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Imagining 5G: Public sense-making through advertising in China and the US

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Abstract

This study initiates a line of research on how the fifth generation of wireless infrastructure ("5G") is being imagined through media portrayals—in this case through advertising. At the time of this writing, 5G is not yet widely available, however the media is saturated with narratives about how it will revolutionize everyday life. Drawing from the social imaginaries and media infrastructures traditions, this textual analysis examines the social shaping of 5G through advertisements from leading telecoms in leading markets, including China and the United States. Findings reveal an overarching trend with ads from both societies imagining 5G in futuristic and utopian ways, suggesting new possibilities for people, objects, and places to be connected through smart homes, vehicles, factories, and cities—not just through smart phones. The findings also reveal distinctions in how 5G is envisioned at the societal level. For example, ads from China imagine 5G as a source of national pride that will elevate its global standing, while the US telecoms have a more inward focus on domestic competition. The discussion offers interpretations of these and other findings, along with directions for future research.

Keywords

5G, augmented reality, social imaginary, infrastructure studies, internet of things, smart homes, smart cities, virtual reality, wireless networks

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Introduction

This study examines narratives in advertising that help set the stage for the fifth generation of wireless infrastructure, commonly referred to as "5G." With substantial upgrades in speed and coverage, 5G has the capacity to connect people and objects in ways that support novel uses and consequences. Technically speaking, 5G refers to a new set of standards for enhancing the capacity of cellular networks to process data. As this study addresses, 5G is also laden with social meanings, rooted as much in what the technology does as what it is. At the time of this writing, 5G is largely inaccessible for everyday use, available mainly in pilot markets with limited reach and impact. Yet, the wider media environment is saturated with narratives priming, if not shaping, its adoption and use. This study helps open a new line of inquiry into the public sense-making of 5G through media representations. Drawing from the social imaginaries and media infrastructures traditions, it offers a textual analysis of how 5G is being imagined through advertising in two leading markets, including China and the United States.

Advertising is a particularly salient source of meaning for an emerging technology whose uses can only be anticipated. Advertising helps us understand how "the cultural valorization of mobile information and communication technologies" becomes "generalized" (Barney, 2015, p. 16), and scholars commonly rely on it as a contributor to the social imaginary of mobile communication technology (e.g., Goggin, 2015; Murkherjee, 2019; Watts, 2015). Yet, advertising offers a limited view into the public dialogue surrounding 5G because its job is to valorize, not to reflect the range of meanings circulating in the wider public dialogue. In that sense, this study takes an initial step into a larger line of inquiry into the social imaginary of this new wireless infrastructure. Like other scholars, we do not rely on advertising to capture the full social imaginary of an evolutionary turn in mobile media, but rather "key aspects" and "prominent representations" of it (Goggin, 2015, pp. 141–142). As we return to in the discussion, this study provides a view through one window of public sense-making, while laying a foundation for additional insights into the broader social imaginary of 5G constructed through mass and social media.

Social imaginaries and mobile media

Social imaginaries refer to shared modes of understanding about collective life that run throughout society (Steger & James; 2013; Thompson, 1984). As Taylor (2002) puts it, "the social imaginary is that common understanding that makes possible common practices and a widely shared sense of legitimacy" (p. 106). Goggin (2015) further explains the social imaginary "has a relationship to actual practices, and also new possibilities. It also is the matrix of values and norms that frame an understanding of the world" (p. 135). In other words, social imaginaries are common ways of understanding that reflect deep-seated norms, while also defining the scope of new possibilities within a society.

This theoretical perspective has been taken up across various fields, including scholarship on the uses and consequences of mobile media. Watts (2015) examines how developments in mobile form factors (e.g., wristphone) and services (e.g., mobile internet) are shaped by social imaginaries that reach back to the earliest days of wireless

telecommunication. Using a variety of ethnographic methods, Watts unearths the ideal of ubiquitous connectivity as a powerful, yet taken-for-granted, imaginary driving developments throughout the history of the wireless industry. Among the evidence, Watts (2015) points to newspaper advertising stating that 2G technology "grew from a vision. A revolutionary vision that mobile phones should keep customers connected anytime, anywhere" (p. 157). Goggin (2015) also relies on advertising as a way to detect social imaginaries of mobile media. He observes that ads in Latin American markets reflect a notable shift in how the mobile internet has been imagined, from an individual experience toward one that is more characteristically social in nature.

Goggin (2015) explains there are multiple levels of analysis when studying the social imaginaries of ICTs, positioning those associated with mobile media within the broader imaginary of "the information society" (p. 140). With roots going back to the 1960s, this imaginary reflects notions that society is increasingly structured around networks of information and communication, and has been taken up widely to interpret major pivots in cultural, economic, occupational, and other social domains (Webster, 2002). Although MMC scholarship is often focused around devices (Horst, 2013), much of the so-called mobile revolution is more reliant on the infrastructures that provide the networks than the devices and interfaces people interact with directly (Goggin, 2020). As Ling and Donner (2009) assert, "It is the networks, not the handset, that allow us to connect" (p. 31). The social imaginaries of these networks matter because they can open up different use cases and perceptions of novel types of mobile communication.

(In)Visibility of media infrastructures

An important part of the social imaginary of mobile media is recognition that generations of wireless infrastructure have advanced about every 10 years. The first generation (1G) emerged in Japan in 1979 and pioneered "cellular" networks of radio towers to carry analog voice signals (Ling & Donner, 2009). Although 1G had limited reach and impact, this is when the mobile phone entered the public imaginary as a symbol of status and wealth (Murkherjee, 2019). 2G, advanced in Europe in 1991, converted analog wave forms into digital signals, allowing for longer voice transmissions, short messaging service, and photos. As the diffusion of mobile calling and texting reached critical mass, mobile communication began its journey toward being an embedded part of everyday social life (Ling, 2012). Introduced in 2001, 3G offered enhanced data processing speeds for accessing the mobile internet and location awareness (Goggin, 2020). Socially, however, the diffusion of mobile data didn't take off widely until the uptake of the iPhone and Android smartphones in the latter 2000s, supporting an expanded range of mobile media practices, including going online, using social media, participating in the growing app ecology, and engaging with places through location awareness (Frith, 2015). Unlike previous generations, 4G did not introduce novel forms of connection whole cloth as it diffused in the early 2010s. Instead, it improved upon 3G so that users could have faster, more reliable experiences with apps and data while away from Wi-Fi. 4G's impact may be a difference of degree rather than kind; however, the difference is meaningful when considering the rise of data-heavy mobile media practices and services, including image-based social media apps (e.g., Instagram, Snapchat) and streaming (e.g., Hulu, Netflix).

The shifting affordances and practices associated with each generation shows what has become a key point in much of the research on infrastructures more generally. That is, infrastructures shape perceptions, uses, and consequences of a technology (Parks, 2010; Parks & Starosielski, 2015; Starosielski, 2015). Despite the common perception that they offer neutral foundations upon which more interesting practices occur, infrastructures shape those practices (Dourish & Bell, 2007). At the same time, they tend to fade into the background of public and scholarly imagination, especially wireless infrastructure eclipsed by the mobile phone as an object of fascination and study (Horst, 2013). This should not be surprising because infrastructures are often designed not to be noticed, evidenced by cellular network towers disguised as trees (Farman, 2015, Parks, 2010). As Susan Leigh Star (1999) puts it, infrastructures are commonly pseudo-invisible, only to "become visible upon breakdown" (p. 380).

Although invisibility is a commonly understood characteristic of infrastructure, more recent scholarship complicates the relationship between invisibility and visibility. As Larkin (2013) points out, infrastructures can go through moments of hyper visibility where they become objects of public fascination. Part of that public fascination is the result of corporate and state actors strategically making infrastructures visible. For example, Murkherjee's (2019) research shows how 4G development in India resulted in corporate and state actors going out of their way to highlight the built infrastructure of cell towers, in contrast to the more common practice of hiding them. Murkherjee asserts, "Such representations of infrastructures (cell towers) in maps and ads are a key part of infrastructural imaginaries, which are connected to national imaginaries" (p. 186).

However, in contrast to Murkherjee's analysis of the role that 4G's material infrastructures have played in advertising, the ads examined in this study treat 5G as something abstract, foregrounding its potential social advancements rather than the underlying materials and technical standards. Part of that focus can be explained by the material and technological realities of the 5G infrastructure. 5G relies on radio towers that may be smaller than with previous infrastructures, however more pervasive and no more attractive. In addition, the focus on behaviors and advancement supposedly enabled by 5G, rather than the objective properties, is likely strategic. One of the contributions of our study is to make the strategic invisibility of 5G in advertising newly visible by highlighting how the material aspects of the infrastructure are elided in favor of more abstract areas of focus.

It is also important to acknowledge the complexity of communication infrastructures, which can be overlooked in advertising. 5G itself is a complicated object of study. It refers to a new set of wireless standards, technologies that can harness those standards, and a generational shift in how people will engage with information and communication in everyday life. In that sense, 5G is a "boundary object" (Star & Griesemer, 1989) used differently by different communities in different contexts. And, like many infrastructures, the meaning shifts as it moves through different discourse communities, while still maintaining a core conceptual integrity that enables the term to maintain salience. As this study shows, much of that complexity is washed away in advertising that focuses on the practices enabled by 5G rather than what it *is* as an object of interest. That contribution and others from this study may help inform future scholarship on the social imaginary of 5G, within and beyond the context of advertising.

Infrastructural imaginaries

Integrating the literatures above, scholars have advanced the concept of the "infrastructural imaginary" to characterize social imaginaries associated with media infrastructures. Drawing from key scholars in this area, we identify conceptual contours of infrastructural imaginaries to help frame a series of research questions asking how 5G is being imagined through advertising. For Parks (2015), infrastructural imaginaries are "ways of thinking about what infrastructures are, where they are located, who controls them, and what they do" (p. 355). Adding on to these dimensions, Murkherjee (2019) calls attention to the affective types of imaginaries associated with individual experience and how infrastructure is shaped on the national level through corporate and state actors. As he explains, "Infrastructural imaginaries emerge at the micro-level of affective encounters between individual citizens and telecom infrastructure and at the macro-national level where telecom infrastructures epitomize a nation's vision of development and modernity in the near future" (Murkherjee, 2019, p. 191). Drawing from these contours of infrastructural imaginaries, the following research questions were used to guide the analysis:

RQ1: According to the ads, what will 5G do?

RQ2: What ways of thinking and feeling about 5G are reflected in the ads?

RQ3: Where do the ads portray 5G as being located?

RQ4: Who has control of 5G in the ads?

This study also offers a comparative approach with analysis of ads from two of the leading countries in developing and deploying 5G technology, including China and the US. Others, such as South Korea, warrant analysis, however were excluded here due to limitations in scope and resources. Also, China and the US present a particularly interesting point of comparison because of the overt competition and hostility among them over 5G technology. It has been widely reported that US President Donald Trump banned partnerships with the Chinese telecom Huawei over concerns about data spying. At the same time, Huawei has emerged as a dominant player in the global 5G industry, partnering with many countries seeking to deploy the technology (Kean, 2020). For these reasons, China and the US provide a reasonable point of entry for a multi-national perspective on the public sense-making of 5G technology.

RQ5: How is 5G imagined similarly and differently in the ads from China and the US?

Analysis

Video advertisements

Because we are interested in the public sense-making of 5G, we chose to analyze advertising offering the most reach and visibility, as opposed to niche ads with a bounded

viewing audience. Our first step in this direction was to read industry articles to identify leading telecoms in China and the US, thinking that the biggest and most influential telecoms would have advertising with the greatest reach in each respective country. That research led us to identify five telecoms in China (China Unicom, China Mobile, China Telecom, Huawei, and ZTE) and seven telecoms in the US (AT&T, Cisco, Intel, Sprint, T-Mobile, Qualcomm, and Verizon; T-Mobile and Sprint have since merged). After identifying the leading players in the 5G industry, the next step was to locate their 5G advertisements. We narrowed the scope to video advertising because of accessibility and because this format offers the potential for a great deal of audience reach via television and internet.

With those decisions in place, we searched online video-sharing platforms for ads using each company's name plus "5G" as keywords (e.g., "Huawei 5G"). The most popular video-sharing platform in each country was searched, including Bilibili.com in China and YouTube.com in the US, during October and November 2019. All available ads from the two platforms were included for analysis ($N = 89$). For context, it is important to understand that ads on Bilibili were uploaded by individual users (between May 2018 and October 2019), while those on YouTube were uploaded by US telecoms (between March 2015 and November 2019). It is also important to note that some of the ads have been aired as television commercials, while others have been used for web-based advertising. Thus, this is not a representative or exhaustive dataset, but rather one that is illustrative of how 5G has been imagined through advertising in the two societies. Thirty-two of the 89 ads are from Chinese companies [China Unicom ($n = 12$), Huawei ($n = 8$), China Mobile ($n = 7$), China Telecom ($n = 4$), and ZTE ($n = 1$)]. Fifty-seven are from US companies [Verizon ($n = 13$), AT&T ($n = 12$), T-Mobile ($n = 10$), Sprint ($n = 7$), Qualcomm ($n = 7$), Intel ($n = 5$), and Cisco ($n = 3$)]. The videos vary in average length, from 108 seconds for ads from China to 78 seconds for those from the US (overall *range* = 14–374 seconds).

Analytic approach

The ads were analyzed by two co-authors for textual and visual themes. Drawing from Hammersley and Atkinson's (1995) framework for analyzing qualitative data, the authors first became familiar with the ads by viewing and reviewing them while identifying patterns in the words conveyed via audio and text, as well as the images comprising the video. Ads were viewed by authors together and separately as each generated notes on initial patterns. After sharing and discussing their notes, the authors came to agreement on a set of sensitivity concepts. Hammersley and Atkinson (1995) discuss sensitivity concepts as loose collections of consistencies in qualitative data, providing the initial "germ of analysis" (p. 212). The next step moved toward refining the sensitivity concepts into a thematic structure, involving overarching topics and more nuanced themes. The authors met regularly over a period of weeks to share and discuss their observations, arriving at points of agreement and working through cases of difference. Each made subsequent passes through the ads, reviewing for additional insights and notes to help clarify the emergent topics and themes. After multiple rounds of viewing, note-taking, and discussion, the authors arrived at a coherent set of broad topics and

nuanced themes. As we turn to next, these insights help tell a story about how 5G is being imagined through advertising, just as the technology is about to become widely deployed.

Findings

What will 5G do?

The first research question asks what 5G does, or in this case what the ads forecast it will do when fully available. Two overarching answers to this question are reflected in the ads from China and the US, namely that 5G will (1) connect people and (2) objects in revolutionary new ways. Within each of these narratives are a number of themes and illustrations to help the viewer imagine how aspects of everyday life will be different with 5G.

To begin with, the ads imagine how 5G will connect people in a number of different domains, including health, education, work, sociality, and leisure. With regard to health, they envision a near future where there are no barriers separating patients and doctors. We see this in an ad by Sprint inviting the viewer to "imagine a doctor examining patients in remote, underserved communities," along with imagery of a physician looking up medical records using an AR interface. This ad not only illustrates how 5G can impact health, but also how the telecoms are literally asking viewers to "imagine" 5G in certain ways. In another example, a China Mobile ad depicts a doctor using 5G-enabled imaging technology to diagnose the internal injury of a young child. Messages of robotic surgery also help comprise this theme. As a medical expert in a Verizon ad explains, "Low latency is crucial for things like surgery because the response time has to be immediate, it has to be real." Beyond the operating room, the videos show how doctors and patients will be connected through robots in 5G-equipped ambulances and emergency response vehicles.

In addition to health, the ads also promise that people will be connected through 5G in ways that revolutionize education and work. They feature mobile AR and VR as playing important roles in enhancing access to education and learning experiences. An ad by T-Mobile illustrates this finding by explaining how 5G will support access to education in remote and rural areas by supporting augmented field trips, virtual hands-on learning, real-time language translation, and digital partnerships with other schools. In this case, 5G is not merely an educational resource, but a "social equalizer," as the ad puts it. Work is another basic duty that will be enhanced, with promises that 5G will make it more enjoyable and efficient by allowing people to be connected in new ways. For example, a China Mobile ad depicts a man and his co-workers using 5G technology for sharing data, conferencing remotely, and navigating complicated laboratory equipment with the help of an AR interface. These ads also show how 5G will support work outside of laboratories and offices by depicting workers using the technology in applied and outdoor settings.

Ads featuring connected people also highlight uses of 5G for new modes of sociality and leisure. For example, a Huawei ad depicts a man camping in a remote part of nature using a device to generate a live 3D hologram of his wife and child, bringing them into the woods with him, and him into the living room with them. Similarly, a China Telecom

ad depicts a family celebration involving a live hologram of a uniformed soldier joining in from afar as a young girl blows out candles on a birthday cake. These types of hybrid digital–physical connections are complemented by images of more immersive uses of 5G as well, where people put on headsets to play social games and explore virtual worlds.

The other narrative that helps answer RQ1 is that 5G will connect objects in ways that will radically improve daily life. One of the most prominent themes within the messaging of "connected objects" is that 5G will support driverless vehicles that communicate with other vehicles, places, and things so that humans can have more comfortable, safe, and productive commutes. For instance, an ad by Sprint asks the viewer to "imagine a car that can drive you safely home from work and lets your home know when you arrive." Here again we note the language of "imagine." Another example of this theme can be seen in a Huawei ad claiming, "5G-enabled driverless cars will enable ultra low-latency communication between car, people, and infrastructure—allowing them to operate smoothly over great distances without limitations."

In addition to driverless cars, smart delivery vehicles are commonly featured in the messaging about connected objects. For example, Verizon dedicates an entire ad featuring the ways ambulances will be equipped with robotic equipment manipulated by doctors from afar wearing VR goggles. Drones also appear in the ads as connected objects that will optimize logistics and deliveries, particularly in ads from China. For example, China Mobile opens one of their ads with a fleet of futuristic drones delivering boxes and stacking them with precision. This theme is also illustrated in a Huawei ad proclaiming, "A large port may handle millions of containers, moving billions of products with vast amounts of information. 5G technologies, with the capacity for massive connections, will provide [end-to-end] tracking, increasing efficiency and reducing cost dramatically."

These ads also invite people to imagine how domestic and work objects will be connected directly to each other in new ways. One from China Telecom illustrates this theme with a sleeping man whose home appliances work together to ensure the temperature is adjusted, window shades are opened, and coffee is made just before he is awakened by a 3D hologram springing out of his smartwatch. The ad continues on to feature various other futuristic versions of domestic objects, including an interactive mirror that allows the man to map out a bike trip while brushing his teeth.

This collection of messages also offers futuristic visions of objects connected in new ways for work. They highlight how 5G will be used to automate manufacturing with connected robots, enhance design through AR interfaces, and bring construction templates to life through holographic imaging. The China Mobile ad discussed above for its fleet of delivery drones also prominently displays the words "Wireless Connected Factory," followed by images of a manufacturing plant with an automated logistics system, synchronized robots, AR digital overlays, and a mesh of 5G infrastructure flowing above and throughout everything. Another example is an AT&T ad depicting a group of construction workers in hard hats having a team meeting around a 3D hologram of the project template. That and other images of 5G-enabled objects are accompanied by a voice overlay stating, "AT&T's creating a 5G network that will change the world. It will be everything you imagined, and everything that hasn't been imagined yet."

Ways of thinking and feeling about 5G

The second research question asks about ways of thinking and feeling about 5G reflected in the ads. Findings show they encourage people to think about 5G in technological as well as social terms. Technologically, the ads consistently encourage people to think of 5G as fast and ubiquitous, allowing users to do new things in new places with mobile media. Through voice and text, the ads invite people to think about how 5G is fast, using the language of "speed" and "low latency." Speed refers to the time it takes for a mobile device to communicate with the network, while latency refers to the time it takes to process data within the network. In addition to claims of high speed and low latency, visuals offer abstract representations, such as a car speeding down the road only to be passed by a scooter zipping by with a "5G" sign on the back (China Unicom ad). Viewers are asked to think about the ubiquity of 5G through abstract representations as well, for example through images of planet Earth fully enmeshed in a 5G network that is alive and flowing with data.

In addition to thinking about 5G in terms of universal coverage, the videos suggest it will have some universal social implications as a big step into the future. The ads reflect a great deal of optimistic, if not utopian, sentiments about this pivotal moment in human history. Notably, they also insist on honoring the past as we move into this new socio-technological era. For example, one Huawei ad places 5G on the order of the industrial revolution, while another honors the past with depictions of people using 5G-enabled VR to step back into history to learn about ancient Chinese dynasties. The very same types of thoughts and feelings are portrayed on the US side, as is the case with AT&T's ad featuring a "5G coffee house" themed around Alexander Graham Bell and American culture of his time. Patrons are depicted using 5G-enabled VR headsets and 3D AR holograms to experience a neighboring venue offering live performances of American music and culture from over a century ago, when jazz and the telephone were both new. A senior marketing manager from AT&T comes into view to explain, "what we really wanted to do was think about the future while honoring the past."

Beyond those aspects of similarity, the two sets of ads also reveal differences in how people should think and feel about 5G. Several of the ads from China equate 5G with national pride, oftentimes using sports, particularly the 2022 Beijing Winter Olympics, as a metaphor to evoke these feelings. Ads from the US have less of a focus on overall national advancement, imagining instead the possibilities of 5G for elevating marginalized groups within the country. According to Sprint, the speed and ubiquitous coverage of 5G are especially beneficial for "remote, underserved communities." Also, as noted above, a T-Mobile ad declares 5G to be a "social equalizer" because it will close the digital divide between urban and rural areas. We do see some, although less, of this theme from China, evidenced by a China Mobile ad that states, "Let the broad masses of people move from using electricity to making good use of it." However, the vantage point in the ads from China is more about the country's overall development and global status. The very same ad with an interest in "the broad masses" invokes President Xi Jinping's declaration that "Technology is an instrument of the country, the country depends on it to be strong, the company depends on it to win, and the people's lives depend on it to be

better." As we elaborate on soon, these insights not only help address questions about thoughts and feelings about 5G in the ads, but also differences in how it is being imagined at the national level in China and the US (RQ5).

Where do the ads portray 5G as being located?

The third research question examines where the infrastructure is located in the ads. There are two primary facets of 5G infrastructure: the visible material of network hardware and the invisible radio waves that support the flows of data. The findings reveal an inverted pattern, where the material part of the infrastructure is rendered wholly invisible while the invisible is portrayed through abstract representations. In fact, none of the ads sampled for this study depicted images of what 5G cell towers look like, providing little opportunity for viewers to imagine their exact physical location. At the same time, the ads commonly use graphics to abstractly represent 5G network coverage and data, evidenced by images of the enmeshed planet noted above. What engineers call "the stuff you can kick" (Parks, 2015) is literally left out of the picture, while virtual representations of radio waves are visibly foregrounded, presumably to help people imagine 5G as something more magical and transformative than what a collection of metal parts has to offer.

Although the infrastructure itself is not located, the ads do call a great deal of attention to the locations where 5G can be used—and also how using 5G can transform the way people experience those locations. The (smart) home stands out as a prominent area of application in both sets of ads. This theme is evident in the China Telecom ad above depicting home appliances working together to ensure that coffee is made, shades are opened, and temperature is adjusted before a man wakes to start his day. In addition to smart homes, the ads feature smart factories, laboratories, and field sites. They highlight ways 5G will automate manufacturing with connected robots, enhance laboratory equipment with AR interfaces, and make construction more manageable with advanced imaging. Ads from China and the US also feature smart cities that are more fun, safe, and efficient thanks to 5G connectivity. This theme entails images of cities enmeshed in 5G infrastructure connecting buildings to each other, while supporting novel practices as people and things move about urban areas.

Who has control?

The theme of smart cities also helps address the fourth research question about who has control over 5G, as well as RQ5 regarding differences across China and the US. The ads from China uniquely feature surveillance as a beneficent form of state power exercised through control of 5G technology. They portray people being tracked at the individual level as they move about densely populated areas through the use of 5G-enabled sensors, cameras, and drones equipped with facial recognition. In one China Unicom ad, an exciting drama unfolds when a fugitive is identified through facial recognition and law enforcers chase the fugitive throughout the city with the aid of 5G-enabled glasses that monitor and even change the surrounding physical environment. In the end, the villain is caught, and the hero is 5G.

In addition to surveillance, ads from China uniquely make reference to state control through recognition and appreciation of policy. As already noted, an ad from China Mobile quotes President Xi Jinping's vision that "Technology is an instrument of the country." Recognition of governmental steering and support appear in ads by other Chinese telecoms as well, such as Huawei highlighting research and development trials organized by the Ministry of Industry and Information Technology and China Telecom's agreement with the government to initiate a 5G pilot network. As with state surveillance, these aspects of institutional control are not prevalent in the ads from US telecoms.

The locus of control is not solely focused on the Chinese state, with many ads portraying control as distributed across people and objects. As explained above, the theme of "connected people" promises new possibilities for health, medicine, education, work, sociality, and leisure. These ads portray individual users as having control over 5G. Of course, they do not have direct control over the material infrastructure because it is hidden; however, they do have control over the devices and data connecting people to objects, places, and each other. On the other hand, ads reflecting the theme of "connected objects" place control outside of people and into the domain of things. This point is well illustrated in the findings about connected appliances at home, connected vehicles on the road, and connected robots in the factory. We assume people set the systems up to work autonomously; however, that is not what we see in the ads. Instead, we see objects directly communicating with each other through 5G networks. The intended messaging here is probably not so much about control as it is about convenience and productivity. However, when looked at through the lens of infrastructural imaginaries, dynamics of control become more visible.

Differences in ads from China and the US

The final research question (RQ5) asks about differences across the two sets of ads. As we return to in the discussion, there is more coherence than difference among them. At the same time, the findings for RQ1–4 reveal a number of nuances and distinctions across the two sets of ads. As noted, surveillance through drones and facial recognition is featured in those from China, but not the US. Also, ads from China imagine 5G as elevating the nation as a whole, while those from the US characterize it as a way of elevating populations within the country. Thus, 5G is imagined as a source of national pride in China and as a social equalizer in the US. Policy is another area where differences emerge in the findings, with ads from China lauding government support for developing the technology, while those from the US remain silent on that front.

In addition to those from RQ1–4, we observe one additional distinction. Whereas much of the messaging above is about the implications of 5G for everyday life, a number of ads have more of an industry focus, appealing to business clients as opposed to individual consumers. Within these types of ads we see a strong domestic focus from the US telecoms and just as strong an international focus with those from China. US telecoms prominently boast of their domestic business clients, evidenced by Verizon's messaging about partnerships with the Madison Square Garden arena, the US National Football League, and the Corning company. While an international perspective is rare on the US side, it is the norm in business-oriented ads from China. For example, ZTE positions

itself as "a globally trusted partner in the 5G era." Huawei's international appeal for business is evident in their choice to produce some ads in English, while depicting people and settings evidently outside of China. China Mobile keeps the setting in China, but offers an international feel with images of high-quality video-conferencing among business colleagues who appear to be in Europe or North America. These ads reflect an international appeal by the Chinese telecoms, particularly with an eye toward business partners in the West, while telecoms from the US seem to be more embroiled in domestic competition.

Discussion

Guided by the social imaginaries and media infrastructures traditions, this study brings visibility to the ways the 5G wireless infrastructure is being imagined through advertising in two key markets as it approaches diffusion into everyday life. As scholars note, infrastructures are commonly designed to be imperceptible, only to become visible through failure (Star & Ruhlehder, 1996). However, some infrastructures also go through moments of hyper-visibility in public domains, such as policy discussions and advertising (Larkin, 2013; Murkherjee, 2019). As we show, that visibility in the case of 5G is limited mostly to what it might potentially enable rather than 5G itself as a set of standards or material technology. We recognize this moment as a unique opportunity to examine how 5G is being imagined through the media during a period when, for the most part, people have yet to experience the technology directly for themselves.

As noted, the material part of the 5G infrastructure that can be seen, i.e., the cell towers, are left invisible in the advertising, while the invisible aspects of it, i.e., radio waves, are displayed abstractly. Furthermore, in contrast to Murkherjee's (2019) study of 4G advertising in India, the emphasis is placed on what 5G does rather than on what it is. Why would the telecoms represent 5G so abstractly? To begin with, cell towers are unattractive, to the point that they are commonly hidden or disguised (Farman, 2015), and therefore fail to capture the imagination of what 5G has to offer. The new cell towers are different, but they still resemble the old ones in a way that does not suggest a revolution for everyday life. To capture that revolution, the telecoms resort to foregrounding shifts in the present mindsets and practices surrounding mobile media. In these ads, the primacy of the smartphone gives way to a more distributed view of wireless connectivity, with graphical depictions of data flowing above and throughout homes, factories, cities, and even the entire planet. There is a great deal of complexity underlying the scientific advancement of 5G, and abstract representations of it, along with a focus on what it does, offer patterns of interpretation that are accessible to the ordinary person. As Pentzold et al. (2019) explain, abstract representation through visuals offers salient ways of imagining new technologies that embody scientific advancement. In this case, visuals of ubiquitous and free-flowing data help prime the infrastructural imagination of what 5G has to offer, whereas images of the cell tower would only remind about constraints of their fixed locations and material vulnerabilities. The material infrastructure and the 5G standards themselves are left invisible. At times, 5G signals are graphically represented as abstract flows of data; however, a more prominent emphasis is placed on practices, applications, and consequences of the technology.

The findings also show a number other ways 5G is imagined. Both sets of ads coherently imagine 5G in futuristic and utopian ways—as a revolution that will bring new possibilities for connecting people, objects, and places. Telecoms in China as well as the US promote this narrative through themes of smart vehicles, factories, homes, and cities. The shared message is that within these and other contexts, 5G will connect people and objects in novel ways while making existing mobile media practices incredibly faster and more accessible. Indeed, there is more coherence around that messaging than differences across the two sets of ads. The differences, however, are notable because they reveal how social imaginaries are situated in societal context, which shapes how people perceive, feel about, and experience technological infrastructure.

As reported in the findings, ads from China imagine 5G as an opportunity to be a global leader in the industry, as opposed to the focus on domestic competition reflected in those from the US. Ads from China also uniquely imagine 5G as both a product of governmental support and a mechanism of state control. We see this through policy references as well as messaging about surveillance of citizen movement and activity. These themes come together to form a coherent pattern that resonates with Murkherjee's (2019) argument that infrastructural imaginaries "are coproduced by states and citizens, and lie at the intersection of structured state policy/corporate initiatives and lived experiences/affective encounters of ordinary citizens" (p. 175).

These findings can also be understood in the context of the shuffling roles that China and the US have played in the global wireless telecom industry. In the 1990s China relied heavily on foreign companies for 2G products and services as its own telecom industry began to emerge with new corporations such as Huawei and ZTE (Fan, 2011; Hong, 2017; Zhao, 2010). During this time, American companies, such as Qualcomm and Motorola, were vital players in China's telecom market (Hong, 2017), while domestically they experienced unprecedented levels of privatization and deregulation (Jin, 2005; Shah & Kesan, 2007). During the 3G era in the 2010s, China developed its own set of standards for wireless infrastructure, reflecting an important shift from technological dependence to indigenous innovation (Hong, 2017; Xia, 2017). US telecoms maintained a competitive foothold in China well into the 4G era; however, privatization and deregulation at home led to over-competition, resulting in bankruptcies and spin-off companies (Jin, 2005; Ryu et al., 2018). Now China's telecom industry is stepping up to not only service its own markets, but to also partner with many other countries around the world to build out 5G networks. Beyond industry competition, this trend raises concerns about security, with the US government warning that China's government can gain access to data exchanged on Huawei's 5G networks (Kaska et al., 2019). In fact, 5G has become a major source of geopolitical conflict, with China and the US jostling at the center of it (Kean, 2020). Although the line delineating security from trade may be murky in this case, this context makes it clear that infrastructures are inherently political. It also helps explain patterns in the findings, with 5G as a source of national elevation and pride in China and a site of domestic competition in the US.

Next steps

This study helps open a new line of research on how 5G is being imagined in the media leading up to widespread availability. Messaging in advertising is especially salient when

a new technology is on the cusp of diffusion because people have yet to form their own judgments through experience. Yet, advertising is just one window through which we can look, and it carries the bias of valorizing new technologies. In addition, advertising offers a limited window into communication infrastructures because it tends to focus on potential future practices rather than the enabling standards and technologies that will supposedly make those practices possible. A primary goal of this study is to lay a foundation from which additional research on the social imaginary of 5G can be carried out, and future scholarship should examine other sources of public sense-making to broaden the vantage point.

In addition to advertising, news is a meaningful source for thinking and feeling about 5G, and an important step forward is to examine patterns and themes in news articles that reflect and shape social imaginaries of 5G. It would be useful to include industry as well as mainstream news sources for insights into both insider and popular messaging about 5G through news. Social media also serve as a hub of public dialogue about 5G. To illustrate, the popular micro-blogging sites Weibo.com (in China) and Twitter.com (in the US) both have "5G" hashtags that have attracted many thousands of posts. Analyzing this type of content would help in understanding how 5G is being imagined at the grassroots level, complementing the messaging from telecoms and news media.

Future research will also benefit from a better understanding of how 5G is being imagined by ordinary people. The initial themes uncovered in advertising and other media can be used as guides for developing interview protocols and surveys to capture ways in which people think and feel about 5G, and how they condition adoption and usage. These types of approaches will not only help to identify the infrastructural imaginaries surrounding 5G; they will also help to explain them by accounting for media exposure and other sources of public sense-making. The findings generated here should provide sufficient grounds to develop preliminary hypotheses linking advertising exposure to perceptions, knowledge, and attitudes about 5G, as well as select differences in China and the US.

Concluding remarks: From MMC to "ubiquitous media and communication"?

In addition to health, education, work, leisure, and the geopolitical landscape, 5G may have implications for the growing field of MMC. As explained, revolutions in wireless infrastructure support changes in technology and social practice. This is not to suggest technological determinism, but rather that advances in infrastructure make possible new devices, services, and social behaviors. It remains to be seen if 5G will serve as the scholarly pivot on the same order as the so-called smartphone revolution. To be sure, this is not the kind of question best addressed through advertising; yet, the ads do provide a clear view into how the telecoms envision life in the 5G era. If any of those visions become reality, we might anticipate a shift in the field of MMC, with questions about the uses and implications of connecting in ways that are not so much mobile, but ubiquitous in nature (Weiser, 1991). The ads do not suggest smartphones are going away; however, they do imply that the ubiquity of 5G in connecting people, objects, and places will make

the smartphone a relatively smaller fish in a much larger pond. Perhaps Laura Watts (2015) has it right in proposing the future of MMC has always been fundamentally guided by imaginaries of ubiquity.

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