicting ‘a new class of reconnaissance drone’ designed to provide a surveillent ‘overview’ of an area while perching therein (Imaginactive, 2019). Designed to take-off from a ‘vertical surface’, the description accompanying the image states that the drone ‘mimics the behaviour of birds’ (Imaginactive, 2019). The drone pictured is small and grey, aesthetically merging into the buildings surrounding it. It sits atop a high-rise, above blurred-out windows – eschewing glimpses of people populating the scene. Both the description that the drone could enact diverse applications from the provision of ‘aerial monitoring during disaster response’ to those ‘in law enforcement’ (Imaginactive, 2019, n.p), and the depiction of the platform itself, appears malleable and ambiguous. The drone is mobile yet still, inviting questions of whom or what it is monitoring, and if it is noticed at all. Without clear markings or a sense of its operator, the platform arguably acts, like the term ‘drone’ more widely, to ‘obscure rather than clarify’ (Jumbert and Sandvik, 2017, p.16).

Figure 4: Whisper, Imaginactive (2019) http://imaginactive.org/2019/01/whisper/

The drone's malleability is well known, with scholars unpacking its 'disturbance' of boundaries between 'military and civilian, battleground and home front' (Kaplan and Miller, 2019, p.419; see also Graham, 2016). In the case of Whisper, this boundary-blurring is evident in both the descriptive mobilisation of discourses of 'inconspicuousness' typically used to describe military drones (Jackman 2021), and in the platform's design itself. Whisper's colouration enables it to blend into grey-scale urban environments, enacting a form of contemporary camouflage, namely design to 'conceal' and 'obscure' (Bousquet, 2018, p.154). Both the platform's morphology and described enaction of 'bird-like behaviours' (Imaginactive, 2019) also resonate with wider developments in the military drone world, particularly in the area of biomimetics. Biomimicry, the practice of apprehending biological organisms and life as sources of 'inspiration' for the development of 'new design techniques', has permeated US defence to the extent that a 'biological' turn has been identified therein (Johnson, 2011, p.11; see also Jackman, 2021). Inclusive of bio-inspired military experiments from gecko adhesion to robotic lobsters (Johnson, 2011), the reimaging of biomimetic urban surveillance both raises questions of shifting urban privacies (Jensen, 2016), and prompts us to take pause with the 'our' in our future urban environments. In addition to attending to wildlife such as birds (earlier discussed), so too must a 'more-than-

human geopolitics' (Shaw, 2017, p.451) consider the range and 'multiplicity' of intelligences evoked in robotically-mediated urban futures (Lynch and Del Casino, 2020, p.382).

In this vein, the textual description of Whisper continues that the drone 'can be deployed in swarms to provide multiple sources of feedback' (Imaginactive, 2019, n.p). Building upon swarming as technique particular animals use to act together in nature, the drone swarm is understood as a 'collective organism, sharing one distributed brain…adapting to each other' (Roper in Sanders, 2017, p.11). Swarming as operational configuration both enables 'persistent and ubiquitous intelligence' gathering (Sanders, 2017, p.2) and represents a shift from 'discrete platforms' to 'amorphous and autonomous' cooperative collectives (Shaw, 2017, p.459). As such, swarming is understood as marking a potentially 'profound development' in the 'rewiring' of warfare (Shaw, 2017, p.451). What then of potential urban drone swarms (Shaw, 2016a)? In its speculative imagining of the urban drone swarm, Whisper at once demonstrates the notion that military drone applications have come to 'coexist with the brisk development' of civil, commercial, and recreational ones (Kaplan and Miller, 2019, p.422), and urges further interrogation of the domestic drone's potential 'detoxification' of violent military overwatch (Jumbert and Sandvik, 2017). As Graae (2020, p.330) notes, the 'prospects of a future society of drone swarming call for critical reflection'. In interrogating the 'embedding of self-governing technologies' into urban spaces and lives (Graae, 2020, p.330), we must consider the drone's potential impacts upon both human life below and aerial life co-habiting and dwelling with. While Whisper's speculative envisioning shows a sky devoid of other aerial life or craft, the air nonetheless remains 'changeable' and 'lively' (Adey, 2014, p.171), and as such further attention is needed to how we (speculatively) 'think of, and design for, more-than-human future cities' (Pollastri et al., 2021, p.23).

Speculative architecture: drone tower

The remaining two design concepts explored centre on the domestication of drones as actors in inside or above the home. Entitled 'drone tower', the second design (figure 5) is described as a 'futuristic vision for an apartment building' with balconies 'adapted' to enable 'small electric aircraft or shipping drones' to land (Imaginactive, 2016). Alongside delivery drones, the speculative balconies enable the reception of aerial taxis, transporting users to their 'favourite city hotspot' (Imaginactive, 2016).

Figure 5: Drone Tower, Imaginactive (2016) http://imaginactive.org/2016/09/drone-tower/

Geographers have long held an interest in architectural forms, whether around the 'political-economic imperatives built into them', or the ways in which they can be ‘read’ in relation to the material and affective (Kraftl, 2010, p.402). Therein, scholarship reflects upon the “practices and ideas that allow built forms to cohere” (Kraftl, 2010, p.407). In recognition that ‘architecture has become increasingly complicit in the commercialisation and branding of urban environments’ (Degen et al., 2017, p.20), scholars have turned attention to visualizations as a key tool through which architects as well as speculative designers – actors who arguably ‘practice architecture’ of sorts (Jacobs and Merriman, 2011) - work to envision (future) buildings. As such, we can valuably engage geographies at the intersections of the architectural, digital, and visual. Writing of future urban developments, scholars argue that digital images or ‘visualisations’ are key ‘marketing tools’ (Melhuish et al., 2016) seeking to both ‘evoke and manipulate specific place atmospheres’ (Degen et al., 2017, p.3). Here, they foreground ‘affective design’, namely the use of ‘seductive’ imagery placing an emphasis on the ‘experiential’ (Rose, 2016, p.337; Wigley and Rose, 2020, p.156; Degen et al., 2017, p.3). Such visualizations thus play a role in ‘shaping distinct urban imaginaries’ (Melhuish et al., 2016, p.231). This too is the case for speculative design. The ‘drone tower’ evokes the utopian promise of the ‘good drone’ (Jumbert and Sandvik, 2017), one seamlessly flying and temporarily landing as it conveniently delivers to select customers (Jackman and

Jablonowski, 2021). In figure 5, drones are pictured in service of a single high-rise equipped with modular balconies and in proximity to silhouettes of few individuals. As the design's description reads, "large balconies are always a welcome feature in a condo, but imagine if you wouldn't need to use an elevator or even drive to reach your office tower" or "shopping mall"? (Imaginactive, 2016, n.p). This vision of a drone-enabled future evokes Charles' ethos of mobility as "fast and fluid, no constant stop and go with traffic" (personal correspondence, 2020). Here, 'architectural space' enables 'particular kinds' of privileged movements (Kraftl, 2010, p.409).

Such imagery, however, is also underscored by the embedding and exacerbation of existing socio-economic relations around wealth, living space and investment into high-end 'exclusive' properties (Macrorie et al., 2021). While drones are commonly presented as 'disruptive' innovations, in recognition that political and social 'struggle takes on an increasingly three-dimensional character' (Graham, 2016), we must therefore ask: disruptive how, to and for whom? Here we can think with developments in the built form itself. In 2016 marketing materials detailed that luxury residential high rise 'Spire London', to be built in London, UK and touted to become the 'tallest residential tower in Western Europe', would feature "drone deliveries to private balconies" (Homes and Property, 2016, n.p). While speculative, such marketing is indicative of a lengthier association between "height and power in the capital" (Garrett and Fish, 2016, n.p). As Graham and Hewitt (2012, p.83) write of the imagination and construction of 'vertical mega-projects', the 'uneven social geographies' that accompany and underpin 'vertical mobility are likely to proliferate'. For example, reflecting on the 'politics of the air', they add 'the rich have access to good air while the poor are relegated to the dregs' (Choy in Graham and Hewitt, 2012, p.84; see also Graham, 2016). However, the case of the anticipated urban wealthy-serving transport drone complicates this somewhat, raising questions about airspace politics in the context of shifting aerial composition.

For example, as cities continue to grapple with congestion (Bissell and Fuller, 2017), modelling of potential delivery drone emissions asserts that while "drones are likely to provide a CO2 benefit" when compared to delivery trucks, this depends and relies upon both the volume of drones and their 'service zones being close to the depot, and/or there being few delivery stops' (Goodchild and Toy, 2018, p.58). In the image of the drone tower, a clear blue sky is shown. Alongside the presence of sun rather than weather conditions presenting navigational challenges, we see only several drones – all in service of a single tower. The

airspace pictured is not congested, punctuated with legions of drones passing each other. This anticipatory depiction requires pause in light of wider plans around 'Unmanned Traffic Management' (UTM), namely the at-scale integration of drones into domestic airspace through airspace segmentation and communication between aerial craft (Kuhn, 2017). While cognisant of the complexities of UTM, this operational approach nonetheless remains underpinned by the premise and promise of shared and multiply-occupied airspace. As such, in interrogating what it might 'mean to be above or below' (Graham, 2016) in urban drone futures, work is needed to explore diverse anticipations by and across multiple commercial and civil drone users, each differently vying for airspace while collectively contributing to a shifting choreography of emissions, buzzes, and light-blocking shadows.

Speculative drone dwellings: Odron

The final example explores the drone as it is speculated within the home. Odron (figure 6) is an autonomous drone 'engineered to water and care for plants at home' (Imaginactive, 2019a). Citing the robotic vacuum 'Roomba' as inspiration, the device is described as enabling the roboticisation of a domestic chore. With sensors attentive to "soil and air humidity, sun levels and air temperature", this 'robotic gardener' enables the growing of 'beautiful plants without the worry of having to…care for them on a daily basis' (Imaginactive, 2019a). Designed to water 'discretely' when the 'user leaves the house' (ibid), the drone at once takes on and masks particular 'dimensions' of care (Jackman and Brickell, 2022).

Figure 6: Odron, Imaginactive (2019a) ttp://imaginactive.org/2019/03/odron/

In unpacking Odron, we can engage literatures attentive to both producing and critically reading digital imagery, and the multiple actors that make up domestic dwellings. Writing of CGIs produced in the design and marketing of urban developments, scholars argue such imagery exceeds 'glossy representations' and rather encompasses the 'capturing' and 'marketing' of 'particular embodied sensations' and relations (Degen et al., 2017, p.3). In speculating future domestic scenes, Odron evokes particular relations between both humans and drone, and drone and plant non-human. In examination of "'being-in' architecture", geographers have called for attention to both humans and non-humans that "inhabit and act with buildings in all manners of ways" (Jacobs and Merriman, 2011, p.213, 211). This sentiment is echoed in geographies of robotics interested in how such technologies 'make and remake the conditions and relations of everyday life' (Del Casino et al., 2020, p.606; Bissell and Del Casino, 2017). In this vein, Dodge and Kitchin (2009, p.1352) note that 'domestic objects are gaining capacities that extend their technicity and enable them to do additional work in the world'. Odron offers a glimpse of a domestic robot anticipated to assist with everyday chores - subservient yet independent.

Odron thus invites reflections on the delegation of household labour to robotic and digital assistants (Dodge and Kitchin, 2009; Richardson, 2018). Crucially, Odron is positioned as

caring device – nurturer of plant life, carefully and care-fully attending to each plants' needs. While there remains potential for robots to 'stake out positions as caring subjects', so too does this raise 'fundamental questions' (Del Casino, 2016, p.852; Lynch, 2021). Here we can think with feminist scholars of 'home', who in noting that inhabitation 'is a more than human affair' (Blunt, 2005, p.511) call for attention to the role of non-humans in the 'construction of home and processes of dwelling' (Harris et al., 2020, p.1228). In this vein, scholars have argued that domestic-assistance drones act to both sanitize, displace and devalue household labour (Jackman and Brickell, 2022). Further work, then, is needed to understand the multiple and shifting caring relations in and between humans and diverse, multiple, and 'lively' non-humans (Sumartojo and Lugli, 2021) in the future drone home.

CONCLUSION

Drones are 're-wiring' contemporary warfare and everyday worlds (Shaw, 2017, p.451). Increasingly diverse in form and application, the drone comprises a diverse ecosystem. Employing Law's framework of 'fractionality', Jablonowski (2015, p.3,13) calls for an attentiveness to multiple 'military, commercial and amateur drone uses' that seeks not to conflate the politics of the drone's differential employment, but rather to build a wide-reaching 'critical project' of entanglement, through the telling of diverse 'drone stories'. In this article, I develop two distinct drone stories. Approaching the drone through the lenses of patents and speculative design, this article offers contribution to work both interested in 'everyday robo-deployments' (Del Casino et al., 2020, p.608) and calling for the "mapping of the political geography of our domestic dronescape" (Bradley and Cerella, 2019, n.p).

Recognising that the drone both 'exists, taking to the skies every day' and yet also 'doesn't', 'existing as much in the imagination as it does in practice' (Rothstein, 2015, p.x; Kinsley, 2019, n.p), this article foregrounds patents and speculative design as under-examined yet 'powerful agents' and 'instruments' in the 'envisioning' and normalizing of drone techno-futures (Bissell and Fuller, 2017, p.2478; Wigley and Rose, 2020, p.158). In re-approaching the drone's 'making' (Klauser and Pedrozo, 2015) therein, it engages speculative images as generative 'techniques through which specific futures' are 'envisioned' and crafted (Bissell and Fuller, 2017, p.2493,2478; Kinsley, 2010). Given that imaginaries remain an 'important part of the assemblage of robotic technologies' (Sumartojo et al. 2021, p.99) and technologies play a central role in the 'production of space' and 'uneven' 'socio-spatial relations'

(Leszczynski, 2019a, p.14; Ash et al. 2019, p.2), this article urges attention to the relations and configurations speculative visualisations anticipate and their 'elevation of some imagined futures above others' (Valdez et al., 2018, p.3387; see also Luque-Ayala & Marvin, 2015).

While acting to *reveal*, so too do such visualisations also *elide*. In addition to the absence of wildlife, so too does the imagery engaged absent a specific geographical location. It thus acts to simultaneously promote the drone somewhere, nowhere and everywhere, or as Wigley and Rose (2020, p.156, 159) write of autonomous vehicle imagery, acts to "envision a mobility of entrepreneurial capital" while promoting wider 'investment and public acceptance'. Further, while compelled by the commercial adage of the drone as '*disruptive* technology' 'changing the way things are done' (Cambridge Dictionary, n.d.), such visualisations elide the ways in which the drone can also be *disrupted*. For example, returning to Odron (figure 6), the drone is pictured in a luxurious and open space described as home (though amorphous enough to evoke commercial premises) – it flies unobserved, navigation unencumbered. While drones have of course advanced in navigational terms, they remain open to disruption. From animals that attack, humans that hack, and malware that spoofs (Holland Michel, 2019), multiple agencies - both human and nonhuman – can disrupt the drone's idealised functioning. As such, the drone might too participate in domestic 'umaking' (Harris et al., 2020, p.1292). Thus, while such visualisations feed into the wider fetishization of the drone as 'dreamlike, silver-bullet' (Wall, 2013, p.36), so too do they elide the 'complex agencies' at play, those which can contravene 'imaginaries of automated convenience' in 'interruptive' ways (Bissell, 2018, p.57; Fish and Richardson, 2021).

As such, while speculative designs remain performative and under-examined windows into techno-futures, they remain only ever partial. While they can be 'read' in relation to 'intertwinements' between robotic and social (Del Casino, 2016, p.846), we need also to reflect critically on the kinds of 'free-of-constraint' futures they present (Auger, 2013, p.2). In returning to the vignette that opened this article, we see this partiality laid bare. While Amazon's 'Prime Air' drone venture is recurrently touted as the poster child of an ecommerce airspace future enabling dronified convenience (Jackman and Jablonowski, 2021), the company's patents elide wider challenges encountered in their foray into drone delivery. For example, while the company's 'UK operations were at the centre of a frenzied public relations campaign', 'half a decade after first conducting UK test flights', it is reported that 'over 100' employees at Prime Air have 'lost their jobs' (Kersley, 2021, n.p). Thus, while domestic drone innovation remains an investment area for the UK Government, so too

can the drone feel like something that ‘has not yet quite arrived… defined by its *glitches* and gaps in connection’ (Richardson, 2018, p.93, emphasis added; see also Del Casino et al., 2020). Writing in the context of urban policy, Temenos and Lauermann (2020, p. 1110,1113) describe failure as that which is ‘thwarted, stalled’ or ‘failed to deliver on its promises’, while arguing that failure nonetheless has ‘generative effects’. Rather than focus on the ascribing of ‘failings’ to Amazon’s multi-sited and international drone programme, this example offers an opportunity to think about how anticipatory visualizations can generatively contribute to wider drone imaginations, whether or not they physically materialise.

Here, the use of the word ‘glitch’ is interesting. Noting that most often the ‘predominant orientation’ in writing of urban futures remains ‘technodystopian’, feminist scholars have argued that while attention to ‘digital mediations of domination’ is crucial, so too are there opportunities to ‘theorize beyond’ this (Elwood, 2021, p.211). Here, Legacy Russell’s (2012) re-reading of the ‘glitch’ has been mobilised. While the word ‘glitch’ commonly implies ‘error’, Russell (2012) reframes this as an opportunity for ‘erratum or correction to a system’ (Leszczynski, 2020, p.191). By theorising in ‘the minor’, scholars argue we make space for the everyday ways in which people mundanely, hopefully, and creatively intervene in and comprise digital space (Leszczynski, 2020, p.191, 2016). After all, alongside their commercial and policing roles, so too can drones ‘participate in protest’ (Kaplan, 2020, p.51). Examples such as the doctor-activist group ‘Women on Waves’ who used drones to deliver abortion pills across the Germany-Poland border to highlight ‘Poland’s restrictive abortion laws’ (Khomami, 2015, n.p) demonstrate that both imaginations of the delivery drone, and speculative imagery as a facet of these, can provoke wider ‘capacities for resistance’ (Bissell and Fuller, 2017, p.2493). After all, while anticipatory visualizations may be understood as 'techniques that aim to diminish uncertainty in a drive towards return on investment' (Sumartojo et al., 2021, p.101), future airspace is of course co-constituted – multiply authored and experienced, comprised of diverse actors, creatures and craft, conflicted and resisted. In further exploring domestic drone futures, then, work is needed that at once foregrounds a wider range of speculative sites and sources through which the drone is anticipated and ‘made’, while recognising these as partial – revealing as much as they elide.

[i] Following Dodds et al. (2013), I have used the term 'site' to describe the sources of the patent and speculative design. In recognising the 'multiple spaces and sites of geopolitics', Dodds et al. (2013, p.9) call for attention to a growing diversity of both authors, agents, representational forms, and more-than-representational practices and experiences. In recognition that 'digital platforms are changing what constitutes the field' (Ash et al., 2019, p.2), scholars have explored the speculative as both 'imbued with meanings and values' that anticipate 'very particular kinds of futures', and as 'mediations' at once co-constituted by multiple human and non-human agencies and 'carrying traces of their digitality with them' (Rose, 2019, p.168). In this article's critical visual analysis of patents and speculation design, it recognises each image's 'making, remaking and unmaking' force (Anderson, 2019, p.1120), focusing attention to its envisioning of 'social settings' and (uneven) relations while also cognisant of its 'digital qualities' (Degen et al., 2017, p.20,21).

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