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INTIMACY IN THE TIME OF COVID-19

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ABSTRACT

In this essay, we tell a story with data about how our relationship with technology has transformed our collective notion of intimacy and rituals of connecting with others. Framed by the COVID-19 pandemic, our starting point is that technology is neither good, bad, nor neutral. The goal of this study is to step back and have conversations with people –from all over the United States of various ages, occupations, and relationship statuses– about how they define intimacy and understand these practices in a mediated environment. In this essay, we discuss technology as more than a performative platform. It is an ambient architecture that sets the tone for interactions meant to preserve social ties and sustain social capital potentially depleted through pandemic conditions of seclusion. Through the voices of our participants, we conceptualize how intimacy is experienced and understood, and how this relational quality is amplified in a mediated environment during moments of disruption. In the end, what COVID-19 has revealed as we reflect on our relationship with technology is the fluidity of intimacy in moments of change.

Keywords: intimacy; media; COVID-19.

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In the acclaimed novel *Love in the Time of Cholera,* Gabriel García Márquez seductively deconstructs myths about love, passion, and immortality through a powerful narrative.[1] The pandemic serves as both context and metaphor, against which the characters latch on, reimagine, or abandon their mythology of being. We take inspiration from the magical vernacular Márquez offers. Through interviews with everyday strangers, [2] all ensconced in their private islands of community and isolation, we can revisit the meaning of intimacy in the time of our current pandemic. As technology, for many, scales from a supplemental to a primary avenue for connection and expression, how does our psyche, collective and personal, adjust to this transition?

The data presented in this essay originate from a larger qualitative project that focuses on how intimacy is mediated through communication technologies. The goal of this research is to step back and have conversations with people – from all over the United States of various ages, occupations, and relationship statuses – about how they define intimacy and understand these practices in a mediated environment. In the end, this research is about uncovering how mobile technologies have transformed our collective notion of intimacy and the rituals of connecting with others. What we hope to provide here is a snapshot of the stories our informants shared and our analysis of the larger research question guiding this investigation: What pressure does COVID-19 put on the relationship between technology and intimacy?

Our experiences with COVID-19, as a society, present a unique lens through which to re-examine what intimacy means, how it is experienced during a pandemic, and what role technology plays in this equation. For instance, Oliver remarks that "Having technology makes me feel like I am part of a community all the time" and goes on to explain that he views technology as "a tool for livelihood."[3] Technology shapes our perception of social and relational life. We often take for granted how quickly media become part of the social fabric of our lives, and this invisible infrastructure frames our daily interactions. For many of us during the pandemic, we found ourselves living our social lives primarily through a screen. These invisible, everyday technologies, became the center of our way of life.

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[1] Márquez, G. G. (1997). *Love in the time of cholera.* Everyman's Library.

[2] The interviews talked about in this piece were conducted by Jamie Foster Campbell as part of her dissertation research under the mentorship of Dr. Zizi Papacharissi. The accounts represented here are an illustration of the data collected between May 2020 and December 2020.

[3] The quotes referenced here come from people who are 23-64 years old and identify as straight, gay, or queer, whose occupations vary (e.g., Editor, Tattoo Artist, RN, Early Childhood Educator, Office Manager, Social Worker), and locations include California, Washington, Oregon, Colorado, Kansas, Illinois, and Georgia.

Gabriella adds, "Before the quarantine, there was a period of maybe 5 months I was home alone with the baby and I think I was more socially isolated during that time than I have been since the quarantine and that is because everyone is isolated at home, not just me." Gabriella says this laughing, but the reality is as a first-time mom she has felt less isolated since the pandemic started because she can now join in on conversations that she would normally miss, whether that be during a Zoom happy hour or when she attends virtual events with her family and friends. In this case, Gabriella is reimagining intimacy in her relationships by engaging in different ways that make her feel more connected.

Intimacy is dynamic and relational; experienced not just in the context of our everyday relations, but also measured against the backdrop of how we think others experience intimacy. We, as a society, often worry that social media increases our fear of missing out; it would appear that technology can also flatten that fear; sometimes diminishing it and sometimes rendering it stable. To this point, Sophie adds, "my communication with my adult children is more constant right now, so you get a glimpse into the small moments of their daily life. If you wait for a couple of weeks to talk or for the next time you're all together you miss things… we only talk about the bigger moments. But now since we are communicating more through technology I get to hear about the daily frustrations or struggles, the triumphs and it helps me understand a little better and feel more connected to them."

Technology is a shared cultural backdrop and a place for communication. It lends a space for interaction; a way to extend feelings of intimacy with close relational others as we traverse through our worlds. We are conditioned to think of technology as an alternative path to intimacy, pursued only in the absence of other, preferred routes. Yet we end up using technology for intimacy more often than we realize in our everyday lives, and even more so now, from our sheltered abodes. How we envision and practice intimacy in our close relationships is formed by what we expect technology to offer; and what we are sure it cannot. We apply these expectations to our design of technology, inadvertently limiting the true potential of what technologies might provide. Still, technology is woven into the daily fabric of our interactions, our intimacy vocabulary, our relational histories, and our sense of being. Technology, in its many forms and platforms, supports our soft structures of intimacy.

Intimate acts are momentary, lasting for a brief time – however, they are also everywhere and necessary for social connection. "Intimacy, for me…" says Marie, "is feeling really seen. Like in a way that somebody can only do if they really know you on a very deep level. It is feeling safe with somebody and very connected." Marie highlights how intimacy is not just associated with romantic love or physical acts but related to trust,

understanding, and exposure. This same sentiment is expressed by Marcos who describes intimacy as layered, he says "I tend not to think of physical intimacy as the end all be all because I don't hold physical intimacy on this pedestal, this pure thing that needs to be sacred. I would much quicker qualify my in-depth conversations with my best friends as intimate than I would me sexting a random guy that I just met and who will ghost me in a week. While that conversation with the guy could be seen as intimate, I don't consider it as intimate because there is no emotional context there." Thus, intimacy is linked to emotion, it is fueled by time, and grows alongside our relationships. Intimate acts and the feeling of intimacy are not always viewed as the same construct among our informants. Intimacy can also be experienced in the fleeting moment, between passing strangers who feel seen as they evanescently cross paths. Gabriella believes intimacy is "space, either physically or intellectually, where you are actively expressing and receiving without any judgment… It's an act without consciousness." So, intimacy is not necessarily tangible or something we all define equally. Intimacy frequently lurks in the background and often manifests itself in invisible ways, that is, moments that we label intimate upon further reflection.

Thus, temporality not only punctuates our acts of intimacy. It defines how we interpret them. Nora passionately says "Intimacy is time. Personal time and that's it. Time is the greatest luxury. Time is the biggest gift we can give someone, our focused attention, our singular attention. Slowing down. Taking the time to make time, to be present, to be available. To me, that is intimacy." As we retreat to our homes, work from our living rooms, and have more time to talk to our close networks through our screens we see how intimacy is subjectively experienced. As technology becomes the mediator for social gatherings, and the pandemic surges on, time acquires a different meaning. We have more time to reflect on how we use technology to cultivate intimacy. We have less time to manage the new insecurities brought on by the pandemic. Yet the benefit of time often affords reflection and hindsight, in overcoming insecurities and as we craft the ties of intimacy. Time shrinks and expands simultaneously, and our technologies permit us to both stretch and speed up time. Yet the platforms we use frequently suggest ways of doing that limit our options. They afford ways of transferring our routines online, and this transition is uneasy. Different spaces produce varying paths to intimacy. We are speeding down the desire lines of intimacy as we move our gatherings online. In our efforts to adjust, we turn to the familiar and seek to transition that online. Desire paths in nature typically reflected the most often travelled route. Still what worked for us pre-pandemic may not meet our pandemic wants. We change and evolve during the pandemic, and we will possible return to a normal, post pandemic, that we no longer recognize as familiar. When we go back

to what was normal, we will no longer be the same people who live in that normal.

We quickly learn how to use technology to bend time as we live through times that feel simultaneously fast and painfully slow. We can't catch the eye of someone across the room, so Orion explains how he is 'dating' differently through his smartphone now: "I've got the chance to know more about people because of this...I can't see you, so therefore I can't touch you, so we are having conversations. I get to sit down and actually talk to them, get to know them, it's different." Orion speaks about how before he would call someone, they would get together, and it was physically driven. He then explains, "… now I actually get to know people. It's like 'oh wow…is that a Bears picture in your background, you're into football, we can watch a game together.' I am finding out a lot about people that I would have never bothered to ask."

Our collective experience with COVID-19 provided opportunities that would not have existed outside of this moment. For instance, Lola explains how she initially met her 74-year-old neighbor through a community Facebook group when her neighbor posted a question asking for a house cleaner recommendation. "We ended up chatting on messenger in that way," said Lola, "it was at the beginning of the year, right around the time of the pandemic and I realized I don't know if anyone's checked on her? Does she need groceries? So I sent her a text message and she replied 'I'm very depressed and very scared' so I said 'why don't we do a social distancing happy hour and we'll have some wine.' This was the first time we met in-person, and we've been doing it every Friday since then." Lola continues to explain that this ritual has continued throughout the pandemic and she's formed a close friendship with her neighbor, which all started from a group message on social media. "We both look forward to this every week" explained, Lola. "It's also during a time where we need things to look forward to. And also for her, it's something to do that gets her some human interaction."

In these stories we see how moments carved out in the time of COVID-19 are chances for intimacy to be experienced in big, small, new, and reconstructed ways. Technology provides opportunities for us to experiment with intimacy and forge renewed possibilities to connect with others. Grace describes how her increased use of Zoom, and other video applications to talk to friends and family, helps her feel more in tune with people and catch up with those she usually only gets to see once or twice a year. Grace said "we've probably shared more in the past 3 months than we would have over the course of 5 years. I am forced to trust technology a little more now and I really do believe that technology enhances our relationships, it bonds us."

Still, stories of connection surface among our informants as often as stories of fatigue with technology. For instance, Patrick explains that "the longer this goes on, I think it almost draws more attention to the fact that things aren't normal. For me, it doesn't make me feel better, it brings into focus the gravity of the situation. This is what we're forced to do… and everything with technology now is kind of a reminder that our 'normal' lives will never return the same way." Lucy also continues to talk about the reality that is setting in as the pandemic continues. When we spoke in May of 2020 she said, "Now, the more I engage in video chatting the harder it's becoming. I get off the call and I am sad because I realize even more now that my physically near and physically distant relationships are happening solely through my laptop. So, eight weeks in… I am experiencing more points of grief; the mediated interactions are starting to drain me now."

Iris adds that one of the biggest lessons she's learned from the pandemic is that "technology is super limiting. It is great for being able to share small snippets of your life and it is great for having a conversation but [long pause] it will be nice when I can visit and see people again, it does not actually resolve that desire." Iris explains how technology is replacing social gatherings during COVID-19 and that is just the reality of our current situation, but the more she uses technology to talk to people, engage in virtual experiences together, seek information, and so on, the more she realizes what we cannot do through this medium. As we talk she laughs and says "you can't share food virtually" – for someone that cultivates intimacy through sharing food and cooking for others this is what she misses most. Iris said, "We can have a painting party virtually, but we can't eat the same cheese together on a piece of bread."

Through these interviews, we've learned that intimacy is an abstract, yet familiar term. Intimacy is dynamic; it happens in a lot of different places and with a lot of different people, as well as relationship types. In the age of COVID-19, we are becoming *creative* and *intentional* with how we use technology because media are the primary paths to intimacy. So, what does intimacy look like during a pandemic? We think it is still the act of sharing, supporting, and revealing the raw parts of ourselves to others. It is a reminder that we are a part of a community. It evolves beyond romantic love gestures or physical acts of connection. Intimacy is a visceral feeling. It can be sustained through technology. Intimacy and connection are imbricated across the different layers of communication technologies we, as a collective, use daily.

When asked *what the future holds,* Bella quickly offered that, "there are certain things – like virtual happy hours or movie parties that I would like to carry on since I live in a different city now than my community. I've been communicating more with friends and family that don't live nearby and I really like that." Yet Patrick countered that, "when we return to some state

of being together offline I don't think we will realize how much things have changed until it is written in the history books." Andrew reminds us "there's no replacement for personal connection, physical in-person interaction. There's no replacement for that and I think people are doing the best that they can." Luciana agrees that we cannot expect technology to replace the in-person interactions, but "we're so fortunate to have this technology" she explains, with her increased use of video calls for work and her social life right now she realizes that "it's such a different experience talking to people where you can see them, their body, their rooms and expressions, all of that, it adds to the intimacy, the connection between you and whoever you're talking to." No one has a crystal ball that allows one to look into the future. Our informants suggest that some of these rituals will stay and some will disappear. Importantly, as our informants also reveal, time will allow us to understand how this has affected us, as a collective, with greater clarity.

Indeed, a temporal paradox resurfaces as conversations on intimacy focus on the COVID condition. We are asked to adjust our routines during a time where the odds change daily, if not hourly, and insecurity is heightened. *Slow living at a fast pace* is the dominant ethic of our time. Our technologies, including our platforms, our media, our hardware but also our homes, our offices, our streets were not designed for slow living. Technology is our architecture of many forms, and it is an architecture that was designed to accommodate acceleration, multi-tasking, and a culture of expedition. Our primary platforms support transient interaction across the globe, not intimacy from a distance. Still, we find ourselves in and give ourselves comfort through structures of feeling and solidarity, facilitated through social media.

In Chicago, our home base, we used platforms to coordinate new routines of blinking our lights, honking our horns, signing and clapping together, banging surfaces to the rhythm of social solidarity. We told ourselves that we were applauding health workers, and we were, but we were also patting ourselves on the back and signaling intimacy across our balconies, windows, and spheres of solitude. We were seeking ways of performing slow living amid cities, suburbs, towns, structures, and technology that support the accelerated rhythms of times past. The pandemic is inviting us to rethink how we, as a society, understand intimacy, much like disease (cholera, in Gabriel Garcia Marquez's case) prompted previous generations to think again about love and modes of being.

So, this is not 'new' to the era of COVID-19. Communication technologies of the past have played a significant role in growing the seeds of intimacy in close relationships when distance and pandemics separated loved ones. For instance, letters have long been associated with intimacy,

viewed as a private space to communicate with close ties.[4] Writing – on a papyrus scroll, in sealed letters, through telegraph wires, or smartphone keyboards – is a way for messages to travel, and intimacy to unfold and live on as an archive of people's experiences and imagination. Writing promotes rituals of expression and discovery; and has long been a part of our culture of communication. With each of these technologies, from handwritten letters to telephone conversations, comes a new culture of communication that changes our habits and the way we think. Communication technologies are woven into the many layers of human behavior over time and just like with other historical pandemics, people have needed to distance themselves from their communities before. Thus relying on the technologies at hand to feel connected to others as they imagine their prose, hear their voice, or now see their face through a screen.

People have been intimate in moments of chaos before. People still love; they are intimate in physical, emotional, and intellectual ways. People start and end relationships, as well as experience major life and relational transitions – these do not stop because our familiar ways of life are disrupted. What COVID-19 has revealed as we reflect on our relationship with technology is the fluidity of intimacy in moments of change. The mediated nature of intimacy that is amplified by pandemic conditions. Our desire to be seen, heard, understood remains. Our technologies feast on this want and this desire. One is reminded of the prescient words of Alluquère Rosanne (Sandy) Stone (1995) well before the close of the previous century, in *The War of Desire and Technology at the Close of the Mechanical Age:*

> Electronic virtual communities represent flexible, lively, and practical adaptations to the real circumstances that confront persons seeking community ... They are part of a range of innovative solutions to the drive for sociality – a drive that can be frequently thwarted by the geographical and cultural realities of cities increasingly structured according to the needs of powerful economic interests rather than in ways that encourage and facilitate habitation and social interaction in the urban context. In this context, electronic virtual communities are complex and ingenious strategies for *survival.*[5]

Different worlds lurk behind the screen and our collective experience during this COVID crisis has magnified the liquid nature of intimacy, and the role technology plays in our relational lives as we strive for well-being

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[4] For a deeper discussion on the intimate nature of letter writing and embodied presence see Milne, E. (2003). Email and epistolary technologies: Presence, intimacy, and disembodiment. *Fibreculture, 2*(2), 1-14.

[5] Stone, A. R. (1995). *The war of desire and technology at the close of the mechanical age*. MIT press.

in moments of disruption.[6] These stories show us that intimacy is both mundane and unique, it is necessary for the human connection and something we build in ways that feel familiar and novel at the same time.

Ultimately, as the pandemic surges on we see how intimacy manifests itself in the place of technology by allowing us to share experiences and provide support. For instance, our communication devices enable us to send text messages, memes, share articles and resources, or video chat with our network. They provide a space for us to hold events virtually like a book club, concerts, or dinner parties. COVID-19 forced us to think about our social connections and intimacy differently, and in response, we are also creating new rituals for how to navigate this world. We are experimenting with how to use the technology that serves our lives right now, investing our time and energy into media that acts as a bridge between ourselves and our social networks. We are living with and through these technologies in a way that allows us to reevaluate what we want from our social connections, and to consider how technology is transforming our experiences of intimacy.

One thing is clear based on the research referenced above: We all understand intimacy in different ways, but we will use everything and anything at hand, and will creatively adapt it as we strive for intimacy. The question that remains is: Have we built a society that can support our need for intimacy, through times good and bad, slow and fast, through technology and in its absence?

FUNDING STATEMENT

REFERENCES

Márquez, G. G. (1997). Love in the time of cholera. Everyman's Library.
Stone, A. R. (1995). The war of desire and technology at the close of the
        mechanical age. MIT press.

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[6] We take inspiration from Zygmunt Bauman with the term "liquid" here. See Zygmunt, B. (2000). *Liquid modernity.* Polity Press.

THE NETWORK LIFE OF NON-BIOMEDICAL KNOWLEDGE: MAPPING VIETNAMESE TRADITIONAL MEDICINE DISCOURSES ON FACEBOOK

Dang Nguyen [a]

ABSTRACT

Traditional medicine is hugely popular throughout Southeast Asia and other parts of the world. The development of the internet and online social networks in these contexts has enabled a significant proliferation of non-biomedical knowledge and practices via platforms such as Facebook. People use Facebook to advocate for non-biomedical alternatives to unaffordable biomedicine, share family medical recipes, discuss medicinal properties of indigenous plants, buy and sell these plants, and even crowdsource disease diagnoses. This paper examines the network characteristics of, and discourses present within, three popular Vietnamese non-biomedical knowledge Facebook sites over a period of five years. These large-scale datasets are studied using social network analysis and generative statistical models for topic analysis (Latent Dirichlet allocation). Forty-nine unique topics were quantitatively identified and qualitatively interpreted. Among these topics, themes of religion and philanthropy, critical discussions of traditional medicine, and negotiations involving overseas Vietnamese were particularly notable. Although non-biomedical networks on Facebook are growing both in terms of scale and popularity, sub-network comment activities within these networks exhibit 'small world' characteristics. This suggests that social media seem to be replicating existing social dynamics that historically enable the maintenance of traditional forms of medical knowledge, rather than transforming them here.

Keywords: non-biomedical knowledge; traditional medicine; social network analysis; topic modeling; Vietnam.

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1   INTRODUCTION

This paper examines the structure and discourse of Vietnamese non-biomedical knowledge propagation on public Facebook sites and considers how the characteristics of non-biomedical networks on Facebook may differ from or resemble traditional community-based social processes. Non-biomedical knowledge is defined as "therapeutic modalities that exist in separation, but not isolation from, biomedicine" (Nguyen 2019, p. 1). Non-biomedical knowledge as a term is better equipped to capture the diversity as well as the historical continuities and discontinuities of therapeutic traditions and practices at the margin of mainstream scientific medicine (Nguyen 2019). While partially displaced by mainstream biomedicine as a unifying yet plural system propelled by the scientific enterprise, non-biomedical practices persist in forms of integration, amalgamation, hybridization, and borrowing in various contexts around the world (Singer et al 2019). In this paper, the terms non-biomedical modalities and traditional medicine (TM) are used interchangeably with the dual purpose of recognising the historical trajectories of medical practices that continue to exist outside of the scientific enterprise, while paying attention to local expressions of these non-biomedical modalities. In the Vietnamese context, the phrase y dược cổ truyền (traditional medicine) is often used to refer to the codified non-biomedical modalities examined in this paper.

Traditional medicine in Vietnam is regulated by the Ministry of Health. According to Ministry of Health statistics, about 30% of patients receive treatment with traditional medicine throughout Vietnam in a formal capacity. According to Ministry of Health statistics, about 92.7 per cent of public hospitals in Vietnam has a traditional medicine division (Hai Chau 2017). Despite comparatively high level of integration to mainstream biomedical practices, the rate of treatment with traditional medicine in Vietnamese public hospitals varies along a rural-urban divide. Treatment with traditional medicine in public hospitals, either exclusively or in combination with biomedicine, rises progressively from 4.1 per cent at the central level to 11.7 per cent at the provincial level. This rate rises to 13.4 per cent at the district level, and 28.5 per cent at the commune level (Hai Chau 2017). These statistics, however, do not include visits to private practice and treatment through informal practices. Even though it is not clear whether opting for traditional medicine would always result in lower cost of treatment compared to exclusive use of biomedicine, traditional medicine remains a popular alternative and/or complementary option in the way Vietnamese manage their experience of health and illness (Nguyen 2021a).

Traditional medical knowledge and skills have often been transferred from generation to generation orally, which in the past made it difficult to identify qualified practitioners and to systematically monitor popular discourses and protocols surrounding quality, safety, and efficacy. The large-scale propagation of traditional medical knowledge and practices via social media offers opportunities to

expand the global knowledge base about indigenous therapeutic traditions and practices while understanding how these practices are transformed by digital technologies. In resource-poor contexts, economic constraints on data collection, monitoring, processing, dissemination, and publication are often worsened by poor institutional conditions and capacities that perpetuate non-standardization, non-structured information operations, and non-transparency (Mol 2009, Feather 2013). This is especially prominent in Vietnam, and Southeast Asia more generally, where there is a continuing lack of robust knowledge databases, frequent national surveys, and national research centers (Mol 2009, Ortmann 2017). In the meantime, heavily subsidized internet access in these contexts has allowed people to perform increasingly significant parts of their everyday lives online, which as a by-product generates a large amount of standardized and structured data as well as data in the form of unstructured natural language. The analysis of these data is capable of providing unique insights into the dynamics, discourse characteristics, and networked dimensions of the emerging health ecologies that reflect the historical continuities of local and regional socio-cultural realities as they condition health experiences of the local population.

2 NETWORK SOCIALITY AND THE PROPAGATION OF VIETNAMESE MEDICAL KNOWLEDGE

2.1 Background

In 2020, 70 per cent of the population in Vietnam are using the internet – higher than the Asia-Pacific average at 53.1 per cent (Kemp, 2020; Internet World Stats, 2021). The majority of internet users in Vietnam access the internet via mobile broadband, with 74 million mobile broadband subscriptions recorded in 2020 (MIC 2020). Vietnamese are increasingly performing significant parts of their everyday lives online; the average daily time spent on the internet is six and a half hours, 2.22 of which are spent on Facebook (Kemp, 2020). Facebook is the third most popular website in Vietnam after Google and YouTube, and is the most popular social media platform in the country (Kemp, 2020). There are around 61 million Facebook users in Vietnam (out of the population of over 96 million people) in 2020, making Vietnam the seventh-largest market for Facebook worldwide (Kemp, 2020; We Are Social, 2020). This intense participation in digital modes of sociality is having significant impacts on the way Vietnamese seek, construct, produce, and consume information about their social world.

2.2 Network sociality and Actor-Network Theory

The changing nature of sociality against the background of modern economic and technological development is a rigorously theorized issue in academic literature. Wittel (2001), for example, speaks of a 'network sociality' in late capitalism wherein

social relations are informational rather than narrational. Characterized not by a sense of common history or community but rather a logic of data exchange and 'catching up', network sociality is fleeting and transient, ephemeral but intense encounters of iterative social relations (Wittell 2001, p.51). Arguing that network sociality is emerging alongside and sometimes displacing community-based sociality, Wittel (2001) draws on Castells' preceding body of works on the network society (Castells 1996, 1997, 1998) to elaborate how network sociality is becoming increasingly formalized and institutionalized, while at the same time promoting the commodification of social relationships (Zuboff 2019). In his influential Actor-Network Theory (ANT), Latour (2005) on the other hand, asks us to rethink the 'social' as bundles of ties that can be mobilized to account for some other phenomenon; it is only through following the 'actors' who interact with each other while leaving behind traces of network among themselves that the 'social' can properly be assembled. In other words, from a Latourian view, the social and network are one and the same: the social is never fixed, and there does not exist a social world outside of networks of relations among actors. Latour calls this the actor-network – whose existence ceases as soon as the actors involved stop performing the interactions that characterize their relations. Sociality, as theorized from the ANT point of view, is therefore always dynamic, contingent, and momentary. This sociality is also all-inclusive: the actors involved in the assembling of actor-network also include objects, whose agency equals that of human actors. From this perspective, Vietnamese internet users, their mobile phones, their personal computers, social media platforms, and the information they create and share on these platforms are all actors and actants in a dynamic network of sociality. This network can constantly be assembled and disassembled as the actors traverse through their connections and disconnections.

In drawing extensively from the vocabulary of ANT, which qualifies humans and non-humans as actants, this paper attends to the hybrid sociality that is inclusive, but not made of, network traces in the form of standardized platform data (e.g. Facebook metrics such as posts, comments, reacts, shares, and so on). As such, platform data are understood as visible traces that are not the whole, but only part of the hybrid sociality that network actors are forging through their participation on platforms such as Facebook. This is particularly useful if we want to understand how network sociality can materialize over and beyond these highly structured traces of platform data as measures internally constructed for platform administrative purposes, which prescribe sociality through design (Wu & Taneja 2020). Assembling the networks that can be constructed from platform data is the first step towards reassembling their hybrid sociality through systematically examining what is being exchanged on these networks. Here, the role of ANT is not to offer interpretation, but to assemble traces into descriptions or accounts (Latour 2005). ANT views sociality not only on the level of association between humans and non-humans, but from a dynamic of interaction between entities and categories, which produces social effects (Latour 2005). In this sense, ANT is not

a 'social theory' but an adaptable, open repository (Mol 2010); it is a way to "attune to different events and situations" (Mol 2010, p. 259), where different "networks", simultaneously interdependent and in tension, coexist.

This shift to a 'network sociality' might have important implications for the propagation of traditional medical knowledge in contexts such as Vietnam. Historically, Vietnamese non-biomedical knowledge has been passed down from generation to generation through oral traditions and written recipes that are kept within the family, or sold to those in need – both by healers and specialists as well as petty traders (Monnais et al 2011, Wahlberg 2006). Thompson (2017a) investigated the gia truyền (most literally 'family transmission') genre of medical texts in Vietnam and found that these texts were often written anonymously, which is reflective of not only the practice of communal authorship but also a community that can produce such texts as 'familial'. A 'medical family' (thuốc gia truyền) is a family in which for more than one generation some of the members of the family, both men and women, were known as healers. An important social distinction is made, however, between physicians who were literati and who happened to be interested in medicine, healers who come from 'medical families', and those who earn a majority of their livelihood from medicine or pharmacy (Thompson 2017a). As such, there exists a hierarchy of traditional medical knowledges in Vietnam that maps onto different socioeconomic classes. These classes in turn form quite distinct, although sometimes overlapping communities, consisting of medical practitioners of different kinds, those who seek them out for therapeutic relief, and those who pass on these knowledges within their immediate networks.

2.3   Non-biomedical knowledge in the Vietnamese context

Throughout history, knowledges produced by these different social classes received different levels of marginalization under French colonialism and through competition from the more 'learned' and established Chinese medical traditions. Thuốc Bắc (Northern medicine), for example, is commonly associated with the literati class and is heavily influenced by Chinese medicine, whereas thuốc Nam (Southern medicine) is commonly associated with medical families (Monnais et al 2011). Those who make a living by scouting, growing, collecting, prescribing, and selling raw medicinal plants also contribute to this knowledge ecosystem with their own interpretations and revisions of family recipes through direct interaction with patients as well as experience with local flora and fauna. The propagation of these knowledges throughout history has followed flexible patterns and structures that enabled composition, retention, reperformance, as well as constant revision. These knowledges fulfil clear and immediate functions for communities that maintain them – namely managing illnesses and preserving health – through their ability to vary and respond to different circumstances. Weak ties among traditional medicine groups on Facebook, for example, provide various types of social support, including informational, emotional, tangible, esteem, and network support (Nguyen 2021a).

The adoption and domestication of livestreaming technologies on Facebook among emergent non-biomedical therapeutic practices also create alternative temporal spaces for them to thrive at the margin of scientific biomedical practices and at the centre of everyday life (Nguyen 2021b).

What is not known, however, is whether the democratization of these knowledges through decentralized propagation on social media has changed the very fabric of their sociality: whether new crossovers and contacts are being forged as a result of intensified and increasingly visible flows of these historically marginalized knowledges. What also remains unknown is the content of knowledges being exchanged on these sites, as well as its associated discourses. Given that social media have their own agency, to follow Latour's line of thinking, it is worth asking whether new forms and expressions of knowledge are being created on these sites. These unknowns may be addressed in this way:

RQ1: What are the network characteristics of Vietnamese non-biomedical sites on Facebook?

RQ2: What types of non-biomedical knowledge discourses are present within these sites?

3 METHODS

3.1 Methodological choices and motivation

This paper uses social network analysis (SNA) and machine learning techniques (particularly natural language processing and topic modeling) to answer the two research questions. SNA is both a set of theoretical perspectives and analytic techniques used to examine how exchanges between individual units both shape, and are shaped by, the larger context in which those two individual units are embedded (Carolan 2016). SNA assumes an emphasis on relations among individuals and not their individual attributes, with a particular focus on individuals not as members of discreet groups but rather as members of overlapping networks (Marin & Wellman 2011, Carolan 2016). Formal network measures provide a rigorous language with which to discern network properties and make sense of the way non-biomedical knowledge propagates on internet environments (Hanneman & Riddle 2016).

Machine learning techniques, particularly that of an unsupervised nature such as Latent-Dirichlet Allocation (LDA), allow for the statistically-driven uncovering of topics 'hidden' in the dataset under the assumption that underlying topics match with the probabilistic distribution of words over a set vocabulary (Blei et al 2003, Blei and Mcauliffe 2007). These techniques allow for robust and automated discovery of a large corpus, which is useful for the current context. Subsequent interpretation and labeling of the topics discovered by this automated process are

conducted by the researcher, which ensures that these topics are meaningful according to human evaluation standard.

3.2 Site selection strategy

This study was reviewed and approved by the Human Ethics Sub-Committees (HESC) at The University of Melbourne (Ethics ID: 1852471). The selected sites were purposively sampled from an automated list of 1900 Vietnamese non-biomedical health groups and pages on Facebook, based on three criteria: (i) popularity, measured in number of active participants, (ii) activity, measured in number of posts per week, and (iii) privacy settings, in that only public sites with fully public content are selected. Criteria i and ii ensure the sites sampled are active rather than abandoned sites (Hether et al 2016, Smith & Graham 2019). Criterion iii ensures that automatic collection of textual data does not violate participants' privacy; informed consent was not sought because participants were engaged in a public discussion and no personally identifiable information was collected. These criteria are also consistent with what van Dijck and Poell (2013) theorize as the four grounding principles of social media logic: programmability (the mutual layering of technological features and human agency in shaping platform usage), popularity (the algorithmic and socioeconomic conditioning of influence and importance), connectivity (socio-technical affordances of the platform apparatus that mediate user activity), and datafication (the ability of network platforms to render into data aspects of life that were not quantified before). Only sites with over 30,000 members and a posting frequency of over 10 posts per day were selected for the sample. The automated list was generated by automating searches using the search function on Facebook with 21 different keywords. Table 1 provides descriptive statistics of the sampled sites.

Table 1. Descriptive statistics of sampled sites (as of August 2019)

Site	Number of members	Number of posts	Number of comments	Number of 'reacts'	Number of 'shares'
Site 1 Good traditional medical recipes (*Các bài thuốc dân gian hay*)	38,744	3,940	16,459	55,511	13,921
Site 2 Southern medicinal plants and family recipes (*Cây thuốc nam và những bài thuốc gia truyền*)	82,008	2,983	6,874	36,159	69,120
Site 3 Your wise medical cabinet (*Tủ thuốc thông thái*)	45,829	1,034	17,699	94	29
Total	166,581	7,957	41,032	91,764	83,070

Facebook has been chosen as the platform in focus, despite changes to the Graph API in 2016 following the Cambridge Analytica scandal (Albright 2018), as it remains the most popular social network site in the world and remains the fastest growing platform in Vietnam and Southeast Asia (Kemp 2019a). Facebook is the most popular social network site in Vietnam, and Vietnam is Facebook's seventh-largest market worldwide (Kemp 2019b).

The sites sampled here are public sites where membership is not moderated, as opposed to moderated membership where applicants are required to answer a set of questions to gain access approval from site administrators. As such, gatekeeping within these sites is minimal. Sites 1 and 2 are more similar to each other than they are to Site 3 in that they are both sites built exclusively around promoting and sharing Vietnamese traditional medical recipes. Site 1 centers on the sharing of traditional Vietnamese medicine in general, while Site 2 is focused on Southern medicine and family recipes. Site 3 has an explicit anti-biomedicine philosophy; the site description outlines its advocacy against over-reliance on biomedicine as an expensive therapeutic option. Each of these sites corresponds to a different existing knowledge paradigm that characterizes the diversity of non-biomedical practices in Vietnam. Together, these sites are the top active sites for the exchange of non-biomedical knowledge on Facebook in Vietnam.

3.3 Data collection and network generation

Data were collected with a purpose-built web scraper. The scraper utilizes the Puppeteer library developed by Google to collect publicly available data via the Chrome web browser. The scraper collected all text content on original posts and their associated comments over five years, from 19 August 2014 to 19 August 2019. As shown in Table 1, the dataset contains 7,957 unique posts and 41,032 comments, representing the activities of 166,581 unique members. Table 1 also includes the total number of 'shares' across all posts for each of the three public sites. A 'share' means that a viewer of a post has shared the post and any associated links within their personal network. All together for this dataset, posts were shared over 80,000 times. A 'react' on Facebook is an emotional response that takes on one out of six available emotional reactions, signified by six distinct emojis. Due to the limits of non-API scraping, finer data for the 'react' construct are not available. There were altogether 91,764 reacts in this dataset.

Table 2. Descriptive statistics for constructed co-commenting networks

Site	Nodes	Edges	Density
1	3560	10208	0.000805
2	2783	5136	0.000663
3	5475	12137	0.000405

Although site 3 has a significant number of members and a high count of commenting activity, their 'React' and 'Share' metrics are significantly lower than sites 1 and 2. This peculiar dynamic could be due to the nature of site 3 as a consumer movement site; while the positive framing of knowledge propagation found in sites 1 and 2 might entice more affective engagement and sharing behavior, the negative framing of site 3 (anti-biomedicine) might limit these forms of engagement. Table 2 provides descriptive statistics for the co-commenting networks constructed from the data collected, with density measuring the prevalence of dyadic linkage or direct tie within a social network (Frey 2018). The index of network density is expressed as the ratio of observed ties (edges) to all possible pairwise ties in a network, whose value ranges between 0 and 1. It can be interpreted as the proportion of potential ties that are actually present (Frey 2018).

4   RESULTS

4.1   Network analysis

From the data collected, undirected co-commenting activity networks were constructed for each site, wherein nodes represent unique users and edges represent comments. An undirected edge is created if users co-commented on any posts; a low bar is therefore set for creating a relationship between users (Smith & Graham 2019). Two users are connected if they have both commented on the same post within the five-year time period. This construction adapted the methods proposed by Graham and Ackland (2016), as data on 'Reacts' and 'Shares' could not be collected with the current non-API scraper. Figure 1 illustrates the structure of the networks constructed, wherein the thickness of the edges represents the weight value associated with the frequency of co-commenting between users.
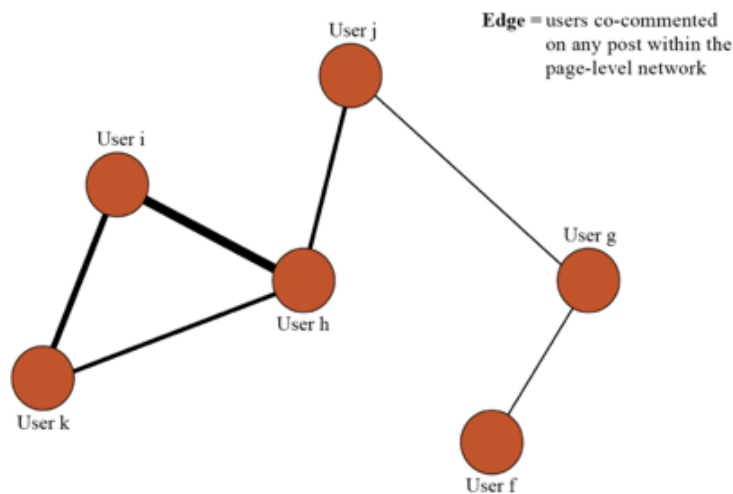

Figure 1: Structure of the constructed Facebook co-commenting activity network (adapted from Smith & Graham 2019)

User comment networks provide a more fine-grained understanding of the structure and nature of user interactivity on Vietnamese non-biomedical knowledge sites, even though Facebook does not directly provide this type of data. Comments are individually composed as open-text and as such represent a novel contribution and extension to discussion, as compared to a reproduction of a previous contribution through reacting or sharing. Comments also contribute differently to the propagation of non-biomedical knowledge on Facebook, as users often read each other's comments, interpret and learn from them, as well as engage in discourse by posting their own comments (Smith & Graham 2019). Within online health contexts, users actively seek and provide various types of social support through interacting with each other via the interface of social media platforms (Hether et al 2016, Nguyen 2021a). As such, these networks provide interesting insights into user (co)participation and discourse dynamics not only within each site, but also across these sites as an aggregate network. Figure 2 presents a sample discussion thread from the dataset.

Text translation:
Post content: "I used to have sinusitis and I had it cured by southern medicine plants. Now I want to share to anyone that needs it. My only hope is that everyone will no longer be sick and be happy: Buy a big bottle of saline solution then perform nose washing by tilting your head to one side. Pumping the solution into one nostril until the solution and nasal fluid flow to the other one (please also consult Youtube) then do the same with the other nostril 🍀🍀🍀. Once it's clean, pound the green manure leaves to get its extract and pump it into your nose. I guarantee it will be gone after around one week. And you can maintain for two to three weeks for it to be completely gone. 🌸🌸🌸🌸 Thanks for reading 🌺🌺🌺 Good luck.";
Comment 1:"But this is Siam weed";
Comment 2: "This person is a treasure… They are giving medical help without asking for anything return… Namo amitabud.")

Figure 2: Sample Facebook thread from the dataset (usernames are hidden)

Although a large number of users are members of these sites, only a small portion of users participated in the form of commenting regularly. As Table 3 shows, a majority of users only commented on a post once or twice over a five-year period, which constitutes a highly skewed out-degree distribution. Only a small subset of

users within each site contributes in terms of posting content and commenting frequently, and there is a 'long tail' of users who are very infrequent in their commenting activity. This finding is similar to what Smith and Graham (2019) found in their study of anti-vaccination Facebook groups in Australia – where 'transient users', whose participation in anti-vaccination Facebook sites is few and far between – also dominated their sample. This could be indicative of larger trends in user participation on Facebook within health-related groups across different contexts, although further research is needed to examine these dynamics.

Table 3. Out-degree distribution of user activity by site-level network

Network	Number of users who commented twice or less	Percentage of total activity within network
Site 1	2082	55.24%
Site 2	1606	54.66%
Site 3	3904	70.64%

On an aggregate network level, it is of interest to examine whether users who participate in one site-level network also participate in other sites within the sample. Perhaps quite surprisingly, the percentage of cross-participation within the selected sites is very low (see Table 4). In each pair of the site-level network, cross-participation is below one per cent, with a particularly low cross-participation rate between sites 2 and 3. As such, not only does site 3 have a very low affective engagement rate ('Reacts') and sharing behavior within the site itself, its members also do not seem to engage in the other most popular non-biomedical knowledge sites. Contrasting this against the high intensity of discussion that happens within the site (high counts of comments and posts), it seems that non-biomedical knowledge groups that rely on an anti-biomedicine philosophy could be exhibiting cult-like behavior, in the sense that content is frequently discussed within, but not does not propagate outside of, the group. This implies a sense of insularity that does not benefit knowledge exchange among the examined groups. However, overall low cross-participation rates across the sampled sites are again consistent with what Smith and Graham (2019) have found in their anti-vaccination study. This further supports the observation of the 'transient user' on Facebook, wherein users 'pass by' discursive groups without investing in maintaining discursive relationships or coordinating different discourses across groups.

Table 4. Percentage of user participation across pairs of site-level networks

	Site 1	Site 2	Site 3
Site 1	100%	0.83%	0.46%
Site 2	0.83%	100%	0.06%
Site 3	0.46%	0.06%	100%

Considering that each network from the sampled sites remains largely separate from each other, it is worthwhile to further examine whether these networks exhibit the properties of 'small world' networks (Watts & Strogatz 1998). Small world networks are network structures that are both highly locally clustered and have a short path length – two network characteristics that are usually divergent (Watts 1999). Small world networks are interesting for many reasons. For example, small world networks enable infectious diseases to spread much more quickly and easily than other types of networks, as the dynamics of the network is an 'explicit function of structure' (Watts & Strogatz, 1998, p. 441). Empirical research has also shown that the more a network exhibits characteristics of a small world, the more connected actors are to each other and connected by persons who know each other well through past interactions, or through having had past interactions with common third parties (Uzzi & Spiro 2005). These conditions allow information circulated in separate clusters to also circulate to other clusters, and to gain the credibility that unfamiliar materials require to be regarded as valuable in new contexts and subsequently used by other members of other clusters (Uzzi & Spiro 2005). Small world networks are also interesting because they are robust and resistant to damage, in the sense that randomly removing nodes from the network will not significantly impact the effectiveness and dynamics of the network (Smith & Graham 2019). The small-world phenomenon is not only common in sparse networks with many vertices, as even a tiny fraction of short cuts would suffice. Research has demonstrated that it is common in biological, social and artificial systems (Watts & Strogatz 1998, Uzzi et al 2007, Telesford et al 2011, Bassett et al 2017, Opsahl et al 2017, Smith & Graham 2019).

Two methods were used to assess whether the three co-commenting networks are 'small worlds'. The first approach follows the conditions set in Watts & Strogatz (1998), where a network is considered small world if (1) its average local clustering coefficient is much greater than a random network generated from the same set of vertices and (2) the mean shortest path length of the network is approximately the same as the associated random network. To do this, I calculated the average local clustering coefficient and mean shortest path length for the three networks studied here, and compared these metrics against those of three randomly generated networks with the same number of edge sets. I generated these three random networks using the Erdős-Rényi model implementation in the 'igraph' R package (Csardi & Nepusz, 2006). The second approach employs Humphries & Gurney (2008)'s small-worldness index, where the index is calculated as transitivity (normalized by the random transitivity) over the average shortest path length (normalized by the random average shortest path length). Transitivity, an alternative definition of network clustering, is understood as the propensity for two neighbors of a network node also to be neighbors of one another (Newman et al 2000, Newman 2009). Using the 'qgraph' R package (Epskamp et al 2019), the average of the same indices was calculated on 1000 random networks for each co-commenting network. A network can be said to be 'small world' if its small world

index is higher than one; a stricter rule requires the index to be higher than three (Humphries & Gurney, 2008). Results are presented in Table 5, where all three networks satisfy the conditions in both approaches to be small worlds.

Table 5. 'Small world' metrics for user co-comment networks vs. random graphs (bolded in brackets) and small-worldness index (Humphries & Gurney 2008)

Network	Average local clustering coefficient	Average shortest path length	Small-worldness index
Site 1	0.0214 (**0.0018**)	4.414 (**4.871**)	3.353
Site 2	0.0058 (**0.0014**)	5.525 (**6.152**)	9.689
Site 3	0.0099 (**0.0007**)	4.316 (**5.933**)	9.704

4.2 Text analysis and topic modeling

In order to understand the nature of discourse on these networks, topic modeling was performed on the complete set of textual data collected, including original posts and their associated comments, across all three sites. Probabilistic topic modeling allows for efficient and reproducible analysis of large amounts of textual data without requiring prior annotations or labeling of the textual corpus; topics that emerge from this analysis are determined through the co-occurrence of words and the themes they carry within the texts (Blei 2012). The analysis was carried out using the LDA method (Blei et al 2003, Blei and Mcauliffe 2007), an established generative statistical topic modeling method within the social sciences (DiMaggio 2015). LDA defines a topic as a distribution over a fixed vocabulary; it assumes that topics are specified before textual data are generated (Blei 2012). This method formalizes the intuition that there exists hidden topics within set texts, and that these hidden topics can be inferred through examining words that appear with particular probabilities. The utility of topic models lies in the property that the hidden structures inferred resembles the thematic structure of the dataset (Blei 2012).
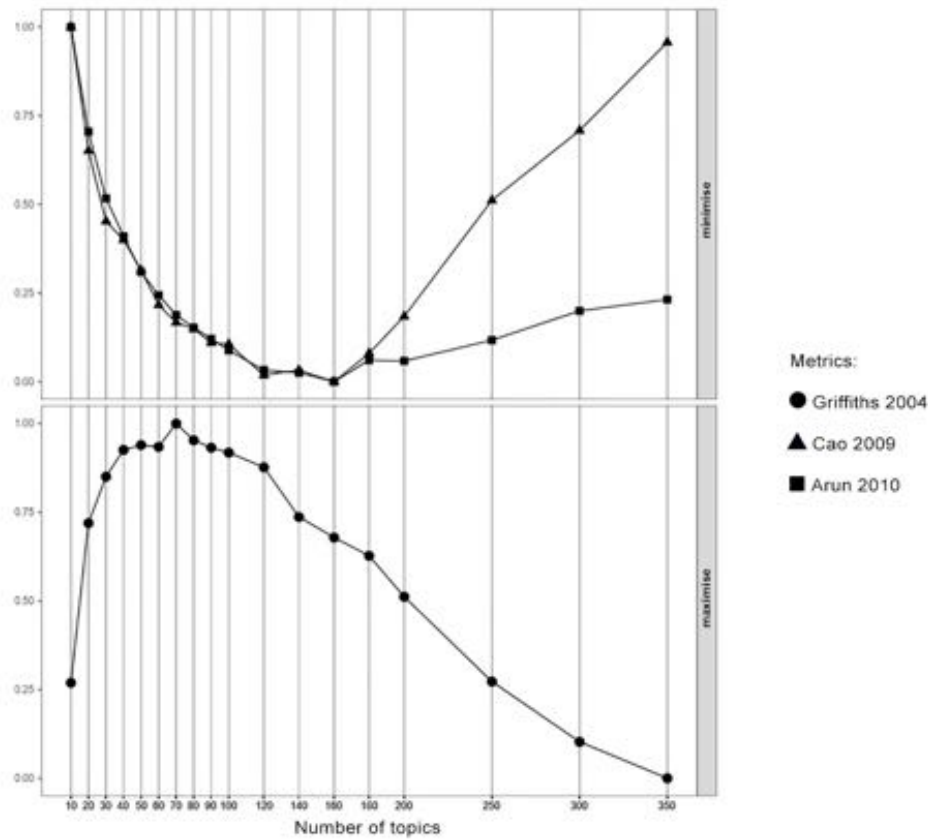
Figure 3. Computed metrics and estimated k number of topics using the 'ldatuning' R package

To prepare the corpus for LDA, a natural language processing annotation pipeline specific to the Vietnamese language was used to segment individual words and tag them with the appropriate part-of-speech (Vu et al 2018). The analysis was then conducted on 469,388 noun terms such as 'cancer', 'monk fruit', 'hibiscus', that occur in at least 80 per cent of 25,356 discussion threads in the dataset. The rationale behind this method is based on the observation that, within this dataset, discussions usually involve support seeking and provision (i.e. people naming a disease or condition to seek out names of medicinal plants or ingredients that supposedly help with said disease or condition). As such, disease names and names of medicinal plants or ingredients that appear alongside each other in the same discussion threads with high frequency could indicate popular non-biomedical therapeutic beliefs and practices. Specifying the LDA model consists of three steps: (1) draw k topics from a symmetric Dirichlet distribution, (2) for each document d, draw topic proportions from a symmetric Dirichlet distribution, and (3) for each word n in each document d, draw a topic assignment from the topic proportions and draw the word from a multinomial probability distribution conditioned on the topic (Grün & Hornik 2011). There are many approaches to choosing k number of topics, such as perplexity (Blei et al. 2003), marginal likelihood (Griffiths &

Steyvers 2004), density (Cao et al 2009), and symmetric Kullback–Leibler divergence (Arun et al 2010). No one approach is currently considered the standard; researchers working with LDA often choose the method most appropriate with the nature of their data (Smith & Graham 2019). To ensure rigorous k selection, I calculated all four metrics using the 'ldatuning' and 'topicmodels' R packages (Nikita 2016, Grün & Hornik 2011). Figures 3 and 4 plot the results of these metrics. Figure 3 indicates that the best number of topics lies somewhere in the range between 70 – 160, while Figure 4 indicates that the range is between 60 – 80. It is documented that Cao et al (2009) and Arun et al (2010) metrics tend to overfit the data (Hou-Liu 2018, Gerlach et al 2018). Marginal likelihood (Griffiths & Steyvers 2004) has been widely used as a measure to specify k on large-scale social media datasets across different languages and health topics, where the topic candidate with the highest likelihood value is considered the best fit (Paul & Dretze 2012, Ma et al 2016, Zhao 2018, Liebeskind & Liebeskind 2018, Rissola et al 2019). Perplexity is often used alongside marginal likelihood as a method of cross-validating k selection, where lower perplexity is considered better fit (Hoang 2015). Based on these analyses, k topic is selected at 70.

To validate the topic model fitted to the current data, Maier et al (2018) suggested employing 'systematically structured combinations of existing metrics and in-depth investigation to boost the significance of the validation process' (p.97). They devised a three-step process to operationalize this: summarizing the most important quantitative information from the model, outlining exclusion strategies for uninterpretable topics, and close reading of the data and labeling of topic.

Maier et al (2018) proposed the use of four particular metrics: rank-1 metric (Evans 2014), coherence (Mimno et al 2011), relevance (Sievert & Shirley 2014), and the Hirschman-Herfindahl Index (HHI). Rank-1 metric is useful for helping identify background topics. Coherence score, when applied to single topics, can help guide intuition in interpretation. Relevance score can help reorder the top words of a topic by considering their overall corpus frequency through manipulating the weighting parameter λ, with best interpretability of topics using a λ-value close to 0.6 (Sievert & Shirley 2014). Finally, HHI = 1 signifies maximum concentration (the topic is pronounced by only one source) and a very low HHI value, conversely, indicates that a topic can be found in many sources. HHI, while useful in Maier et al (2018)'s specific dataset which tracks the hyperlink network of over 300,000 websites, is not useful to the current Facebook dataset. HHI is therefore not calculated here. A sample summary statistic of these metrics is included in Appendix 2.
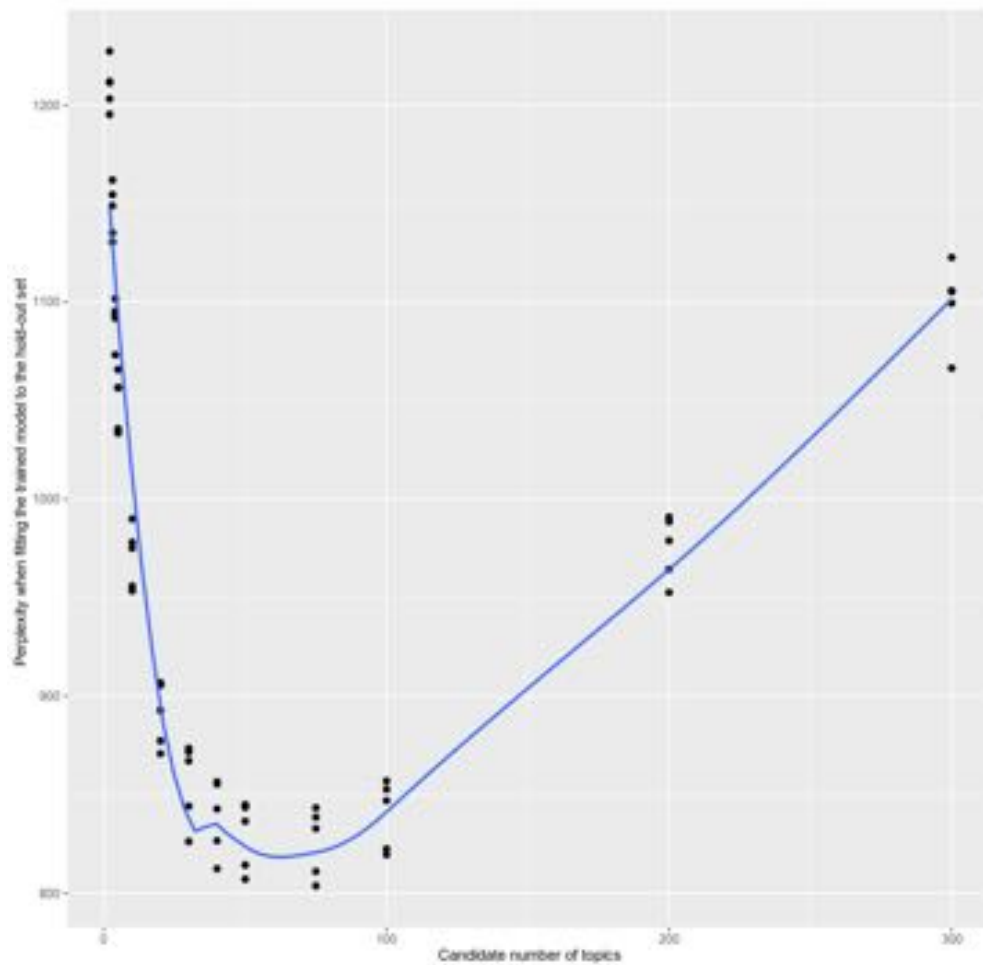
Figure 4. Computed perplexity and estimated k number of topics using the 'topicmodel' R package

Of the 70 topics generated, there were 17 overlapping topics (i.e. topic 2 appearing 17 times in the results). Only four topics include mostly 'junk' terms such as 'shhh', 'kkkkk', 'hehehehe' – which are words that were not interpretable in relation to others in the topic. These terms are generally considered to be an artifact of social media data and the phatic nature of online communication, which is commonly encountered (Smith & Graham 2019). These four topics, which contain mostly 'junk terms', are also excluded from analysis. From this filtering process, there are 49 topics that are eligible for analysis. The most representative threads containing each identified topic was retrieved; a close reading of each thread was then conducted manually to ensure that the topic labeling is reflective of the underlying topic by human evaluation standard. This is an indispensable step as the labeling of topics should be based on the basis of broader context knowledge (Maier et al 2018). The final analysis of the remaining 49 topics is presented in Appendix 1 Table 6, together with relevant statistics.

5   DISCUSSION

Following from the analysis, it appears that Vietnamese non-biomedical networks on Facebook are quite sparse: they do not seem to function as close-knit communities of knowledge exchange and support, where participants interact in a sustained fashion over time. The nature of this social exchange pattern diverges from how traditional medical knowledge has historically been passed down from generation to generation in Vietnam, which relied on upholding, and sometimes gatekeeping, closed therapy communities. This does not mean, however, that traditional medical knowledge is being 'democratized' as such. There is very little cross-pollination of knowledge sharing among the three sampled sites; people who participate in one site are not likely to also participate in others. Considering that each of these sites was organized around a different therapeutic regime (Southern medicine vs. 'Traditional' Northern medicine) with different philosophical outlooks (consumer advocacy vs. agenda-free knowledge sharing), the analysis seems to be suggesting that existing boundaries among different 'traditions' are being replicated online. This pattern is similar to the behavior of, for example, Australian anti-vaccination pages on Facebook, where cross-group participation is also not prevalent (Smith & Graham 2019). More research examining this emerging dynamic of Facebook groups and pages is warranted, especially against the context of Facebook redesigning its interface to prioritize interest-based group and community interactions to mitigate uses of the platform merely as an 'address book' (Statt 2019).

The lack of coordination across these sites might also have deeper roots in existing social mechanisms that maintain the propagation of traditional medical knowledge. Craig (2002) noted how the legacy of Vietnamese family health knowledge and practice, transmitted in its most durable forms through oral traditions and written recipes, is located within the household level where it is readily put to use. Since this locates the primary caregiving responsibility within the family unit rather than with professionals and institutions or online strangers, the logic that drives the propagation of non-biomedical knowledge is that of use-value: that people seek traditional medical knowledges in times of sickness and share them mostly in response to those in need in a transactional fashion. Unsolicited sharing of recipes and knowledges, when it happens, also seems to be grounded in collectively imagined boundaries between various undercurrents of TM. The lack of cross-pollination among different 'traditions' and consumer movements – Southern medicine vs. Northern medicine vs. Anti-biomedicine – seems to be replicating itself online, where people engage in rather insular and separate networks that map onto existing knowledge paradigms that are anchored in well-established everyday practices.

Despite the lack of interaction across different sites, network activities within the sites themselves are quite robust and resistant to change. All three networks exhibit 'small world' characteristics – which structurally enables quick and

easy propagation of information. It is in this regard that Vietnamese non-biomedical networks resemble the characteristics of other networks on Facebook (Catanese et al 2011, Caci et al 2012, Wohlgemuth and Matache 2012, Smith & Graham 2019). This analysis contributes to the growing body of evidence of the ubiquity of small-world networks on Facebook, which could indicate that the affordances of Facebook as a platform might be shaping networks towards 'small-worldness'. If this is the case, then the growing popularity of self-contained community groups on Facebook might be fertile ground for resilient and durable discourse communities. Future research should look at the new temporalities that this mediated sociality is giving to the information and knowledge being propagated on social networking sites such as Facebook, especially with regards to rich and complex multimedia formats such as live-streaming videos and synchronous viewing of pre-recorded videos.

Following the Latourian approach to tracing the interactions and discourses left behind by actors in this knowledge network also means acknowledging the co-production of sociality and materiality (Law & Mol 1995, Latour 2005). Materials are relational effects; when we look at the social, we are also looking at the production of materiality. This materiality needs not stop at the collection of texts exchanged, photos shared, videos uploaded, or livestreams watched; the material heterogeneity of networks extends to people, medicines, money, institutions, food, traditional medicine clinics. Artifacts of this sort could embody social relations in materials more durable than those in online interactions. Durability is a relational effect; the strategies that reside within the materiality and affordances of things are contingent on durability as much as the manipulability and scale of these materials. A recipe shared as text on Facebook has a different malleability and tractability to a video instructing how to follow the same recipe, or suggestions on where to buy the necessary ingredients, or offers to send these ingredients through the mail to those who want them. Strategies or strategic loci of things are recursive and reflexive effects produced in a space where materials of different durability and manipulability join together (Law & Mol 1995). Following this, the discourse network traced here is not the end, but rather the beginning of reassembling the actor-network anew by the passage of another medium, another circulating entity (Michael 2017). The computational analyses conducted in this paper, while not addressing the materialistic conditions of the texts collected, serve as a reminder about the materiality that is already embedded in networks beyond the visible traces of data that can readily be collected as a result of platform enclosure of human behaviour (Wu & Taneja 2020).

Some cues as to how to continue this tracing can be found by looking into the discourse content existing within the networks traced. With the LDA method, 49 unique topics were identified and qualitatively labeled. The significant number of overlapping topics found within the dataset is reflective of both the nature of social networking behavior and the way TM is communicated in Vietnamese. Reposting popular and interesting content found elsewhere is common behavior on

social media (Lu et al 2014, Wang et al 2019), making frequently recurring content characteristic to social media data. LDA modeling picked up this pattern in the dataset.

Overall, the topics identified through LDA can fit under eight broad themes: managing health and illnesses (topics 2-12, 14-17, 19-20, 24-25, 28-33, 35-40, 45-49), institutionalization of TM (topic 1), origins and legitimacy (topic 23), sales (topics 3, 7, 26, 27), lifestyle (topics 6, 21, 22, 34), religion and philanthropy (topic 4), negative aspects to TM (topics 13, 18, 42), and TM and overseas Vietnamese (topics 14, 16, 44). Among these broad themes, the last three themes are probably the most interesting. A close reading of posts containing the theme of religion and philanthropy reveals that Buddhist temples remain an important locus through which people of disadvantaged socioeconomic background in Vietnam seek and receive healthcare. TM, usually in the form of raw ingredients, is also frequently distributed for free by monks who practice medicine through Buddhist temples. This is an interesting finding, as it is pointing to the informal yet significant healthcare role that religious institutions continue to play, especially in a secular, post-socialist society such as Vietnam. One of the earliest extant Vietnamese medical texts, 'Miraculous Drugs of the South' (*Nam Dược Thần Hiệu*), for example, was written by the Vietnamese Buddhist monk-physician Tuệ Tĩnh (ea. 1330 – ca. 1389). For many centuries in Vietnam and East and Southeast Asia more generally, it was common for Buddhist monks and nuns to work as healers; Buddhist contexts have continued to be the most important loci for the cross-cultural exchange of diverse currents of medicine ideas and practices concerning illness and healing (Thompson 2017b). Local traditions of Buddhist medicine represent unique hybrid combinations of cross-culturally transmitted and indigenous knowledge (Salguero 2018). In addition to the transformations happening to Buddhist medicine by means of interactions with Western colonialism, scientific ideas, and new biomedical technologies, the internet and its social media platforms are the latest actors to contribute to the evolution and persistence of these non-biomedical modalities.

Critical discussions against TM are also present on these networks. There appear to be negotiations of what constitutes legitimate uses of medicinal plants, and indeed what counts as 'medicine' through these critical discussions. For example, in one discussion, speculations on the medicinal properties of shrimp paste – a Southeast Asian fermented condiment – was criticized as nonsensical and labeled as 'country bumpkin' thinking. "Food as medicine" has long been a prominent characteristic in the East and Southeast Asian systems of medical thought, where local food cultures are inseparable from traditional therapeutic systems (Ogle et al 2003, Pieroni & Price 2006). The perceived multiple functions of edible plants and local food, however, are not immutable; as the above example shows, the medicinal functions of local food are subject to ongoing negotiation and reinterpretations as understandings about nutrition and health evolve. Future research could look into the ways in which living discourses surrounding policing

and adjudicating the boundaries between food and medicine intersect with processes of urbanization and modernization, as well as how the changing distinction between functional foods and food medicines is being played out on social media.

Finally, it appears that the discourses conducted on and through these sites are transnational in nature. *Việt Kiều*, or overseas Vietnamese, are present in these online discussions; they are distinct actors insofar as they facilitate discussion topics that are distinct from those who reside inside Vietnam. These discussions involve, among others, requests for and provision of referrals to unlicensed traditional medical practices outside of Vietnam and transnational trading of herbal ingredients through informal means. It is estimated that there are around 4.5 million Vietnamese living overseas, contributing USD15.9 billion to the Vietnamese economy annually in remittances (Minh Huy 2018). The majority of the Vietnamese diaspora left Vietnam as political and economic refugees at the end of the Vietnam War in 1975; almost half of overseas Vietnamese reside in the United States, and the majority of *Việt Kiều* live in other industrialized countries such as Japan, France, Australia, and Canada. Given that non-biomedical therapies are much more marginalized and stigmatized in these societies, future research could look at the ways in which diasporic communities navigate, with or without success, the healthcare systems of host-states while forging and maintaining links with the 'homeland' through participating in networked propagation of traditional knowledges. Beyond issues concerning the navigation of biomedical health systems, issues with transnational belonging and emergent hybrid narratives about health and illness may also manifest themselves in novel ways through these networks. Furthermore, these network connections have the potential to materialize through the increasingly dense networks of transnational mobility.

Many of the discussions involving overseas Vietnamese also involved word-of-mouth referrals to private non-biomedical practices both within and outside of Vietnam, sales of medicinal plants and deliberations of international shipment details, and negotiations of international money transfers – through both formal and informal channels. The ways in which online networks manifest themselves materially beyond digitally-enabled interactions, particularly in health contexts, warrant closer attention in future studies. It is important to note that although material and social relations might be matters of local performance, they may not 'add up' to form an overall pattern or structure (Law & Mol 1995, Latour 2005). This 'patchwork' outlook, while promising to neither tell coherent stories nor provide a complete map of actors and their connections, is faithful to material multiplicity and committed to the generalized symmetry that treats material differences not as given, but rather generated in relations themselves.

6   CONCLUSION

This paper explored the network dynamics of, and discourses present within, Vietnamese non-biomedical discussion sites on Facebook. It is among the first of its kind to combine both natural language processing and generative topic modeling techniques to explore a large-scale online dataset in the Vietnamese language; it is also among the first of its kind to explore the proverbial network life of traditional medical knowledges on the internet. While limited by the sites sampled, the analysis presented here provides a foundational and empirically driven account of online propagation of traditional knowledges. The goal was not to exhaust all possible social media content, but rather to provide a rigorous analysis and suggest future directions in an under-researched topic that could have important implications in different disciplines. Vietnamese non-biomedical knowledges are propagating on social media with mechanisms that seem to be replicating existing socially and culturally constrained boundaries of knowledge regimes, with little evidence of cross-pollination between different 'traditions' of knowledge. The open and transnational nature of social media, however, has allowed for micro (national religion and philanthropy, negotiations of meaning and legitimacy) and macro (diasporic networks of resource and care) processes to unfold with increasing visibility and reach. More comprehensive studies in different developing contexts are certainly warranted, and comparative perspectives into how different traditional and non-mainstream knowledges perform on online networks could enrich current discussions on the changing sociality and the production of materiality in the network society.

7   REFERENCES

Albright, J. (2018). The Graph API: Key Points in the Facebook and Cambridge Analytica Debacle. *Medium*. Available at https://medium.com/tow-center/the-graph-api-key-points-in-the-facebook-and-cambridge-analytica-debacle-b69fe692d747

Arun, R., Suresh, V., Madhavan, C. V., & Murthy, M. N. (2010). On finding the natural number of topics with latent dirichlet allocation: Some observations. In M.J. Zaki, J.X. Yu, B. Ravindran, V. Pudi (Eds.) *Pacific–Asia conference on*

knowledge discovery and data mining (pp. 391-402). Springer, Berlin, Heidelberg. 10.1007/978-3-642-13657-3_43

Bassett, D. S., & Bullmore, E. T. (2017). Small-world brain networks revisited. *The Neuroscientist*, *23*(5), 499-516, 10.1177/1073858416667720

Blei, D. M. (2012). Surveying a suite of algorithms that offer a solution to managing large document archives. *Communication of the ACM*, *55*(4), 77-84, 10.1145/2133806.2133826

Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet allocation. *Journal of machine Learning research*, *3*, 993-1022, 10.5555/944919.944937

Blei, D.M., Mcauliffe, J. (2007). Supervised topic models. *Neural Information Processing Systems Proceedings*. 121-128, *10.5555/2981562.2981578*

Caci, B., Cardaci, M., & Tabacchi, M. E. (2012). Facebook as a small world: a topological hypothesis. *Social Network Analysis and Mining*, *2*(2), 163-167, 10.1007/s13278-011-0042-8

Cao, J., Xia, T., Li, J., Zhang, Y., & Tang, S. (2009). A density-based method for adaptive LDA model selection. *Neurocomputing*, *72*(7-9), 1775-1781, 10.1016/j.neucom.2008.06.011

Carolan, B.V. (2016). *Social Network Analysis*. Oxford Bibliographies in Education, 10.1093/OBO/9780199756810-0167

Castells, M. (1996). *The rise of the network society*. Malden, Mass, Blackwell Publishers.

Castells, M. (1997). *Power of identity: The information age: Economy, society, and culture*: Blackwell Publishers.

Castells, M. (1998). *End of Millennium: The Information Age: Economy, Society and Culture*. Oxford and Maiden: Blackwell Publishers.

Catanese, S. A., De Meo, P., Ferrara, E., Fiumara, G., & Provetti, A. (2011, May). Crawling facebook for social network analysis purposes. In *Proceedings of the international conference on web intelligence, mining and semantics*. pp. 1-8, 10.1145/1988688.1988749

Craig, D. (2002). *Familiar medicine: Everyday health knowledge and practice in today's Vietnam*. University of Hawaii Press. USA.

Csardi, G., & Nepusz, T. (2006). The igraph software package for complex network research. *InterJournal, Complex Systems*, 1695(5), 1-9.

DiMaggio, P. (2015). Adapting computational text analysis to social science (and vice versa). *Big Data & Society*, *2*(2), 1-5, 10.1177/2053951715602908

Epskamp, S., Costantini, G., Haslbeck, J., Cramer, A. O., Waldorp, L. J., Schmittmann, V. D., & Borsboom, D. (2019). Package 'qgraph'. Available at https://cran.r-project.org/web/packages/qgraph/qgraph.pdf.

Evans, M. S. (2014). A computational approach to qualitative analysis in large textual datasets. *PloS one*, 9(2), e87908, 10.1371/journal.pone.0087908

Feather, J., 2013. *The information society: A study of continuity and change*. 6th edition. Facet publishing. London, UK.

Frey, B. (2018). *The SAGE encyclopedia of educational research, measurement, and evaluation* (Vols. 1-4). Thousand Oaks,, CA: SAGE Publications, Inc. 10.4135/9781506326139

Gerlach, M., Peixoto, T. P., & Altmann, E. G. (2018). A network approach to topic models. *Science advances*, *4*(7), eaaq1360, 10.1126/sciadv.aaq1360

Graham, T. & Ackland, R. (2016). SocialMediaLab: Tools for collecting social media data and generating networks for analysis. CRAN (The Comprehensive R Archive Network). Retrieved from https://cran.rproject.org/web/packages/SocialMediaLab/SocialMediaLab.pdf

Griffiths, T. L., & Steyvers, M. (2004). Finding scientific topics. *Proceedings of the National academy of Sciences*, 101(suppl 1), 5228-5235, 10.1073/pnas.0307752101

Grün, B. & Hornik, K. (2011). topicmodels: An R package for fitting topic models. *Journal of Statistical Software*, *40*(13), 1-30. 10.18637/jss.v040.i13

Hai Chau 2017. *Increasing the number of patients receiving traditional medicine treatments in public hospitals. People's Police Newspaper.* Retrieved from http://cand.com.vn/y-te/Tang-ty-le-kham-chua-benh-bang-y-hoc-co-truyen-430413/. Access 22 May 2021.

Hanneman, R. A. & Riddle, M. (2016). Concepts and measures for basic network analysis. In Scott, J., & Carrington, P. J. (Eds.). *The SAGE handbook of social network analysis*. EBook Central, ProQuest. 10.4135%2F9781446294413.n24

Hether, H. J., Murphy, S. T., & Valente, T. W. (2016). A social network analysis of supportive interactions on prenatal sites. *Digital health*, *2*, pp. 1-12. 10.1177/2055207616628700

Hoang, T. A. (2015). Modeling user interest and community interest in microbloggings: An integrated approach. In *Pacific–Asia Conference on Knowledge Discovery and Data Mining* (pp. 708-721). Springer, Cham. 10.1007/978-3-319-18038-0_55

Hou-Liu, J. (2018). *Benchmarking and Improving Recovery of Number of Topics in Latent Dirichlet Allocation Models*. Available at https://pdfs.semanticscholar.org/2175/aa77463e23da96281cc2fb5125e0b9de3bbd.pdf

Humphries, M. D., & Gurney, K. (2008). Network 'small-world-ness': a quantitative method for determining canonical network equivalence. *PLoS One*, 3(4), e0002051. 10.1371/journal.pone.0002051

Internet World Stats. (2021). *Internet 2021 Usage in Asia*. https://www.internetworldstats.com/stats3.htm

Kemp, S. (2020, 18 February). *Digital Vietnam: 2020*. DataReportal. https://datareportal.com/reports/digital-2020-vietnam

Kemp, S., 2019a, Digital 2019: Global Digital Overview, DataReportal, viewed 12 December 019 < https://datareportal.com/reports/digital-2019-global-digital-overview>

Kemp, S., 2019b, Digital 2019: Vietnam, DataReportal, viewed 12 December 2019 < <https://datareportal.com/reports/digital-2019-vietnam>

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*, Oxford University Press. UK.

Law, J., & Mol, A. (1995). Notes on materiality and sociality. *The sociological review*, *43*(2), 274-294. 10.1111/j.1467-954X.1995.tb00604.x

Liebeskind, C., & Liebeskind, S. (2018). Identifying Abusive Comments in Hebrew Facebook. In *2018 IEEE International Conference on the Science of Electrical Engineering in Israel (ICSEE)* (pp. 1-5). IEEE. 10.1109/ICSEE.2018.8646190

Lu, X., Yu, Z., Guo, B., & Zhou, X. (2014). Predicting the content dissemination trends by repost behavior modeling in mobile social networks. *Journal of Network and Computer Applications*, *42*, 197-207. 10.1016/j.jnca.2014.01.015

Ma, S., Zhang, C., & He, D. (2016). Document representation methods for clustering bilingual documents. In *Proceedings of the 79th ASIS&T Annual Meeting: Creating Knowledge, Enhancing Lives through Information & Technology* (p. 65). American Society for Information Science. 10.5555/3017447.3017512

Maier, D., Waldherr, A., Miltner, P., Wiedemann, G., Niekler, A., Keinert, A., Pfetscha, B., Heyerc, G., Reberd, U., Häusslerd, T., Schmid-Petrie, H. & Adam, S. (2018). Applying LDA topic modeling in communication research: Toward a valid and reliable methodology. *Communication Methods and Measures*, *12*(2-3), 93-118. 10.1080/19312458.2018.1430754

Marin, A., & Wellman, B. (2011). Social network analysis: An introduction. In J. Scott, P. J. Carrington (Eds.) *The SAGE handbook of social network analysis*, 11-25. 10.4135/9781446294413

Michael, M. (2017). *Actor-network theory: Trials, trails and translations*. SAGE. UK.

Mimno, D., Wallach, H., Talley, E., Leenders, M., & McCallum, A. (2011, July). Optimizing semantic coherence in topic models. In *Proceedings of the 2011 conference on empirical methods in natural language processing* (pp. 262-272). 10.5555/2145432.2145462

Minh Huy (2018). 'Overseas remittances to Vietnam continue increasing'. *Sai Gon Giai Phong News Online*. Available at https://m.sggpnews.org.vn/business/overseas-remittances-to-vietnam-continue-increasing-79438.html.

Ministry of Information and Communication (2020). *Report on internet statistics of Vietnam*. https://thongkeinternet.vn/jsp/trangchu/index.jsp

Mol, A. (2010). Actor-Network Theory: sensitive terms and enduring tensions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft*, 50, 253-269.

Mol, A.P., 2009. Environmental governance through information: China and Vietnam. *Singapore Journal of Tropical Geography*, *30*(1), pp.114-129. 10.1111/j.1467-9493.2008.00358.x

Monnais, L., Thompson, C. M., & Wahlberg, A. (Eds.). (2011). *Southern medicine for southern people: Vietnamese medicine in the making*. Cambridge Scholars Publishing. UK.

Newman, M. E. (2009). Random graphs with clustering. *Physical review letters*, *103*(5), 058701. 10.1103/PhysRevLett.103.058701

Newman, M. E., Moore, C., & Watts, D. J. (2000). Mean-field solution of the small-world network model. *Physical Review Letters*, *84*(14), 3201. 10.1103/PhysRevLett.84.3201

Nguyen, D. (2019). Mapping knowledge domains of non-biomedical modalities: A large-scale co-word analysis of literature 1987–2017. *Social Science & Medicine*, *233*, 1-12. 10.1016/j.socscimed.2019.05.044

Nguyen, D. (2021a). Dropping in, Helping Out: Social Support and Weak Ties on Traditional Medicine Social Networking Sites. *Howard Journal of Communications*, 1-18. 10.1080/10646175.2021.1878478

Nguyen, D. (2021b). Can't wait to feel better: Facebook Live and the recalibration of downtime in tending to the body. *Media, Culture & Society*, 10.1177/01634437211003458

Nikita, M. (2016). Package 'ldatuning': Tuning of the Latent Dirichlet Allocation Models Parameters'. r package version 1.0.0. Available at https://CRAN.R project.org/package=ldatuning

Ogle, B. M., Tuyet, H. T., Duyet, H. N., & Dung, N. N. X. (2003). Food, feed or medicine: the multiple functions of edible wild plants in Vietnam. *Economic Botany*, *57*(1), 103-117. 10.1663/0013-0001(2003)057[0103:FFOMTM]2.0.CO;2

Opsahl, T., Vernet, A., Alnuaimi, T., & George, G. (2017). Revisiting the small-world phenomenon: efficiency variation and classification of small-world networks. *Organizational Research Methods*, *20*(1), 149-173. 10.1177/1094428116675032

Ortmann S. (2017) *The Vietnamese Government and Institutional Reforms. In: Environmental Governance in Vietnam*. Palgrave Macmillan, Cham

Paul, M. J., & Dredze, M. (2012). A model for mining public health topics from Twitter. *Health*, *11*(16-16), 1.

Pieroni, A., & Price, L. (2006). *Eating and healing: traditional food as medicine*. CRC Press. USA.

Ríssola, E. A., Bahrainian, S. A., & Crestani, F. (2019). Anticipating Depression Based on Online Social Media Behaviour. In *International Conference on Flexible Query Answering Systems* (pp. 278-290). Springer, Cham. 10.1007/978-3-030-27629-4_26

Salguero, C (2018). Buddhist Medicine and Its Circulation. *Oxford Research Encyclopedia of Asian History.* Retrieved 23 May. 2021, from https://oxfordre.com/asianhistory/view/10.1093/acrefore/9780190277727.001.0001/acrefore-9780190277727-e-215.

Sievert, C., & Shirley, K. (2014, June). LDAvis: A method for visualizing and interpreting topics. In *Proceedings of the workshop on interactive language learning, visualization, and interfaces* (pp. 63-70). 10.3115/v1/W14-3110

Singer, M., Baer, H., Long, D., & Pavlotski, A. (2019). *Introducing medical anthropology: a discipline in action*. Rowman & Littlefield. USA.

Smith, N., & Graham, T. (2019). Mapping the anti-vaccination movement on Facebook. *Information, Communication & Society*, *22*(9), 1310-1327. 10.1080/1369118X.2017.1418406

Statt, N. 2019. 'Facebook is redesigning its core app around the two parts people actually like to use'. *The Verge*. Available at https://www.theverge.com/2019/4/30/18523265/facebook-events-groups-redesign-news-feed-features-f8-2019.

Telesford, Q. K., Joyce, K. E., Hayasaka, S., Burdette, J. H., & Laurienti, P. J. (2011). The ubiquity of small-world networks. *Brain connectivity*, *1*(5), 367-375. 10.1089/brain.2011.0038

Thompson, C. (2017b). 57. c. In *Buddhism and Medicine* (pp. 561-568). New York Chichester, West Sussex: Columbia University Press. 10.7312/salg17994-059

Thompson, C. M. (2017a). The implications of gia truyền: Family transmission texts, medical authors, and social class within the healing community in Vietnam. *South East Asia Research*, *25*(1), 34-46. 10.1089/brain.2011.0038

Uzzi, B., & Spiro, J. (2005). Collaboration and creativity: The small world problem. *American journal of sociology*, *111*(2), 447-504. 10.1086/432782

Uzzi, B., Amaral, L. A., & Reed-Tsochas, F. (2007). Small-world networks and management science research: A review. *European Management Review*, *4*(2), 77-91. 10.1057/palgrave.emr.1500078

Van Dijck, J., & Poell, T. (2013). Understanding social media logic. *Media and communication*, *1*(1), 2-14. 10.17645/mac.v1i1.70

Vu, T., Nguyen, D. Q., Nguyen, D. Q., Dras, M., & Johnson, M. (2018). VnCoreNLP: A Vietnamese Natural Language Processing Toolkit. *arXiv preprint arXiv:1801.01331*. 10.18653/v1/N18-5012

Wahlberg, A. (2006). Bio-politics and the promotion of traditional herbal medicine in Vietnam. *Health: An Interdisciplinary Journal for the Social Study of Health, Illness and Medicine*, *10*(2), 123-147. 10.1177/1363459306061784

Wang, W., Chen, R. R., Ou, C. X., & Ren, S. J. (2019). Media or message, which is the king in social commerce?: An empirical study of participants' intention to repost marketing messages on social media. *Computers in Human Behavior*, *93*, 176-191. 10.1016/j.chb.2018.12.007

Watts, D. J. (1999). Networks, dynamics, and the small-world phenomenon. *American Journal of Sociology*, *105*(2), 493-527. 10.1086/210318

Watts, D. J., & Strogatz, S. H. (1998). Collective dynamics of 'small world' networks. *Nature*, *393*(6684), 440-442. 10.1038/30918

We Are Social. (2020). *Digital in 2020.* https://wearesocial.com/digital-2020

Wittel, A. (2001). Toward a network sociality. *Theory, culture & society*, *18*(6), 51-76. 10.1177/026327601018006003

Wohlgemuth, J., & Matache, M. T. (2012). *Small world properties of Facebook group networks*. University of Nebraska at Omaha. ProQuest Dissertations Publishing. 10.25088/ComplexSystems.23.3.197

Wu, A. X., & Taneja, H. (2020). Platform enclosure of human behavior and its measurement: Using behavioral trace data against platform episteme. *New Media & Society*, 10.1177/1461444820933547

Zhao, Y. (2018). *An Investigation of Autism Support Groups on Facebook. Doctoral disseration*. The University of Wisconsin-Milwaukee. Available at https://dc.uwm.edu/cgi/viewcontent.cgi?article=2968&context=etd.

Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. PublicAffairs Hachette Book Group. NY, US.

APPENDIX 1

Table 6. Topics generated and their top twenty terms.

Topic	Share % M (SD)	Top twenty terms (translated)
Topic 1: TM in context of formal national healthcare	3.33 (0.67)	Limited time, Curcumin, Seniority, Ranking, Two-week period, Bcl-2 protein family, Tràng phục linh (Colitis medication), Namo amitabud, Bảo an khang (Name of insurance scheme), Cutleaf groundcherry, Sickness, Tiger bone glue, Gathering, Half portion, Short course, Corn, Dental care, Russia, Kidney stone, Geoduck
Topic 2: General principles of TM	3.84 (1.02)	Local dialect, Quality, Ease, Human organs, Equilibrium, Blood veins, Medical effects, Fruits, Human anatomy, Egg, Cashew, Selection, Alternative, Kidney, Vinegar, Good quality, Pepper, Immersion, Softness, Food dish
Topic 3: Knowledge sharing as advertising for direct sales	2.67 (0.57)	Symptom, Dragon's tongue leaf, Phlegm, Service, Human back, Tuber fleeceflower, Southern medicine, Tomorrow, Once a day, Circumstances, Plant processing, Plant scouting, Inbox, Knowledge, Medicine, Parasite, Recipe, Soda, Lymphatic system, Frequency
Topic 4: TM as religious philanthropy	3.31 (0.18)	Seafood, Frequency, Healing, Buddhist monk, Fruit, Phlegm, Basic, Consequences, Philippines, Yao people, Species, Hua Tuo, [Redacted username], Favour, Variety, Tree trunk, Plucking, [Redacted username], Sharpness
Topic 5: General childcare advice	2.21 (0.46)	Blanket, Hotness, False daisy, Homegrown, Fibraurea leaf, Table, Standard, Correction, Determination, Ground substance, Average, Seeing, Thread, Malignant hyperthermia, Chickenpox, Addiction, Childhood, Vân Hồ (a district in Sơn La, Vietnam), [Redacted username], Feces
Topic 6: TM as lifestyle	4.39 (1.04)	Blowing, Multitude, Avoidance, Shower, Tickling, Discovery, Leanness, Gypsum, Moisture, Sleep, Territory, Udumbarra flower, Backside, [Redacted usersame], [Redacted username], Atherosclerosis*, Vinegar*, Prevention, Fine meal, Miracle
Topic 7: Dietary benefits of traditional plants and call for direct sales	4.26 (1.42)	Sabah snake grass, Digestion problems, [Redacted username], Contrast, Ray, Year, Condensed, Tonsillitis, Pneumonia, Instructions, [Redacted username], Tomorrow, Soup, Red blood cell, Effectiveness, Zalo (a Vietnamese messaging application), This, Body, Gift, [Redacted username]
Topic 8: TM as dietary supplements	3.21 (0.44)	Vietnamese ginseng, Brand name, An Tôn (a former village in Vĩnh Phúc district, Thanh Hoá province), Alleviation, Negativity, Hihi, Vitamin B12, Body temperature, Sympathy, Small dots, Familiarity, Chinese mesona, Falling, Western, Fairy, Cashew, Cornea, Half portion, Intermediate, Men
Topic 9: TM as narratives	4.02 (1.32)	Medicality, Hour of the pig, Desire, 30 minutes, Publishing request, Once upon a time, Brothers and sisters, Death, Heat, Stop, Flanovoid*, Pencil cactus, Steaming, Cannabis, Seeds, Paper-thin, Medicine, Ingredients, Country, The Americas
Topic 10: TM in family health	3.75 (1.02)	Rice wine, Lightness, Eternity, Itchiness, [Redacted username], [Redacted username], Bastard children, Tropics, Warmth, Calmness, Sand, Cashew, Sweetness,

		Computer, Beauty, Menstrual cramps, Tumour, Household equipments, Substance
Topic 11: Ethnic variations in TM	1.09 (0.43)	Peeling, Gold apple, Career, Cardboard, Socks, Body part, Support, Satisfaction, Lâm Thao (a Northern province in Vietnam, also name of a fertiliser brand), [Redacted username], Solasodine*, Peony, Thuốc Nam Phong (rheumatism medication), Promotion, Noel*, Infection, Doctor Triệu Thị Thanh (a Yao doctor), Clots*, Magnesium, Zinc
Topic 12: Managing alcohol addiction	2.14 (0.98)	Wood, [Redacted username], Body, Sickness, Pearl, Retrograde ejaculation, Baldness, Darkness, Trick, Movement, Bad luck, Thuỷ Ngàn (alcohol addiction medication), Bad temper, Vitamin K, Confession, Infection, Folliculitis, Craziness, Below*, Hemorrhoids
Topic 13: Shaming uses of TM	1.30 (0.40)	Beta-Sitosterol*, Shrimp paste, Speed, Pomade, Technology, Space*, Sterculiaceae*, 6 years, Monoglucoside*, Rarity, Precipitation, Supression, News, Mood, Bookstore, Country bumpkin, Reasoning, Morning sickness, Occasionality, Belief
Topic 14: Managing mental health among overseas Vietnamese	2.23 (0.34)	America, Wormwood, Rowatinex*, Hatred, Juice, Contact, Heaviness, Thankfulness, Isothiocyanate, Insomnia, Anxiety, Kohlrabi, Rhythm, Sunglasses, Translation*, Participation, Bruises, Borrowing, Vacuum, Sickness
Topic 15: Managing smoking addiction with TM	2.36 (0.26)	Antonin Seipin* (supposedly Russian doctor), Sleep, Vontaren*, [Redacted username], Gấc seeds, Bird, Walking, Dog blood, Hunger, 70 years old, Rheumatism, Water, Spine, Chicken, Picture, Gift, Food, Thankfulness, Heaviness, Intern
Topic 16: Cardiovascular health and overseas Vietnamese	2.26 (0.42)	Dick*, [Redacted username], Kkkkkkk, Untimely diagnosis, Shred, Penis, Garden, Combination, Announcement, Contradiction, Urging, Vitality, Hole, Hematology, Acceleration, Withdrawal, Visa*, Blood veins, Good reputation, Cikan (heart health supplement)
Topic 17: Anti-infective plants and pain management	2.00 (0.48)	La Gi (small town in Bình Thuận, Southern Central Vietnam), Common Purslane, Admin, Surplus, Usefulness, Salonpas, Indigenousness, Natural antibiotics, Summer, Autumn, Aches, Flower, Catching wind, Exercise, Trần Hưng Đạo (name of a street), Mink*, Bloodline, 100k, Boil
Topic 18: Cautionary tale against misuse of TM	1.57 (1.07)	Body, Women, Buying, Asking, Extra, Wine, Strength, Usage, Cancer, Diagnosis, Death, Sugar, Men, Friend, Steambath, Weekly, Turmeric, Tea, Derris
Topic 19: Men's sexual & reproductive health	3.42 (1.44)	[Redacted username], Dry-zone mahogany bark, Expenses, Cure, Scabies, Effectiveness, [Redacted username], Researcher, Materials, Archipelago, Regret, Prevention, Amber, Gossypol*, Indian goosegrass, Testicles, Limonene*, Hygiene, Schefflera heptaphylla, Pedology
Topic 20: Food as medicine	3.84 (0.24)	Food with 'cold' properties, Fermented tofu, Money, Duck meat, Area, Cash flow, Contradiction, Sickness, Interaction, Diaper, Method, Water, Bear gallbladers, Springing, Medical practice, Pig, Mother, Reference, Honey, Hybridity
Topic 21:	2.28 (0.28)	Mushroom, PDR* (Physicians's Desk Reference), Happiness, Moment, [Redacted username], Tongue, 50

Agrarian lifestyle as healthy lifestyle		years, Buffalo, Quảng Ninh (a Northern province in Vietnam), Boil, Salt, Flies, Fullness, Applying ground leaves over wound, Shampoo, Class of plants, Fruit tree, Tea, Eating habits, Từ Sơn (a village in Bắc Ninh, a Northern province)
Topic 22: Buddhist lifestyle as healthy lifestyle	1.94 (0.12)	Suffocation, Digestion, Vegetarianism, Piper lolot leaf, Proof, Cần Thơ (a province in Southern Vietnam), Namo amitabud, Tree stump, Black bean, Studying overseas, Brain, Today, [Redacted username], The truth, Boat*, Taking medication, Storytelling, Adrenal gland, Happiness and Prosperity, Body organ
Topic 23: Discussions on the origins and originality of Vietnamese medicine	3.14 (1.73)	[Redacted username], [Redacted username], Patent, Clutching, Usage, Southern territories, [Redacted username], Better quality, Ethnic minorities, Lips, Determination, Admin approval, Destiny, Tuệ Tĩnh Đường Liên Hoa (a TM dojo in Huế, Central Vietnam), Trịnh Hoài Đức (18th century historical figure), [Redacted username], Coach bus, Malt, Pounding
Topic 24: Processes of preparing plants as medicine	1.62 (0.29)	House yard, Đống Đa (a district in Hà Nội), 6 months, Chromatophore, Purity, Daytime, Itchiness, Sleep, Nutrition, Rice wine, Oxygen, Chaff-flower, Gastrict acid, Bowl, Citizen, Fermenting and Drying, Purpose, Afternoon, Ribs, [Redacted username]
Topic 25: Emergency childcare advice	1.37 (0.43)	Tools and equipments, Baby colic, Examination, Squeezing, Amount, Inner body, Selection, Sharp pain, Binystar (baby colic medication), Liking, Roseola, Couch, Lung, Dollar, [Redacted username], [Redacted username], Alkaloid*, Statistics, Ceylon hill gooseberry, Mothers
Topic 26: Negotiating sales of medicinal plants	2.35 (0.44)	Hedyotis*, Willow bark, [Redacted username], Parasite, Personal taste, Family recipe, Blue, Middle, White, Negativity, Experience, Lingao County, Savings, Colitis, Eel, Storm, Feet, Virginity, Post office, Quality
Topic 27: Negotiating shipping methods and sales of medicinal plants	2.13 (0.72)	[Redacted username], Shade trees, Bank, 350k, Carboxymethyl cellulose, Peanut, Miracle, Flagellate, Hà Nội, Incomprehensibility, Index finger, Stemona tuberosa, Concurrence, Long Biên (a district in Hà Nội), Dear friend, Billards, Hoàng Công (coach bus brand), Square, Birds, Wrapping cloth
Topic 28: Gastroenterology health	2.62 (0.51)	Recipe, Sugar beets, Investment, [Redacted username], Business, Gastralgia, Eating*, Falling off, Country, Family recipe, Discussion, Flatulence, Macau, [Redacted username], Urination, Guava, Stinkvine, Effect, [Redacted username], Money
Topic 29: Mental health and longevity	2.00 (0.62)	Reason, 100-year-old, [Redacted username], Greetings, Finickiness, Reasoning, Well-wishing, Anolyte, Acute pain, [Redacted username], Oneself, Sending, The truth, Quảng Ninh (a Northern province in Vietnam), Bait, Costliness, Heaviness, Jokes, Spa
Topic 30: Aging and Loneliness	1.42 (0.23)	Belonging, Myself, Sesame, Animal bones, Chỉ Thống Hoàn (osteoarthritis medication), Cadmium, Diaphoretic, Drawing, Blood, Dr. Lê Minh, Viettel (a telecommunication company), Envelope, Shampoo, Ramnoza, Kangaroo, Traditional medicine street, Lipstick, Prescription, Earth, Cat

Topic 31: Old age and health	1.29 (0.39)	Produce, Virus, Grind, Ringworm, Hypertension, Quality, Pleiku (a city in the Central highlands), Food dish, Unit, Coughing, Stew, Everybody, Water pipe, My aunt, Sickness, Manhood, Items*, Pharmacist, [Redacted username], Bad temper
Topic 32: Manging the common cold with TM	2.65 (0.28)	Sky, Capture, Labour, Weight, Panax pseudoginseng, Plant family, Samurai (energy drink brand), Conclusion, [Redacted username], Acyclovir, Buying, Cupping therapy, [Redacted username], The academy, Bravery, Treasure, Majority, Master
Topic 33: Nutrition and cardiovascular health	2.05 (0.19)	Battleground, Soil, Voice, Bran, Tip*, Nun, Quality, Ease, Human organs, Equilibrium, Blood veins, Medical effects, Fruits, Human anatomy, Egg, Cashew, Selection, Alternative, Kidney, Vinegar
Topic 34: Healthy lifestyle and religious narratives	2.02 (0.44)	Winter melon detox juice, Zona, Job's tears seeds, Strawflower tea, Freshness, Observation, Dharmapala, Afternoon, Namo amitabud, Inauguration, The moon*, Fruit, Instance, Beauty, Hibiscus, Medicinality, Multitude, Mint, Adults, Share*
Topic 35: Men's health and cardiovascular health	2.03 (0.60)	Actuality, Chia seeds, Spora Lygodii, Mass communication, Positivity, Magnolia bark, Bracelet, [Redacted username], Flatulence, Sudden, [Redacted username], High endogenous testosterone, Sharing, Total occlusion, Infection, Certainty, Guava, 10kg, Water, Basic
Topic 36: Women's beauty and sexual health	1.02 (0.16)	[Redacted username], Chlorophyll, Helping, Body, Know-how, Soul, Droppers*, Counsellor, Indochinese serrow, [Redacted username], Senior Colonel, Obstetric, Tetronic acid*, Euphorbia ambovombensis, Forrest, North winds, Flabby, Secret code, Ficus*
Topic 37: Narratives of medical families and family recipes	4.01 (1.57)	Efficacy, [Redacted username], False ginseng, Familiy recipe, Household registration book, Goods, Caterpillar fungus powder, Infertility, [Redacted username], Tour*, Retaining, The passing of spring, [Redacted username], Flower, Chickrassy, Water caltrops, Listed price, Wind, Filtered water, Aches, Rice
Topic 38: Insomnia and discussion of burnout	1.37 (0.22)	Disinfection, Wooden floor, Week, Sock*, Burning pain, 'Bread and butter', Year of the Dog, [Redacted username], Virus, Inadequate sleep, Gum, [Redacted username], Jaundice, Root cause, International*, [Redacted username], Caligan*, 330mg, Willow tree, Jelly
Topic 39: Diet and women's health	3.34 (1.33)	Snake, Forgotten recipes, Multitude, Winged bean pods, Women, Coconut shell, Once upon a time, Waistline, Weight loss, Ignoring, Rice paddy herb, Hypertension, Vestibular disorders, Shellfish, Toxaemia, Đà Nẵng (a city in Central Vietnam), Salt, [Redacted username], Virgin fish sauce
Topic 40: Pregnancy advice	2.94 (0.55)	Gypsum, Choking on a fishbone, Liver, Cornea, Helicteres hirsuta Lour, Long Ju, Flatulence, Aiming, Từ Dũ (an obstetric hospital in Ho Chi Minh City), Afterhour shirts, City, Night, Manufacturer, [Redacted username], [Redacted username], Pomade, [Redacted username], Kilogram, Common cold during pregnancy, Legitimacy

Topic 41: Health and beauty tips	2.10 (0.13)	Indian goosegrass, Flower stigma, Someday, Past recipes, Sarsi, Rice paddy herbs, Skills, Member*, Gifting, Blood cockle, Five fruits, Water caltrop, Brother and sisters, Cafeine, Salt, Professional, Delivery, [Redacted username], [Redacted username], Homegrown
Topic 42: Cautionary tales against abuse of indigenous tobacco	1.41 (0.20)	Coronary artery disease, Experience, Thuốc rê (traditional rustic tobacco), [Redacted username], Eggplant, U Minh (commune in Cà Mau, Southernmost province in Vietnam), [Redacted username], Almond, Wisdom teeth, Anticipation, Miracle, Monk fruit, Asthma, Phú Thọ (province in Northern Vietnam), Vestibular disorders, Step, Gấc seeds, Positivity, Origins, Sinusitis
Topic 43: Fantastic tales about the religious and historical origins of Vietnamese medicine	2.73 (0.76)	Miniscule, Today, Baton, Annoyance, Northern Central, Ākāśagarbha (a Buddhist Bodhisattva), Regret, Đà river (Northern Vietnam), The way, [Redacted username], [Redacted username], Himalayas, Needles, Joy, Trưng sisters (ancient history women warriors), Snakehead, Time, Panadol, Accidentality, [Redacted username]
Topic 44: Traditional alternatives to biomedicine and overseas Vietnamese	1.22 (0.19)	Friend, Germany, [Redacted username], Miniscule, Dandruff, Military, Apple, Operation, Nature, Anti-inflammatory, Muscovy duck, Testicles, Timeliness, Heat, Pregnancy, Baby, mmol/L*, Oysters, [Redacted username], Multitude
Topic 45: Constipation and hot/cold binary	4.45 (0.78)	Sickness, Orchid, Loneliness, Orphan, Tightness, Extract, Sharing, Alcohol*, Goose, List, Sapodilla, Hygiene, Remainder, [Redacted username], [Redacted username], [Redacted username], Blue*, Eyedrops, Gulan*, Cooling agent, Purple heart plant
Topic 46: Northern medicine and haemostasis	4.02 (1.09)	Reduction, 50cm, Bleeding, Red beans, Pebbles, Phú Xuyên (a district in Hà Nội), Tip*, Pangolins, Pueraria thomsonii flower extract, Concurrency, Activity, Parasite, Thorns, Cover, Fish, Fungi, Health, Steaming, 1 month, Weighing scale
Topic 47: Nutritions and women's health	3.35 (1.72)	Withdrawal, Overreaction, Name, Mutuality, Aches, Mentality, Jar, Early, Long process, Infection, Sinusitis, Women, Pharmacy, Pouring, Sisters, Soaking, Time, Symptoms, Ming aralia, Crinum latifolium
Topic 48: Pain management with TM	1.78 (0.77)	Raising, Gratitude, Daisy, X-ray, Spinal disc herniation, Hospital, Phoenix eyes, Rambutan, Myself, Dry blood, Gauze, Advice, Cabbage, [Redacted name], Criticism, Quantifying, Superior grade, Poaching, Truthfulness, Sliding
Topic 49: Otolaryngology and TM	1.12 (0.07)	Photograph, Gum, Nose, Care, White, [Redacted username], Cabbage, Bone, Lemon, Buttox, Conclusion, Minority, Life, Bottle cap, Sea, Vitamin B, Children, Papaya, Belching, Hot temper

Note: Terms are translated into English where appropriate. Proper nouns (brand names, location names) are kept in Vietnamese, accompanied by explanations in brackets. Common names of plants are preferred over their scientific names, although not all plants have common names in English. Usernames are redacted to ensure anonymity. Terms that were originally written in a language other than Vietnamese are marked with "*".

APPENDIX 2

Summary statistics for the interpretation of a topic

Note: This statistic presentation is modeled after Maier et al (2018). The figure depicts a divided table and an inter-topic distance map, where the specific topic in summary is colored red. The table maps out the top-words according to two different relevance values (λ = 1 and λ = .6). Below the table, the ranks of the Rank-1 and the coherence metrics are given.

Topic 30 – Aging and loneliness

Top words	
λ = 1	λ =0.6
Sesame	Belonging
Animal bones	Myself
Prescription	Sesame
Earth	Animal bones
Belonging	Chỉ Thống Hoàn (osteoarthritis medication)
Dr. Lê Minh	Cadmium
Myself	Diaphoretic
Cat	Drawing
Envelope	Blood
Viettel	Dr. Lê Minh
Shampoo	Viettel (a telecommunication company)
Chỉ Thống Hoàn (osteoarthritis medication)	Envelope
Diaphoretic	Shampoo
Kangaroo	Ramnoza
Lipstick	Kangaroo
Cadmium	Traditional medicine street
Drawing	Lipstick
Blood	Prescription
Viettel (a telecommunication company)	Earth
Ramnoza	Cat

Rank-1 metric: rank 37 out of 70

Coherence metric: rank 23 out of 70

Inter-topic distance map (via multidimensional scaling using 'LDAvis' package)
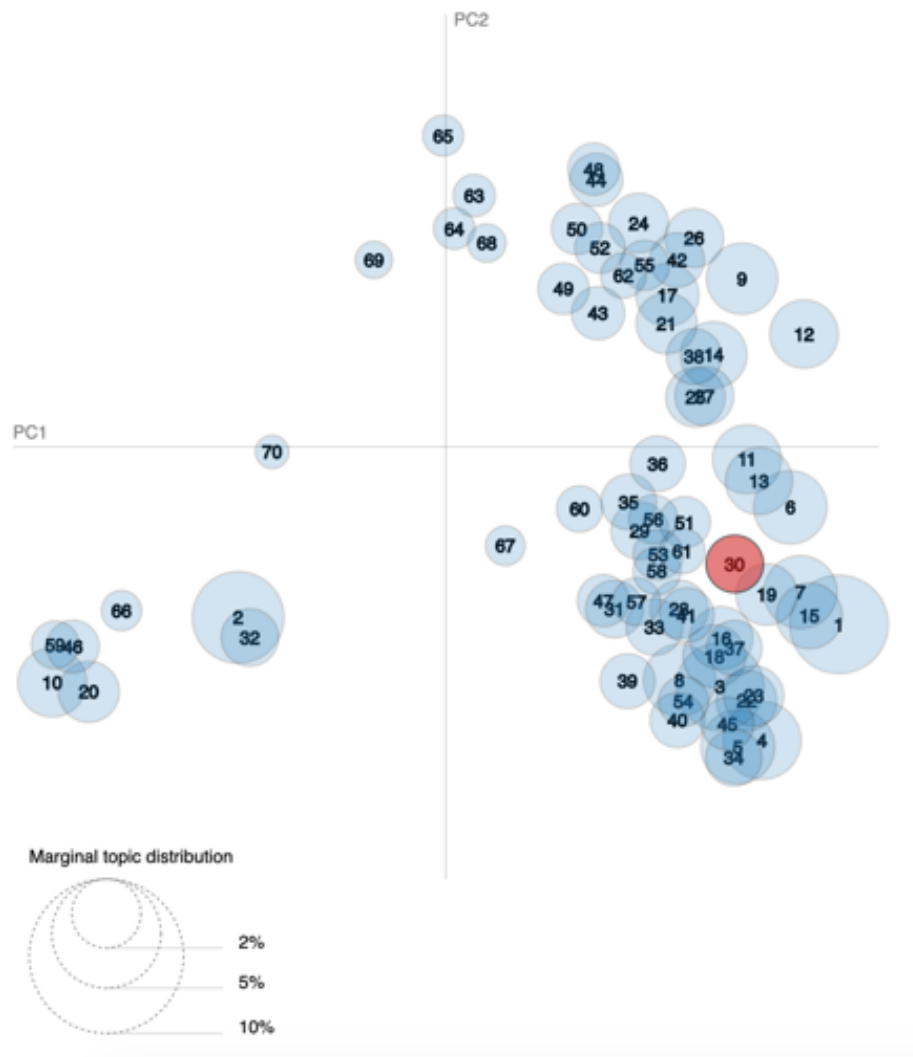
RESEARCHING DIGITAL SOCIALITY: USING WHATSAPP TO STUDY EDUCATIONAL CHANGE

Hany Zayed[a]

ABSTRACT

Digital technologies have become deeply implicated in and constitutive of contemporary social life. They are reshaping who we are and how we associate with one another, and are profoundly reconfiguring social relations, processes, and practices in a host of social spheres, particularly education. With Covid-19 further entrenching this implication and accelerating those changes, we are forced to rethink what research is and how it is done. This article presents a step towards researching a changing sociality using social media. Drawing on fieldwork on the digital transformation of Egyptian education, it argues that and showcases how WhatsApp can be systematically used as a qualitative data collection instrument to examine educational change. This article also situates WhatsApp research within digital ethnographic traditions, unpacks emergent methodological challenges and ethical quandaries, and presents potential ways to manage them. In so doing, it problematizes extant methodological categories (such as participation), entrenched dichotomies (such as private/public space), and epistemological questions (such as research temporality). Using a unique case from the Global South at an exceptional time of (educational) change, this article can help researchers as they think about their questions, design their research, conduct their fieldwork, and maneuver an elusive digital landscape. It informs broader methodological discussions within digital sociology and anthropology (of education), digital ethnography, and social media research. It also informs research in other domains like healthcare, geographies beyond the Global South, and platforms with similar affordances like Telegram.

Keywords: WhatsApp; Research; Education.

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1 INTRODUCTION: UNDERSTANDING DIGITAL SOCIALITY

"We now live in a digital society." With those words, Deborah Lupton (2015, p.2) captures how digital technologies, primarily the internet, digital devices and social media, have become intimately woven in the tapestry of society. As they become "embedded, embodied and everyday" (Hine, 2015), digital technologies are becoming unremarkable and invisible for billions tangled in an "'always on' culture of ubiquitous connectivity" (Madianou, 2017, p.105). This 'ubiquitous connectivity' has been further intensified and accelerated by Covid-19, with digital technologies framed as necessary and exulted as inevitable.

Digital technologies are becoming not only a part of who we are and how we operate but are also "transforming what it means to be social and human in the world" (Markham, 2018, p.1134). They are fundamentally penetrating social domains and activities from the most intimate to the most public, and are radically reconfiguring social relations, processes, interactions, practices, identities, institutions, and structures. For more than two decades, this reshaping of sociality – of how people associate with one another – has been at the crosshairs of scholarly theorizing. This includes Wittel's (2001) network sociality, Postill and Pink's (2012) hybrid sociality of social media, Van Dijck's (2013) platformed sociality, Ellison and boyd's (2013) social media platform sociality, and Miller and colleagues' (2016) scalability sociality. Other scholars have also been exploring the methodological implications and empirical realities of those changing socialities such as Hjorth et al. (2017), Pink et al. (2016), and Miller et al. (2016).

This "coevolution of socialities and technologies" (Kozinets, 2021, p.115) has been especially true of social media. Boasting a global population of more than four billion *active* users as of January 2021 (Statista, 2021), social media platforms are becoming a "new online layer through which people organize their lives" (Van Dijck, 2013, p.4). And nowhere is this reorganization stark as in education. Following the Covid-19 education disruptions and school closures, social media platforms have been changing what education is, transforming cultures of learning, affecting the organization and function of schools, reshaping key relations and interactions in educational communities, and impacting student behaviors and teaching practices (for example, Matzat & Vrieling, 2016; Miller et al., 2016; Robson, 2016; Van Dijck et al., 2018).

This transformation of social organization and everyday social reality also prompts us to rethink what research is and how it is done. It pushes us to return to the foundations of qualitative research, to ask not just the *how* of research but also the *why*, and to rethink fundamental

methodological categories (like field) and dichotomies (like private/public) (Markham, 2013, p.437). It also implores us not just to revamp our methodological arsenal but come up with new ways to study this novel, contingent, and unruly sociality. This transformation prompts a continuously evolving methodological bricolage whereby "research methods evolve as a complicated mixture of the new and the old" (Sandvig & Hargittai, 2016, p.24).

This article presents a methodological intervention towards understanding a changing digital sociality in educational settings. Drawing on fifteen-months of fieldwork on the digital transformation of Egyptian secondary education, this article argues that and showcases how WhatsApp can be systematically used as an instrument of qualitative data collection to examine educational change. WhatsApp's prominence, especially in the Global South, and its critical role in education, especially after Covid-19, render it a compelling methodological device. This article also situates WhatsApp research within digital ethnography and problematizes research temporality and what participation means. Ultimately, this article unpacks emergent methodological challenges and ethical dilemmas associated with WhatsApp research, and provides potential ways to manage them.

This article provides a timely intervention that helps (educational) researchers as they think about their questions, design their research, conduct their fieldwork, and maneuver an incessantly elusive digital landscape. Redressing oversights and imbalances in methodological and educational literatures, this article also informs broader discussions within digital social research, digital sociology and anthropology (of education), digital ethnography and (qualitative) social media research. Ultimately, this research can be instrumentalized in other domains such as healthcare, in different geographies beyond the Global South, and with different platforms with similar technological affordances such as Telegram.

This paper is organized in three sections. Section one introduces WhatsApp, outlines its key affordances, highlights its role as a 'technology of life' especially in the Global South, and underscores its prominence in Egyptian education, particularly after Covid-19. Section one also surveys existing literature, highlights its prominent gaps, and shows how this article addresses them. Showcasing how to study this changing sociality in education, section two introduces a systematic way of conducting qualitative research on WhatsApp. It situates this method within digital ethnographic traditions and in the process, complicates the notions of research temporality and participation. Finally, section three introduces several methodological challenges (including mercurial unpredictability, politics of invisibility, and personal and professional entanglement) and ethical problematics (including situated ethics and access) pertaining to WhatsApp research, and presents ways to manage them.

2   WHATSAPP, EGYPT, AND EDUCATION

WhatsApp is an instant messaging social media platform with more than two billion active monthly users in more than 180 countries (Statista, 2020, pp.2-3). WhatsApp allows (a)synchronous communication in individual conversations (one-to-one) and group chats (one-to-many/many-to-many) using phones, tablets, or computers. Communication on WhatsApp is conducted through text messages, media content (such as voice messages, photos, videos, and documents), and voice and video calls.

WhatsApp shares the technological affordances of persistence, replicability, scalability and searchability of information (boyd, 2011). Yet its appeal stems from its ease of use (it requires a smartphone, phone number, and an internet connection), convenience (it targets a broad class base with its free usage and minimal data consumption), functional versatility and feature richness (it can be used for personal, business, educational and political communications), relative privacy and perceived secrecy (with its end-to-end encryption and reduced censorship) and uniquely fast temporal structure (with its simultaneity and instantaneity) (Baulch et al., 2020; Bruns, 2015, p.1; Cruz & Harindranath, 2020; Dodds, 2019, pp.732, 740; Matassi et al., 2019, p.2184).

With those affordances, WhatsApp has become the leading mobile messaging platform in 112 countries (Bobrov, 2019). Specifically, it emerged as "the most important everyday technology in several parts of the Global South." Moving beyond a mere social media platform, WhatsApp has come to embody a 'technology of life'. That is, WhatsApp has been profoundly organizing people's lives, and mediating and shaping a wide array of everyday social activities (Cruz & Harindranath, 2020) including education. WhatsApp, in other words, has been central to a changing digital sociality, particularly in the Global South.

This critical role of WhatsApp is particularly visible in Egypt. With users constituting almost three quarters of Egyptian internet users as of January 2021 (Datareportal, 2021), WhatsApp has been integral in an array of social domains and activities with different classes, geographies, and ages. Younger users, who comprise the bulk of WhatsApp's users, have been using it primarily to communicate with individuals and groups, and to a lesser extent to get or share entertainment content (Middle East Monitor, 2019a; 2019b). As Covid-19 gained traction, WhatsApp's prominence was further amplified. Between March and May 2020, there was a seventy percent jump in WhatsApp usage in Egypt and a considerable part of this increase can be attributed to education (NTRA, 2020a; 2020b). This trend has been observed not just in Egypt but in other low-and-middle-income countries such as India and Peru (Jordan & Mitchell, 2020).

Before Covid-19, WhatsApp played a limited role in (in)formal education, which depended mostly on face-to-face communication, yet this role has invariably proliferated with school closures. As education migrated to e-learning platforms and social media spaces, WhatsApp has played a key role in restructuring socio-educational processes and relations. Concretely, WhatsApp emerged as a critical, messy, and contradictory social space for collaborative learning as students and teachers shared, discussed and debated educational resources. Interestingly, this collaboration extended to using the platform for cheating during examinations. WhatsApp also served as a space for psychological support, technical troubleshooting, administrative help, and teacher professional development. It facilitated sharing official communications and (mis)information and acted as a barometer of public opinion. WhatsApp also functioned as a space for socializing, bonding and socialization, for forging solidarity, building community and forming shared identities, for practicing politics and resistance, and for the instantiation and exacerbation of class inequalities. This far-reaching reorganization of education in Egypt renders WhatsApp a de facto educational technology. One that embodies the messy realities of contemporary education in a moment of disruption.

Yet, despite its critical role, empirical wealth and edifying potential, there has been a general underfocus on WhatsApp in methodology literatures – at least compared to other social media platforms like Facebook. In major methodological discussions and with few exceptions (such as Burgess et al., 2018 and Hjorth et al., 2017), WhatsApp is cursorily mentioned as an example or case (for example, Costa & Condie, 2018; Fielding et al., 2017; Kozinets, 2021; Sloan & Quan-Haase, 2017; Snee et al., 2016; Van Dijck, 2013), an absence even starker in education literatures. This methodological imbalance results from a weaker salience of WhatsApp in the US compared to other countries. It also results from empirical constraints in studying WhatsApp such as the relative inaccessibility and invisibility of chat groups, which make it harder for researchers to see and research WhatsApp spaces, and which this article seeks to overcome (Barbosa & Milan, 2019, pp.49-50; Baulch et al., 2020; McCay-Peet & Quan-Haase, 2017, p.17; Pang & Woo, 2020).

Fortunately, there have been some exceptions. A number of scholars have recently been paying more attention to different methodological facets of WhatsApp, yet this effort has been fragmented, incomplete and disconnected from educational research. For example, Garimella and Tyson (2018, p.1) provide a (quantitative) "generalisable data collection methodology and a publicly available dataset for use by other researchers," Resende et al. (2019, p.820) propose "a methodology to infer which identified publicly accessible groups are related to politics," and Barbosa and Milan (2019) outline a robust discussion of WhatsApp ethics. Still, a

more comprehensive and systematic methodological account on the qualitative use of WhatsApp, particularly in educational research, is missing.

In more empirical discussions, WhatsApp has been studied in the context of healthcare (Kamel Boulos et al., 2016), spreading misinformation (Rossini et al., 2020), shaping journalism (Dodds, 2019), digital activism and political organization (Milan & Barbosa, 2020), and the everyday living experience (Brabham, 2015; Matassi et al., 2019). In education, researchers have been investigating the *impacts* of using WhatsApp on specific learning outcomes such as writing skills (for example, Fattah, 2015; Mingle et al., 2016; Zan, 2019) and the *role* of WhatsApp in education and how it is changing relations (for example, Abualrob & Nazzal, 2019; Bouhnik et al., 2014; Costa-Sánchez & Guerrero-Pico, 2020) using quantitative, qualitative, and mixed methods. Those accounts, nonetheless, provide largely formulaic methods, uncritically classify WhatsApp research as observation, content analysis or archival research, do not sufficiently situate WhatsApp research within broader methodological streams, and pay scant attention to methodological challenges and ethical issues that this kind of research urgently raises.

3   USING WHATSAPP TO STUDY EDUCATIONAL CHANGE

The following method emerges from fifteen months of research on the digital transformation of Egyptian secondary education, and is a product of multiple discussions, reflections, and workshops. My fieldwork included conducting in-depth interviews with educational communities, oral history interviews with policymakers, event and class observations, content analysis of policy documents and official communications, and more importantly, digital social research. The latter includes e-learning platform research as well as qualitative social media research – including WhatsApp, Facebook, Telegram and YouTube.

Particularly informing this methodological piece is my empirical research in and on educational WhatsApp groups. This includes more than fifty geographically dispersed groups for a period ranging between a few days to more than fifteen months. Those groups had between 20 and 257 members, included high school students, teachers and parents, and fulfilled different functions such as learning, socializing and cheating. Those (relatively public) groups ranged in interaction intensity, oscillated from the tightly controlled to the completely unruly, and had relatively anonymous and transitory interactions marked by relatively weak ties between members.

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3.1   Doing WhatsApp Research in Educational Settings

WhatsApp spaces are empirically rich yet overwhelmingly unruly. On those spaces, researchers can examine a panoply of educational processes (such as learning), relations and interactions (such as between teachers and students), sentiments and opinions (such as what parents think about e-learning), or practices (such as online cheating). That is why prior to data collection, researchers need to have research questions to structure and guide the research process and force them to think about what and who it is they are researching. Those research questions will mostly be tentative, fluid and overlapping; developing as the research progresses and as new situations unfold. WhatsApp research is, in other words, part inductive and part deductive.

After developing research questions, the second step entails surveying. How can researchers *find* WhatsApp groups including the intended actors and embodying the examined educational processes and relations? As previously mentioned, one prominent empirical constraint is WhatsApp's relative invisibility and imperviousness to research. One cannot simply search for groups and request to join one like on Facebook. Instead, one needs a *link*. This link functions as the permission or invitation to access particular groups. To overcome this, the following are two ways to get group links, and those can represent different non-probability sampling techniques.

The first way can be considered a sort of *snowball sampling*. It entails using existing social connections to get group links or join groups. An informant, for example, can share with the researcher a group link or simply add them to the group. Furthermore, members in existing groups occasionally share links to other WhatsApp groups. The researcher can thus use those shared links to join those groups. The second way can be considered a sort of *convenience* or *purposive sampling*. It entails searching other social media platforms for educational WhatsApp group links. For example, Facebook has innumerable publicly accessible educational groups and oftentimes, members of those groups (usually students) promote their WhatsApp group links in posts and/or in comments to bolster their group membership. Researchers can find those shared links by having accounts in other searchable platforms, joining educational groups, and searching for WhatsApp links. Searching can be done by typing 'chat.whatsapp' or 'whatsapp' in the group's search box which will elicit results (in posts and comments) with WhatsApp group links that one can join.[1] The clear ethical issues pertaining to this will be discussed in section three.

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[1] Garimella and Tyson (2018) and Resende et al. (2019) provide a similar (quantitative) data collection method to find chat groups (that they designate as public) from Google, Twitter, and Facebook, albeit in politics.

Next comes accessing groups. After acquiring them, group links can be copied and pasted in a web browser (for desktops) or just clicked on (on cell phones), and researchers would then be prompted to 'join chat'.[2] Having joined the groups, the next step becomes sampling: how can researchers select the groups to actually research? Sampling will depend on several factors including research questions, group size, composition and function, schoolyear phase, group link validity, interaction intensity, geographical location, and time constraints of the researcher. One point of caution is that researchers need to consistently keep track of groups (for example, through recording group information) as groups can become numerous, massive, and ephemeral. Many groups emerge, change, and die swiftly in response to situational factors, and thus can be easily confused and lost. For example, during examinations, several cheating WhatsApp groups changed their names and icons in response to perceived surveillance by the state, and so recording group information proved invaluable as it enabled me to keep track of those groups.

After settling on which groups to research, actual *data collection* can commence by organizing a document chronologically, thematically, or both, with themes potentially functioning as qualitative codes for future data analysis. Data collection can be conducted as interactions unfold or post-hoc. It can be done using WhatsApp Web (i.e., on computer) or phone, although the former is easier for copying, downloading, and organizing the material. It is also important to be mindful of the different media shared over WhatsApp (text, videos, photos, documents and voice notes) and how each can be collected differently. For example, textual interactions can be copied and pasted, photos could be screenshotted, and voice notes and videos could be downloaded.

Oftentimes, social media research oscillates between "periods of relative calm and periods of intense activity – even turbulence" (Postill & Pink, 2012, p.130). This is true for WhatsApp research. While on days interactions would be meager, on others, thousands of messages are shared in a span of hours. This requires anticipating when interactions might be intense, carefully planning data collection sessions and scheduling more sessions at critical times. This is crucial because the deluge of messages can overwhelm researchers, inundate important insights, and become practically unmanageable. It is also important to resist the "temptation to collect and archive everything, just in case" (Markham, 2013, p.439). In addition to sampling groups, sampling would thus be needed for messages. This can be done through picking only a few groups to research or picking particular times per day or a few days per week depending on the research

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2 On several occasions, however, researchers might face broken or expired links that lead nowhere.

at hand (see for example, Kligler-Vilenchik & Tenenboim, 2020, pp.270-271; Milan & Barbosa, 2020), and researchers can ultimately stop when they reach saturation. At this point, it is important to contextualize WhatsApp research within broader methodological traditions.

3.2   WhatsApp Research as Digital Ethnography

While WhatsApp research can fall under different methodological streams, this paper argues that we need to approach WhatsApp with an ethnographic sensibility that provides a sustained, immersive and textured understanding of social phenomena. One that aims not for breadth, generalizability and thinness, but for depth, diversity and thickness. Ethnographic work, in short, is central to understanding a changing sociality, especially in education (Barbosa & Milan, 2019, pp.54-55; Cruz & Harindranath, 2020; Horst et al., 2012, pp.89-90; Madianou, 2015; Postill & Pink, 2012; Sinanan & McDonald, 2018, p.179). Yet, this can be a difficult endeavor with the proliferation of (overlapping but competing) web-based ethnographies such as 'virtual ethnography' (Hine, 2000), 'netnography' (Kozinets, 2010), 'digital ethnography' (Murthy, 2008), 'ethnography of virtual worlds' (Boellstorff et al., 2012), 'social media ethnography' (Postill & Pink, 2012), 'appnography' (Cousineau et al., 2019), and 'chatnography' (Käihkö, 2020).

From this methodological plurality, this article argues that WhatsApp research is most apt to be situated within *digital ethnography*. Although digital ethnography has been approached from different perspectives (for example, Born & Haworth, 2017, p.70; Caliandro, 2014; 2017; Hjorth et al., 2017; Murthy, 2008; Pink et al., 2016; Tunçalp & Lê, 2014, p.61), this article understands it in two complementing ways. First and more broadly, this article follows Abidin and de Seta's (2020, p.8) designation of digital ethnography as "a methodological common ground for scholars doing ethnographic research on, through and about digital media." This echoes Tunçalp and Lê's (2014, p.61) general note that digital ethnography "encompasses all forms of ethnography mediated by digital technology." Second and more specifically, this article follows Pink et al.'s (2016) conception of a digital ethnography that views the digital as multiple and thus integrates its different facets, understands how the digital is situated within the rhythms of everyday life and thus considers the non-digital topography, complements digital methods with more traditional methods, encourages disciplinary and methodological cross-fertilization, and is fluid, flexible and more importantly, reflexive.

Situating WhatsApp research within digital ethnography is consistent with how some researchers envision social media research in general and WhatsApp research in particular (for example, Barbosa & Milan, 2019;

Caliandro, 2014; Murthy, 2008). It is general enough to preserve a nimble ethnographic sensibility that studies swiftly changing (educational) socialities, to ensure that we are driven by what works best for our research, and to sidestep methodological debates and ethnographic siloing. In addition, given that WhatsApp is mostly used in conjunction with other social media and e-learning platforms and is embedded in non-digital processes, relations, and practices (Madianou & Miller, 2012; Miller et al., 2016), the specific facets of digital ethnography afford the versatility to examine digital and non-digital ecosystems. They also allow us to integrate more traditional, digitized or natively digital methods, to overcome methodological categorization (such as whether WhatsApp research is content analysis, archival research, or observation), and to examine the multiplicity of methodological practices (such as participation). Those last two points deserve to be further unpacked for they exemplify how the digital is unsettling *research temporality* and *modes of participation*.

3.3 Digital Ethnography, Research Temporality, and Participation Modes

As previously mentioned, WhatsApp research has been referred to as content analysis, archival research, and as a form of observation. At the heart of those distinctions, nonetheless, is an analytically problematic conception of time. As Markham (2018, p.1145) deftly puts it, "even the most subtle and sophisticated qualitative methods are not designed to grapple with the personalized experience of time and place…or the simultaneity of global and local in a single moment." WhatsApp, Dodds (2019, p.732) argues, is causing a "transformation of both the rhythm and structures of time." Traditional methodological categories assume a temporality that is not completely applicable to or compatible with digital sociality.

With the ephemerality of synchronous physical interactions, traditional 'offline' research (such as observations) depends on a collapsed notion of time where the present becomes shorter. For example, an interaction between two students at a school happens at a particular time and is gone. There is no way to retrieve it, intervene in or interact with it after the fact. The distinction between archival research, content analysis and observation makes sense in those forms of interactions as the past (precedence) and present (succession) are clearly demarcated.

With the persistence of asynchronous online interactions, digital social research (such as WhatsApp research) depends on a stretched notion of time where the present becomes longer. For example, an interaction between two students on WhatsApp happens in a 'fixed' present. It can be retrieved, intervened in and interacted with in real-time or 'after' the fact.

The distinction between archival research, content analysis and observation becomes untenable, as the past (precedence) and present (succession) are tightly tangled in a 'longer now'.

In other words, when we speak of observations, archival research or content analysis, we assume a particular notion of time that does not necessarily hold in digital sphere. In online spaces in general and WhatsApp in particular, interactions become "temporally suspended" and "omnipresent" (Akemu & Abdelnour, 2020, p.300). Adopting digital ethnography therefore gives us some breathing space to navigate this without being crippled by issues of categorization.

Another key issue remains unresolved: *participation*. Should researchers participate on WhatsApp groups? Some scholars argue that participation is integral to ethnographic research for it provides a deeper understanding, thicker description and meaning verification (Hine, 2017a, p.321; Hooley et al., 2012, p.81; Markham, 2013, p.439), yet others contend that covert research allows meanings to emerge in a natural state without being influenced by the researchers' presence, interests or bias (Burles & Bally, 2018, p.3; Kavanaugh & Maratea, 2020, p.6; Thompson et al., 2021, p.678). Some digital ethnographers have argued that direct and prolonged interactions are not applicable in digital spaces (Cousineau et al., 2019, p.101; Pink et al., 2016, p.3). Instead, the supposedly thin description symptomatic of covertness can be thickened through a sustained immersion in online spaces or triangulation with other methods (Janetzko, 2017, p.78).

Both overt and covert approaches are common and accepted ways of doing (digital) ethnographic research (Kavanaugh & Maratea, 2020, p.6; Markham, 2013, p.440). In fact, a survey of digital ethnographic scholarship shows that covert approaches have been significantly used vis-à-vis more overt approaches (Thompson et al., 2021, p.678). Nonetheless, this debate is couched in a narrow understanding of participation as interaction with or talking to participants. At its core, participation is a vehicle that "allows one to get *closer* to the experience" (Markham, 2013, p.440 – emphasis added). This closeness or proximity can be spatial (co-presence) or temporal (for an extended period). Social media platforms, and especially WhatsApp, afford a wide range of forms, layers and possibilities that go beyond this restricted notion of participation (de Seta, 2020, p.86). This includes talking to participants, watching stories, moving between groups, following links, consuming material, sending emojis, forwarding messages and merely listening (Crawford, 2009). This widening and layering of participation modes unsettles the overt/covert designation, and as researchers constantly slip in and out of different modes of participation, this dichotomy gets even more complicated.

Ultimately, the choice of participation mode is situation specific. It *depends on* the research topic and questions, the population one is

researching, and the processes, relations and practices one is exploring. Those factors, among others, will shape the form, level and length of participation. As researchers assume a more fluid research positionality, issues of participation, Markham (2013, p.440) argues are "negotiated…on a case-by-case basis." Nonetheless, to get closer to the experience, be able to capture the richness associated with an ethnographic sensibility and avoid a cross-sectional perspective, participation needs *time* (Madianou, 2017; Miller et al., 2016, p.29). Joshua Bluteau (2021), for example, extended his fieldwork on Instagram from twelve to twenty-four months. Similarly, while my research was originally planned for six months, I extended it to fifteen to get a thicker description. Clearly, this will depend on the sort of engagement one is doing as well as the phase of research one is in.

As this discussion is beginning to show, conducting qualitative data collection using WhatsApp in educational settings unsettles existing, and raises novel, epistemological problematics, methodological challenges, and ethical quandaries that researchers must grapple with. The following paragraphs continue with an exploration of a number of those issues and outline potential ways to manage them.

4 MANAGING METHODOLOGICAL CHALLENGES AND ETHICAL QUANDARIES

4.1 Mercurial Unpredictability and Creative Flexibility

The internet has been described as unstable, unpredictable, fragmented, and multiple (Hine, 2015, p.88; Lindgren, 2018, p.446; Rogers, 2013, p.24). With its rapid, incessant, and unexpected pace of innovations, social media is a prime embodiment of those qualities (Ellison & boyd, 2013, p.17). As a social media platform, WhatsApp regularly changes its interface, features, policies and affordances, and users change their practices in response to those as well as to new situations unfolding. This protean nature of social media makes the process of digital inquiry ever more complicated, and requires equally responsive research focus, methods, and practices.

Faced with dynamic, impromptu, ephemeral, and uncontrollable situations, researchers need to be methodologically flexible, creative, nimble, and imaginative. They need to conceptualize methods "as a creative act" (Sandvig & Hargittai, 2016, p.2) and practice what Lindgren (2018, p.447) calls methodological bricolage. That is, "improvising and putting pre-existing things together in new and adaptive ways." This methodological bricolage is not entirely thought out in advance, nonetheless, but "emerges as a patchwork of solutions – old or new – to problems faced while carrying out the research." In educational research,

this might include, for example, following students as they migrate to new platforms, and learning not only how to use those platforms and access those spaces, but also how to research (with) them.

4.2 Politics of (In)visibility and Triangulation

Social media's regime of visibility is another methodological challenge to be wrestled with. To begin with, not everyone has access to internet, and not everyone with internet has access to social media. On WhatsApp, not everyone is available on educational spaces and not everyone on educational spaces produces visible traces. Some users simply read and listen (Crawford, 2009), others drown in a sea of messages at times of intense interaction, and others are simply excluded by the platforms' algorithmic architectures.

In the face of this, researchers need to be mindful of WhatsApp's politics of (in)visibility and take active steps to improve the validity and reliability of the research. This can be accomplished through *triangulation* – a point which harks back to the choice of digital ethnography. To understand educational processes unfolding, meanings embodied, and practices enacted on (non)digital ecosystems, it is important to observe different WhatsApp groups at different points in time. In addition, WhatsApp should not be the sole 'site' studied. It should be complemented with other social media platforms as well as e-learning platforms. With no epistemic privilege given either to 'online' or 'offline' methods, it also becomes crucial to supplement WhatsApp research with more (traditional) research methods like interviews (boyd, 2016, pp.81-82, Hooley et al., 2012, p.7; Madianou, 2017, p.109; Murthy, 2008, p.837; Orgad, 2009).

4.3 Personal and Professional (Dis)entanglement

The blending of personal and professional spheres emerges as yet another challenge of doing WhatsApp research (Dodds, 2019, p.733; Käihkö, 2020, p.85). WhatsApp is linked to one cell phone and one number. This means that if the researcher has one of each, their number and phone will be used both for research and personal activities. This blurring of the lines between researchers' personal and research activities has been captured in Mainsah and Prøitz's (2019, p.272) auto-ethnographic reflections on social media. The authors cogently show how researchers are consistently carrying the field with them and trying to manage "'being in the field' and 'being out of the field'." This encroachment of research activities on personal life has been a common recurrence in my research. I was experiencing an always-on research state prompted by the unpredictability and eventfulness of

those social media spaces. For example, chatting with family members would frequently be interrupted by messages from cheating groups.

One step towards active disentanglement would be to get another phone with a new number exclusively for WhatsApp research. Yet, this solution is not always cheap or feasible. It also risks too much detachment from the 'field'. While I was 'always there' with one mobile number, getting another rendered me more disconnected from my fieldsites and my research participants. That is why before taking any remedial steps, it is crucial to *reflexively* examine this entanglement and how it affects both the researcher and the research process – a point that will be further developed in the conclusion.

In addition to those methodological issues, WhatsApp research (and qualitative social media research in general) raises a number of novel ethical quandaries. Those pertain to research categories such as harm, privacy, personhood, consent and access, as well as to research stages, from "defining field boundaries; accessing participants; raising a sample; collecting, organizing, analyzing, and archiving information; representing ourselves and others in writing; framing knowledge; and maintaining professional autonomy" (Tiidenberg, 2018, p.477). To address those, scholars have been providing important guidelines for digital research ethics both individually (for example, Burles & Bally, 2018; Hewson, 2017; Hooley et al., 2012; Snee et al., 2016) as well as institutionally (for example, the Association of Internet Researchers) (Franzke et al., 2019; Markham & Buchanan, 2012).

4.4   Situated Ethics, Grounded Flexibility, and Informed Consent

With the incessant changes, compounding complexity and dynamic unpredictability of social media, researchers are oftentimes confronted with impromptu ethical choices that they need to address immediately. Yet, those challenges cannot be met only with a rigid set of archaic rules that manages the research process (Barbosa & Milan, 2019). Those one-size-fits-all rules are becoming neither feasible nor useful. Instead, scholars have been calling for a "situated approach to online research ethics" (Hine, 2020, p.6) in which ethical decisions are not carved in stone, but flexible, context dependent and situation specific (Franzke et al., 2019; Hewson, 2016, p.215; Markham & Buchanan, 2012; Tiidenberg, 2018). This situatedness includes the immediate context of data collection (for example, the WhatsApp group dynamics, features and affordances), the broader research context (for example, the digital ecosystem examined), and the broader socio-cultural context of research (for example, the cultural understandings, perceptions, beliefs, and attitudes about those ethical issues).

This flexibility is not untethered, however. Rather, it needs to be rooted into some fundamental ethical precept. A golden rule that holds itself to a standard higher than ethics boards and signed forms (Eynon et al., 2018, p.27; Tiidenberg, 2018). The novelty, ambiguity and situatedness of ethical issues in the digital age thus prompts a return to the basic ethical tenet of *do no harm* (Barbosa & Milan, 2019, p.49; Käihkö, 2020, p.83). Except for some illegal activities, researchers should be careful to protect their participants, regardless of their participation overt-ness, consent granted and space publicness.

This issue can be exemplified through the case of *informed consent*. Upon entry to WhatsApp groups and before data collection, should researchers ask for informed consent? And would this consent be from all group members or just a select few (for example, group administrators)? Some researchers argue that informed consent ought to be taken from all members, while others contend that as long as a space is accessible, no consent is needed. boyd and Crawford (2012, p.672) capture this tension nicely, yet in the context of Twitter, arguing that while "it may be unreasonable to ask researchers to obtain consent from every person…it is problematic for researchers to justify their actions as ethical simply because the data is accessible." In other words, having access does not always mean it is ethical.

With situated ethics, getting consent *depends* on the case and the context. Researchers need to consider factors such as group nature, function and size, interaction volume and speed, member turnover, anonymity, publicness of the space, topic sensitivity, the intended audience and how the data will be used (Burles & Bally, 2018, p.8; Eynon et al., 2018, p.25). In larger groups of (relatively anonymous) participants with fast/heavy interactions and high member turnover, getting consent from students (and their parents) would be next to impossible. In smaller groups with (relatively known) participants, slow/light interactions and low member turnover, getting consent would be more practical. For instance, in Barbosa and Milan's (2019, p.53) digital ethnography on WhatsApp, the authors "posted a message to inform group members of the research" and sent out occasional reminders. They regarded the lack of opposition as a consent to continue their work. Yet, the authors contend that informed consent is "outdated" and "potentially dangerous," and are ultimately skeptical of its viability in digital research (p.57).

Consent aside, how can researchers 'do no harm' to WhatsApp group members? One strategy is anonymity: assigning pseudonyms and making sure that no identifiable information (such as names, photos, and phone numbers) is available, and that the data is protected from leakage, hacking and stealing. This anonymity requirement becomes even more stringent for vulnerable participants such as high school students. Another strategy is

avoiding direct quotes either through paraphrasing (boyd, 2016, p.91) or by employing the fabrication method, the "creative, bricolage-style transfiguration of original data into composite accounts or representational interactions" that cannot be traced to the original participants (Markham, 2012, p.334).

4.5   Access and Online Spaces

One thorny issue lurking within the discussion so far has been that of space. Are WhatsApp groups public or private spaces? WhatsApp has been described as a "semi-public" platform (Milan & Barbosa, 2020), a "semi-private space" (Costa-Sánchez & Guerrero-Pico, 2020, p.9) and a "(private) public sphere" (Barbosa & Milan, 2019, p.50). WhatsApp groups have been described as "public" (Garimella & Tyson, 2018) and "'private' (by invitation, run by administrators) or 'public' (joined via link)" (Barbosa & Milan, 2019, p.52). Most of those designations, however, are not unpacked, problematized, or defended.

Publicness of a space can be argued to entail visibility, co-presence, and restrictions to access. A purely public space is one where there are no restrictions to access, and one is visible to and co-present with others – what Hannerz (2016, p.151) calls 'consociality'. As one places more restrictions and as one is less visible to and co-present with others, the space becomes more private. Publicness is thus not a binary designation, but a continuum with (online) spaces relationally situated against each other. An online space is more private than some and simultaneously more public than others, and one can be on several relatively public and private groups on the same platform at the same time. The digital is thereby forcing us to question our simple dichotomy of public and private (boyd, 2011, p.52). One illustration of this comes from Miller et al.'s (2016) scalability sociality, which overcomes those binaries by moving between the private and the public on different social media platforms.

Publicness of a space can also be argued to be a characteristic of the space itself as well as the *perceptions* and *expectations* of privacy by its members. As Hewson (2016, p.214) notes, knowledge about "privacy expectations of users…is fundamental to reaching conclusions on the public–private distinction debate" (see also Franzke et al., 2019, p.7; Nissenbaum, 1997). In relatively public spaces with fewer restrictions, there are expectations that people are co-present and that one is visible. Conversely, in relatively private spaces with more restrictions, there are expectations that people are not co-present, and that one is not visible. Importantly, those understandings, perceptions, expectations and attitudes towards space and privacy (and their violation) are shaped by and differ according to the broader socio-cultural contexts (see Miller et al., 2016, p.30;

Sinanan & McDonald 2018, p.186). For example, throughout my research on WhatsApp groups, there were rarely any discussions about privacy or its violation. In fact, many students were aware that parents, teachers, and even state actors were present on those groups as well. In short, publicness of an online space is tethered to expectations of co-presence, perceptions of visibility and actuality of restrictions to access.

How would this apply to WhatsApp? To have a WhatsApp account, one needs to have a digital device, internet access, a phone number and some technical literacy. Those are some of the preliminary restrictions to access. To enter a WhatsApp group, one needs to have the link or be added by an administrator. In this sense, the group link becomes the key to the publicness of the group for it restricts access, and shapes expectations and perceptions around visibility and co-presence and ultimately the group's publicness. As WhatsApp itself cautions, group administrators need to be mindful that "anyone with WhatsApp can follow this link to join this group," and implores them to "only share it with people you trust."

While relatively small/known groups with stronger ties among members (like families) do not publicly share links and police admission, other bigger/anonymous groups with weaker ties among members (like educational groups) share their links to friends or on more public social media platforms like Facebook. This practice of public sharing creates the perception and expectation that *anyone* can join the group. The process of link sharing thus renders the group more public; a perception that is further concretized as group members see others join and leave en masse. In other words, the link provides the permission, and if it is publicly shared, then this permission is granted for all. This takes us to the British Psychological Society's statement that online observation should take place when and where users "reasonably expect to be observed by strangers" (British Psychological Society, 2009, p.13).

5   CONCLUSION: A NOTE ON REFLEXIVITY

This article joins a growing conversation on digital social research in education at a critical time of change. Showcasing how social media can be used to study a changing digital sociality, this article argued that WhatsApp can be systematically used in qualitative data collection to yield thick and in-depth insights about educational change. This article also moved away from a decontextualized methodological discussion and connected WhatsApp research to digital ethnography, raised a number of key methodological challenges and ethical quandaries, and outlined potential ways to manage them. In the process, this article overcomes the relatively impervious nature of WhatsApp, problematizes fundamental research categories (such as participation), entrenched dichotomies (like

public/private space) and broader epistemological questions (such as research temporality), redresses various literature imbalances, and informs other research domains, geographies, and platforms.

One final note is in order. Digital ethnographic practice, Abidin and de Seta (2020, pp.9-10) argue, is strewn with "anxieties, challenges, concerns, dilemmas, doubts, problems, tensions and troubles." This is true. But those can become sources of and opportunities for insight and enlightenment. "The most widely recommended remedy to assuage epistemological anxieties, participatory doubts and ethical dilemmas" the authors continue, "is self-reflexivity." Reflexivity is a potent tool for rigorous ethnographic work, and its role has become even more critical with the swift changes, rife uncertainties, novel situations, and major implications of digital technologies (Davies, 2002, pp.3-4; Hine, 2017b, p.26; Lupton, 2015; Markham, 2013; Pousti et al., 2021). In fact, reflexive practice has been a critical component in digital social research, social media research, and as previously mentioned, in digital ethnography (Airoldi, 2018; Baym, 2009, p.186; boyd, 2016, pp.81-82; Hine, 2015; Käihkö, 2020, p.72; Lindgren, 2018, pp.447-448; Pink et al., 2016).

Although scholars speak of multiple reflexivities (Gough, 2003, p.22), some common threads could be discerned. Reflexivity is a skill, capacity or practice that examines how researchers' "own experiences and contexts (which might be fluid and changing) inform the process and outcomes of inquiry" (Etherington, 2004, pp.31-32). Reflexivity involves understanding (and being explicit about) one's (fluid) positionality, motivations, assumptions, biases, choices, doubts, reactions, decisions, and mistakes, as well as the broader socio-cultural context and the situation's contingencies. Reflexivity can eventually bolster the research process, enrich research insights, enhance understanding, strengthen arguments, foster transparency, and most importantly, provide signposts for other researchers (Davies, 2002, p.5; Finlay, 2003, pp.16-17; Gough, 2017, p.311).

In WhatsApp research, reflexivity should be an iterative process that evolves with the changing circumstances of research and the fluid positionality of the researcher. It should be implicated in all research stages from design, practice to dissemination, and should include the abstract and theoretical (such as constructing the 'field') as well as the concrete and practical (such as obtaining informed consent). Finally, reflexivity should move between more private and individualistic practices (such as maintaining a journal) and more public and collective practices (such as discussions with other researchers). Reflexivity, in other words, should be thought of as a *social* process of "mutual reflection" (Sandvig & Hargittai, 2015, p.5), which in a way, is what this article has attempted to offer.

REFERENCES

Abidin, C., & de Seta, G. (2020). Private messages from the field: Confessions on digital ethnography and its discomforts. *Journal of Digital Social Research*, 2(1), 1-19.

Abualrob, M., & Nazzal, S. (2019). Using Whatsapp in teaching chemistry and biology to tenth graders. *Contemporary Educational Technology*, 11(1), 55-76.

Airoldi, M. (2018). Ethnography and the digital fields of Social Media. *International Journal of Social Research Methodology*, 21(6), 1-13.

Akemu, O., & Abdelnour, S. (2020). Confronting the digital: Doing ethnography in modern organizational settings. *Organizational Research Methods*, 23(2), 296–321.

Barbosa, S., & Milan, S. (2019). Do not harm in private chat apps: Ethical issues for research on and with WhatsApp. *Westminster Papers in Communication and Culture*, 14(1), 49–65.

Baulch, E., Matamoros-Fernández, A., & Johns, A. (2020). Introduction: Ten years of WhatsApp: The role of chat apps in the formation and mobilization of online publics. *First Monday*, 25(1).

Baym, N. K. (2009). What constitutes quality in qualitative internet research? In A. N. Markham & N. K. Baym (Eds.), *Internet Inquiry: Conversations about Method*, (pp. 173-190). SAGE.

Baym, N. K., & Markham, A. N. (2009). Introduction: Making smart choices on shifting grounds. In A. N. Markham & N. K. Baym (Eds.), *Internet Inquiry: Conversations about Method*, (pp. vii–xix). SAGE.

Bluteau, J. (2021). Legitimising digital anthropology through immersive cohabitation: Becoming an observing participant in a blended digital landscape. *Ethnography*, 22(2), 267-285.

Bobrov, L. H. (2019). *Mobile messaging app map of the world – January 2019*. Similar Web. https://www.similarweb.com/corp/blog/mobile-messaging-app-map-january-2019/

Boellstorff, T., Nardi, B., Pearce, C., & Taylor, T. L. (2012). *Ethnography and virtual worlds: A handbook of method*. Princeton University Press.

Bonilla, Y., & Rosa, J. (2015). #Ferguson: Digital protest, hashtag ethnography, and the racial politics of Social Media in the United States. *American Ethnologist*, 42(1), 4-17.

Born, G., & Haworth, C. (2017). Mixing it: Digital ethnography and online research methods—A tale of two global digital music genres. In L. Hjorth, H. Horst, A. Galloway, & G. Bell (Eds.), *The Routledge Companion to Digital Ethnography* (pp. 70-86). Routledge.

Bouhnik, D., Deshen, M., & Gan R. (2014). WhatsApp goes to school: Mobile instant messaging between teachers and students. *Journal of*

Information Technology Education: Research, 13, 217–231, https://doi.org/10.28945/2051

boyd, d. (2011). Social network sites as networked publics: Affordances, dynamics, and implications. In Z. Papachrissi (Ed.), *Networked Self: Identity, Community, and Culture on Social Network Sites* (pp. 39-58). Routledge.

boyd, d. (2016). Making sense of teen life: Strategies for capturing ethnographic data in a networked era. In E. Hargittai, & C. Sandvig (Eds.), *Digital Research Confidential: The Secrets of Studying Online Behavior* (pp. 79-102). MIT Press.

boyd, d., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, communication & society*, 15(5), 662-679.

Brabham, D. C. (2015). Studying normal, everyday social media. *Social Media + Society*, 1(1), 1-2.

British Psychological Society. (2009). *Code of ethics and conduct guidance published by the ethics committee of the british psychological society*.

Bruns, A. (2015). Making sense of society through social media. *Social media + Society*, 1(1), 1-2.

Burles, M. C., & Bally, J. M. G. (2018). Ethical, practical, and methodological considerations for unobtrusive qualitative research about personal narratives shared on the internet. *International Journal of Qualitative Methods*, 17(1), 1-9.

Caliandro, A. (2014). Ethnography in digital spaces: Ethnography of virtual worlds, netnography, and digital ethnography." In R. M. Denny & P. L. Sunderland (Eds.), *Handbook of anthropology in business* (pp. 658-680). Routledge.

Caliandro, A. (2017). Digital methods for ethnography: Analytical concepts for ethnographers exploring social media environments. *Journal of Contemporary Ethnography*, 47(5), 551-578, https://doi.org/10.1177/0891241617702960

Costa-Sánchez, C., & Guerrero-Pico, M. (2020). What is WhatsApp for? Developing transmedia skills and informal learning strategies through the use of whatsapp—A case study with teenagers from spain. *Social Media + Society*, 6(3), 1-11.

Costa, C., & Condie, J. (Eds.). (2018). *Doing research in and on the digital: Research methods across fields of inquiry*. Routledge.

Cousineau, L. S., Oakes, H., & Johnson, C. W. (2019). Appnography: Modifying ethnography for app-based culture. In D. Parry, C. W. Johnson & S. Fullagar (Eds.), *Digital Dilemmas* (pp. 95–117). Springer International Publishing.

Crawford, K. (2009). Following you: Disciplines of listening in Social Media. *Continuum*, 23(4), 525–535.

Cruz, E. G., & Harindranath, R. (2020). WhatsApp as 'Technology of Life': Reframing research agendas. *First Monday*, 25(1).

Datareportal. (2021). *Digital 2020: Egypt*. https://datareportal.com/reports/digital-2021-egypt

Davies, C. A. (2002). *Reflexive ethnography: A guide to researching selves and others*. Routledge.

de Seta, G. (2020). Three lies of digital ethnography. *Journal of Digital Social Research*, 2(1), 77–97.

Dodds, T. (2019). Reporting with WhatsApp: Mobile chat applications' impact on journalistic practices. *Digital Journalism*, 7(6), 725–745.

Ellison, N. B., & boyd, d. (2013). Sociality through social network sites. In W. H. Dutton (Ed.), *The Oxford Handbook of Internet Studies*. Oxford Handbooks Online.

Etherington, K. (2004). *Becoming a reflexive researcher: Using our selves in research*. Jessica Kingsley Publishers.

Eynon, R, Fry, J., & Schroeder, R. (2018). The ethics of online research. In N. G. Fielding, R. M. Lee, & G. Blank (Eds.), *The SAGE handbook of online research methods* (pp. 19-37). SAGE.

Fattah, S. F. (2015). The effectiveness of using Whatsapp messenger as one of mobile learning techniques to develop students' writing skills. *Journal of Education and practice*, 6(32), 115-127.

Fielding, N. G., Lee R. M., & Blank, G. (Eds.). (2017). *The SAGE handbook of online research methods*. London: SAGE.

Finlay, L. (2003). The reflexive journey: Mapping multiple routes." In L. Finlay & B. Gough (Eds.), *Reflexivity: A Practical Guide for Researchers in Health and Social Sciences* (pp. 3-20). Blackwell Science.

Franzke, A. S., Bechmann, A., Zimmer, M., & Ess, C. M. (2019). *Internet research: Ethical guidelines, 3*. The Association of Internet Researchers.

Garimella, K., & Tyson, G. (2018). WhatsApp, doc? A first look at whatsapp public group data', *ArXiv*, 1-8, http://arxiv.org/abs/1804.01473

Gough, B. (2003). Deconstructing reflexivity. In L. Finlay & B. Gough (Eds.), *Reflexivity: A Practical Guide for Researchers in Health and Social Sciences* (pp. 21-36). Blackwell Science.

Gough, B. (2017). Reflexivity in qualitative psychological research. *Journal of Positive Psychology*, 12(3), 311-312.

Hannerz, U. (2016). *Writing future worlds: An anthropologist explores global scenarios*. Springer.

Hewson, C. (2016). Ethics issues in digital methods research. In H. Snee, C. Hine, Y. Morey, S. Roberts & H. Watson (Eds.), *Digital Methods for Social Science* (pp. 206-221). Palgrave Macmillan, London.

Hewson, C. (2017). Research design and tools for online research. In N. G. Fielding, R. M. Lee, & G. Blank (Eds.), *The SAGE Handbook of Online Research Methods* (pp. 57-75). SAGE.

Hine, C. (2000). *Virtual ethnography*. SAGE.

Hine, C. (2015). *Ethnography for the internet: Embedded, embodied and everyday*. Bloomsbury.

Hine, C. (2017a). Ethnography and the Internet: Taking account of emerging technological landscapes. *Fudan Journal of the Humanities and Social Sciences*, 10(3), 315–329.

Hine, C. (2017b). From virtual ethnography to embedded, embodied, everyday internet. In L. Hjorth, H. Horst, A. Galloway, & G. Bell (Eds.), *The Routledge Companion to Digital Ethnography* (pp. 21-28). Routledge.

Hine, C. (2020). Ethnographies in online environments. *SAGE Research Methods Foundations*. SAGE Publications Limited.

Hjorth, L., Horst, H., Galloway, A., & Bell, G. (Eds.). (2017). *The routledge companion to digital ethnography*. Routledge.

Hooley, T, Wellens, J., & Marriott, J. (2012). *What is online research?: Using the internet for social science research*. A&C Black.

Horst, H., Hjorth, L., & Tacchi, J. (2012). Rethinking ethnography: An introduction. *Media International Australia*, 145(1), 86-93.

Janetzko, D. (2017). Nonreactive data collection online. In N. G. Fielding, R. M. Lee, & G. Blank (Eds.), *The SAGE Handbook of Online Research Methods* (pp. 76-91). SAGE.

Jordan, K., & Mitchell, J. (2020). Messaging Apps, SMS & Social Media: Rapid Evidence Review. *The EdTech Hub.*

Käihkö, I. (2020). Conflict chatnography: Instant messaging apps, Social Media and conflict ethnography in Ukraine. *Ethnography*, 21(1), 71–91.

Kamel Boulos, M. N., Giustini, D. M., & Wheeler, S. (2016). Instagram and WhatsApp in health and healthcare: An overview. *Future Internet*, 8(37), 1-14, https://doi.org/10.3390/fi8030037

Kavanaugh, P. R., & Maratea R. J. (2020). Digital ethnography in an age of information warfare: Notes from the field. *Journal of Contemporary Ethnography*, 49(1), 3–26.

Kligler-Vilenchik, N., & Tenenboim, O. (2020). Sustained journalist–audience reciprocity in a meso news-space: The case of a journalistic Whatsapp group. *New Media & Society* 22(2): 264–282, https://doi.org/10.1177/1461444819856917

Kozinets, R. (2010). *Netnography: Doing ethnographic research online*. SAGE.

Kozinets, R. (2021). *Netnography: The essential guide to qualitative social media research*. SAGE.

Lindgren, S. (2018). The Concept of 'Data' in Digital Research. In U. Flick (Ed.), *The SAGE Handbook of Qualitative Data Collection* (pp. 441-450). SAGE

Lupton, D. (2015). *Digital sociology*. Routledge, Taylor & Francis Group.

Madianou, M. (2015). Polymedia and ethnography: Understanding the social in Social Media. *Social Media + Society*, 1(1).

Madianou, M. (2017). 'Doing Family at a Distance' Transnational family practices in polymedia environments. In L. Hjorth, H. Horst, A. Galloway, & G. Bell (Eds.), *The Routledge Companion to Digital Ethnography* (pp. 102-111). Routledge.

Madianou, M., & Miller, D. (2012). Polymedia: Towards a new theory of digital media in interpersonal communication. *International Journal of Cultural Studies* 16(2), 169-187.

Mainsah, H., & Prøitz, L. (2019). Notes on technology devices in research: Negotiating field boundaries and relationships. *Qualitative Inquiry*, 25(3), 271–277.

Markham, A. (2012). Fabrication as Ethical Practice. *Information, Communication & Society,* 15(3), 334-353.

Markham, A. (2013). Fieldwork in Social Media. *Qualitative Communication Research*, 2(4), 434–446.

Markham, A. (2018). Ethnography in the digital internet era: From fields to flows, descriptions to interventions. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (pp. 1129-1162). SAGE.

Markham, A., & Baym, N. K. (Eds.). (2009). *Internet inquiry: Conversations about method*. SAGE Publications.

Markham, A., & Buchanan, E. (2012). *Ethical decision-making and internet research: Version 2.0. recommendations from the aoir ethics working committee*. aoir.org/reports/ethics2.pdf

Matassi, M., Boczkowski, P. J., & Mitchelstein, E. (2019). Domesticating WhatsApp: Family, friends, work, and study in everyday communication. *New Media & Society*, 21(10), 2183–2200.

Matzat, U., & Vrieling, E. M. (2016). Self-regulated learning and Social Media – a 'Natural Alliance'? Evidence on students' self-regulation of learning, Social Media use, and student–teacher relationship. *Learning, Media and Technology*, 41(1), 73-99.

McCay-Peet, L., & Quan-Haase, A. (2017). What is Social Media and what questions can Social Media research help us answer. In L. Sloan & A. Quan-Haase (Eds.), *The SAGE Handbook of Social Media Research Methods* (pp. 13-26). SAGE.

Middle East Monitor. (2019a). *Media use in the middle east, 2019. % Who use whatsapp for the following reasons.*

http://www.mideastmedia.org/survey/2019/interactive/social-media/who-use-the-following-platforms.html

Middle East Monitor. (2019b). Media use in the middle east, 2019. % Who use the following social media platforms. http://www.mideastmedia.org/survey/2019/interactive/social-media/who-use-whatsapp-for-the-following-reasons.html#Q6%5B%5D=%3D1&Q4%5B%5D=BETWEEN+18+AND+24

Milan, S., & Barbosa, S. (2020). Enter the Whatsapper: Reinventing digital activism at the time of chat apps. *First Monday*, 25(1).

Miller, D., Sinanan, J., Wang, X., McDonald, T., Haynes, N., Costa, E., Spyer, J., Venkatraman, S., & Nicolescu, R. (2016). *How the world changed Social Media*. UCL press.

Mingle, J., Adams, M., & Adjei, E. A. (2016). A comparative analysis of Social Media usage and academic performance in public and private senior high schools. *Journal of Education and Practice*, 7(7), 13-22.

Murthy, D. (2008). Digital ethnography: An examination of the use of new technologies for social research', *Sociology*, 42(5), 837–855.

National Telecommunications Regulatory Authority (NTRA). (2020a). Internet and communications technology usage in Egypt in March and April. https://tra.gov.eg/en/media-center/press-releases/Pages/An-Increase-in-the-Indicators-of-Telecom-Services-Usage-During-March-and-April.aspx

National Telecommunications Regulatory Authority (NTRA). (2020b). Internet and communications technology usage in Egypt in Ramadan. http://tra.gov.eg/en/media-center/press-releases/Pages/The-NTRA-Telecom-Service-Usage-Indicators-Report-for-the-Month-of-Ramadan.aspx

Nissenbaum, H. (1997). Toward an approach to privacy in public: Challenges of information technology. *Ethics & Behavior*, 7(3), 207-219.

Orgad, S. (2009). How can researchers make sense of the issues involved in collecting and interpreting online and offline data? In A. N. Markham & N. K. Baym (Eds.), *Internet Inquiry: Conversations about Method*, (pp. 33-54). SAGE.

Pang, N., & Woo Y. T. (2020). What about WhatsApp? A systematic review of Whatsapp and its role in civic and political engagement. *First Monday*, 25(1).

Pink, S., Horst, H., Postill, J., Hjorth, L., Lewis, T., & Tacchi, J. (Eds.). (2016). *Digital ethnography: Principles and practice*. SAGE.

Postill, J., & Pink, S. (2012) Social Media ethnography: The digital researcher in a messy web. *Media International Australia*, 145(1), 123–134.

Pousti, H, Urquhart, C., & Linger, H. (2021). Researching the virtual: A framework for reflexivity in qualitative social media research. *Information Systems Journal*, 31(3), 356-383.

Resende, G., Melo, P., Sousa, H., Messias, J., Vasconcelos, M., Almeida, J., & Benevenuto, F. (2019). (Mis)Information dissemination in WhatsApp: Gathering, analyzing and countermeasures. *The World Wide Web Conference*, 818–828.

Robson, J. (2016). Engagement in structured social space: An investigation of teachers' online peer-to-peer interaction. *Learning, Media and Technology*, 41(1), 119-139.

Rogers, R. (2013). *Digital methods*. The MIT Press.

Rossini, P., Stromer-Galley, J., Baptista, E. A., & de Oliveira, V. V. (2020). Dysfunctional information sharing on Whatsapp and Facebook: The role of political talk, cross-cutting exposure and social corrections. *New Media & Society*, 1-22.

Sandvig, C., & Hargittai, E. (2016). How to think about digital research. In E. Hargittai, & C. Sandvig (Eds.), *Digital Research Confidential: The Secrets of Studying Online Behavior* (pp. 1-25). MIT Press.

Sinanan, J., & McDonald, T. (2018). Ethnography. In J. Burgess, A. Marwick & T. Poell (Eds.), *The SAGE Handbook of Social Media* (pp. 179-195). SAGE.

Sloan, L, & Quan-Haase, A. (Eds.). (2017). *The SAGE handbook of social media research methods*. SAGE Publications.

Snee, H., Hine, C., Morey, Y., Roberts, S., & Watson, H. (Eds.). (2016). *Digital methods for social science*. Palgrave Macmillan UK.

Statista. (2020). *WhatsApp Dossier 2020.* https://www-statista-com.proxy2.library.illinois.edu/study/20494/whatsapp-statista-dossier/

Statista. (2021). *Global digital population as of January 2021*. https://www-statista-com.proxy2.library.illinois.edu/statistics/617136/digital-population-worldwide/

Thompson, A., Stringfellow, L., Maclean, M., & Nazzal, A. (2021). Ethical considerations and challenges for using digital ethnography to research vulnerable populations. *Journal of Business Research*, 124, 676–683.

Tiidenberg, K. (2018). Ethics in digital research. In U. Flick (Ed.), *The SAGE Handbook of Qualitative Data Collection* (pp. 466-481). SAGE.

Tunçalp, D., & Lê, P. (2014). (Re) locating boundaries: A systematic review of online ethnography. *Journal of Organizational Ethnography*, 3(1), 59-79.

Van Dijck, J. (2013). *The culture of connectivity: A critical history of Social Media*. Oxford University Press.

Van Dijck, J., Poell, T., & De Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford University Press.

WhatsApp. (2021). *WhatsApp Features*. https://www.whatsapp.com/features/

Wittel, A. (2001). Toward a network sociality. *Theory, culture & society*, 18(6), 51-76.

Zan, N. (2019). Communication channel between teachers and students in chemistry education: WhatsApp. *US-China Education Review*, 9(1), 18-30.

DOES NUMERACY IN DIGITAL JOURNALISM INCREASE STORY BELIEVABILITY? EXPERIMENTS COMPARING AUDIENCE PERCEPTIONS FROM THE US, ZAMBIA, TANZANIA

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ABSTRACT

This exploratory study contributes to the literature on numeracy in digital journalism studies by theoretically incorporating the audience/news consumers. While most studies have focused on journalists' perception and role in the use of numeracy, this study examines how audience perceive stories with numerical values. Through an experimental design, and by comparing the United States, Zambia, and Tanzania, the study was able to demonstrate that news stories with numerical values diminished audience/readers' affective consumption. In other words, news stories with numerical values were negatively associated with audience appeal. However, individuals with a lower understanding of probabilistic and numerical concepts seemed to trust news stories with numbers more than those with a higher level of numeracy. This was especially true in Zambia and Tanzania where most participants recorded lower numeracy levels. The overall sample in all the three countries seemed to favor news stories with less or no numeracy.

Keywords: numeracy; digital journalism; audience perception; audience appeal; digital storytelling

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1   INTRODUCTION

The rapid transition from traditional to digital journalism across the globe has inevitably led to multipronged debates of the credibility of online news reporting (Ausserhofer, et. al., 2020; Ekström & Westlund, 2019; Lecheler & Kruikemeier, 2016; Cassidy, 2007). To improve and increase media credibility, several strategies have been suggested since the development of digital journalism. These strategies include but are not limited to nuanced and rigorous journalism education and training (Pickard & Williams, 2014), different reporting styles that befit digital journalism (Molyneux & Coddington, 2020; Ferrucci & Vos, 2017; Franklin, 2014; Vis, 2013; Westlund, 2013), as well as the use of number in journalism reporting. Accordingly, these strategies help provide augmented and substantial arguments in news reporting (Diakopoulos, & Koliska, 2017; Coddington, 2015; Appelgren & Nygren, 2014).

Defined as the "ability to understand and use probabilistic and numerical concepts (Peters, 2020)", scholars continue to question the feasibility of delivering a message that most of the audience can resonate with (Stalph & Borges-Rey, 2018; Nguyen & Lugo-Ocando, 2016). A myriad of studies suggests that most audience are less equipped with numeracy competence. In most of sub-Saharan Africa, for example, several studies have raised concerns about how the ideas of numeracy in journalism could be Western-oriented, and thus disregarding the needs of an African audience (Middleweek & Mutsvairo, 2020; Ugangu, 2020; Kerunga, et. al., 2020; Ezumah, 2019). Such studies suggest the idea of knowing the abilities that your audience possess in understanding your news stories – we write for our audiences and not for ourselves. Breit (2020), for example, calls for environmentally relevant approaches that ensure cognitive relevance through cognitive flexibility to allow the reportage of relevant information in and for a particular social context. This argument calls for the ability to understand your audience in your reporting.

This study contributes to the literature by exploring how the audience perceives the use numeracy in the news. The study used experiments to compare audience's perception of numerical values in Zambia, Tanzania, and the United States. Several existing studies have taken a journalistic perspective to explore the importance of numbers in journalism stories (Lewis & McAdams, 2020; Borges-Rey, 2016). While this is important, a gap in research on how the audience perceives and feels about numbers has been created. Particularly, there is a dearth of research on the relationship between numeracy, audience attention to numbers, and their attitude to stories with numerical value. This study attempts to fill that gap. Does the quest for numbers in journalism aligns with the audience's ability to interpret those numbers?

2   LITERATURE REVIEW

Numeracy as a concept in journalism studies has become popularized by data and digital journalism, or the gradual shift of editorial content from traditional approaches, such as print, to online or internet distribution (Jones & Salter, 2011; Kawamoto, 2003). While debates about the necessity of numeracy in journalism are still ongoing, some scholars such as Tiede, et. al., (2020) have classified two types of journalists that use numeracy in their stories: Those who use it for their actual ability and belief that they tell a compelling story (objective numeracy) versus those who just prefer the use of numbers even when they do not fully understand them (subjective numeracy). Most scholars hold the idea that numeracy, when used correctly in media reporting, does indeed help tell a compelling journalistic story. However, there is still a limited understanding among journalists and scholars on how numbers should be implemented in the news stories, and what that kind of journalism should be called (Cohen, 2019). For some, it is digital journalism, while others call such kind of reporting as 'data journalism'. The major characteristics of the two terms are "numeracy" and "quantitative literary", which have also been understood in ontological, rather than epistemological terms, therefore, delimiting a sphere of knowledge and competence (Harrison, 2020, p.26).

As Swain (2012) had earlier noted, "numeracy in journalism refers to the understanding of numbers and statistics for the purpose of minimizing common errors in journalistic reporting" (p. 2). This is consistent with several studies that perceive journalistic shortcomings as emanating from the inadequacy of skills in numeracy (Maier, 2002; Genis, 2001). A more closely and compounded definition comes from Peters (2020) who defines numeracy as "the ability to understand and use probabilistic and numerical concepts" (p. 5) among those with the ability to use numbers (objective numeracy) verses those who only prefer the use of numbers (subjective numeracy) regardless of their abilities. Generally, the process involves the use of huge datasets that are 'quantitatively analyzed' and interpreted either through visuals or narratives. As Appelgren & Nygren (2014) had put it, "data journalism stories are usually based on large data sets that often consist of public data or data collected with the aid of the general public, i.e., so-called crowdsourcing" (p. 394). Nonetheless, the plethora of definitions does not make it easy for understanding the distinctions between numeracy and digital/data journalism. What holds the two together is the quest for not only telling a compelling story, as Swain (2012) had suggested, but also for the purpose of telling a story that the audience understands and trusts as true (Gondwe, 2018; Appelgren & Nygren, 2014). This means that numbers that complicate a story to the audience are devoid of telling a true and credible journalistic story.

2.1 Numeracy as a form of credibility and trust in the news

Many scholars assert that numeracy in the news increases news story quality by creating a more in-depth approach (Borges-Rey, 2016; Appelgren & Nygren, 2014; Gray, Chambers & Bounegru, 2012, Maier, 2003). Maier (2002) asserts that innumeracy or the lack of numerical values in the news has been found to contribute to inaccurate and misleading news stories. For Maier, stories consisting of numeracy are more trusted that simple narratives with qualitative data. As he argues, stories of numeracy have provided a reliable confidence level of accuracy in reporting. Drawing from various findings Maier (2002) showed that empirical research supported his argument as indicated in the following statement:

> For example, Charnley's seminal accuracy study in 1936 found that only 6.3% of factual errors reported by news sources involved "numbers wrong," ranking fourth highest out of 12 error categ0ries.l' In a recent study, Maier found that "numbers wrong" represented 14.6% of factual errors, ranking third of 13 error categories.12 A content analysis of a Canadian daily newspaper revealed a very small proportion of numbers in news stories-about 3% of 2,053 calculations identified over a three-week period-contained mathematical errors or misrepresentations of data. (p. 922)

Other scholars have supported this observation, including most contributors in Nguyen's (2018) edited volume entitled, "News, Numbers and Public Opinion in a Data-Driven World". Central to their arguments is that numbers in the news provided readers with an understanding of what robust and thoughtful statistical reasoning can offer to journalism. However, several concerns can also be observed in the above arguments. First, the studies on accuracy of numeracy are not in comparison to other stories without numeracy. Second, several studies have shown that most people, because of being number-phobic, are likely to believe erroneous information presented with numbers (Peters, 2020). For example, Crettaz Von Roten (2016) pointed out that most statistical information in the media were used – this is because of the assumption that numbers amount to accuracy. Crettaz Von Roten observed through an analysis that most news stories provided misleading visual representations, incomparable data sets and misapplication of statistical terminology. This argument is consistent with Len-Ríos & Hinnant (2014) who found out that most stories with numerical values were replete with technical language, and that those with visuals seldom added to the understanding of the news. These conflicting arguments suggest that in both accounts, errors or inaccuracies lead to the lack of credibility and trust of the news media. This is because errors and

inaccuracies blur transparency in the news, therefore, impact the trust that people have for that organization (Fisher & Hopp, 2020).

2.2   Numeracy and journalism in Sub-Saharan Africa

Although the idea of numeracy in journalism stems way back in the history of news reporting, it is also true that most journalists around the world are number-phobic. This is also true in most sub-Sahara African countries where low levels of numeracy among journalists have been identified (Genis, 2001) As Brand (2008) had observed, "Low levels of numeracy among journalists in South Africa cannot be seen in isolation from broader social and educational problems facing the media in most sub-Saharan Africa" (p. 218). In support, De Beer and Steyn (2002: 13) argue that the 'core knowledge needed by journalists is changing', but the education and skills training of journalists have not adequately reflected this change. Some critiques have argued that an aversion to mathematics and the use of numerical values or quantitative data is a reason why some journalists choose journalism as their career (Gondwe, 2021a and b; Ferrucci, 2020; Harrison, 2020).

The early days of print media seemed to privilege numbers especially when it came to reporting military activities, mortality rates, and commodity prices (Harrison, p. 33). Such form of reporting required less manipulation or interpretation of data since it simply recounted numerical values in a binary. A few, but stipulated forms of reporting, such as "Financial/business reporting", did indeed need some advanced levels of understanding. The increasing prevalence of sports journalism in the nineteenth century, too, led to more statistics appearing in newspapers, again rarely requiring numeracy skills on the part of the journalist. Equally, election results also gave totals for each party. However, such kind of reporting was not for everyone, but those with special interests to the topic.

Regardless, the landmark of numeracy in journalism is attributed to Philip Meyer's 1973 *Precision Journalism* publication– now in its fourth edition (Meyer, 2002) in which the author idolized computer-assisted reporting (CAR). For Meyer (2002) the availability of datasets provided room for journalists to expand their sources from depending on humans, to extracting objective data from existing databases. Accordingly, he argued that "journalists had to be database managers, data processors, analysts and interpreters" (p.1). Similarly, Grundy et. al. (2012) had argued that, "If you thought getting into journalism was a good career choice because you hated doing mathematics at school, think twice" (p. 96). Despite this emphasis, the journalism curriculum did not fully emphasize the need for numeracy – therefore attracting a huge number of students that felt uncomfortable with numerical values. This trend was also transferred to

qualified journalists operating in the field. For example, MagScene (2020) observed that when most scholars and journalists are asked what skill other than writing is necessary for a good journalist, their response is as follows:

> You need to be enthusiastic, determined, have great ideas and you need to be able to get things done. Incredibly talented writers simply don't make it if they can't meet their deadlines. In an age of multi-media journalism, you also need to be skilled across a range of platforms, as well as be the face of your magazine at various events and networking functions. All round communicators are in strong demand (p. 30).

Obviously, skills for analyzing and interpreting data continue to be less emphasized in the practical process of professional journalism reporting. If acknowledged, most consider numeracy as only a tool for measuring the effectiveness of editorial content (Harrison, 2020) and handing quantitative information. In one of his chapters, "Numeracy's Secret connection with life outcomes", Peters (2020) asks, "Why should we care if people don't understand or use numbers well? After all, their physicians, financial advisors, friends or family can straighten them out" (p.101). While this is a relevant question to ask and a relevant assertion to make, it is also arguably true that this question begs more answers, when it comes to the field of journalism. Probably, the most relevant question is, whom do we write for? As you might have observed in the accounts above, the ideas of numeracy across the historical development, have ignored the role of the audience. This is not to suggest that the use of numeracy and data in news reporting is irrelevant, but that audience perceptions of numeracy in the news stories are as important as the role of journalists in effecting credibility through numeracy. To fill the gaps in literature, we ask the following question:

RQ: How do the audience/news consumers perceive news stories with numerical values?

And thus, we hypothesize that:

H1: News stories with numerical values diminish reader affective consumption of that news story.

The rationale behind this hypothesis lies in the idea that most news consumers are uncomfortable with stories accompanied by numerical (Except a few that have the ability and special interest in numbers (objective numeracy). Therefore, the more numbers are added to a news story, the less the story will appeal to the audience.

H2: *That there is a relationship between objective numeracy and attention to numbers; and that the relationships vary between the United States and Zambia and Tanzania.*

Hypothesis two (H2) aims at exploring the relationship that exists between individuals possessing the ability to understand the numbers (objective numeracy) and the attention they put they have for the numbers found in the story. In other words, those with interest and the ability to understand numbers will be attentive to the details and meanings of numbers in the news story than those with less ability to understanding numeracy in news stories. Therefore, we ask the following question. The US is especially included for two main reasons: Convenience, and for the purpose of comparing numeracy levels in different countries outside Africa.

3 METHOD AND MATERIALS

3.1 Data collection process

This study employed an experimental design to examine whether numeracy in a news story increases story trust and believability from the audience perspective. Data for this study were collected from Zambia, Tanzania, and the United States through a survey experiment after receiving Institutional Review Board (IRB) approval of the project in May of 2020. The data collection period was June through August 2020. Participants from the United States were recruited with an incentive from the Amazon Mechanical Turk (MTurk) population using TurkPrime. According to Buhrmester et al., (2011), TurkPrime is a managerial interface that helps researchers better ensure that obtained data are high quality. This assumption is supported by Litman et.al., (2016)'s study in which the authors were show that how "TurkPrime GUI environment provides improved functionality over MTurk in six general areas: control over who participates in the study, flexible control over running HITs, more flexible communication and payment mechanisms, tools for longitudinal and panel studies, tools to increase sample representativeness, and enhanced study flow indicators" (p. 434). However, external validity may be slightly problematic for Mturk samples (Berkinsky 2011) as respondents self-select based on the title of the survey, projected amount of time to complete the survey, and level of compensation offered.

On the other hand, participants from Zambia and Tanzania were recruited from avid readers and followers of online media platforms, particularly the *Jamii Forum* (a popular online news media platform in Tanzania) and *Mwebantu* online news. Both platforms host more than 50

million participants, and with more than 5,000 daily active participants. Participants from Zambia and Tanzania were invited with a request message to respond to email with an expression of interest to participate in the study. In both the United States and the sub-Saharan case, a pre-test questionnaire was provided to assess the quality of our respondents in terms of readership, age group (accepting only those above the age of 18), gender (to ensure that both genders were significantly represented, and location (to ascertain that participants were indeed living in Sub-Saharan Africa, and especially Zambia and Tanzania where this study was conducted from).The experiments in the three countries were all hosted on Qualtrics which was able to randomly assign respondents to the control or treatment groups run in conjunction with each other. This technique allowed for true randomization in each experiment rather than flagging a respondent as control or treatment at the beginning and having them follow that path in each of the experiments embedded into the larger survey. Bondrunova, et. al. (2016) approaches were utilized for determining authentic respondents online.

3.2   Sample selection process

A total sample of 387 from the United States, 219 from Zambia, and 267 from Tanzania complete responses were obtained ($N = 873$). The average age for the three countries were 33 years for the US ($SD = 4.49$), 27 years for Zambia ($SD = 2.87$), and 35 years for Tanzania ($SD = 5.72$). Gender was also scientifically divided with 61.3% representing the female US participants, 53.2% representing female participants from Zambia, and 47.6 % representing females from the sample in Tanzanian. Median completion time for the study in the three countries was 245, 331, and 203 seconds respectively.

Condition assignments also varied by country. In the US, 173 participants were randomly assigned to a control group while the remaining 214 served as an experimental group. Zambia had 100 randomized participants to a control group and 119 to an experimental group, and Tanzania had 121 in the control group and 146 in the experimental group. Most of all, before testing the hypotheses, we accounted for missing data based on overall responses. Little's (1988) MCAR test was used and indicated that the data were missing at random, $X^2(318) = 319.87$, $p > .52$. Thus, cases with missing variables were dropped, resulting in an analytical sample of $N = 873$ participants.

3.3 Stimuli Development

The experimental design consistent of three distinct stages. Participants were invited to the study via Amazon MTurk and through direct online contact in Zambia and Tanzania. Particularly, the Zambian and Tanzanian participants were invited through online platforms and asked to respond to an email provided to them expressing interest to participate in the study. In both the US and Zambia and Tanzanian cases, the respondents were promised an incentive. The respondents on MTurk received $ 0.15 cents and the Zambian and Tanzanian participants were entered into a draw to win $25 for the first four selected participants ($25 x 4 = $100). Second, respondents were asked to do a 10 -question quiz for the sake of assessing their knowledge and understanding of the COVID-19 pandemic. The criteria were that those who got above 70 percent of the results would be recruited for the study. Third, each of the recruited candidate was randomly assigned to either a treatment or control group. The Qualtrics was used to randomly assign respondents to the treatment or control group.

For each country, one treatment groups and one control group were generated for the experiment. The treatment groups were exposed to a news story about COVID-19 from the New York Times published on June 30, 2020 by Carl Zimmer[1]. We picked a story that addressed the issue of a global pandemic and that was easy to manipulate for numeracy purposes. The idea behind was for all the participants to feel included in the story. This allowed for objective responses from the respondents. Therefore, we stripped of all the identifiers from the story – i.e., story source and author. Then we rewrote the same story in two forms. The first form included a traditional style by which we qualitatively rewrote the story to exclude all forms of numeracy. In other words, this kind of rewriting focused on giving the narrative without the numbers even when the numbers were in the original story. The second rewrite focused on numeracy in the story but deliberately infusing the story with inaccurate numbers, therefore, changing the whole narrative of the story.

On the other hand, the control group received the same but original data-driven news story, and the accurately qualitatively rewritten one that was also offered to the treatment group. Then both the treatment and control groups were asked to respond to the same survey provided to them. In each case, story believability was measured through message attitude, knowledge and understanding of the COVID-19 pandemic, appeal, and story trust or news trust. These variables were operationalized through various survey questions drawn from several scale measures.

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[1] https://www.nytimes.com/2020/06/30/science/how-coronavirus-spreads.html

3.4 Measures and manipulation of variables

Since this research is cross-national, two measures were used for the purpose providing an objective assessment to the participants from three countries under study. 1. *Objective numeracy:* simply referring to the actual ability and skills to understand numbers in the news and 2. *Subjective numeracy:* as the preference for numbers in the news even when one has limited numeracy skills. The two measures were weighted on the variables of numeracy, message attitude, knowledge and understanding of the COVID-19 news story, appeal of the story, and news trust. Essentially, we developed a survey questionnaire aimed at gauge the readers' perceptions, attitudes, and trust of the news item presented to them. In other words, we wanted to know what news story the readers thought was more authentic, appealing, and credible. This was done by gauging the reader's reaction affect to the story provided, and how that news story influenced affective responses. The two affective measured were tied to numeracy, message attitude, knowledge and understanding of the COVID-19 news story, appeal of the story, and news trust.

*Numeracy***:** Drawing from Hopp (2015)'s study, a seven-item item measure was constructed using items taken from scales previously validated by Lipkus, Samsa, and Rimer (2001) and Frederick (2005). Essentially, we wanted to examine the understanding levels of numeracy among the readers and whether their trust in numbers is informed by that understanding. Therefore, some questions asked were like, "Imagine that we rolled a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)? The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected? Which of the following numbers represents the biggest risk of getting a disease? ___ 1 in 100, ___ 1 in 1000, _X_ 1 in 10". The responses for all the three countries are presented in the in the findings below.

Message attitude: Message attitude was measured on a six-item scale placed on a 7-point semantic differential scale. This scale had anchored items such as easy to read/not easy to read, Clear/unclear, reliable/unreliable.

Knowledge and understanding of the COVID-19 news story: We drew our assessment of the knowledge of COVID-19 from the 'Avert'*COVID-19 Quiz (https://www.avert.org/take-our-covid-19-quiz)*. Avert is a website providing access to online testing of your knowledge of various pandemics, including COVID-19. Essentially, the quiz asked basic multiple-choice questions about the COVID-19. The idea is to assess the knowledge that individuals have regarding the COVID-19 pandemic. Although some questions were more frame in the US context, most of them were general

and, therefore, reflected one's knowledge of the pandemic. For example, questions like "True or False: A person who has no symptoms of COVID-19 is not a risk to others; People under the age of 35 can get infected" were asked. Responses were recorded as either a zero (0) for an incorrect response or a one (1) for a correct response.

Appeal: Stories were also examined through the appeal variable. That is, whether a story with numeracy was more appealing to the audience that the one without numeracy. This measure is important because it helps examine whether there is a rational reason for believing in a news story provided to the participants other than the fact that it has numbers. In other words, this question about appeal is asked for the purpose of gauging the support of one story over the other without the implications of the audience trust of a story based on numeracy or source.

Story/News trust: News trust is used as a variable because the nature of trust allows for the measurement of the general perception in theory and performance (Riggs, 2017, p. 41). While a question could be directly asked about how the participants think of a particular news story (i.e., whether they trust it or not), it is also questionable as to whether the respondents will give a biased response. To avoid the biases, news trust was measured on 12 items (each on 7-point scales) as Hopp, et. al (2020) and Kohring and Matthes (2007) had earlier assessed. Although this measure has been used in general terms, we twisted the questions to fit our objectives and attend to questions pertaining to COVID-19.

4 FINDINGS

To examine the impact of the predictor variables on our multiple dependent variables, path modeling was used. Our analysis of the fit indices indicated that the data from all the three countries did fit the model acceptably well. The US data was represented by $\chi^2 = 23.41$, $df = 17$, $\chi^2/df = 1.51$, $p > .13$; $CFI = .97$; $RMSEA = .02$ $(90\%_{CI} = .00. .05)$; $SRMR = .05$; the Zambian data by $\chi^2 = 19.62$, $df = 13$, $\chi^2/df = 1.09$, $p > .11$; $CFI = .95$; $RMSEA = .04$ $(89\%_{CI} = .00. .03)$; $SRMR = .07$; and the Tanzanian data had $\chi^2 = 20.83$, $df = 15$, $\chi^2/df = 1.22$, $p > .10$; $CFI = .94$; $RMSEA = .03$ $(90\%_{CI} = .00. .06)$; $SRMR = .05$, as their model fit.

Hypothesis 1 (H1) held that news stories with numerical values will diminish reader affective consumption of that story. The findings support H1 as observed in the heightened levels of negativity elicited in the affective consumption of the story among the respondents. After controlling for significant effects of numeracy in all our sampled data, the path between the manipulation (coded as 0 = low potential of diminishing reader affective consumption, and 1 = high potential) and audience perception of the story was generally significant, *($\beta = .62$, p.01)*. However, compared to samples from Zambia *(($\beta = .79$, p.01)* and Tanzania *($\beta = .66$, p.01)* data from the US *(β

= .42, p.05) showed lower levels of significance to suggest that numerical values in the news story, though significant, had little effects in diminishing readers affective consumption of the story. Hypothesis 2 (H2) held that there is a relationship between numeracy and attention to numbers; and that the relationships vary in the United States, Zambia, and Tanzania. To measure this relationship, we looked at the significant effects of objective (actual ability to deal with numerical values) and subjective numeracy (Just a preference for numbers). After performing multilevel SEM analyses, findings indicate that individuals with higher objective numeracy felt more comfortable and looked for numeric information in the news stories than individuals with lower and/or subjective numeracy. This was especially true in data sampled from the United States where most individuals indicated higher levels of understanding probabilistic and numerical concepts in their everyday lives.

As **table 1** below indicates, participants in all the three countries did not do well in converting proportions into percentages. Particularly, only 38% (332 respondents) of the total sample (873 respondents) got the third question in the table below correct. This means that 541 respondents did get it wrong. Specific results for each country support the above findings indicating that that an average of 25% of the US sampled population failed to solve both basic probability problems and/or convert a percentage to a proportion as opposed to the 57%% and 47% from Tanzania and Zambia respectively. This conclusion was arrived at after dichotomizing the item responses to the general and expanded numeracy questions as either correct (1) or incorrect scored (0). Essentially, the number of times respondents attended to numerical values in the news seemed to compulsively mediate the association of objective numeracy. However, variations were observed among the three countries. While respondents from the United States seemed to pay more attention to numbers, individuals from Zambia and Tanzania showed less interest in attending to the numbers in the story.

Research question one (RQ1) asked an 'all-encompassing question': How does the audience/news consumers perceive news stories with numerical values? In response we examined the attitude that the audience had to the message with numerical values versus one without numerical values, whether stories with numerical values appealed to the audience, and the trust shown by the audience for story with numerical values. Findings from all the three countries (USA, Zambia, and Tanzania) suggest that the relationship between audience perception of a news story and message attitude was moderated by numeracy in the sense that higher levels of numerical values in the news story amplified the negative relationship between audience perception and message attitude. Numeracy, $\beta = -.19$, $p<.01$, and message attitudes $\beta = -.14$, $p<.01$, were negatively related to how the audience perceived a news story in numbers

in all the three countries. This is also true for the appeal variable in the three countries in the sense that stories with numerical values were negatively and significantly perceived to have less appeal *(β = -.26, p<.01)* to the audience.

Table 1: Percentage of correct responses to Risk Numeracy questions

	USA	ZM	TZ
	(n = 387)	*(n = 219)*	*(n = 267)*
Question			
General numeracy scale items			
Imagine that we rolled a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)? *Answer: 500 out of 1000.*	68.2%	53.6%	59.4%
In the LOTTERY, the chances of winning a $10.00 prize is 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single lottery ticket? *Answer: 10 persons out of 1000.*	78.36%	60.3%	55.4%
In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets to ACME PUBLISHING SWEEPSTAKES win a car? *Answer: 0.1%*	21.5%	7.42%	9.08%
Expanded numeracy scale items			
Which of the following numbers represents the biggest risk of getting a disease? ___ 1 in 100, ___ 1 in 1000, _X_ 1 in 10	51.7%	44.3%	59.6%
Which of the following numbers represents the biggest risk of getting a disease? ___ 1%, _X_ 10%, ___ 5%	85.1%	38.2%	47.8%
If Person A's risk of getting a disease is 1% in ten years, and person B's risk is double that of A's, what is B's risk?	87.9%	32.02%	40.3%
If Person A's chance of getting a disease is 1 in 100 in ten years, and person B's risk is double that of A's, what is B's risk? *Answer: 2 out of 100*	83.5%	46.8%	56.9%
If the chance of getting a disease is 10%, how many people would be expected to get the disease: A: Out of 100? *Answer 10* B: Out of 1000? *Answer 100*	96.4%	37.8%	86.7%
If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease. *Answer: 20*	88.3%	55.6	43.2%
The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected? *Answer: 5 people*	90.2%	59.4%	66.8%

Note: USA = United States, ZM = Zambia, TZ =Tanzania. Also, we drew from Lipkus, Samsa, & Rimer (2001) and performed the following "Before answering the numeracy questionnaires, as a practice question, participants were asked, imagine that we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips? This question was part of the general numeracy questionnaire by Schwartz and colleagues.6 The die question was used as a practice question in their study. Questions that were left blank were assessed as being incorrect" (p.40)

Specifically, findings indicate that numerical values in the news seemed to strengthen the negative effects of the appeal variable among the audience. More importantly, it was observed that numeracy was negatively associated with the appeal variable when evaluated on a simple slope. Particularly, in the data from Zambia and Tanzania, the appeal variable at two-standard deviations was above the numeracy score (b = -0.73, p <.001; at one standard deviation above the numeracy score *(b = -0.54, p<.001)*; and at another one standard deviation below the mean numeracy score *(b = -0.17, p.<.05)*. However, the US data, the appeal variable at two-standard deviations was below the mean numeracy score *(b =0.02, p. = .81)* to suggest that numeracy was not a major general significant variable to audience appeal.

Ironically, the three countries under study seemed to have more trust in news stories with numbers in them. The trust was stronger among the Zambian respondents *(β = 1.34; SE = 0.63; p<.001)*, and Tanzania *(β = 0.58; SE = 0.51; p<.001)*, than the sample from the United States *(β= 0.51; SE = 0.43; p<.05)*. This means that although numeracy did not seem to appeal to audience perception of a news story, their trust for the news item did not faulter. Given the fact that there was a strong correlation between subjective numeracy and story trust (i.e., Zambia that recorded less in objective numeracy seemed to have more trust in stories with numeracy) it is likely that people trusted information without subjecting it to a critical lens.

5   DISCUSSION AND CONCLUSION

This study set out to better understand audience perception of numeracy in journalism. Throughout the literature, we were able to show how numeracy has become a necessity for journalistic practice and the quest for improved credibility. The study also identified the gaps brought about by such a quest – whether the use of numerical values coincides with audience perception of those numbers. Using data from Zambia, Tanzania, and the United States, we were able to demonstrate that the use of numerical values in a news story diminished story appeal. However, this did not seem to alter the trust the audience had on that story. Zambia, for example, where most individuals recorded understanding and interpreting of numerical values in the news story, showed more trust for the same news story than Tanzania and the United States that respectively recorded moderately higher understanding of numeracy. Overall, findings suggest that the audience perception of the news story was negatively associated to numeracy. However, the levels of perception differed in the three countries, with the United States (that had more participants with higher numeracy levels of understanding) recording less negativity of audience perspective of numeracy in the news, followed by Tanzania and Zambia respectively.

Two primary dichotomous implications emanate from this study's results. First, that numbers diminished audience/consumers appeal of a news story; and second that the less people understood the numbers, the more they seemed to trust a news story. Such findings pose a rather relevant question that Peters (2020) had earlier hinted on. Whom do numbers serve in a news story between the writer and reader? If it is the writer, then the implications have little or no effects. But if it is the reader and/or both the reader and the writer, then use of numeracy in the news has more implications that need to be attended to. Primarily, as journalism seeks to improve its credibility and believability using numeracy, there is also a need to understand what story appeals to the audience and whether the strategies used are designed with a purpose of telling a clear and concise story to the audience. Gondwe (2021) had asked, what does it mean to tell a journalistic story? Accordingly, it is by using methods that the audience understands better – going beyond the use of numerical values (unless they offer a better explanation) to include narratives that resonate with people's abilities to understand the essence of the intended message in the story. Just as most journalists are number-phobic, so are most audience members. Therefore, while numbers can improve the accuracy of a story, the fact that they limit readership and diminish audience appeal renders them useless. This is because journalists write for an audience – if that audience cannot understand what you are writing, then your message is irrelevant.

The study was posed with some limitations that which might have affected our results. First, the data collect process and the online nature of the measurement tools used, limited our ability to control the testing environments of our experiments. While the data collection process could be more established in the United States, Zambia and Tanzania's online information are posed with various intervening and confounding variables that might make the interpretation of data less generalizable. Further limitations might include the questioning of causal sequences with our predictor variables. Nonetheless, these limitations do not in any way discredit the reach findings of this study but call for an extensive and polished approach. Introspectively, the current study recommends possible pragmatic alternatives for merging journalists' ideas of improving news stories through numeracy, with audience's appeal and approval of such news stories. As Ashby (2017) had noted, "ensuring that both parties encounter the same amount of information diminishes the effect of numeracy on choice alignment" (p.135). Thus, there is need to find strategies that bring together a mutual understanding of numeracy between journalists and their audience. This could be done by using simplified visual aids that most audience could interpret without a complicated ability to understand and use probabilistic and numerical concepts (note: that's the definition for numeracy). For this reason, future research should continue

to explore and emphasize ways that "less numerate individuals can be nudged toward more efficient and deliberative information search, so that they too might become more independent and skilled decision makers" (Ashby, p. 135).

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REFERENCES

Appelgren, E., & Nygren, G. (2014). Data Journalism in Sweden: Introducing new methods and genres of journalism into "old" organizations. *Digital Journalism*, 2(3), 394-405. doi.org/10.1080/21670811.2014.884344

Ashby, N. J. (2017). Numeracy predicts preference consistency: Deliberative search heuristics increase choice consistency for choices from description and experience. *Judgment and Decision making*, 12(2), 128.

Ausserhofer, J., Gutounig, R., Oppermann, M., Matiasek, S., & Goldgruber, E. (2020). The datafication of data journalism scholarship: Focal points, methods, and research propositions for the investigation of data-intensive newswork. *Journalism*, 21(7), 950-973. doi.org/10.1177/1464884917700667

Bodrunova, S. S., Blekanov, I. S., & Maksimov, A. (2016, November). Measuring influencers in Twitter ad-hoc discussions: active users vs. internal networks in the discourse on Biryuliovo bashings in 2013. In 2016 *IEEE Artificial Intelligence and Natural Language Conference (AINL)* (pp. 1-10). IEEE.

Borges-Rey, E. (2016). Unravelling data journalism: A study of data journalism practice in British newsrooms. *Journalism Practice*, 10(7), 833-843. doi.org/10.1080/17512786.2016.1159921

Brand*, R. (2008). The numbers game: A case study of mathematical literacy at a South African newspaper. *Communicatio: South African Journal for Communication Theory and Research*, 34(2), 210-221. doi.org/10.1080/02500160802456155

Cassidy, William P. "Online news credibility: An examination of the perceptions of newspaper journalists." *Journal of Computer-Mediated Communication* 12.2 (2007): 478-498. doi.org/10.1111/j.1083-6101.2007.00334.x

Coddington, M. (2015). Clarifying journalism's quantitative turn: A typology for evaluating data journalism, computational journalism, and computer-assisted reporting. *Digital journalism*, 3(3), 331-348. doi.org/10.1080/21670811.2014.976400

Crettaz von Roten, F. (2016). Statistics in Public Understanding of Science review: How to achieve high statistical standards? *Public Understanding of Science*, 25(2), 135-140. doi.org/10.1177/0963662515595195

De Beer, A.S. and E. Steyn. 2002. Sanef's '2002 South African national journalism skills audit'. *Ecquid Novi* 23(1): 11–86. doi.org/10.1080/02560054.2002.10798725

Diakopoulos, N., & Koliska, M. (2017). Algorithmic transparency in the news media. *Digital Journalism*, 5(7), 809-828. doi.org/10.1080/21670811.2016.1208053

Ekström, M., & Westlund, O. (2019). The dislocation of news journalism: A conceptual framework for the study of epistemologies of digital journalism. *Media and Communication*, 7(1), 259-270. doi.org/10.17645/mac.v7i1.1763

Ferrucci, P. (2020). It is in the numbers: How market orientation impacts journalists' use of news metrics. *Journalism*, 21(2), 244-261. doi.org/10.1177/1464884918807056

Ferrucci, P., & Vos, T. (2017). Who's in, who's out? Constructing the identity of digital journalists. *Digital Journalism*, 5(7), 868-883. doi.org/10.1080/21670811.2016.1208054

Fisher, J., & Hopp, T. (2020). Does the Framing of Transparency Impact Trust? Differences Between Self-Benefit and Other-Benefit Message Frames. *International Journal of Strategic Communication*, 14(3), 203-222. doi.org/10.1080/1553118X.2020.1770767

Franklin, B. (2014). The Future of Journalism: In an age of digital media and economic uncertainty. *Journalism Studies*, 15(5), 481-499, DOI: 10.1080/1461670X.2014.930254

Genis, A. (2001). *Numbers count: the importance of numeracy for journalists* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Gondwe, G., & White, R. A. (2021). Data Journalism Practice in Sub-Saharan African Media Systems: A Cross-National Survey of Journalists' Perceptions in Zambia and Tanzania. *African Journalism Studies*, 1-16.

Gondwe, G., Muchangwe, R., & Mwaya, J. E. (2021). Motivations for Social Media Use and Consumption in Zambian Online Platforms. In *Analyzing Global Social Media Consumption* (pp. 204-215). IGI Global. DOI: 10.4018/978-1-7998-4718-2.ch011

Gondwe, G. (2021). News worthiness and Public trust in sub-Sahara African: Examining the impact of tabloid journalism in Zambia. *Journal of Media and Communication Studies*, 13(1), 12-22. doi.org/10.5897/JMCS2020.0720

Gondwe, G. (2018). News Believability & Trustworthiness on African Online Networks: An Experimental Design. International *Communication Research Journal*, 53(2), 51-74.

Gray, J., Chambers, L., & Bounegru, L. (2012). The data journalism handbook: How journalists can use data to improve the news. O'Reilly Media, Inc.

Harrison, S. (2020). *A Study into the Value Placed on Numeracy as Symbolic Capital Within the Journalistic Field* (Doctoral dissertation, Liverpool John Moores University).

Hopp, T. (2015). The effect of numeracy on the relationship between state reactance and message evaluations. *Communication Research Reports*, 32(4), 314-321. doi.org/10.1080/08824096.2015.1089855

Jones, J., & Salter, L. (2011). *Digital journalism*. Sage.

Kawamoto, K. (Ed.). (2003). *Digital journalism: Emerging media and the changing horizons of journalism*. Rowman & Littlefield Publishers.

Kerunga, J., Rowe, E., & Gondwe, G. (2020). Journalism Credibility in the digital age–Examining shifts in paradigms. Available at SSRN 3641943.

Lecheler, S., & Kruikemeier, S. (2016). Re-evaluating journalistic routines in a digital age: A review of research on the use of online sources. *New media & society*, 18(1), 156-171. doi.org/10.1177/1461444815600412

Len-Ríos, M. E., & Hinnant, A. (2014). Health literacy and numeracy: A comparison of magazine health messages. *Howard Journal of Communications*, 25(3), 235-256. doi.org/10.1080/10646175.2014.922909

Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical decision making*, 21(1), 37-44. doi.org/10.1177/0272989X0102100105

Maier, S. R. (2003). Numeracy in the newsroom: A case study of mathematical competence and confidence. *Journalism & Mass Communication Quarterly*, 80(4), 921-936. doi.org/10.1177/107769900308000411

Molyneux, L., & Coddington, M. (2020). Aggregation, clickbait and their effect on perceptions of journalistic credibility and quality. *Journalism Practice*, 14(4), 429-446. doi.org/10.1080/17512786.2019.1628658

Nguyen, A. (Ed.). (2017). *News, numbers and public opinion in a data-driven world*. Bloomsbury Publishing USA.

Nguyen, A., & Lugo-Ocando, J. (2016). The state of data and statistics in journalism and journalism education: Issues and debates. *Journalism*, 17(1), 3-17. doi.org/10.1177/1464884915593234

Peters, E. (2020). *Innumeracy in the wild: Misunderstanding and misusing numbers*. Oxford University Press.

Pickard, Victor, and Alex T. Williams. 2014. "Salvation or Folly? The Promise and Perils of Digital Paywalls." *Digital Journalism* 2(2): 195–213. doi:10.1080/21670811.2013.865967.

Riggs, T. S. (2017). *Using Experimental Design to Test the Effect of Campaign Donation Knowledge on Interpersonal Political Trust in the United States* (Doctoral dissertation, Central European University).

Stalph, F., & Borges-Rey, E. (2018). Data journalism sustainability: An outlook on the future of data-driven reporting. *Digital Journalism*, 6(8), 1078-1089. doi.org/10.1080/21670811.2018.1503060

Tiede, K. E., Bjälkebring, P., & Peters, E. (2020). Numeracy, numeric attention, and number use. http://www.sjdm.org/presentations/2020-Poster-Tiede-Kevin_E.-Numeracy-Attention-NumberUse~.pdf. Retrieved, December 12th, 2020.

Vis, Farida. 2013. "Twitter as a Reporting Tool for Breaking News: Journalists Tweeting the 2011 UK Riots." *Digital Journalism* 1(1): 27–47. doi:10.1080/21670811.2012.741316.

Westlund, Oscar. 2013. "Mobile News: A Review and Model of Journalism in an Age of Mobile Media." *Digital Journalism* 1(1): 6–26. doi:10.1080/21670811.2012.740273.

FEATURE ANALYSIS: A METHOD FOR ANALYZING THE ROLE OF IDEOLOGY IN APP DESIGN

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ABSTRACT

Many apps are designed to solve a problem or accomplish a task, such as managing a health condition, creating a to-do-list, or finding work. The solutions that app developers offer reflects how they believe that users and other stakeholders understand the problem. Each individual developer may have different ideas but analyzing many apps together can reveal the average or typical ways that developers in the set think about the problems that their apps are designed to solve. Building on content analysis, interface analysis, the concept of affordances, and speculative design, this article offers a new method that we call "feature analysis" to analyze what a set of apps designed to solve the same problem can tell us about the relationship between app design and ideology. By counting and classifying the features in a set of apps, feature analysis enables researchers to systematically answer questions about how app developers' design choices reflect existing cultural norms, assumptions, and ideologies.

Keywords: app studies; mobile apps; software studies; content analysis; affordances.

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INTRODUCTION

"Want to Stop Rape? There's an App for That," claimed a headline in the politics section of *Mother Jones* magazine (Pasulka, 2012). The article focused on an app called Circle of 6, which has also been described in *Wired* as "the 21st century rape whistle" (Lapowsky, 2014). We saw these headlines and wondered, could apps really help prevent rape? We were curious how developers'[1] assumptions about the nature of sexual violence might show up in the design of these kinds of apps. When we found over 200 of them, we designed a study to answer these questions (Bivens and Hasinoff, 2018). Through that process, we developed a method we call "feature analysis" to systematically answer questions about how app developers' design choices reflect existing cultural norms, assumptions, and ideologies. The method involves counting and classifying the features in a set of apps intended to address the same social problem. This article describes the method of feature analysis by first situating it in the literature on apps and other technologies and then describing the four phases of the method. We conclude by discussing some complementary methods and feature analysis' unique contributions.

A range of scholars demonstrate that despite often appearing neutral and objective, many technologies reproduce and reinforce social hierarchies and systemic inequalities, including, for example, Google search algorithms (Noble, 2018), facial recognition software (Buolamwini and Gebru, 2018), airport security body scanners (Costanza-Chock, 2018; Magnet and Rodgers, 2012), and automated systems for determining public service benefits such as welfare (Eubanks, 2018). This kind of work often examines the discriminatory outcomes of these technologies and focuses on investigating and describing how they impact users. Feature analysis offers one way to gain insight into the design choices—specifically in apps— underlying the kinds of discriminatory outcomes that these other scholars have demonstrated.

Research on how racism, sexism, and other forms of systemic discrimination are embedded in the design of technologies reinforces the insight from science and technology studies that "culture has always been technological and technologies have always been cultural" (Slack and Wise, 2005, p. 9). "Culture" here means a "socially shared symbolic system of signs and meanings" (Balsamo, 2011, p. 5). This shared symbolic system includes dominant ideologies – the widely held beliefs that typically justify the status quo and existing social arrangements—as well as residual norms and habits and emergent ideas. Our method of feature analysis is built on

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[1] In this paper we use the term "developer" to mean anyone who is involved in the creation and marketing of an app. For some apps, the coding, interface design, and marketing are handled by separate teams of people while for others one person completes all these tasks.

the understanding that culture—particularly the dominant, taken-for-granted ideas about a particular social problem—shapes technological development, becomes embedded within technologies, and suggests intended users and uses. For example, the cultural notion of a gender binary is built into airport security body scanners, thus employees operating the devices must select "male" or "female" for each passenger. Because this design does not anticipate trans and nonbinary travelers, they face higher rates of false positives and undue burden passing through airport security systems (Costanza-Chock 2018). As Balsamo (2011) argues, "Through the practices of designing, cultural beliefs are materially reproduced, identities are established, and social relations are codified" (p. 3). Feature analysis stresses the interdependence of culture and technology by offering a technique for uncovering the role of ideology in one practice of technological design: app development. It does this by allowing researchers to analyze how a set of app developers working to create solutions to the same issue translate ideas about social problems and assumptions about users into designed objects.

While there are many studies of apps, most of the work on large sets of apps is not intended to investigate the relationship between app design and dominant ideologies. Many primarily quantitative studies examine health-related apps, and their goals are generally to assess the apps' quality and effectiveness, including which ones people should use, what features are missing in the available apps, and how some proportion of health apps are inaccurate or fail to follow most or any of the clinical recommendations. One review of research on health apps found that 79% of studies assess apps' clinical or scientific basis (Grundy, Wang, and Bero, 2016), and researchers taking this approach typically focus on how well apps' design features fulfill established treatment guidelines.

Meanwhile, the studies of apps that do focus on the relationships between design and ideology typically use qualitative approaches to examine just one or a few apps. Researchers use methods from internet studies, cultural studies, and critical discourse analysis to analyze individual apps, interfaces, and websites in detail. For example, one study of the features and marketing of seven self-tracking sexual and reproductive health apps finds that they reflect normative assumptions about gender and sexuality (Lupton, 2015). Further, in Morris and Murray's (2018) preeminent collection of qualitative research on apps, many authors take media and cultural studies approaches to examine individual apps "as vectors for the production, transmission, and interactions of culture" (p. 3). For example, Schüll's chapter on the weight-loss app LoseIt! examines "the assumptions about human agency and the technological mediation of health that inhere in the app's design logic, marketing appeals, functional affordances, and user practices" (2018, p. 103). Feature analysis shares this

collection's fundamental orientation to apps as "vectors of culture" but allows researchers to investigate a large set of apps.

One common qualitative approach to studying apps is to examine their interfaces. As Dieter and coauthors (2019) explain, "Enquiries into interfaces can tell us not only about the apps but also about the expectations that those interfaces have of users and how certain ideas about users are designed into those apps" (p. 4). In particular, the "walkthrough" (Light, Burgess, and Duguay, 2018) is a qualitative method that allows researchers to systematically document the interface in one or more apps to investigate design from the perspective of an app user. As Light, Burgess, and Duguay (2018) explain: "By walking through the app's registration, everyday use and deletion, this technique allows for recognition of embedded cultural values in an app's features and functions" (p. 896). For Light, Burgess, and Duguay (2018), culture can manifest in design in a variety of ways, which they analyze primarily as the characteristics of the "mediators"[2] in an app. These characteristics include the arrangement of the interface, such as "how the app guides users through activities via the placement of buttons and menus," the functions and features of an app "that mandate or enable an activity," the textual content of the app, and its symbolic aspects, including "the look and feel of the app and its likely connotations and cultural associations" (Light, Burgess, and Duguay, 2018, pp. 891-892). They explain that these characteristics "are embedded with culture because their meanings exist in reference to cultural texts and understandings that exist outside the app" (Light, Burgess, and Duguay, 2018, p. 891).

Researchers have examined how apps and website interfaces imagine and assume particular users, uses, and contexts in a range of ways. For example, Stanfill's (2015) discursive interface analysis investigates the "functionalities, menu options, and page layouts" (p. 1059) of website interfaces to consider "how technologies both arise from particular beliefs about what [u]sers ought to do and reinforce them by constraining the actions of site visitors" (p. 1071). Other studies investigate app interfaces and features alongside the materials produced by and about apps to consider how apps imagine their users and uses. A study of the family location tracking app Life360, for example, analyzes the apps' accompanying website, press releases, FAQs, and user reviews of the app (Hasinoff, 2017). Some researchers also investigate how developers choose to market their product to users and to potential advertisers. Bivens and Haimson (2016), for example, took on the role of "potential advertiser" to explore how the identity categories programmed into the interface built for users of an app differ from those in the interface built for advertisers.

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[2] Here they refer to Latour's (2005) concept of a "mediator" as an actor that transforms meaning; in contrast, an "intermediary" passes along meaning unchanged.

Further, Light, Burgess, and Duguay's walkthrough method involves analyzing the "environment of expected use," which includes the intent, monetization, and rules of an app. They suggest that researchers analyze the "vision" of an app, which includes "its purpose, target user base and scenarios of use, which are often communicated through the app provider's organisational materials" (Light, Burgess, and Duguay, 2018, p. 889). They also suggest that researchers interested in how apps imagine users examine the "governance" (Light, Burgess, and Duguay, 2018) of apps by examining their terms of service and other policies and guidelines. This "governance" perspective can provide insight on how apps construct their legal relationship with users, including how users' personal data is retained and distributed, what constitutes acceptable use, and how developers attempt to limit their legal liability.

Feature analysis builds on the close attention other scholars pay to app interfaces and the ways culture is embedded in app design by specifically concentrating on features and applying an analysis of the mechanisms and conditions of those features' affordances (Davis, 2020; Davis and Chouinard, 2017). This allows researchers to focus on analyzing developers' assumptions about the range of appropriate or reasonable actions an app can take to solve a problem, which we discuss in detail in Phase Three below. Using this framework of "affordances" to quantify the imagined conditions for a feature to effectively work against a social problem, researchers can examine developers' choices in aggregate in a large set of apps. As Davis explains:

> Technologies are designed, implemented, and used through webs of choices. Some of these choices are explicit and reflect a clear intention for the technology to affect human action in some specific way. Other choices are implicit and may not ever enter the conscious minds of designers, distributors, or end users. Each choice—explicit or implicit—reflects and affects value orientations, sociostructural arrangements, and social dynamics. (Davis, 2020, p. 14)

Feature analysis demonstrates the choices developers have made to create features that they think will be compelling solutions to users and/or to investors and granting agencies. Further, by using speculative design in the final phase of feature analysis to imagine fictional apps that use existing technologies in different ways, researchers can explore the proportional influence of cultural, technological, and other constraints on design.

In what follows, we explain how feature analysis builds on and intervenes in a range of existing methods for studying media in general and for investigating the cultural and ideological aspects of design and technology. We divide feature analysis into four phases: (1) identify a social problem and find apps that attempt to address it; (2) identify the features

that each app offers; (3) categorize how the features address the problem; and (4) use speculative design to imagine alternative apps. We describe each phase by first situating feature analysis in the existing literature and then explaining the concrete steps for applying the method in that phase. Throughout the article, we use our study of anti-rape apps (Bivens and Hasinoff, 2018) as an illustrative example.

1 PHASE ONE: CHOOSE A PROBLEM AND USE KEYWORDS TO FIND APPS

In the first phase of feature analysis, researchers select an issue or problem and find the apps designed to address it. Feature analysis builds on work in media studies investigating how cultural objects reflect and uphold taken-for-granted ideas and existing social orders. For example, a content analysis of reality TV shows about policing can demonstrate that people of color are disproportionately represented as criminals (Oliver, 1994). In particular, feature analysis builds on cultural and media studies' traditions of investigating how popular media construct social problems. For example, one of the foundational works of cultural studies is a study of how journalists (and police) misrepresented the problem of "mugging" (Hall et al., 1978). Framing is a related model for analyzing how news promotes and reflects particular understandings of the world:

> To frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described. (Entman, 1993, p. 52)

In this model, journalists "select" and "highlight" aspects of a "perceived reality" according to professional and organizational norms. In the context of apps, feature analysis builds on framing by considering app developers as authors of cultural texts that define problems, offer interpretations, and propose solutions. These models investigate and highlight how social values shape communication choices—and with feature analysis, design choices as well—which in turn shape social values. As Carey (1989) explains: "Communication is a symbolic process whereby reality is produced, maintained, repaired, and transformed" (p. 23). Feature analysis investigates how app design is a form of communication in these terms.

Building on these frameworks, feature analysis can help illuminate which social problems and what type of solutions designers believe will be marketable in an app. Indeed, Lupton (2014) urges researchers studying health apps to view them as sociocultural artefacts. She observes that "the content and use of health and medical apps can tell us much about which

types of illnesses and health conditions are considered important at a particular moment and what medical or health promotion strategies are privileged to prevent or treat these conditions" (Lupton, 2014, p. 611). One example of this approach compares the actual prevalence of health conditions in the population to the number of apps addressing those conditions, finding that while "diabetes and depression have an overwhelming number of apps and research, there is a lack of apps related to other conditions, such as anemia, hearing loss, or low vision" (Martínez-Pérez, de la Torre-Díez, and López-Coronado, 2013). Indeed, researchers would expect that a set of cultural objects does not mirror actual or measurable cultural, social, or material conditions—such as disease prevalence in a population or the racial demographics of the people who commit burglaries—but instead reflects the beliefs and assumptions about these issues. As such, the value of this kind of work, including feature analysis, is that it can assess and interpret the nuances of what these inaccuracies or inconsistencies can tell us about society, ideology, and dominant cultural assumptions.

1.1 Steps for Phase One

To create a set of apps, researchers can begin with an initial list of apps from any source, such as media coverage or a funders' campaign, or simply with a list of common terms that describe the problem in question. For our study, we began with a list of apps from the US Department of Health and Human Services' 2011 "Apps Against Abuse" initiative and developed a list of search terms from their descriptions. We used those terms to search the app store, and eventually developed a longer list of keywords (ultimately 13 in total) by examining the titles and descriptions for apps from our ever-growing list. We also found some apps in media coverage (ie. "The 10 best safety apps for women") as well as directory sites like App Annie. Gerlitz and coauthors (2019) also suggest that researchers should carefully consider app titles because developers are strongly encouraged by app store guidelines to write "accurate and focused titles and descriptions to cover what the app is about" (p. 6). Researchers should describe their process and rationale for the chosen search terms, given that neither their choices nor the search results will be neutral or objective (Noble, 2018; Rogers, 2013).

Next, develop a set of inclusion criteria that meet the study's goals (such as language, region, or current availability) and whether the app's title and/or description states or implies that it is intended to address the problem in question. Our study analyzed all the English anti-rape apps we could find in the Apple and Android app stores because our aim was to collect as complete a set as possible. Researchers could develop a method for limiting the set of apps (e.g. most downloaded, highest search-ranked,

etc.) as long as they provide a rationale for each choice and consider the resulting implications for their analysis.

Searching app stores on a mobile device replicates how many users might find apps, but these search engine results likely do not actually capture all existing apps designed to address a particular problem. Indeed, there is no public information about how the Apple or Android app stores rank search results. Web-based app stores and Google search results for apps are inconsistent so we recommend using mobile devices, primarily, to search app stores instead. We note that a mobile device's location and IP address will also influence search results, which meant that our study was limited by the use of only one location. Based on our experiences searching for particular keywords, we discovered that alongside app names and descriptions, Google Play's search results also seemed to include reviews from the app store page; for some results we could not find our keyword anywhere in the title or description.

We recommend systematically collecting data about the apps in a database. Consider including: app name, developer, app store category, app store description, cost, in-app purchases, operating system, release and update dates, and ideally, all of the app store images. We used Excel spreadsheets to create our database and do not recommend this approach because it becomes onerous to recategorize and organize the data. Content analysis software packages such as NVivo, Quirkos, or open source options such as Taguette, CATMA, or AQUAD would be useful for calculating frequencies and relationships between classification systems in the following phases.

2 PHASE TWO: IDENTIFY THE FEATURES THAT EACH APP OFFERS

In the second phase, researchers identify and classify the features in each app in their set. Feature analysis builds on qualitative studies of app interfaces and extends these with content analysis, specifically taking an inductive grounded theory approach. The variations on content analysis are well developed in various handbooks (e.g. Krippendorff, 2012; Neuendorf, 2017), which offer detailed guidance on developing classification systems as well as other aspects of content analysis such as sampling techniques (if the entire set of apps is too large to analyze) and intra- and inter-coder reliability.[3]

Following desciptions of the term "feature" from human-computer interaction and science and technology studies, we define a "feature" as a function that users control or are likely aware of. Some examples of features

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[3] Reviewers' and journals' needs for such precise methodological techniques vary.

in our set included: tracking location, sounding an alarm, contacting the police, and taking a quiz. A feature can be any function that the user executes in the app, including anything the user can access, modify, or control, as well as functions performed on the user's behalf. In particular, we follow the definition of the term "feature" that is described in an article on the communication features of Facebook: "a technical tool on the site that enables activity on the part of the user" (Smock et al., 2011). Feature analysis asks researchers to analyze features separately rather than using individual apps as the units of analysis. Breaking apart each app into its component features helps the researcher gain a more fine-grained data set that can yield persuasive findings about the range and frequency of design choices made across the entire sample of apps.

Because we define features as functions that developers publicize or make visible to users, we do not view functions that are hidden from users as "features." Determining whether a function is a feature or not depends on the context of each app, which is necessarily a subjective interpretation. For example, tracking location would be a "feature" according to our definition in a safety app that advertises location-tracking as a safety feature. On the other hand, in a sexual-violence prevention app that provides educational materials and quizzes but also tracks user location to serve tailored advertisements, location-tracking would be a function but not a feature. While such an app may have informed users that it collects and uses location information, such as in its terms of service or by requesting location access to install the app, this function is not publicized to users so we would not consider it a "feature."

Given that the focus of our study was on how features address a problem, we did not examine every feature in each app. Instead, we limited the set of features to those that directly relate to solving the problem—this required our interpretation and assessment of each app as a whole. We rarely found features that were ambiguous in whether or not they were intended to directly address the problem, and if we had any doubt we included the feature. In our study, that meant we were only interested in features that were specifically designed to prevent rape because our research question was to examine and compare the various strategies these features used to achieve this goal. For example, we did not include actions related to settings, documentation, or cosmetic features, such as "view the privacy policy" or "update profile photo," because these features were not designed to directly help prevent sexual assault, even if they were functions that were required or suggested to the user. Researchers could, of course, choose to analyze all the features in their set of apps if it serves their research questions.

2.1 Steps for Phase Two

There are two ways of finding features in apps: (a) rely on the app store page description and screenshots for each app or (b) download and "walkthrough" (Light, Burgess, and Duguay, 2018) each app individually. We chose the app-store based approach because it was more efficient, though we did "walkthrough" a sample of the apps in our set to gather background information and find illustrative examples for our paper. Using this first option, we examined each app store page, including the app store descriptions and screenshots, and recorded each discrete feature we could identify. This method of relying on app store pages captures all the features that developers think are important enough to entice users to download their apps. By limiting our study to the features that were described or pictured in the app store pages, we only rarely needed to exclude any features that seemed as though they were not aimed in any way at preventing rape. That is, developers who are advertising an app to address a specific problem tend to highlight the features that they think users will find appealing for solving that problem.

The second option, downloading and doing a "walkthrough" (Light, Burgess, and Duguay, 2018) of each app, would have only been practical for us with a smaller set of apps or more resources. This method involves recording all the features of each app, and requires using each app with one or more user profiles, including setting up the app, exploring all its options and features, and then deleting or discontinuing it—researchers might find dozens of features in each app. The advantages of the "walkthrough" method are that it captures all the features in the set of apps and that researchers could also then compare which features are publicized to users in the app stores and which features are only presented within the app itself.

After recording the features of each app in a database, researchers can create a classification system that captures and names all the relevant features in the set. Using inductive content analysis techniques, we began with an initial random sample, and analyzed all the apps one at a time, recording each new feature we discovered. Then, we returned to the entire set to analyze it again based on this classification system. We found new ways to classify features throughout the analysis and so we returned to the set a number of times until all apps had been classified according to the same comprehensive list of features. In the end our classification system consisted of 47 individually named features. For example, in our set of 215 apps, 8% offered a "loud alarm" feature and 43% offered a "GPS tracking" feature.

3   PHASE THREE: CATEGORIZE HOW THE FEATURES ADDRESS THE PROBLEM

In the third phase, researchers consider apps as tools, using the concept of "affordances" to assess each feature's mechanisms, conditions, and expected outcomes. Techniques from content analysis are basically sufficient to complete the identification and classification of features in the previous step (Phase Two). However, apps' capacity to act or to be used as tools for action sets them apart from other cultural objects like newspaper articles or TV shows. As Dieter and coauthors (2019) propose, "App research necessitates a renewed interest in the role of practices … as opposed to the study of content …[because] apps are first and foremost operational media; they are applications, things for doing" (p. 12). This is important because many apps are designed to solve a problem or accomplish a task, from managing a health condition, to creating to-do-lists, finding work, or tracking calories. In this way, like most software, apps are both tool and text, though of course the distinctions between these two categories are already fuzzy. Still, apps are more responsive, interactive, and non-linear than most other texts, such as TV shows or even most websites. Apps also change more dynamically than most other non-digital tools. Contrast, for example, the way a pencil changes as it is used, sharpened, broken, or chewed with the way an app's interface is programmed to respond to each tap of the user's finger.

Apps are also distinct from software: they are more mobile, ubiquitous, and integrated into everyday life, and are often in more intimate proximity to users' bodies (Morris and Murray, 2018). Apps' interactivity means that users' every action in an app can be potentially recorded and sold to advertisers. Though a well-loved novel might bear traces of readers' favorite passages or marginal notes, apps can harvest and distribute an unprecedentedly detailed record of each user's actions. Apps can also collect intimate and personal data. As Lupton (2014) points out, "sensor technologies in smartphones or wearable devices ... promote detailed and continuous monitoring of bodily functions and behaviours" (p. 611). All of this data collection raises important questions about security and privacy. Feature analysis—especially if researchers use the walkthrough method to collect all features—can help uncover and catalogue the ways that a set of apps could collect behavioral data about users.

We turn to Davis' model of "affordances" for its precise theoretical framework for assessing what features can do, for whom, and under what conditions. As Davis (2020) explains: "Affordances are how objects shape action for socially situated subjects" (p. 6). Using the model of affordances helps researchers avoid technological determinism while still appreciating

the complex interactions between people and objects. The model stresses that "technologies don't *make* people do things but instead, push, pull, enable, and constrain" (Davis, 2020, p. 6). In other words, the outcomes that developers expect their app to produce are not simply or directly determined by an app's features. Instead, as Davis (2020) explains: "affordances mediate between a technology's features and its outcomes" (p. 6). This mediating role of affordances is vital for feature analysis. Specifically, in Davis' (2020) model: "The mechanisms of affordance specify *how* technologies afford, while the conditions of affordance situate technologies in context" (p. 13). This approach of thinking about the mechanisms and conditions of affordances can help illuminate how the outcomes of features might vary for different people under different conditions.

The concept of "mechanisms" describes the different ways a feature and a user might interact with one another: "artifacts *request, demand, allow, encourage, discourage,* and *refuse*" (Davis and Chouinard, 2017, p. 242) actions from the user. For example, a speed bump *requests* that drivers reduce their speed while a speed-limiting device installed in a car *demands* it by restricting the engine's power. Davis and Chouinard (2017) explain that *requests* and *demands* are "bids that the artifact places upon the subject;" generally a *demand* is required while a *request* is optional (p. 242). The model also captures how features respond to a user's actions: features might *discourage* or *refuse* what a user wants. For example, one app might *discourage* users from deleting their account by burying the option deep in the settings menu while another app might *refuse* this desire by providing no such option at all.

For feature analysis, it is especially crucial to consider that the way affordances work also depends on the user and their contexts. In other words, affordances are relational, and "emerge in the mutuality between those using technologies, the material features of those technologies, and the situated nature of use" (Evans et al., 2017, p. 36). Davis' model captures this relational nature with a framework for assessing the "conditions" of affordances. Davis and Chouinard (2017) explain: "the conditions of affordances vary with subjects' awareness of the function (perception), their skill and ability to execute the function (dexterity), and social support in executing the function (cultural and institutional legitimacy)" (p. 245). The analysis in Phase Three uses these concepts to allow researchers to assess the nature and size of the gap between designer's imagined outcomes for the features they have included in their apps and the likely outcomes for a range of different users in different social and personal contexts.

3.1 Steps for Phase Three

In this phase, researchers use Davis' model of affordances to develop classification systems to organize and describe what features offer, to whom, and under what conditions. If they have chosen the walkthrough method described above, researchers will likely want to begin by classifying features based on whether they address the problem or whether they are instead merely suggested or required for using the app itself (e.g. "change the background" or "create a profile"). Recall that in contrast, the app store method generates a smaller set of features that are all (or almost all) designed to address the problem simply because those are typically the features developers think are worth advertising in app stores.

Researchers' task in feature analysis is not only to classify the outcomes that apps promise their features will provide, but to then analyze and assess them in relation to the literature on the nature and causes of the problem in question. Using Davis' framework for analyzing the mechanisms and conditions of affordances, researchers can consider how the features in their set of apps might lead to different outcomes for different users in different contexts. This step of the analysis is vital, as researchers will likely find that some claims about what features do or who they are for may be implausible or unlikely based on the literature about the characteristics of the problem the feature is claiming to address.

Consider an example from our study: a feature to call the police in an app that claims that it can help prevent date rape. Applying Davis' framework, we could say that a "call police" button is a feature that uses the *mechanism* of *encouraging* users to call police for help during or after an assault. However, consider the *conditions*: even if a user is aware of the option to call police (perception) and is physically capable of reaching for a phone and tapping a "call police" button during an attempted date rape (dexterity), the personal and cultural context—including emotional manipulation, abuses of power, fear of further violence from the person threatening to commit harm, or an expectation that police would disregard their report or make the situation worse (legitimacy)—means that such a feature likely will not lead to the purported outcome of preventing date rape. Indeed, we found no evidence in the extensive literature on the prevention of date rape that increasing ease of access to 911 calls (in this case presumably by providing a button within an app rather than dialing the number via the phone's keypad) would be an appropriate or useful solution to the problem of date rape. Through this kind of analysis of each feature, our study found that most of the features in our set would only likely lead to the imagined outcome (rape prevention) in the rarest cases (stranger perpetrators).

Analyzing how the mechanisms and conditions of affordances mediate the relationship between features and their supposed outcomes can help researchers consider the following questions: the exact type or version of the problem each feature is designed to address; which social and cultural contexts each feature would be useful for; the kinds of action each feature uses to address the problem; the intended user of each feature; and the implicit causes of the problem or theories of prevention that underlie each feature. Each of these lines of inquiry could yield distinct, and potentially useful, classification systems, which researchers can then compare to each other.

In our study, we created a total of four classification systems that were useful for our analysis. First, we classified (a) all 47 unique features in our set, as described in Phase Two. Then, we created three more classification systems to describe the affordances of these features and their mechanisms and conditions: (b) seven types of action; (c) two contexts of use (in relation to an incident or not); and (d) three types of intended users (victim, bystander, or perpetrator). While feature analysis asks researchers to examine features individually, sometimes researchers may also need to look at each app as a whole to classify a feature. For example, a feature such as "recording video" could be used or intended for use by any type of user (a potential victim, bystander, or perpetrator), so we classified its intended use based on the description on the app store page.

Table 1. Feature types and examples

Type of action	Examples from our study
Send information	A button to call a sexual assault hotline
	Share sexual harassment incidents on a map
Get information	Take a quiz about sexual assault
	View map of registered sex offenders
Monitor or track the user and/or their immediate environment	Automatic geofence check-in
	Keep a diary of abusive incidents
Use the device as a tool in the immediate physical environment	Sound a loud alarm
	Get a fake diversion call

One classification system we used in our study described features' specific types of action. While we ultimately used seven categories, we simplify them here into four (see Table 1) in hopes that it will be more broadly applicable as a starting point for other researchers. We encourage researchers who use this classification system to modify it to reflect the specific themes in their data sets. In our study, for example, we divided "get information" and "send information" into a total of five distinct categories.

Though we used the literature on sexual violence as a starting point to develop our classification systems, we modified them to create the best possible representation of our data set. For example, one classification system we started with based on the literature was intended to capture "prevention strategy" with three items: "incident intervention," "precautionary measures," and "education and awareness." However, we found too much overlap between the latter two categories in our set of features. We could not determine, for example, if things like maps of registered sex offenders or quizzes about safety strategies should be considered "precautionary" or were better classified as "education." In the end, we decided to collapse these two categories, creating a classification system we labeled "context of use" instead. This classification system used a binary distinction that was relatively uncomplicated to apply: whether the feature was intended for use in relation to a specific incident or not.

4   PHASE FOUR: USE SPECULATIVE DESIGN TO IMAGINE ALTERNATIVE APPS

The fourth and final phase of feature analysis uses speculative design to help researchers gain a better understanding of how social norms, assumptions, and taken-for-granted ideas are translated into technologies. Speculative design methods generally involve developing and analyzing fictional future scenarios (DiSalvo, 2012; Dunne and Raby, 2013; Forlano and Mathew, 2014). As DiSalvo (2012) explains, "Speculative design works by isolating facets of culture and recasting those facets in ways that alter their meaning in order to produce new images—new imaginative instantiations—of what might be" (p. 111). The purpose of speculative design is not to predict the future or design better apps, but "to better understand the present and to discuss the kind of future people want, and, of course, [futures] people do not want" (Dunne and Raby, 2013, p. 3). This approach can help researchers consider how ideologies are entangled with technological development.

4.1   Steps for Phase Four

Feature analysis applies speculative design by imagining fictional apps that use the existing components of mobile phones in different ways. This exercise can help clarify the particular role of technological constraints in the set of features. After all, if a feature is common in other app genres but is not used in the set of apps addressing a particular social problem, that provides some evidence that the choice to not deploy those features is likely not the result of a technological constraint. For example, in our study we found that social connectivity features in anti-rape apps position the users'

friends primarily as emergency responders, not as sources for increasing motivation or engagement (such as in fitness apps, games, and goal-setting apps).

In our study, we imagined and described some fictional apps that used features that were already available in mobile phones and were in use in other kinds of apps. These fictional apps were based on the rape-prevention literature and offered features designed to prevent rape that were absent from our set of apps. For example, we imagined a fictional app for potential victims that could provide users with evidence-based training in overcoming the social and emotional barriers to resisting unwanted sexual advances from people they know. We also imagined an app that could complement comprehensive rape-prevention programs that reduce the likelihood that a person will commit acts of sexual violence. And we imagined an app for potential bystanders that focused on dismantling rape myths. Imagining these fictional apps allowed us to bolster our conclusion that the limited set of features and imagined outcomes we found in our set of anti-rape apps were likely not the result of technical limitations and thus could be evidence of persistent rape myths instead.

To help researchers design fictional apps, we offer the following list of "actions" (Table 2) which describe the possible inputs and outputs of the components of mobile phones. [4] Features, as we define them above, generally use two or more actions in combination. For example, some safety apps offer a geofence check-in feature that automatically sends a message to another user (e.g. a spouse or parent) when the device arrives at a pre-set location (e.g. "home"). This feature operates through a number of device actions: detecting location, sending data to another device, and displaying a notification on the screen, among others.

We recommend that researchers review the literature on how best to address the social problem in question and then consider how this list of the possible "actions" of mobile phones could help users access those kinds of approaches and solutions. This will then allow researchers to discuss whether their set of apps has used all the available features effectively. Then, researchers can explain whether and how imaginary apps might use the possible features more effectively. Researchers may well determine that the existing features of mobile phones are entirely ill-suited to addressing the social problem in question.

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[4] We created this list of the currently possible actions of most (though not all) smartphones by extrapolating from our own study and then reviewing Apple's and Android's documentation for mobile app developers.

Table 2. Some mobile phone components and their actions

Device component	Actions	Examples
buttons	press a button (power, volume up/down, home, etc.)	make selections; initiate actions
camera	capture images	record video; take a photograph
communication chips and antennas	receive GPS data from satellites	make a phone call; send an email or text message; communicate with other devices and networks (eg. airdrop, contactless pay, smartwatch connections)
	communicate with cell towers	
	connect to the internet via wifi	
	communicate with bluetooth devices	
	employ near field communication	
light	emit light	light as an alarm; illuminate the environment
microphone	capture sound	record a voice memo or other sound; monitor ambient noise level
screen display	display (including text, images, video)	display an image or web page; display an alert or pop-up message (e.g. a "toast" or "snackbar" that automatically appears and disappears without user action)
sensors	measure device motion	measure acceleration or speed
	measure environment around the device	measure humidity, temperature, or ambient light level
	assess the position of the device in space or time	measure proximity to another object; measure device orientation in space (e.g. face down initiates "do not disturb" mode); set a timer
	detect fingerprint	read and store biometric information; identify a user
	measure device conditions	measure battery level or internal temperature
speaker or headphone jack	emit sound	play music; emit phone call ringtone; play sound as alarm
storage	store information	record data in persistent memory; install apps
touchscreen	select from options on the screen	select a setting; use a keyboard to select letters to enter text; choose a quiz question answer
	gesture on a touchscreen	swipe left or right to make a choice; scroll through text; draw a letter to enter text
vibration motor	vibrate	notify the user; provide touch feedback

5   CONSIDER ADDING COMPLEMENTARY METHODS

Feature analysis can offer one type of evidence for the ideologies underlying design, but researchers could also consider adding complementary methods to further examine how ideology manifests in design, particularly by studying developers or users more directly.

5.1   Study developers

One way researchers have studied designers' choices is by observing their work directly or speaking with them (e.g. Cohn, 2017; Suchman, 2011). Asking developers questions about their views on the nature and causes of the social problem in question, and where they gained this knowledge, could also provide insights into their design processes. For example, for our study it could have been valuable to find out which developers referred to scholarly research or consulted rape-prevention practitioners and whether and how those practices were related to the set of features in their apps. Further, researchers could consider complementing feature analysis by directly studying the institutional, technological, and economic contexts of developers' design processes. For example, in-depth interviews with developers could provide answers to questions about how they chose to address the problem and what constraints they faced, including: how they imagined and investigated the problem; whether and how they tested the app with users; what approaches they attempted and abandoned; whether they lacked financial or technical resources; whether they were limited by app store policies, operating systems, and other hardware or software constraints; and how funders and/or granting agencies influenced their design choices.

Researchers could also complement feature analysis by pursuing other methods to investigate the precise nature of the infrastructural constraints developers navigate. Getting a better understanding of those constraints could provide further evidence of the relative influence of ideology on the features in the set as compared to technological, financial, legal, or other factors. For example, researchers could build on Dieter and coauthors (2019), who explain that infrastructural approaches to understanding how apps "operate within different sites and involve a diversity of often obscured stakeholders" are "unified by a commitment to unpacking the infrastructural embeddedness of apps and with an eye on political economy" (p. 13). For example, they suggest using app repositories to open app packages and investigate their component parts and creating logs of an app's network connections. Further, researchers could examine how political economic issues influence app design, including investigating

their monetization strategies and how incubators and investors have influenced app development (e.g. Murray and Ankerson, 2016).

The findings feature analysis can offer are limited to the specific sample of apps selected for a study. Indeed, feature analysis is not a mechanism for measuring public opinion about appropriate or desirable solutions for a social problem, as it does not offer a representative sample. Developers, and indeed the particular developers whose apps are included in the data set, may hold views about social problems that are uncommon or unconventional. However, researchers can compare the results of public opinion studies with the apparent assumptions among the developers who designed their set of apps. For example, in our study, we noted that it was not surprising that our set of apps reflected common rape myths, because a range of studies demonstrate that such beliefs are prevalent in the general population.

5.2   Study users

Feature analysis examines what developers assume about users through the features they create. As such, researchers might consider if complementing feature analysis with another method that studies users more directly could help answer their research questions. Researchers interested in studying users can draw on the rich methodological traditions in media studies and mobile media studies that examine how users interpret and use media. For this type of analysis, researchers could conduct surveys, observational studies, automated activity tracking, or participant-directed app use research (Leurs, 2017). For example, researchers could examine user comments in app store reviews to gain information about whether they perceive features as useful and how they use them in both intended and unintended ways. Researchers could also use surveys to compare apps' promises, features, and policies with how people use and understand them. Fiesler, Lampe, and Bruckman (2016), for example, analyze the copyright terms of a few dozen websites where users post content and then find, through a survey, that user expectations differ significantly from the terms they have agreed to. Another option to study users is to use critical theory to examine technological artifacts, user discourses, and the relationships between them by employing Brock's (2018) critical technoculture discourse analysis. With this method, "the goal is to sustain a subtle analysis of both the domestic context of use and the semiotic richness of the online world people engage in" (Brock, 2018, p. 1023). Because feature analysis focuses on uncovering ideology embedded in design choices and only examines what apps offer to users, researchers who also want to know how users perceive or engage with those apps and their features will need to turn to complementary methods.

6   CONCLUSION

We present the method of feature analysis without any normative claim that it offers a greater truth value than other qualitative or quantitative approaches to studying apps. Nonetheless, we conclude here by highlighting the advantages of feature analysis. First, we share our anecdotal observation that some audiences thought that our method's analysis of a large set of apps offered particularly persuasive findings. Second, we summarize the key methodological contributions that feature analysis offers.

Within a year of the publication of our article on anti-rape apps, Bivens was invited to Vienna to participate in a United Nations committee meeting on technology and gendered violence. At the meeting it became apparent that for some participants, the number of apps we included in our study ("over 200!") was especially impressive. Likewise, later that year at a conference in San Francisco, an audience of anti-violence advocates, legal professionals, and law enforcement personnel reacted in similar ways. Though some attendees had conducted their own critical analysis of a handful of apps (National Network to End Domestic Violence), many people remarked on the total number of apps we included in our study.

Yet despite our anecdotes, many studies have not found significant or consistent differences in how qualitative versus quantitative research is used in policy development. In particular, one researcher explains: "Policy decisions in the real world are not deduced from empirical-analytical models, but from politics and practical judgement … what counts as 'evidence' is diverse and contestable" (Head, 2010, p. 83). The extensive literature on how policymakers use research demonstrates that the process is complex, including factors such as personal relationships (e.g. Almeida and Báscolo, 2006; Head, 2010). While it may not be possible to establish direct policy effects, we have observed that at least some civil society stakeholders perceive that an analysis of a larger data set offers more persuasive findings than a qualitative analysis of one or a few apps.

Feature analysis also offers some methodological advantages. First, it allows researchers to analyze data that is collected without the involvement of the people being studied. The benefit of this observational data is that it represents the actual choices developers made by examining a set of design outcomes. While surveys and interviews with developers could provide valuable data on their intentions, beliefs, and perceptions, their answers would likely also be influenced by social desirability biases. The contribution feature analysis offers in this respect is that it allows researchers to analyze a rich data set of designers' actual choices within the financial, technological, and policy constraints of funding, creating, and releasing an app, which all developers face to varying degrees. Developers

do not make use of every device component or possible action, but instead create specific features they feel will be most useful to achieve their goals. Developers do not rely solely (or at all) on scientific evidence to develop appealing products aimed to solve problems; instead, they rely on their instincts and assumptions about what they think people will find appealing as "common sense" easy-to-understand solutions. Feature analysis can provide a systemic analysis of the nature of these assumptions by investigating how they show up in the final product by examining a set of apps created by a group of developers tackling the same problem.

The second advantage feature analysis offers is that combining techniques from inductive content analysis with the concept of affordances and techniques of speculative design illuminates how developers materialize social norms, common sense assumptions, and ideologies in the form of app features. While existing techniques of content analysis are sufficient for the initial phases of feature analysis, because apps are both texts and tools, we apply the concept of affordances to help categorize how the features in the set implicitly conceptualize the problem the app is trying to solve. In particular, using the analytic framework of the mechanisms and conditions of affordances can offer researchers crucial insights on the limitations and assumptions of each type of feature. Moreover, feature analysis offers a way to apply the concept of affordances to a precise analysis of a large set of apps. And, our method's use of speculative design in the final phase offers researchers a creative yet practical way to see which potential features might be missing from the set of apps. This phase of feature analysis can help reveal which ideologies and assumptions could have been embedded in the set of apps but were not.

New apps designed to solve social problems are often presented as revolutionary tools that offer progress, convenience, and control over complex challenges and uncertain conditions. For example, Balsamo argues that the US was founded upon and generally remains committed to a belief in "the capability of information technologies to produce desired social changes, to reinvigorate an ideal of human community and to overcome misuses of power and political advantage" (2011, p. 346; see also: Carey, 1989). Feature analysis' contribution to these observations is that it helps answer questions about how this kind of technological solutionism (Morozov, 2014) works in specific cases. Feature analysis is the first method, to our knowledge, that allows researchers to systematically analyze a large set of apps for evidence of how ideology manifests in design.

The potential political value of feature analysis is that it can support efforts at intervention. Technological solutions to complex social problems—such as anti-rape apps—may be enticing and profitable, but they are rarely effective and are typically simplistic. Such solutions are also

often laden with the same dominant values that led to the problem in the first place. As Davis explains:

> [T]echnologies themselves embody human values and politics in their design, implementation, and use. The bad news is that this means technologies will, by default, reflect and reinforce existing inequalities. The good news is that the default is neither necessary nor inevitable. A sharp analytic tool, like the mechanisms and conditions framework, renders politics visible and pliable. (Davis, 2020, p. 15)

By examining the dangerous fruits of technological solutionism, feature analysis is one method that offers researchers a robust and concrete way to "render politics visible and pliable."

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REFERENCES

Almeida, C., and Báscolo, E. (2006). Use of research results in policy decision-making, formulation, and implementation: A review of the literature. *Cadernos de Saúde Pública, 22*(Suppl.), S7-S19. https://doi.org/10.1590/S0102-311X2006001300002

Balsamo, A. M. (2011). *Designing culture: The technological imagination at work*. Duke University Press.

Bivens, R., and Haimson, O. L. (2016). Baking gender into social media design: How platforms shape categories for users and advertisers. *Social Media + Society, 2*(4), 1-12. https://doi.org/10.1177/2056305116672486

Bivens, R., and Hasinoff, A. A. (2018). Rape: Is there an app for that? An empirical analysis of the features of anti-rape apps. *Information, Communication & Society, 21*(8), 1050-1067. https://doi.org/10.1080/1369118X.2017.1309444

Brock, A. (2018). Critical technocultural discourse analysis. *New Media & Society, 20*(3), 1012-1030. https://doi.org/10.1177/1461444816677532

Buolamwini, J., and Gebru, T. (2018). Gender shades: Intersectional accuracy disparities in commercial gender classification. *Proceedings of Machine Learning Research: Conference on fairness, accountability and transparency, USA, 81*, 1–15.

Carey, J. W. (1989). *Communication as culture: Essays on media and society*. Unwin Hyman.

Cohn, M. (2017). "Lifetime issues:" Temporal relations of design and maintenance. *continent, 6*(1), 4-12. http://www.continentcontinent.cc/index.php/continent/article/view/272

Costanza-Chock, S. (2018). Design justice, AI, and escape from the matrix of domination. *Journal of Design and Science, 3.5.* https://doi.org/10.21428/96c8d426

Davis, J. L. (2020). *How artifacts afford: The power and politics of everyday things*. MIT Press.

Davis, J. L., and Chouinard, J. B. (2017). Theorizing affordances: From request to refuse. *Bulletin of Science, Technology & Society, 36*(4), 241-248. https://doi.org/10.1177/0270467617714944

Dieter, M., Gerlitz, C., Helmond, A., Tkacz, N., van der Vlist, F. N., and Weltevrede, E. (2019). Multi-situated app studies: Methods and propositions. *Social Media + Society, 5*(2), 1-15. https://doi.org/10.1177/2056305119846486

DiSalvo, C. (2012). Spectacles and tropes: Speculative design and contemporary food cultures. *The Fibreculture Journal* (20), 109-122.

Dunne, A., and Raby, F. (2013). *Speculative everything: Design, fiction, and social dreaming*. MIT Press.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Eubanks, V. (2018). *Automating inequality: How high-tech tools profile, police, and punish the poor*. St. Martin's Press.

Evans, S. K., Pearce, K. E., Vitak, J., and Treem, J. W. (2017). Explicating affordances: A conceptual framework for understanding affordances in communication research. *Journal of Computer-Mediated Communication, 22*(1), 35-52. https://doi.org/10.1111/jcc4.12180

Fiesler, C., Lampe, C., and Bruckman, A. S. (2016). Reality and perception of copyright terms of service for online content creation, *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*, USA, 1450–1461. https://doi.org/10.1145/2818048.2819931

Forlano, L., and Mathew, A. (2014). From design fiction to design friction: Speculative and participatory design of values-embedded urban technology. *Journal of Urban Technology, 21*(4), 7-24. https://doi.org/10.1080/10630732.2014.971525

Gerlitz, C., Helmond, A., van der Vlist, F. N., and Weltevrede, E. (2019). Regramming the platform: Infrastructural relations between apps and social media. *Computational Culture* (7). http://computationalculture.net/regramming-the-platform/

Grundy, Q. H., Wang, Z., and Bero, L. A. (2016). Challenges in assessing mobile health app quality: A systematic review of prevalent and

innovative methods. *American Journal of Preventive Medicine, 51*(6), 1051-1059. https://doi.org/https://doi.org/10.1016/j.amepre.2016.07.009

Hall, S., Critcher, C., Jefferson, T., Clarke, J., and Roberts, B. (1978). *Policing the crisis: Mugging, the state, and law and order*. Holmes & Meier.

Hasinoff, A. A. (2017). Where are you? Location tracking and the promise of child safety. *Television & New Media, 18*(6), 496-512. https://doi.org/10.1177/1527476416680450

Head, B. W. (2010). Reconsidering evidence-based policy: Key issues and challenges. *Policy and Society, 29*(2), 77-94. https://doi.org/10.1016/j.polsoc.2010.03.001

Krippendorff, K. (2012). *Content analysis: An introduction to its methodology*. Sage.

Lapowsky, I. (2014, Sept 5). This app is a 21st century rape whistle. *Wired*. https://www.wired.com/2014/09/circle-of-6/

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.

Leurs, K. (2017). Feminist data studies: Using digital methods for ethical, reflexive and situated socio-cultural research. *Feminist Review, 115*(1), 130-154. https://doi.org/10.1057/s41305-017-0043-1

Light, B., Burgess, J., and Duguay, S. (2018). The walkthrough method: An approach to the study of apps. *New Media & Society, 20*(3), 881-900. https://doi.org/10.1177/1461444816675438

Lupton, D. (2014). Apps as Artefacts: Towards a critical perspective on mobile health and medical apps. *Societies, 4*(4), 606-622. http://www.mdpi.com/2075-4698/4/4/606

Lupton, D. (2015). Quantified sex: A critical analysis of sexual and reproductive self-tracking using apps *Culture, Health & Sexuality, 17*(4), 440-453. https://doi.org/10.1080/13691058.2014.920528

Magnet, S., and Rodgers, T. (2012). Stripping for the state: Whole body imaging technologies and the surveillance of othered bodies. *Feminist Media Studies, 12*(1), 101-118.

Martínez-Pérez, B., de la Torre-Díez, I., and López-Coronado, M. (2013). Mobile health applications for the most prevalent conditions by the World Health Organization: Review and analysis. *Journal of medical Internet research, 15*(6), e120. https://doi.org/10.2196/jmir.2600

Morozov, E. (2014). *To save everything, click here: The folly of technological solutionism*. PublicAffairs.

Morris, J. W., and Murray, S. (Eds.). (2018). *Appified: Culture in the age of apps*. University of Michigan Press.

Murray, S., and Ankerson, M. S. (2016). Lez takes time: Designing lesbian contact in geosocial networking apps. *Critical Studies in Media*

Communication, 33(1), 53-69.
https://doi.org/10.1080/15295036.2015.1133921

National Network to End Domestic Violence. (no date). *App safety center*.
Retrieved February 18, 2021 from
https://www.techsafety.org/appsafetycenter

Neuendorf, K. A. (2017). *The content analysis guidebook* (2nd ed.). Sage.

Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce
racism*. NYU Press. https://doi.org/10.2307/j.ctt1pwt9w5

Oliver, M. B. (1994). Portrayals of crime, race, and aggression in "reality-
based" police shows: A content analysis. *Journal of Broadcasting &
Electronic Media, 38*(2), 179-192.
https://doi.org/10.1080/08838159409364255

Pasulka, N. (2012, April 6). Want to stop rape? There's an app for that.
Mother Jones. https://www.motherjones.com/politics/2012/04/way-to-
prevent-rape-app-iphone-apps-against-abuse/

Rogers, R. (2013). *Digital methods*. MIT press.

Schüll, N. (2018). LoseIt! Calorie tracking and the discipline of
consumption. In J. W. Morris & S. Murray (Eds.), *Appified: Culture in
the Age of Apps* (pp. 103-114). University of Michigan Press.

Slack, J. D., and Wise, J. M. (2005). *Culture + technology: A primer*. Peter
Lang. http://www.loc.gov/catdir/toc/ecip0513/2005015547.html

Smock, A. D., Ellison, N. B., Lampe, C., and Wohn, D. Y. (2011). Facebook
as a toolkit: A uses and gratification approach to unbundling feature
use. *Computers in Human Behavior, 27*(6), 2322-2329.
https://doi.org/https://doi.org/10.1016/j.chb.2011.07.011

Stanfill, M. (2015). The interface as discourse: The production of norms
through web design. *New Media & Society, 17*(7), 1059-1074.
https://doi.org/10.1177/1461444814520873

Suchman, L. (2011). Anthropological relocations and the limits of design.
Annual Review of Anthropology, 40(1), 1-18.
https://doi.org/10.1146/annurev.anthro.041608.105640