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Homo prostheticus? Intercorporeality and the emerging adult-smartphone assemblage

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Abstract

Purpose – Young people's attachment to their smartphones is well-documented, with smartphones often described as prostheses. While prior studies typically assume a clear human/machine divide, this paper aims to build on posthuman perspectives, exploring intercorporeality, the blurring of human/technology boundaries, between emerging adults and their smartphones. The paper aims to discuss these issues.

Design/methodology/approach – Drawing on assemblage theory, this interpretive study uses smartphone diaries and friendship pair/small group discussions with 27 British emerging adults.

Findings – Participants in this study are characterized as *homo prostheticus*, living with and through their phones, treating them as extensions of their mind and part of their selves as they navigated between their online and offline, private and social lives. *Homo prostheticus* was part of a broader assemblage or amalgamation of human and non-human components. As these components interacted with each other, the assemblage could be strengthened or weakened by various technological, personal and social factors.

Research limitations/implications – These qualitative findings are based on a particular sample at a particular point in time, within a particular culture. Further research could explore intercorporeality in human–smartphone relationships among other groups, in other cultures.

Originality/value – Although other studies have used prosthetic metaphors, this paper contributes to understanding of smartphones as a *prostheses* in the lives of emerging adults, highlighting intercorporeality as a key feature of *homo prostheticus*. It also uses assemblage theory to contextualize *homo prostheticus* and explores factors strengthening or weakening the broader human–smartphone assemblage.

Keywords Mobile communications, Interpretive research, End user, IT-enabled social innovations

Paper type Research paper

Introduction

Smartphones, "the most successful consumer electronics device of all time" (Deloitte, 2016), are transforming daily life, culture, social structures and values (Jung, 2014). The constant presence of this mobile technology in users' hands as well as their lives has led to the proliferation of prosthetic metaphors, but the human/smartphone interface requires further theoretical attention. This paper, then, aims to explore this interface, and the appropriateness of the prosthetic metaphor, particularly in relation to young people's smartphone use.

Many studies, within and beyond the information systems (IS) field, have highlighted the importance of mobile phones in general and smartphones in particular to young people, to

the extent that mobile youth culture is seen as a distinctive phenomenon (Goggin, 2013; Vanden Abeele, 2016). Prior research, within and beyond the field of IS, offers valuable insights into the meanings and uses of smartphones among young people (Jung, 2014; Trub and Barbot, 2016; Mascheroni and Vincent, 2016). One dominant theme, however, has been young people's smartphone "dependence" or "addiction" (Salehan and Negahban, 2013; Seo *et al.*, 2016). Such concerns privilege both duality and disapproval: young consumers are presented as too weak to withstand the allure of this technology, becoming enslaved by it. Another common but relatively unexamined trope in the literature is that of the smartphone as a *prosthesis*, an extension of the body (Castells, 2007).

Such formulations, whether positive or negative, raise questions about the existence of "an 'I' […] as separate from the technology, a self that is able to put the technology aside so that it can function separate and apart" (Turkle, 2006, p. 16). As Middleton *et al.* (2014) observe, the mobile artifact is now both evolving and dissolving; smartphones empower users, facilitating emergent behaviors that add value to people's lives, whilst having become routine and taken-for-granted. This suggests that researchers need to move beyond dualistic accounts of person-object relations in an increasingly digital, dematerialized world (Belk, 2013).

Resonating with posthuman perspectives on the human–technology interface, this paper aims to "do justice to this distinctive marriage of youth and mobiles" (Goggin, 2013, p. 86). Drawing on qualitative data, its key research question concerns the nature of the human/technology interface in relation to young people's smartphone use. Exploring how older teenagers – or "emerging adults" (Arnett, 2000) – live through as well as with their smartphones, it aims to offer "academically grounded treatments" of mobile information and communication technologies (ICT) as an example of "the most significant socio-technical phenomena" (Sørensen and Landau, 2015, p. 159). These authors suggest that IS journals tend to privilege mobile ICT's technological affordances at the expense of social context, while social science research often foregrounds context whilst neglecting the materiality of mobile communications and "black boxing" the technology. Little research to date, they observe, explores both "complex assemblages of mobile and ubiquitous technology" and the "socio-technical arrangements" they entail. Yoo (2010) also argues that traditional social sciences "are not well equipped to understand the transformative power of digital technology" whilst science and engineering "are not too concerned about the human experience" (p.220). His "experiential computing" research agenda involves greater attention to "digitally mediated embodied experiences in everyday activities through everyday artifacts that have embedded computing capabilities" (p. 220).

This paper, then, seeks to make three specific contributions in the domain of experiential computing (Yoo, 2010). First, its user-centric focus responds to the call by Kreps (2010, p. 104) for researchers to "open up the black box of the computer 'user' and explore the notion of self." Second, it seeks to address the socio-technical divide identified by Yoo (2010) and Sørensen and Landau (2015), by exploring whether young smartphone users may be considered *homo prostheticus*. Finally, it seeks to demonstrate the value of assemblage theory, and its focus on capacities and change, in exploring a constantly evolving technology used by young people whose lives and identities are in flux. It does so by exploring lived experiences of intercorporeality, or the blurring of boundaries between technologies, embodiment, knowledge and perception (Miller, 2014).

Before reporting on a qualitative study of young British smartphone users, existing literature is reviewed on the place of smartphones in contemporary society, young people's relationships with their phones, posthuman and prosthetic perspectives on the human/technological interface, and the promise of assemblage theory in accounting for these.

The inexorable rise of smartphones

Just over a decade since they were introduced, eight in ten adults around the world use smartphones, with over 4 m units sold each day (Deloitte, 2017a, b). These sophisticated, multi-functional devices are now routine parts of personal and organizational practices (Middleton *et al.*, 2014). Embedded in daily life, they invite consumers not only to exploit their features but also to explore and use them in innovative ways (Koo *et al.*, 2015). Given these developments, Sørensen *et al.* (2015, p. 196) note that "we would indeed expect a much stronger body of research to emerge from the global interest in the issue." Such interest is unlikely to diminish, not least because smartphones are "increasingly, the glue that is binding society together, and will soon become the primary way to communicate, interact and transact with customers and fellow citizens (Deloitte, 2017c). Machine learning is expected to provide additional momentum here, as it uses artificial intelligence – remotely or within the handset – to make automated improvements independent of explicit programming (Deloitte, 2018). Thus, as user-empowering and ever-evolving devices, smartphones are not simply a bundle of intended, designed uses; they facilitate emergent, individual and even idiosyncratic behaviors, adding value to many peoples" lives (Middleton *et al.*, 2014; Jung, 2014). This places the user center stage, and calls for greater understanding of the consumer–smartphone relationship, not least among those considered its greatest aficionados.

Young people and their smartphones

Globally, greater engagement with smartphones among younger people is well-documented (Deloitte, 2017a). In the UK – a "smartphone society" where these devices form "the hub of our daily lives" (Ofcom, 2015) – 93 percent of 16–24 year-olds use a smartphone, compared to 72 percent of all adults (Ofcom, 2017a). Striking differences have also been found in the intensity of smartphone use and engagement between UK "teenagers," "parents" and "grandparents" with the 16–19 year-olds surveyed by Deloitte (2017b) checking their phones 90 times a day on average, 57 percent within 5 minutes of waking. Reflecting the "digital native" label associated with this age-group (Akçayır *et al.*, 2016), 16–24 year-olds' smartphone use appears particularly internet focused: according to Ofcom (2017a, b), they were considerably more likely than all adults to use it to go online, use up their mobile data allowance, and have a 4G mobile service.

Young people's smartphone use seems infused with distinctive meanings. Ling (2000) highlighted the "loaded situation" created by combining increasingly sophisticated mobile telephony with adolescence, a time when "apprentice adults" – or "emerging adults," to use Arnett's (2000) evocative term – seek technical and practical mastery while learning how to engage with others and the workplace and develop their personal style and integrity. Vanden Abeele (2016) attributes a distinctive mobile youth culture to young people's position in contemporary society and the developmental challenges of transitioning to adulthood. She sees mobile youth culture as grounded in the social logic of perpetual contact, the network logic of anytime anywhere connectivity, and the personal logic by which time, space, social networks and devices themselves can be personalized. These key themes – and related paradoxes – have been identified among teenage and young adult-smartphone users, within and beyond the IS literature.

Clearly it is difficult to disentangle personal from social and network logics; for example, Bertel's (2013) Danish high school students appreciated how constant access to online information via smartphones fed into conversation, travel and social plans. Nonetheless, some studies offer insights primarily into personal dimensions. Interviewing Korean undergraduates, Jung (2014) found a sense of confidence to be the key value arising from their smartphone use, with comfort, amusement and restoration also important. These values were achieved by phone features empowering users to socialize, be productive in their daily lives, improve communications and acquire information.

Some scholars have highlighted the affective affordances of smartphones. As Miller (2014) notes, cameras at front and back allow the screen to alternate between mirror and window, so that phones function as life recorders, storing intensely personal information that can evoke strong emotions. In this sense, they are becoming "our best friend who will save all our secrets, pleasures and sorrows" (Mihailidis, 2014, p. 67). A small-scale qualitative study with English university students (Fullwood *et al.*, 2017) found smartphones were seen both as a material object and in anthropomorphic terms, and that their use was habitual yet infused with emotions. Given the limited reference made to voice calls, these authors query the term "smartphone," and describe practical, recreational, interactional and informational uses that other features had for their participants.

Focusing more on social and network logics, Mascheroni and Vincent's (2016) extensive qualitative study found European 9–16 year-olds enthusing about the free, continuous and intermittent flow of communication with peers via their phones, and the range of practices they afforded. Indeed, Vanden Abeele (2016) argues that young people socialize each other into "small communicative rituals," micro-coordinating offline social activities and constantly exchanging chat, jokes and gossip. Beyond peer networks, smartphones also appeared to have a role in maintaining and deepening family ties among older British teenagers preparing to leave home (Marchant and O'Donohoe, 2014).

Vorderer *et al.* (2016) also offer insights into social and network logics, distinguishing between being permanently online (PO) and permanently connected (PC) with others via smartphones. For their German university students, being PC seemed more important than being PO, especially when alone.

As Jarvenpaa and Lang (2005) observe, technology paradoxes are common, but felt more strongly with mobile technology because of the closer, more personal relationship involved. Such paradoxes seem keenly felt among young smartphone users, with ambivalence a strong theme across many studies. Mascheroni and Vincent (2016, p. 3) refer to contradictory feelings of "intimacy, proximity, security as well as anxiety, exclusion, and obligation," particularly in relation to perpetual contact. Not only did smartphones facilitate contact, intimacy and reassurance; they also left young people feeling obliged to be always contactable and worried about exclusion from social arrangements. Similarly, Vorderer *et al.* (2016) see smartphone affordances as both "a blessing and a curse"; asked about PO and PC being curtailed by temporary loss of internet access, students mentioned the need to belong, fears of missing out or being excluded, but also a sense of freedom, privacy and relaxation. Similarly, Choi (2016) found that the ubiquitous connectivity afforded by smartphones contributed to the pleasure of social presence and the worry of privacy concerns among Korean students. Trub and Barbot (2016) refer to "the paradox of phone attachment," suggesting that for the young American adults in their study, phones were both an attachment object in their own right and a means of connecting with attachment figures. This made smartphones both "refuge" and "burden": there was a heightened sense of safety when with their phones, and anxiety on being separated from them, but the devices could also be intrusive and burdensome, with separation bringing relief.

In practice, Mascheroni and Vincent (2016) found perpetual contact to be constrained by time, space and ways of working around social norms: some participants described rules about phone use at school or during family meals, problems accessing WiFi, or decisions to leave phones in another room for a while. Moreover, fears about missing out and being isolated became less compelling as young people gained autonomy.

Turning to broader societal implications of young people's smartphone use, this is thought to be a potent force for education and empowerment (Christensen and Knezek, 2017), but may also foster risky and boundary-testing activities including cyberbullying, stealing, drug-taking/dealing and online sexual acts (Lim, 2013; Zheng *et al.*, 2017), and dangerous driving or inattentive road-crossing (Deloitte, 2017b; Gauld *et al.*, 2017).

Heavy dependence on smartphones is also considered problematic. Higher usage levels have been associated with poorer academic performance, higher anxiety levels and lower satisfaction with life (Lepp *et al.*, 2014). Continuous checking of smartphones also creates tensions in terms of social etiquette and relationships in family, cultural and social settings (Ofcom, 2015; Deloitte, 2017b). Indeed, Durex's #DoNotDisturb condom campaign encourages young couples to pay more attention to their partners than their phones in bed (McCarthy, 2016).

Young people themselves use terms such as "compulsion" or "addiction" in describing their own behavior (Mihailidis, 2014; Vorderer *et al.*, 2016), expressing more concern than older groups about overuse (Deloitte, 2017b). A considerable body of research has measured the nature and effects of young people's "addiction" to their smartphones (Pavia *et al.*, 2016). Trub and Barbot (2016) question this conceptualization, seeing it as a simplistic, clinically unhelpful and ignoring smartphones' many social and emotional benefits. The next section offers an alternative, less judgmental conceptualization.

Posthuman and prosthetic perspectives

Sørensen and Landau (2015) call for researchers to engage with the materiality of mobile communications. Materiality concerns "the co-creations, interactions, and relations between human subjects, or selves and others," with "others" including material objects, environments and technological realms as well as fellow humans (Borgerson, 2013, p. 126). Implicit in accounts of young people's smartphone "addiction" is a sense of human weakness in failing to resist the siren call of mobile technology, and of a clear person-object divide.

That divide is challenged by posthuman perspectives emphasizing the "intimate marriage" of humans and machines (Haraway, 1991), and by new materialist theories challenging dual oppositions more broadly (Dolphijn and van der Tuin (2012). As Franklin (2012, p. 316) argues, a cyborg is not a bionically improved human, but "a not-quite-but-oh-so-human research subject." Indeed, when humans engage with new technologies, "they develop new 'tooled' ways of being in the world and reshape the boundaries of human and machine" (Keating, 2005, p. 528). Such engagement has been explored by Moore (2015) and Prasopoulou (2017), for example, in relation to wearable tracking technology.

More than 50 years ago, McLuhan (1964, p. 3) saw as imminent "the final phase of the extension of man – the technological simulation of consciousness." This invokes the idea of a *prosthesis*, often understood as "a device designed to replace a missing part of the body or to make a part of the body work better" (MedlinePlus, 2015); in contrast, an orthosis is "a brace or support designed to align, correct, or prevent" neuromuscular or muscoskeletal problems (Westcoast Brace and Limb, n.d.). Dating from the 1550s, the word prosthesis derives from the Late Latin for "addition of a letter or syllable to a word," and from the Greek *pros-* [addition] and *tithenai* [to place or put] (Online Etymology Dictionary, n.d.; Fineman, 1999). The meaning of "artificial body part" in response to physical injury or deformity was itself a late addition; the noun was first used in this way around 1900, having been linked to the making of artificial limbs from 1706 (Online Etymology Dictionary, n.d.).

Over the centuries, replacement limbs were made from wood, iron, copper or steel, with war injuries creating demand for more sophisticated, mass-produced prostheses. Fineman (1999) documents how the interwar years in Germany saw a drive to transform injured veterans into productive workers. *Homo prostheticus*, then, "embodied a new ideal of the human organism functionally enhanced through technology" (p. 89). Accompanying these developments were debates about whether *homo prostheticus* constituted a superior or dehumanized being (De Araujo, 2016), debates which resonate today in light of "blade-runner" athletes (Greenemeier, 2016), performance-enhancing drugs (De Araujo, 2016) and "smart," responsive artificial limbs (Kannape, 2016).

The sense of a prosthesis as an addition or augmentation rather than a mere replacement for a missing part resonates with much scientific and theoretical work on cyborgs and human–technology interfaces (Clark, 2003; Coates, 2017). Indeed, Hillhorst (2004, in Cranny-Francis, 2008, p. 372) argues that prostheses do not exist only "to make a body more complete, to fill up what is missing, to repair a deficient body, to restore normality," but can create something different and valuable. Although many prostheses are physically attached to or placed within the body, technology can augment human capacities in other ways. Thus, Keating (2005) describes computers with webcams as a prosthesis for deaf people, extending their capacity to communicate using sign language but also changing their embodied, habitualized practices of signing.

Prosthetic metaphors abound in the literature on young people's relationships with their phones. While Castells (2007) describes mobiles as "attached to the body like watches," others see phones as part of the human body. As one of Mihailidis's (2014, p. 64) participants stated, "When I am without it, it is like I lost my arm." Goggin (2009a, p. 233) notes "the emphasis on the mobile as a 'hand' (or 'handy') technology." Even before the advent of smartphones, Clark (2003, p. 9) reported that young Finns called their mobiles "kanny," an extension of the hand. This positioned the device as "a prosthetic limb over which you wield full and flexible control, and on which you come to automatically rely in formulating and carrying out your daily goals and projects." This may explain why students interviewed by Luhrman (2010, in Miller, 2014, p. 217) described their phone "as if it were part of their body, and even more a part of their mind […] their phone was who they were."

The concept of "intercorporeality" (Richardson, 2012, in Miller, 2014, p. 216) captures the "irreducible relation between technologies, embodiment, knowledge and perception." Miller (2014) sees this as arising from mediatization, the process by which media content and platforms become increasingly pervasive and taken-for-granted, their material form less evident and their functionalities more dispersed; this is certainly the case for smartphones as "evolving and dissolving" artifacts (Middleton *et al.*, 2014). Resonating with this perspective, Belk (2013) calls for research examining how we "meld into the digital prostheses on which we increasingly depend."

For Miller (2014), mediatization raises questions about: embodied and extended cognition; technogenesis – the "continuous reciprocal causation" set in train by person–technology relations; and the integration of smartphones into human subjectivity. This tripartite agenda builds on arguments that cognitive processing has never been undertaken exclusively in the brain (Clark and Chalmers, 1998). Rather, the brain works as part of a coupled system, incorporating trusted, reliable and accessible external sources such as a calculator or notebook. Thus, humans are "natural born cyborgs" whose deep neural plasticity allows us "to become one with our best and most reliable tools" (Clark, 2003, pp. 6-7).

Resonating with Miller's discussion of technogenesis and subjectivity, Clark (2003, p. 7) argues that increasingly, our technologies "actively, automatically, and continually tailor themselves to us just as we do to them […] [making it] harder and harder to say where the world stops and the person begins" and raising questions about "the resulting transformation of our capacities, projects and lifestyles" (p. 24).

Assemblage theory and the human–smartphone hybrid
Although experiential computing focuses on dimensions of space, time, artifacts and actors (Yoo, 2010), assemblage theory concerns "the interconnected technological, and social, and organizational elements that enable the physical and social mobility of computing and communication services" (Lyytinen and Yoo, 2002, p. 377). A variant of material-semiotic approaches, it views boundaries as porous, systems as open and entities as emerging and constantly becoming (Schouten *et al.*, 2015). Indeed, as Law (in Kreps, 2007, p. 68) argues,

"what counts as a person is an effect generated by a network of heterogeneous, interacting, materials." This perspective sits well not only with arguments concerning intercorporeality and technogenesis but also with the phenomenon of ever-evolving mobile technology in the lives of emerging adults.

Originating in the work of Deleuze and Guattari (1987), and developed by DeLanda (2006), assemblage theory sees the world as constituted "from more or less temporary amalgamations of heterogenous material and semiotic elements, amongst which capacities and actions emerge not as properties of individual elements, but through the relationships established between them" (Canniford and Bajde, 2016, p. 1). Parmentier and Fischer (2015, p. 1229) define capacities as "what components have the potential to do when they interact with other entities." That potential may be constructive or destructive, since resources may fail to work together. Thus, nimble fingers may quickly tap out a message on a smartphone, but cannot send it without an internet connection. Epp *et al.* (2014) echo Deleuze and Guattari (1987) in distinguishing between capacities that are material (arising in people, bodies, things, spaces) and those that are immaterial or expressive (arising in emotional tone, facial expressions, gestures, symbols and sentiments). They also introduce the notion of imaginative capacity, the ability to envision how a practice could be reassembled.

Assemblages refer not only to situated collections of things, but also to processes of territorialization (stabilization) and deterritorialization (destabilization) by which those things come together or fall apart (Canniford and Shankar, 2013; Canniford and Bajde, 2016). In tracing processes of assembly, disassembly and reassembly, researchers view agency as distributed between elements in the network. Crucially, although objects do not share human intentionality, they can still bring about change (Borgerson, 2013; Kreps, 2007).

Assemblage theory is emerging in conceptual papers examining mobile technology. For example, Goggin (2009b) explored how mobile phones and video content intersect with other technologies in assembling media culture, reconfiguring relations between different media, media genres and user practices. In consumer research, there has been increasing use of assemblage theory, including Epp *et al.*'s (2014) exploration of digital technologies' role in reassembling family togetherness despite geographic distance, for example, by absent parents joining the family meal by Skype.

Overall, prior literature suggests that the relationship between young people and their smartphones is not only intense but also increasingly intimate, blurring the boundaries between human and technology and raising questions about extended cognition, technogenesis and subjectivity. This paper seeks to understand what this means for emerging adults' smartphone use. Assemblage theory, with its focus on becoming and distributed agency, offers a useful theoretical lens here, without sacrificing the human perspective on interactions (Borgerson, 2013). This study, then, responds to calls for fresh light on "new socio-technical configurations" (Sørensen and Landau, 2015) and on experiential computing (Yoo, 2010) by using qualitative, interpretive methods and an assemblage theory lens to examine the nature of the human/technology interface in the case of emerging adults and their smartphones.

Methodology

This paper draws on a qualitative, interpretive study originally focusing on the uses and gratifications of iPhones and iPhone apps among young women, broadening to explore the relationship between older teenagers and their smartphones. Thus, it did not set out to find evidence of intercorporeality or posthuman prostheses; rather, these themes emerged from the data, directing the authors back to the literature in order to understand them. The final sample (Table I) comprised 27 participants (13 male and 14 female) aged 16–19. All were British, with families based in suburban areas of Central Scotland. Recruited through

Date of diary plus focus group	Pseudonym	Age and circumstances	Phone
November 2012 – Group 1	Kirsty	18, just started University, in first term, does not work, living away	iPhone
November 2012 – Group 1	Millie	18, just started University, in first term, does not work, living away	iPhone
November 2012 – Group 1	Kathy	18, just started University, in first term, does not work, living away	iPhone
November 2012 – Group 2	Molly	17, just started final year at school, weekend job, hopes to study abroad next year or take gap year, lives home	iPhone
November 2012 – Group 2	Katie	17, just started final year at school, does not work, intends to go to university next year, living at home, could not attend the focus group so individual phone interview	iPhone
November 2012 – Group 2	Layla	17, just started final year at school, does not work, intends to go to university next year, living at home	iPhone
November 2012 – Group 2	Rosie	17, just started final year at school, weekend job, intends to go to university next year, living at home	iPhone
November 2012 – Group 3	Lauren	17, just started final year of school, weekend job, intends to study art next year, living at home	iPhone
November 2012 – Group 3	Amanda	16, just started final year of school, weekend job, intends to study medicine next year, living at home	iPhone
November 2012 – Group 3	Morven	16, just started final year of school, does not work, intends to study geography next year or take a year off, living at home	iPhone
November 2013 – Group 4	Paul	19, first year at university after a gap year, UK descendent, educated in S Africa, lives in Edinburgh, part time job	Samsung phone
November 2013 – Group 4	Julian	19, first year at university after a gap year, UK descendent, educated in S Africa, living in Edinburgh, part time job	HTC Phone
November 2013 – Group 5	Alan	19, first year student, lives away and does not work	HTC Andriod phone
November 2013 – Group 5	Marty	18, first year student, lives away, does not work	iPhone
November 2013 – Group 5	Oscar	18, first year student, lives away and does not work	HTC phone
December 2013 – Group 6	Jake	19, second year at university, does not work, lives away	iPhone
December 2013 – Group 6	Mark	19, second year at university, does not work, lives away	iPhone
December 2013 – Group 6	Steve	19, second year at university, lives away, does not work	iPhone
December 2013 – Group 7	Jonny	19, second year student, lives away, does not work	iPhone
December 2013 – Group 7	Ian	19, second year student, does not work, lives away	iPhone
December 2013 – Group 7	Phil	19, second year student, lives away, does not work	Samsung phone
January 2014 – Group 8	Frank	17, last year at school, planning to go to university, lives at home	iPhone user
January 2014 – Group 8	Archie	17, last year at school, planning to go to university, lives at home	iPhone user

Table I.
Details of participants in the research

Date of diary plus focus group	Pseudonym	Age and circumstances	Phone
August 2014 – Group 4	Beth	18, between school and university, part time job, lives at home	Blackberry phone
August 2014 – Group 4	Joanne	18, between school and university, lives at home	Sony Experia phone
August 2014 – Group 9	Sharon	16, just started final year of school, hopes to go to university next year, does not work	Sony Experia phone
August 2014 – Group 9	Karen	16, just started final year of school, hopes to go to university next year, does not work	Microsoft phone

Table I.

purposive and snowball sampling using the first author's personal network, they could be characterized as white middle class and still relying to some degree on parental financial support. They were all anticipating or had recently made the transition from school/home to university. Where participants were under 18, parental consent was sought and all participants signed consent forms and were promised anonymity and confidentiality.

DeLanda (2006) stresses that language alone is not enough to understand the nature of assemblages as it can privilege the human voice. In an attempt to capture routine, mundane usage, participants produced daily diaries, in line with growing use of diaries for data generation in information technology and the social sciences (Piras and Zanutto, 2014; Epp et al., 2014). Participants were reassured that they were not expected to provide perfect accounts, but to capture as far as possible when, how and why they used their smartphones. To avoid being over-prescriptive and to prevent fatigue, participants were encouraged to adopt their own diary style for one week (Butcher and Eldridge, 1990). Given the frequency of smartphone use and the preference for electronic diary reporting in previous research with young people (Lim et al., 2010), the smartphone itself was the default medium for completing diaries. Some participants e-mailed diaries nightly, others brought electronic diaries or phone records to the group discussions forming the second phase of the study.

Between November 2012 and August 2014, nine self-selected friendship pairs or small group discussions were undertaken fresh from the previous week's diary generation. These semi-structured discussions created a more relaxed atmosphere than traditional one-to-one interviews or focus groups of strangers, facilitating debate and story-telling between participants. Groups were encouraged to choose a venue where they would feel comfortable: these included a TV room in a hall of residence, a syndicate room in a school sports center and numerous family homes. Pizza was provided as an incentive and token of appreciation. The discussions, each lasting around an hour, began with participants talking through their diaries. This stimulated discussion and comparisons, and led to broader questions about their relationship with and uses of their smartphones. Discussions were transcribed verbatim, with data analysis following Thompson et al.'s (1994) part-to-whole approach: each line of the transcripts and diaries was read, emergent themes identified, and theoretical notes made for each group. Constant comparison between data was undertaken independently and then jointly by the authors, with themes emerging from a process of de-contextualizing and re-contextualizing chunks of data (Spiggle, 1994).

Findings

As with previous studies, it would be difficult to exaggerate the extent to which smartphones were woven into the fabric of participants' daily lives. The following sections first explore the emerging adult-smartphone assemblage and how participants themselves described their relationship with their phones. Factors territorializing and deterritorializing this assemblage are then examined before implications are considered.

The human–smartphone assemblage

The material components comprising the human–smartphone assemblage are easily identified, with participant accounts of their experiences referring to phones, chargers, power points for charging, phone covers, contracts and users. Immaterial components mentioned included relationships with other smartphone users, internet/WiFi connections, electricity to charge the battery, the funds transferred to mobile companies, the network, call minutes, data and paid-for apps. There was also some discussion of material and immaterial components involved in producing and distributing the phones and their embedded technologies.

Miller's (2014) account of mediatization highlights the pervasive, taken-for-granted nature of media content and platforms. Although the physical phone was center stage during the discussions, participants recognized that other components, material and immaterial, played an important role. For example, Archie talked about writing essays on his phone, adding that this task was made easier by using a wireless keyboard. Although particular devices could be replaced within the assemblage, the brand component mattered to many participants. Some expressed loyalty to one brand (typically Apple), justifying this in terms of intuitive user interfaces or "because of the technology." Phil, however, chose a Samsung over an iPhone because it offered external memory and allowed him to sync content with his computer more easily. His account of using his phone to keep in touch with family members living abroad alluded to other capacities:

> […] it's a lot easier for us to use WhatsApp or Skype because those are free. And to SMS you have to have credit on your actual phone. And even if you get the bundle it doesn't allow you to send international SMSs or make phone calls.

The boundaries between material and immaterial components were not always clear-cut. For example, Mark highlighted the seamless relation he sees between the online and offline world:

> […] it's just cos we've grown up with the internet being a tangible part of our lives, kind of not physical, but I suppose it is now with your phone. It's your window into the other world I guess.

Thus, although on one level Mark knew that the internet is "not physical," it was such a constant presence in his generation's lives that it felt tangible. Furthermore, he attributed this to his smartphone: it served as a window on this "other," non-tangible world, and he had looked through it so often that the otherness of that world was easily forgotten.

Homo prostheticus?

Reflecting the study's interest in the emerging adult-smartphone relationship, a projective technique was used at the end of the discussions: participants were asked how they would describe their phone if it were an animal or a person. Consistent with Fullwood *et al.* (2017), none struggled to think of their phones in these ways although human analogies predominated. The intimacy of participants' relationship with their phones was indicated by suggestions including "my baby," "my twin," "best friend," "a companion," or even (from an only child) "my little brother, annoying at times but most of the time a good guy." Others thought that if the phone were a person, it would be "useful […] really reliable […] constant," "efficient, knowledgeable," "probably quite geeky," "older than us," or even a parental figure. Given the demands of heavy usage on batteries, someone saw his phone as "a very tired person."

Jake called his phone "an extension of self," and this sense of intercorporeality emerged spontaneously from several other participants. Thus, phones were also described as "my right arm" and "like a part of you in a way." As Millie put it, "without my phone, I feel there's something missing, I feel naked […]."

As reported by Vorderer *et al.* (2016), phones were rarely turned off, even through the night; as Kathy reflected, "I've had mine for about a year and I've never not had it on me, ever." Asked what he would miss if it were taken away for a week, Jake replied "It just wouldn't happen. It feels like a human right!". Commenting on the daily routine recorded in his diary, Jonny noted that "it's the first thing I look at, the last thing I look at." Considering whether there was ever a time he did not have the phone on him, Steve mentioned showering, but then realized "I might have it on the sink. I'm listening to music so I do have it on when I'm showering."

As befitting an infused technology (Koo *et al.*, 2015), smartphones were incorporated into participants' habitual behaviors: many commented that they had not appreciated how often they used their phones before keeping the diary. Phone checking was particularly common when waiting for buses or friends, or in between classes, but many participants, like Marty, found themselves "checking subconsciously and consciously and constantly," even when they were not sure what they were checking for.

Overall, participants were deeply attached to their phones, feeling they were part of them, suggesting that they could indeed be considered *homo prostheticus*. The components and capacities strengthening this fusion, and the wider human–smartphone assemblage, are discussed next.

Territorialization of the human–smartphone assemblage

Creativity (DeLanda, 2006) or imagination (Epp *et al.*, 2014) are central to the "becomings" of assemblages. At one level, personalization is a form of creativity. As soon as participants acquired a new phone, they customized it, downloading particular combinations of ringtones, screensavers and apps to reflect their daily lives, tastes and interests. In terms of personal logics (Vanden Abeele, 2016), technogenesis territorialized the assemblage: the more participants configured their phones to meet their needs, the more they used them and the more indispensable they became. For example, Jonny enjoyed sports betting, so he downloaded a betting app which encouraged him to use his phone for placing bets on a whim. Realizing that his phone had a high-quality camera, he began using it to take all his photos. He used the SoundCloud app to play music, a university app for e-mails, and the Economist app for researching university essays. Ultimately he realized that "I have basically been using it for everything." Similarly, Archie commented:

> I so much depend on my phone, even for the alarm. And I play music on the bus. And even at one point […] I was typing my essay on the phone […] It's crazy how much I check my mail and Facebook. And Twitter especially is just non-stop.

As Koo *et al.* (2015) note, smartphone use does not only involve exploiting features; it may also be exploratory or innovative, especially among more competent users. Participants reported using their imagination in making the apps work for them. Molly talked about clothes shopping on her own, and using her phone's camera to obtain feedback from absent friends: "If like I'm trying on something I'll send it to Layla […] I'll just sit in the dressing room for like five minutes and wait for a reply." Such constant and rewarding engagement with their devices suggests a "coupled system" incorporating the smartphone as a reliable, accessible and trusted object (Clark and Chalmers, 1998). Their phones were trusted alarms, getting participants out of bed, helping them keep time and keep on top of everything all day:

> Molly: I don't wear a watch, I just check the phone, just subconsciously use it for things.

> Morven: It's like part of you in a way, you can just check everything.

This exchange resonates with Clark's (2003, p. 6) extended mind argument – that humans harness neural plasticity "to create, co-opt, annex and exploit non-biological props and scaffolding" which become transparent due to their ease of use; as Ian put it, using his phone was "second nature." Millie's comment highlights how her phone provided essential scaffolding to her life:

> Well just your whole life is in your phone, if you ever need to talk to anyone. Your music. Your whole day is like planned out in your calendar and your phone and I feel if I don't have it then I don't know what I'm gonna do.

For Vanden Abeele (2016), peer socialization into "small communicative rituals" was part of mobile youth culture. In this study, the social logics of peer and family socialization appeared to strengthen the human–smartphone assemblage. Initially, Frank was encouraged by his parents to use his phone to let them know when to pick him up, but since starting high school its role had evolved: "It's changed a lot [...] as we've matured so can what we do with the phone." Frank's reference to "we" highlights social relationships as a key immaterial component in the human–smartphone assemblage; just as he and his peers had matured together, their smartphone use had developed and intensified collectively. Indeed, diary entries indicated that social sharing and surveillance occurred tens of times a day for many participants – many apologized as they checked their phones so often that their diary entries could never be 100 percent accurate. PC (Vorderer *et al.*, 2016), participants constantly co-ordinated online and offline social plans, supported by more sophisticated group messaging platforms than the basic SMS channel allowing participants to "micro-coordinate" (Ling, 2000). Peers also strengthened the human–smartphone assemblage through modeling behavior, although this was not always well received. Jake noted, for example, that waiting for a tutorial to start, "you look around and everyone is on their phone." Although he would personally prefer to chat to people, "once everyone is on their phone, then you end up picking up the phone." Similarly, Morven commented that at work, her colleagues tended to check their phones rather than chat when they had no customers; with little prospect of conversation, she ended up doing the same.

Over time, participants reached a point where "your whole life is on your phone" due to customization and constant use. In this way, their smartphones became closely aligned with their sense of self (Jarvenpaa and Lang, 2005). Indeed, when some participants were asked about who their smartphone personified, they described themselves. Jonny and Mark answered by considering what the apps they had downloaded said about them, making Jonny's phone "a very sporty person who likes to talk" and Mark's a "boring" individual. Some saw their phones as reflecting themselves in more fundamental ways, however. As Jake put it, "I think it would be just like me [laughter], in terms of – the phone is what I make of it. It does what I want it to do. It's not like a PA or anything."

Resonating with Frank's comment about phone use changing as he and friends "matured," the self-bound up in the phone was an evolving one, updated and refreshed as participants' identities and relationships moved toward adulthood. Many reflected that when they were younger they used them mainly to play games, but now used them for school or university work as well as planning social lives or finding their way around unfamiliar cities. Miller (2014) notes that front and rear cameras made phones both a window and a mirror, but in this study other components and capacities also performed this function: the content and connections held within them contained so many traces of their past and present, and referred to so many future plans, that their phones were both a window on their social world and a mirror reflecting their own identities, desires, and daily routines. The emotions invested in those identities and relationships strengthened the human–smartphone assemblage. The brand had a role to play in this, particularly for

iPhone users. Perhaps reflecting the need to justify the higher cost, iPhone users emphasized the intuitive user interface, wide range of apps available and superior memory/storage capacity of their phones, but attachment to the brand ran deeper than this. Jake referred to "the whole brand thing [...] I'd just say I'm an Apple person now," while some referred to their whole families that way. Steve only bought iPhones, explaining his commitment to the brand with reference to gaming systems: "It's like Playstation. You don't change to an Xbox." Molly highlighted her dependence on her iPhone, having "bought into the whole hype and stuff [...] and I was like, I need it, I need it, I need it." She was not alone in this:

> Interviewer: what do you need it for?
>
> Molly: Living [all laugh].
>
> Rosie I don't know. It just has everything. Like EVERYTHING!

Prior studies have noted the dual attachment to the smartphone itself and to its affordances (Trub and Barbot, 2016; Fullwood *et al.*, 2017). Here, emotional investment was evident in participants' protectiveness toward their phones. For example, Jonny worried about his, and was "just always trying to look after it as much as possible," while Morven announced that "if the house was on fire, I would probably grab my phone," Kathy "hated" seeing people use phones without cases or screen protectors. Her protectiveness toward her phone was legendary within her friendship group:

> Millie: She almost dropped a baby to save her phone [laughs]!
>
> Kathy: I did actually [laughs]. I almost dropped my cousin's kid to save my phone.

Despite the many capacities of the human–smartphone assemblage, the elements did not always come together harmoniously. As with Duus *et al.*'s (2014) artificial leg users, there were contexts in which participants found the digital prosthesis uncomfortable or ineffective, as discussed next.

Deterritorialization of the human–smartphone assemblage
Many participants recounted stories of breakdown in relations between material or immaterial components. Some worried about being separated from their phone through loss or theft, since "it's the worst nightmare when you think you've lost it." Others described the stress of actually losing their phone and being excluded when "everyone was making plans and stuff." Battery loss was another common concern. Archie found it "quite frustrating" that his old phone had a short battery life, while Lauren hated when her battery died because once it started charging, "you've got like no phone for 50 minutes and I'm tearing my hair out!". Karen's phone was "really slow [...] an old man who's really trying hard to be in touch with the cool kids."

Consistent with Vanden Abeele's (2016) network logic and Clark's (2003) discussion of transparent technology, several participants mentioned how "surprisingly stressful" it was when taken-for-granted connectivity was unavailable. Alan's account communicates a sense of intercorporeality: even though his brain registered the lack of WiFi connectivity, he continued to use his phone as though it would materialize:

> I was in Devon for 3-4 days and the transit time between the local town and where I lived not having WiFi or 3G was very hard. I couldn't just sit, I was sitting on Snapchat, trying in vain to download and it just wouldn't [...].

Similarly, echoing the notion of phones as "kanny" (Clark, 2003), Jake commented that if his phone were taken away from him "I'd have to find something to do with my hands."

Other accounts highlighted strong cognitive connections between users and their phones, even when access was restricted. Thus, in the early stages of a three-week African trip, Archie "had that impulse reaction to look for your phone" although he had not brought it with him, knowing it would not work there. By the end of the trip, however "I didn't care about my phone […] it was quite nice." This deterritorialization was short-lived: once home, he picked up the relationship where it left off.

The human–smartphone assemblage could also be destabilized by social relationships and associated norms regarding phone use. Karen attended a church camp where phones are "not really allowed." Like Archie, this involuntary digital detox did not reduce her longer-term attachment to her phone, but at the time, she found this restriction surprisingly positive. Echoing previous accounts of young people experiencing constant connectivity as a "burden" (Trub and Barbot, 2016), Karen reflects:

> It means that not only have you not had the distraction, you've been forced to talk to people face-to-face. It's good. It also means that when you get home, you have more to catch up with your friends, whereas if you're texting all the time you have less to talk about.

While restrictions on Karen's phone use were imposed by authority figures, peers also played a role in establishing acceptable usage patterns. As noted earlier, participants sometimes took out their phones in response to seeing others using theirs. On other occasions, peer pressure worked in the opposite direction. An example of evolving phone etiquette among young people was Beth's description of the arrangement within her social circle: "I mean if we're at lunch and a lot of people are looking at their phones, we'd be like 'put your phones in the middle of the table'." In contrast, Jake found that the rules of his immediate social circle did not always apply. Encountering "bad etiquette" led him to reflect on taken-for-granted practice:

> They'll take their phone out and use it when it's maybe not necessary and it can sometimes come across as being rude […] it's become so habitual, they don't see it as bad etiquette […] If someone's talking to me and they start playing on their phone, I'd be annoyed – it's just a lack of respect.

In some cases, excessive use by others reduced participants' enthusiasm. For example, Frank recounted annoying experiences of group chats; even with as few as five people involved there could be 250 messages in a short space of time, making him reluctant to join in.

Finally, the human–smartphone assemblage could be deterritorialized by participants' sense of themselves, especially if they felt their autonomy challenged. Rosie recalled scolding herself about how much she depended on her phone, implying that changing this was within her power:

> I became really self-conscious when I was on it. And I actually started saying to myself: you probably shouldn't go on it, cos you've been on too much and everything.

Jonny distanced himself from many of his peers who "can't go a day without their phones." However, if he found himself phoneless, he acknowledged that he would have to "try to go without my phone for the day and it is not a bad thing."

Other comments reflected the empowerment/enslavement and independence/dependence paradoxes discussed by Jarvenpaa and Lang (2005) and also a sense of person/object divide in contrast to the fusion of phone and self-alluded to elsewhere in discussions. Reflecting on all the uses he made of his phone, Archie observed that "I love it though I think I'm far too dependent on it." Similarly Jake talked not only of navigating his way around London by downloading the Underground map, and using Facebook to run a cricket team, but also of finding the diary exercise "really scary" because it highlighted just how dependent he was on his phone. He had deleted apps in the past "because I was just playing [games] too much" and "stopped taking it to lectures quite a few times cos I was always on it." His reference to "quite a few times" here is telling, however: leaving his phone behind had not become a new

habit. Furthermore, as he and others indicated, "I wouldn't have the self-control" to withstand the lure of the phone; instead, they would leave it at home, place it out of sight, or remove some capacities to resist its siren call.

Beth was unusual in downplaying her relationship with her phone: although she relied on it as a watch, alarm clock, dictionary and means of connecting with people, she did not see herself as having bonded with it: "It's not like a friend. It's not like an emotional attachment. It's just useful." In general, non-iPhone users tended to express less passion and dependence in talking about their phones. Although some had actively chosen other brands, for others, it was the price of an iPhone that put them off, even though they found their cheaper phones less responsive and less intuitive. A few participants seemed to resist the power of Apple brand or the iPhone itself. Beth did not want an iPhone "cos I don't trust Apple":

> Mainly it's the charger thing because everyone else is reverting to a universal charger now and iPhones aren't and that just makes me annoyed for the environment [laughs]. And it just annoys me that they won't co-operate […].

Apple phones were also framed by non-users as more "addictive": as Sharon remarked, "most people I know with iPhones will just use them all the time, whereas I don't really use mine that much […]" Similarly:

> Beth: everyone who had an iPhone is like, if they ever need to do anything, they just whack out their phone. Like my phone is, I do have Twitter on my phone and WhatsApp and I can use the internet on it, but it's still just a phone to me and I use it for reading my emails and getting texts and calling people.

> Joanne: […] I wouldn't sit on Facebook to look at it in the way I think iPhone users do, they use them [iPhones] more like laptops […] they're so addictive, that's another reason I don't want an iPhone, they're so accessible. If I want to see something I still have to turn it on and load the internet and stuff.

Talking about phone use in this way allowed them to present themselves as more discerning and autonomous than the Apple herd. There may also have been an element of *post-hoc* rationalization here, however: Joanne and Sharon had both mentioned earlier that would like to have an iPhone but could not afford one.

Discussion and conclusion

As smartphones become increasingly woven into the fabric of everyday life, there is a need for the IS literature to pay more attention to the implications of this socio-technical phenomenon (Sørensen *et al.*, 2015). Much media and scholarly attention has been devoted to the intense, intimate relationship between this emergent technology and young people, with previous studies highlighting the strength of attachment and ambivalence involved (Trub and Barbot, 2016). Their constant attachment to their smartphones has led not only to a stream of research on "addiction" but also to frequent use of the less judgmental prosthetic metaphor. Intuitively appealing though it may be, this metaphor requires theoretical attention.

Drawing on diary entries and small group discussions among British 16–19 year-olds, this paper's theorizing was driven by emerging adults' own accounts of their everyday experiences and relationships with their smartphones. Clearly, qualitative studies such as this explore experiences of particular groups of people, at a particular point in time, in particular cultural contexts. While they do not lend themselves to broad generalizations, it is possible to extrapolate by making "modest speculations on the likely applicability of findings to other situations" (Quinn Patton, 2002, p. 584). The remainder of this discussion is offered in this spirit.

This study's participants painted a picture of themselves as *homo prostheticus*, living their lives with and through their phones. At hand almost all the time, these devices were used constantly, consciously and subconsciously, following the personal, social and network logics described by Vanden Abeele (2016). Consistent with accounts of mediatization (Miller, 2014) and of the IS infusion stage when technology becomes deeply embedded (Koo *et al.*, 2015), participants took for granted the ceaseless flow and functionality of content and platforms through their phones: they navigated seamlessly between their online and offline worlds, their past, present and future, and their private and social selves, and they readily described their phones as an extension of themselves.

Prostheses are not limited to replacing a missing body part or restoring the function of a substandard one; they may also augment and transform bodies more generally. By incorporating a new material component, *homo prostheticus* may be seen as an upgrade to the basic human model, but posthuman perspectives emphasize intercorporeality or the blurring of boundaries between technologies, embodiment, knowledge and perception (Miller, 2014). This paper contributes to these theorizations by characterising this study's participants as *homo prostheticus* in this posthuman sense. Their accounts presented themselves as "natural born cyborgs" (Clark, 2003), treating their phones as an extension of their minds as well as their hands, with the brain's deep neural plasticity allowing them to "meld into the digital prostheses on which we increasingly depend" (Belk, 2013).

While the concept of *homo prostheticus* places participants and their phones center stage, the assemblage lens brings into view their integration into a broad, loose and constantly changing amalgamation of material and immaterial components. As "evolving and dissolving" artifacts, smartphones become invisible through habituation (Middleton *et al.*, 2014, p. 504) whilst empowering users to create new and personalized "tooled" ways of being in the world (Keating, 2005; Jung, 2014). Although assemblage theories challenge the autonomy or impermeability of the human component, this does not negate the importance of lived experience or the human perspective (Kreps, 2007; Borgerson, 2013). This study offer insights into technogenesis as a lived experience, showing the "becomings" involved when an ever-evolving technology interacts with emerging adults.

This study also contributes to understanding of *homo prostheticus* and human–smartphone assemblages by showing how they can be strengthened or territorialized, but also deterritorialized, as material and immaterial elements acted on each other, intentionally or otherwise. It identified four key ways in which the emergent adult-smartphone assemblage was territorialized: personalization of components and capacities, socialization practices, evolving identities and intensifying emotional investment. While these factors strengthened the connection between participants and their phones, three deterializing factors emerged from this study: breakdowns as material and immaterial components failed to interact as expected; social relationships and associated rules or norms; and threats to participants' sense of agency, each of which could encourage distancing from the phone, physically or emotionally.

Ambivalence about attachment to mobile technology in general and smartphones in the lives of young people is well-documented, with paradoxes of empowerment/enslavement and dependence/independence (Jarvenpaa and Lang, 2005) evident across many studies. As Cranny-Francis (2008, p. 370) suggests, we are generally untroubled by technology such as cars, planes or fridges, but feel both fear and desire when devices "begin to enter the gestalt of our physical being, to connect with us in ways that challenge bodily boundaries and the autonomy of the individual." This study contributes to understanding of such ambivalence by highlighting the paradoxical nature of technogenesis within the emerging adult-smartphone assemblage: the more transparent the technology, and the more capacities were generated, the more empowering phone use became, yet the greater the potential to feel overpowered. Such fear is a well-established part of the socio-technical imagination

(Bell, 2018, p. 25), to the extent that much writing on cyborgs and cybernetics examines their representation in literature, film and popular culture (Cranny-Francis, 2008; Hayles, 1999; Kreps, 2007).

Although the study showed that the human–smartphone assemblage could be destabilized as well as strengthened, the forces pulling it together appeared stronger and more sustained than those pulling it apart. Lost WiFi connectivity, dead batteries, the rules of social engagement, and even fleeting doubts about autonomy, were to be overcome or endured until normal service was resumed. In contrast, a host of personal, technological and social factors connected participants to their phones both practically and emotionally. In other words, the factors destabilizing the assemblage tended to act as minor, short-term obstacles in the path of *homo prostheticus*.

Commenting on the "infusion" of smartphone devices into daily life, Koo *et al.* (2015, p. 156) call for them to be designed so that people can "continually engage the technology to its full potential, with the goal of enriching the daily lives of users." Whilst this call may be uncontroversial, the means of achieving it, not least in relation to young smartphone users, are highly contested. Some recent design initiatives seem to address deterritorializing the human–smartphone assemblage, reflecting concerns about overuse or overdependence. Deloitte (2017b, p. 9) suggests smartphone usage levels might be increasingly controlled by regulators, content providers or device vendors. Thus, Apple iOS 11 senses when a user is driving and restricts the availability of some features as a result, while Tencent in China introduced age-related restrictions on the time that could be spent playing its most popular game. In what may be a tongue-in-cheek PR exercise, insurance provider MORE > THAN created a "prosthetic phone" – a piece of plastic shaped like a smartphone – for drivers to keep in the car while their real phone was locked in the boot; this was framed as helping to wean them off using their actual phones while driving and reducing separation anxiety (Weston, 2017).

While these examples suggest that deterrialization offers a useful lens for identifying new ways of addressing problematic smartphone consumption, critics lamenting young people's overreliance on their phones may be missing the point: if these devices have become a transparent, performance-enhancing part of the self, then separating the human from the smartphone might actually diminish rather than enhance their human potential. As Hayles (1999) argues, seeing the human as autonomous and independent of its environment creates fear that breaching the boundaries will lead to contamination or dissolution. Seeing the human as part of a distributed system, however, suggests that the full expression of human capability cannot occur in isolation from its environment. From this perspective, the question to ask is not how the young human–smartphone assemblage can be deterrorialized: it seems highly unlikely that the genie can be forced back into the bottle. Instead, educators, policy makers and technology developers might wish to ask how capacity building within this assemblage can be developed and enhanced in positive ways. This agenda sits within what Prasopoulou (2017, p. 294) calls "a perspective so far neglected in IS research; the possibility of entering into productive encounters with digital technologies," and encourages researchers to explore, perhaps through detailed case studies, what helps or hinders *homo prostheticus* in making positive societal interventions. One recent example of this concerns the #neveragain social activism of the Parkland high school students whose ubiquitous, instinctive access to smartphones and social media helped them document their response to the massacre in their school and create a fresh gun control movement (Witt, 2018).

Clearly the smartphone is one of many ICT devices. As Keating (2005) has shown, deaf people using web-enabled computers to communicate via sign language may be seen as *homo prostethicus*. As communications technology continues to evolve, offering an increasing array of small, wearable, even experiential devices (Prasopoulou, 2017), there are

many "tooled" ways of being in the world (Keating, 2005). This in turn raises many questions about experiences of intercorporeality across devices, social groups and contexts.

Finally, Bettany (2015) cautions against using material-semiotic theories such as assemblage theory simply to describe phenomenon, arguing instead for the incorporation of voices that are not heard. Even within this sample of young, middle-class British smartphone users, not everyone could afford the more expensive, sophisticated phones, with implications for the human–smartphone assemblage and its material and emotional capacities. In considering the implications of socioeconomic conditions, future research could explore how (or whether) other, less privileged or even stigmatized groups live their lives as *homo prostheticus*.

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