Implications for Technological Reserve Development in Advancing Age, Cognitive Impairment, and Dementia

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Abstract

This commentary draws connections between technological culture emergence and recent trends in using assistive technology to reduce the burden of Alzheimer's disease. By the technical reasoning hypothesis, cognitively-impaired individuals will lack the cognitive ability to employ technologies. By the technological reserve hypothesis, social-motivational and cultural transmissibility factors can provide foundations for using technology as cognitive prosthetics even during neurodegenerative illnesses.

Commentary

According to Osiurak and Reynaud (2020), cognitive rather than social mechanisms lead to technological culture emergence. Their theory, which is focused on psychological and socio-cultural explanations for technological culture development, also happens to come at a critical time for addressing the real-world burden of Alzheimer's disease and related dementias.

It is estimated that by the year 2050, as many as 152 million individuals across the world will be suffering from dementia (Alzheimer's Disease International, 2018), causing substantial impairments to daily life. For example, persons with dementia may be unable to live safely alone, travel within their community, or manage medications and finances. Each of these impairments requires a concomitant increase in effort by informal caregivers (typically, the spouse or child), a burden that comes at the cost of caregivers' physical and mental health (e.g., Gao, Chapagain, & Scullin, 2019). However, at the same time as dementia prevalence and burden are increasing, humanity's cumulative technological culture is producing innovative technologies that may help individuals compensate for their impairments. Self-driving cars and ride share apps might allow persons with dementia to travel relatively independently even when driving restrictions are in place; video messaging and social media may relieve feelings of social isolation and depression; smartphone devices can provide reminders for prospective memory tasks such as taking medications and paying bills; and smart home technology and wearables can monitor the patient to mitigate safety issues such as falls and wandering (Benge et al., 2020; Barbarosa Neves et al., 2019).

Osiurak and Reynaud's theory on technological culture is thus timely for considering a concept we have termed *technological reserve*. Technological reserve refers to the development of a culture and environment of technology use in older adults that can buffer against the impact of cognitive decline on day to day activities. In a very tangible way, a technologically rich environment and culture may lessen the impact of neuropathological changes on day to day activities for those afflicted with neurodegenerative conditions, even without directly altering the disease itself. Though Osiurak and Reynaud's theory was intended to explain the development of cumulative technological culture as a whole, at the level of the individual, their theory provides a framework for understanding both the challenges and the opportunities for technology and dementia research.

Osiurak and Reynaud's theory provides an explanation for the phenomenon of reduced technology use with aging and age-related cognitive decline (Span et al., 2013). Some have argued that social/attitudinal processes are core to engaging older adults in technological culture (Charness & Boot, 2009). Osiurak and Reynaud though provided a stark contrasting perspective that cognitive rather than social mechanisms impact technological culture development, a view that we believe explains trends in the technology and dementia literature. For example, although social skills tend not to be grossly impaired with normal aging – or even with cognitively-impairing conditions – basic executive processes decline and this decline is associated with decreased use of common everyday technologies (Wu, Lewis, & Rigaud, 2019). Furthermore, older adults who have greater levels of cognitive impairment show less use (but *not* zero use) of the breadth of digital technology available to them (Czaja et al., 2006). By this interpretation of their theory, cognitive decline will relentlessly undermine technical reasoning, thereby leading to futility in using assistive technology to improve the lives of persons with dementia.

However, there is another, perhaps more optimistic, possibility. As the authors noted, cumulative technological culture is transmissible. This implies that as technologically-savvy cohorts age (i.e., people with early and long-instilled experience and motor memories for smart systems), their established technology habits can provide jumping off points for rehabilitative strategies even in the midst of cognitive decline. In this way, vestiges of technical skills may exist as their disease progresses, which can be leveraged into technology-based compensatory tools in clinical settings. After all, the field of cognitive rehabilitation has long noted that the most effective compensatory strategies tend to build on skills and habits previously attained by the patient (Sohlberg & Mateer, 2017).

We need not wait though for the most technology-savvy cohorts to reach older age to begin testing the concept of technological reserve (Lee et al., 2019). Two critical points have already emerged on how to foster and optimize technology use for persons impacted by neurodegenerative diseases. The first is evidence that patients with cognitive disorders and their care partners spontaneously report using the compensatory features on their smartphones more than demographically-matched peers (Benge et al., 2020). Thus, in the face of progressive cognitive decline, individuals are already reaching toward technology to help them compensate. Second, opportunities for social networking may serve as an incentive for older adults to engage with digital technology on a daily basis. Approximately half of patients report using email every day (Benge et al., 2020) and 30%-60% of older adults have a social media account (Pew Research Center, 2018). These social features of technology help to reinforce engagement with devices and cognitive-assisting systems. These positive trajectories signal the development of a subculture in the aged that remains technologically-engaged even in the face of cognitive decline.

Osiurak and Reynaud astutely noted that people are "generators of solutions." As persons with dementia, their caregivers, and the broader research field struggle with the oncoming wave of neurodegenerative illness, we are in need of humanity's technical skills now more than ever. There is an urgent need to understand how to capitalize on technical reasoning skills to build an environment where individuals and their care partners can live well, even in the face of diseases that rob the skills that gave rise to technological culture to begin with.

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