Horizon Scanning Series

The Internet of Things

IoT and the Individual

This input paper was prepared by Kit Huckvale

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What are the potential impacts of IoT on the individual? For example, will there be specific emotional risks (e.g. solitude, narcissism, depression) that arise from the ubiquity of IoT? Or could it help alleviate loneliness and depression by providing alternative means of interaction?

- Viewed in hindsight, previous attempts to predict the psychological and mental-health related impacts of emerging digital technologies have met with limited success.
    - A clear example of a prediction failure concerns a widely-discussed rise[1-3] in technology-associated narcissism in high income settings[4]. This relates, supposedly, to the rapid rise in technology-enabled opportunities for self-presentation, self-monitoring, social display, etc. Recent research that controls for changes in measurement methods indicates the opposite: young adults, who are heavy users of smartphones, social media and smart home devices, today display *lower* levels of measured narcissism compared to both earlier peer generations and other contemporary age groups[5]. Further, related concepts, such as entitlement, do not appear to be increasing[6] and there is no evidence that the clinical manifestation of narcissistic personality disorder (stable at 0.5%-1% population point prevalence) is growing[7]. At the least, this should encourage caution over strong claims about fundamental changes in human experience and behaviour driven by new technology.
    - Technology-specific impacts can be difficult to disentangle from broader social and cultural shifts. As a result, there are significant challenges of causal attribution.
    - From the point of view of identifying the most significant mental health impacts (in terms of public health burden, resource impacts, etc.), it makes sense to focus on technology-related activities/behaviours that *are adopted at significant scale*. The specifics of these behaviours are key to anticipating consequences on mood, cognition and psychological risk factors. Yet predicting which among multiple competing technologies and their uses will 'win out' is a substantial challenge. Examples of hard-to-anticipate phenomena include Pokémon Go, ASMR and 'unboxing' videos on YouTube, and the contemporary youth-focused shift to image-based social media. This challenge is clearly relevant to IoT, given both the heterogeneity of technologies that fall under this umbrella term, and its pre/early adoption status.
- As a result, substantial caution is required when considering potential psychological impacts on individuals arising from the spread of IoT. The high degree of associated uncertainty should be clearly represented in any discussion.
- Changes in the privacy landscape and concomitant reality/perception of surveillance arising from ubiquitous IoT technologies in both private and public spaces are relevant from a psychological point of view, but since this is the focus of a separate work package, it is assumed that these are out of scope for this discussion.
- The following are those issues most consistently identified by expert opinion *and* are consistent with secular trends observed in existing technologies.
- **Psychological consequences, both positive and negative, arising from changing, IoT-mediated opportunities to fulfil the basic human need for social connection[8]**

  e.g. smart city furniture/fabric creating new affordances for interacting with family, friends, and colleagues such as sensor-driven experience sharing or technology-mediated social interactions using shared infrastructure (e.g. public smart screens) *versus* e.g. reductions in day-to-day casual social interactions driven by technology automation e.g. displacement of humans by self-service automation and, in the future, robotic services.

  Evidence from social media research suggests that:

    - Positive and negative impacts arise principally from *within*-individual factors. Social IoT technology will not *cause* people to be happier or more distressed. Rather, it will tend to amplify existing psychological characteristics and risks[9].

- Those who experience positive psychological impacts – e.g. greater perceived social connectedness, belonging and self-worth – will be those who can leverage new technologies to reinforce and maintain their *existing, real-life* social networks[9].
- Those who lack such networks will not be able to derive these benefits. Those who rely on casual interactions, e.g. isolated elderly, for the majority of their interpersonal interactions may be particularly at risk from growing IoT-enabled automation in public spaces.
- Moreover, social IoT that perpetuates the development of online-only (or, perhaps, bot-driven) relationships may drive negative impacts, such as social isolation and withdrawal, since these relationships ultimately cannot satisfy social connectedness needs in the real world[9]. For example, amongst lonely older adults, greater ICT use predicts poorer psychological adjustment[10].
- A greater visibility of performative social displays – for example IoT enabled social interactions in smart urban settings – has the potential to drive negative psychological impacts, such as loneliness, in those who feel excluded or disenfranchised from such interactions.
- Social IoT will *not* fundamentally change the nature or – in terms of the most valued relationships – size of social networks[11]. Although younger people have large social networks, on average, the number of close ties remains unchanged. Mental health relevant interactions, e.g. support in times of significant distress, will continue to rely on interactions amongst a small network of highly trusted friends/family. Digital technologies may create new channels for these interactions but will probably not alter their nature.

- **Potential consequences arising from a reduction in 'socially useful ambiguity'[12, 13].**
  - Humans regularly and routinely provide incomplete or inaccurate accounts of their behaviour and motivations for the purposes of navigating social relationships, even with close ties. These partial truths and 'white lies' fulfil important social functions[14] to manage others' perception of ourselves, protect others from hurt/harm, and enable personal autonomy – for example, a teenager attending LGBTQ+ youth group who tells their conservative parents that they are studying with friends.
  - A growth in sensor-equipped smart fabric in urban, home and workplace settings has the potential to erode this socially useful ambiguity if information about location, behaviour and social interactions becomes available to employers, government and social peers. IoT data itself may be amenable to ambiguous interpretations by different actors[12], increasing scope for disagreement.
  - Negative psychological impacts may be both acute, e.g. direct social conflict when ambiguity is eroded (the parents who can now directly monitor their teenager's location) and more insidious, e.g. depression[15] associated with erosion of interpersonal trust driven by societal/workplace cultures in which individuals can be and are increasingly monitored for compliance rather than trusted to do the right thing.
  - Should smart urban infrastructure reduce the opportunity cost of automatically detecting and penalising minor social infractions (e.g. meter overruns, loud conduct, etc.), perceived benefits must be balanced against the potential effects as a new and potentially coercive stressor on individuals. Any impacts are likely to be disproportionately experienced by marginalised communities already recognised at risk from, e.g. algorithmic biases[16].
  - Cultural and/or commercial developments that normalise the sharing of detailed personal behavioural information will tend to amplify these consequences. Conversely, strong and user-accessible privacy protections will tend to diffuse them.

- **Psychological impacts arising from 'technology foregrounding'[13].**
  - Technology foregrounding describes a shift away from technology artefacts that create a minimal (or only intermittent) attentional burden to those that require routine and significant cognitive resources to set up and maintain. The emergence of smart thermostats

(compared to their 'dumb', single dial predecessors) is an example of technology foregrounding[13].

- The attentional consequence of multiples devices demanding interactions in all aspects of life are a novel potential stressor, although the long-term consequences remain unclear[17].
- Negative impacts are most likely to affect those who lack the cognitive strategies/reserves to effectively manage these demands, for example, those with deficits in attention control[18].
- Evidence about the effects of cognitive overload occupational settings include significant reductions in task performance and productivity, and subjective experience of distress, once burden exceeds a person-specific threshold[19].
- The development of effective automation and smart software agents that reduce technology foreground demands may tend to mitigate this effect in the medium-longer term e.g. Amazon's 'Go' check out experience[20] vs today's self-checkout terminals.

- **Consequences for the significant (and potentially growing) minority who choose to 'opt out' of IoT technologies[8].**
  - Privacy and surveillance concerns and techno-reactionary viewpoints are anticipated to result in a substantial minority of individuals choosing to opt out of IoT-enabled services.
  - Potential 'opt out' strategies include choosing not to purchase smart devices; refusing or revoking permissions for data to be shared; and using strategies to anonymise identity in public spaces. Technical and legal landscapes will substantially shape the extent to which these strategies are feasible/successful (c.f. rights under GDPR in Europe versus other regimes.)
  - Decisions that enable individuals to preserve their sense of autonomy and personal values will tend to drive positive psychological consequences.
  - However, the anticipated reconfiguration of public and commercial services around smart infrastructure raises the prospect of negative consequences (e.g. stress, isolation, negative perceptions of marginalisation) when such individuals start to be unable to access services because they do not have the requisite digital identity or behavioural footprint.
  - Those opting-out who come from the economic elite will be able to use commercial/political influence to circumvent these limitations. As a result, effects will be disproportionately felt by already marginalised and disenfranchised community members; potentially compounding negative personal/social consequences in these groups.

- **New opportunities for mental-health related monitoring and support**
  - IoT sensing fabric creates new opportunities for behavioural monitoring and feedback that could be used to drive new prevention and self-management services for those with or at risk of mental health conditions[21].
  - Growing evidence that digital self-management interventions are effective and safe for treating mild-moderate depression and anxiety (e.g. smartphone apps based on cognitive behavioural therapy[22, 23]), and for helping individuals monitor the symptoms of severe psychiatric disorders such as psychosis.
  - Digital phenotyping using smartphone sensors to passively monitor day-to-day behaviour has been used successfully to identify individuals with bipolar disorder at risk of relapse[24], enabling early intervention to minimise symptoms and impact on quality of life. Significant further research and development is required, however, before such services are ready for clinical/public use[25].
  - There are substantial implementation challenges concerning how public smart infrastructure could augment these kinds of activities without comprising confidentiality for conditions that remain highly stigmatised and place real limitations on work and lifestyle options (e.g. ability to secure insurance, opportunity to work in certain occupations, etc.)

- Looking further ahead, IoT enabled systems also create new opportunities[26] to provide targeted support for those with specific functional limitations, such as cognitive impairments, by detecting deficits and adapting interfaces and functions to user capabilities, e.g. through wearables[27] and personalised virtual agents[28].

Could there be specific childhood or adolescent behavioural problems associated with uptake of IoT?

- 23% of young people in Australia now report symptoms consistent with mental illness and distress[29]. Concern about the potential negative impacts of emerging technologies, such as IoT, is therefore justifiable, particularly given the potential consequences for work, productivity, healthcare utilisation and spend if the burden of mental illness should grow.
- A significant minority of children experience are at risk of – or do experience – social technology-related harms. Specifically:
    - Individuals who lack real world social networks/support and are already at risk of isolation do not derive prosocial benefits from social media[9]. They may instead use social technologies to substitute for meaningful real-world relationships, perpetuating isolation.
    - Social technologies may augment real world risks and vulnerabilities, for example, social media has effectively extended the scope of childhood bullying beyond the school playground[30]; physical distance is no longer an effective means to protect individuals against these negative impacts.
    - Condition-specific social communities can be a source of negative advice, for example, 'pro-ana' (anorexia) and 'cutting' online communities that provide, at best, mixed messages about the need to stop these behaviours. Where these communities fill an 'empathy gap' left by traditional health services[31] then young people are potentially vulnerable to harms.
- To the extent that social IoT broadens the reach of social media into public spaces, this may tend to increase the ways in which vulnerable young people are subject to potentially negative influences. (As noted above, while this may also create new opportunities for positive social interaction, research evidence suggests that some individuals are *intrinsically* unable to exploit these. The extent to which this is modifiable is not clear but there may be a role for digital literacy education[32].)
- Related to the issue of 'socially useful ambiguity'[12], specific concern has also been raised about the potential growth in 'helicopter parenting'[33], in which parents will use IoT technologies to try to optimise the development and educational attainment of their children, for example by monitoring time spent on homework or in physical activity.
    - In 2016, 75% of Australian children with symptoms consistent with a mental illness reported coping with stress as something that they were either 'very' or 'extremely' concerned about[29].
    - Overcontrolling parenting has been found to be associated with negative psychological outcomes in later childhood[34].
- Secondary physical effects of smart device interaction, particularly sleep disruption[35], are an importance consideration in childhood and adolescence because of the potential consequences for learning, brain development and the risk of future mental illness. Smart device-associated sleep disruption appears to be prevalent, affecting up to 50% of participants in one study[36].
- 'Acting out' and minor social infractions are a common aspect of teenage behaviour and development. The potential to detect (and penalise) these behaviours enabled by IoT sensing in urban fabric[37] deserves careful evaluation. Policing youth behaviours in community spaces has significant potential consequences not for individuals' life prospects, but also future criminality, their sense of engagement with society, and the extent to which they will try to hide their activities from their parents and other adults[38].

What are some of the measures that should be in place to support healthy usage of IoT devices and technology?

- The availability and implementation of technology designs that promote autonomy and privacy choices will effectively mediate many of the psychological impacts noted above, e.g. socially useful ambiguity, the ability to opt out and the ability to leverage IoT for personal purposes, such as self-monitoring.
- A recurring thread in the issues discussed above is that the ability to derive positive benefits from IoT services is closely linked with existing social capital. To avoid further perpetuating inequalities, IoT services should be explicitly designed to reflect the wishes and needs of diverse groups of citizens. As has now been recognised in the development of machine learning algorithms[16], the potential for bias and inequity should be an explicit design consideration/managed risk.
- It is critical that IoT enabled services that have a mental health component, such as monitoring services, are designed with the risk of mental health crisis in mind.
    - Public space sensors systems should at least consider the feasibility of actively detecting and responding to suicidal behaviour, particularly in high-risk locations.
    - Similarly, IoT-enabled interpersonal services, bots and avatars should be able to respond to expressions of distress appropriately, for example, by offering to provide information about sources of support.
- Explicit consideration should be given to what is lost when public spaces become managed and subject to continuous surveillance/monitoring in terms of the ability and rights of individuals and groups to associate and define the uses of those spaces. Rational algorithms reduce the potential of public space as a theatre for 'chance encounters'[39]. Explicit 'privacy zoning' could be used to define – and socially signal – limits on the types and extent of IoT- enabled monitoring deployed in specific locations.

References

1. Williams Z: **Me! Me! Me! Are we living through a narcissism epidemic?** In: *The Guardian.* 2016.

2. Davidow B: **The Internet 'Narcissism Epidemic'**. *The Atlantic* 2013.

3. Pierre J: **The Narcissism Epidemic and What We Can Do About It**. *Psychology Today* 2016.

4. Vater A, Moritz S, Roepke S: **Does a narcissism epidemic exist in modern western societies? Comparing narcissism and self-esteem in East and West Germany**. *PLoS One* 2018, **13**(1):e0188287-e0188287.

5. Wetzel E, Brown A, Hill PL, Chung JM, Robins RW, Roberts BW: **The Narcissism Epidemic Is Dead; Long Live the Narcissism Epidemic**. *Psychological Science* 2017, **28**(12):1833-1847.

6. Stronge S, Milojev P, Sibley CG: **Are People Becoming More Entitled Over Time? Not in New Zealand**. *Personality and Social Psychology Bulletin* 2017, **44**(2):200-213.

7. Grijalva E, Newman DA, Tay L, Donnellan MB, Harms PD, Robins RW, Yan T: **Gender differences in narcissism: a meta-analytic review**. *Psychol Bull* 2015, **141**(2):261-310.

8. Rainie L, Anderson J: **The internet of things connectivity binge: what are the implications?** In. Washington, DC, USA: Pew Research Center; 2017.

9. Ryan T, Allen KA, Gray DL, McInerney DM: **How social are social media? A review of online social behaviour and connectedness**. *Journal of Relationships Research* 2017, **8**.

10. Fang Y, Chau AKC, Fung HH, Woo J: **Loneliness Shapes the Relationship between Information and Communications Technology Use and Psychological Adjustment among Older Adults**. *Gerontology* 2019, **65**(2):198-206.

11. Dunbar RIM: **Do online social media cut through the constraints that limit the size of offline social networks?** *Royal Society Open Science* 2016, **3**(1):150292.

12. Brown M, Coughlan T, Lawson G, Goulden M, Houghton RJ, Mortier R: **Exploring Interpretations of Data from the Internet of Things in the Home**. *Interacting with Computers* 2013, **25**(3):204-217.

13. **Will the Internet of Things set family life back 100 years?** [https://www.designcouncil.org.uk/news-opinion/will-internet-things-set-family-life-back-100-years]

14. Iñiguez G, Govezensky T, Dunbar R, Kaski K, Barrio RA: **Effects of deception in social networks**. *Proceedings of the Royal Society B: Biological Sciences* 2014, **281**(1790):20141195.

15. Kim S-S, Chung Y, Perry MJ, Kawachi I, Subramanian SV: **Association between Interpersonal Trust, Reciprocity, and Depression in South Korea: A Prospective Analysis**. *PLoS One* 2012, **7**(1):e30602.

16. Challen R, Denny J, Pitt M, Gompels L, Edwards T, Tsaneva-Atanasova K: **Artificial intelligence, bias and clinical safety**. *BMJ Quality & Safety* 2019, **28**(3):231-237.

17. Wilmer HH, Sherman LE, Chein JM: **Smartphones and Cognition: A Review of Research Exploring the Links between Mobile Technology Habits and Cognitive Functioning**. *Front Psychol* 2017, **8**:605-605.

18. Troy AS, Mauss IB: **Resilience in the face of stress: emotion regulation as a protective factor**. In: *Resilience and Mental Health: Challenges Across the Lifespan.* edn. Edited by Litz BT, Charney D, Friedman MJ, Southwick SM. Cambridge: Cambridge University Press; 2011: 30-44.

19. Karr-Wisniewski P, Lu Y: **When more is too much: Operationalizing technology overload and exploring its impact on knowledge worker productivity**. *Computers in Human Behavior* 2010, **26**(5):1061-1072.

20. Polacco A, Backes K: **The Amazon Go Concept: Implications, Applications, and Sustainability**. *Journal of Business & Management* 2018, **24**(1):80-93.

21. de la Torre Diez I, Alonso SG, Hamrioui S, Cruz EM, Nozaleda LM, Franco MA: **IoT-Based Services and Applications for Mental Health in the Literature**. *Journal of Medical Systems* 2019, **43**(1).

22. Firth J, Torous J, Nicholas J, Carney R, Pratap A, Rosenbaum S, Sarris J: **The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials**. *World Psychiatry* 2017, **16**(3):287-298.

23. Linardon J, Cuijpers P, Carlbring P, Messer M, Fuller-Tyszkiewicz M: **The efficacy of app-supported smartphone interventions for mental health problems: a meta-analysis of randomized controlled trials**. *World Psychiatry* 2019, **18**(3):325-336.

24. Faurholt-Jepsen M, Bauer M, Kessing LV: **Smartphone-based objective monitoring in bipolar disorder: status and considerations**. *International Journal of Bipolar Disorders* 2018, **6**.

25. Huckvale K, Venkatesh S, Christensen H: **Toward clinical digital phenotyping: a timely opportunity to consider purpose, quality, and safety**. *npj Digital Medicine* 2019, **2**(1):88.

26. Ganesan B, Gowda T, Al-Jumaily A, Fong KNK, Meena SK, Tong RKY: **Ambient assisted living technologies for older adults with cognitive and physical impairments: A review**. *European Review for Medical and Pharmacological Sciences* 2019, **23**(23):10470-10481.

27. Ray PP, Dash D, De D: **A Systematic Review and Implementation of IoT-Based Pervasive Sensor-Enabled Tracking System for Dementia Patients**. *Journal of Medical Systems* 2019, **43**(9).

28. Easton K, Potter S, Bec R, Bennion M, Christensen H, Grindell C, Mirheidari B, Weich S, de Witte L, Wolstenholme D *et al*: **A Virtual Agent to Support Individuals Living With Physical and Mental Comorbidities: Co-Design and Acceptability Testing**. *Journal of medical Internet research* 2019, **21**(5).

29. Mission Australia, Institute BD: **Youth mental health report - Youth survey 2012-16**. In. Sydney, Australia: MIssion Australia; 2017.

30. Garett R, Lord LR, Young SD: **Associations between social media and cyberbullying: a review of the literature**. *Mhealth* 2016, **2**:46-46.

31. Baker D, Fortune S: **Understanding self-harm and suicide websites: a qualitative interview study of young adult website users**. *Crisis* 2008, **29**(3):118-122.

32. Swist T, Collin P, McCormack J, Third A: **Social media and the wellbeing of children and young people: a literature review** In. Perth, Australia: Commissioner for Children and Young People WA; 2015.

33. Padilla-Walker LM, Nelson LJ: **Black hawk down?: Establishing helicopter parenting as a distinct construct from other forms of parental control during emerging adulthood**. *Journal of Adolescence* 2012, **35**(5):1177-1190.

34. Perry NB, Dollar JM, Calkins SD, Keane SP, Shanahan L: **Childhood self-regulation as a mechanism through which early overcontrolling parenting is associated with adjustment in preadolescence**. *Developmental Psychology* 2018, **54**(8):1542-1554.

35. Viner RM, Gireesh A, Stiglic N, Hudson LD, Goddings A-L, Ward JL, Nicholls DE: **Roles of cyberbullying, sleep, and physical activity in mediating the effects of social media use on mental health and wellbeing among young people in England: a secondary analysis of longitudinal data**. *The Lancet Child & Adolescent Health* 2019, **3**(10):685-696.

36. Kwok SWH, Lee PH, Lee RLT: **Smart device use and perceived physical and psychosocial outcomes among Hong Kong adolescents**. *International Journal of Environmental Research and Public Health* 2017, **14**(2).

37. Lewis S, Lewis DA: **Examining technology that supports community policing**. Austin, Texas, USA: Association for Computing Machinery; 2012.

38. White R: **Young people, community, space and social control**. In: *Canberra, ACT.* National Conference on Juvenile Justice: Australian Institute of Criminology; 1992.

39. Risom J, Muessig A, Scharnhorst E, Jones T, DeCicco A, Dockstader C: **The public life diversity toolkit**. In. San Francisco, CA, USA: Gehl Institute; 2016.