Psychological and Behavioural Science

Tackling the Digital Divide among Elderly in the UK

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PB403 Psychology of Economic Life Summative coursework
May 2022

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Background

According to the data from the Office of Communications, UK (2021), among those who remain offline, groups least likely to have home internet access are firstly those aged 65+ (18% without access). Meanwhile, data from Office for National Statistics, UK (2019) shows that since 2011, adults over the age of 65 years have consistently made up the largest proportion of the adult internet non-users, with an increasing trend; and over half of all adult internet non-users were over the age of 75 years in 2018. Using the internet has been defined by the United Nations as a basic human right that should be extended to all citizens of the world (Sandle, 2016). The importance of internet usage is contained in the Sustainable Development Goals (SDGs), specifically reflected on an indicator, which is defined within the framework of SDGs by the UK government, for the proportion of individuals who have used the internet in the last three months (Office for National Statistics, UK, 2022). Digital Inclusion has also been part of the UK Government's mission (Cabinet Office, 2014), which has been allocated to local governments to address digital inclusion in its locality.

Furthermore, the digital divide has only widened during the COVID-19 pandemic since people have been more reliant on the internet to access services and health information and socialise with friends and family. 4 out of 10 (39%) people aged 52 plus in England say they are using the internet more since the start of the coronavirus. However, usage has increased most among groups already using the internet regularly, and there is not much evidence that a significant number of non-users have been prompted to get online during the first few months of the pandemic (Age UK, 2021).

The digital-excluded group can no longer fully participate in society - from basic political functions, missed economic opportunities, to recreational exclusion. Increasingly, we see that voter registration and vote-by-mail schemes require some online presence. The track and trace NHS system is digital so there are even elements of health care that are becoming more exclusive. When we describe the internet as a basic human right, we touch on this.

1. Introduction

Digital technology has become integrated with almost all aspects of our lives. Its use has expanded to being a source of information, public services, or work. Digital technologies have also been recognised as one of the factors that can reduce social gaps and can be used to encourage and support social inclusion and increase people's quality of life (Bruner et al, 2017). However, the spread of access and use is uneven and consequently many people remain digitally excluded (OIS, 2013). Hence those who are excluded might be unable to participate fully in the society.

Although the number of internet non-users has been declining, the risk is that the digital divide between those who have access to digital technologies and feel comfortable using them and those who do not is continuously widening. Since 2011, adults over the age of 65 years have consistently made up the largest proportion of the adult internet non-users, and over half of all adult internet non-users were over the age of 75 years in 2018 (Office for National Statistics, 2019).

Contributing factors to this issue are manifold and can be found at all levels of society from government over families and peers to the individual user. This essay aims to focus on the behavioural side of the barriers stopping people aged 65+ from using the Internet while we acknowledge there are also accessibility and logistic issues. Thus, a question that we will aim to address is:

How can behavioural issues that cause the digital divide be tackled?

We will begin by applying Activity Theory to user journey to identify the barriers that elderly face when it comes to using the technology. We will then further discuss underlying issues of digital divide using Installation Theory (Lahlou, 2018). Subsequently, feasible solutions will be introduced and discussed. Following this, limitations are listed, and the paper reaches a conclusion.

2. *User Journey and Activity Theory*

To identify arising barriers, we looked at a scenario where an older person wants to attend an online social event on a platform - e.g., Mirthy – a UK start-up with online events focused on elderly (Mirthy, 2022). To simplify we focus only on attending the event (see Figure 2) and ignore an aspect of registration for the event or platform as issues would be alike in both cases. We apply Activity Theory to identify the trajectory of actions as the structure of users' activity facilitates the analysis (Nosulenko & Samolyenko, 2009).

The 1st barrier arises at the beginning of the activity i.e., switching on the device and is related to present *health issues* such as eyesight - a person might not be able to see the buttons or letters on a screen. If the barrier is overcome or absent the person can navigate on the screen and access the Internet. The next barrier might be *the lack of guidance and instructions* - the person might not know how to navigate the software, where to search for the website or how to type in a search engine and in consequence experiences anxiety. Anxiety is a key issue here to minimise as self-efficacy was found to be a mediator in technology use. Research shows that older people with high self-efficacy are less anxious about, and more likely to use, technology in general (Czaja et al., 2006; Mitzner et al., 2010).

On any stage of navigating around the Internet, an ageing person might ask for *assistance,* for example from children or younger grandchildren. However, most of the time it does not help elderly in improving their digital skills as, in fact, elderly report that younger people navigate and show them solutions too rapidly and hastily and in reality, do it for them instead of supporting and guiding them (Renaud & Van Biljon, 2018). In later stages once the individual finds the desired website, in this scenario Mirthy.co.uk., even if a person finds a link to the event, *lack of knowledge of the interface* might be a cause of confusion for them. Indeed, the Zoom link opens a new app that requires additional actions that might seem like too complex forms of technology. However, when that barrier is overcome or absent the person knows how to turn on the camera, unmute themselves and join the event.

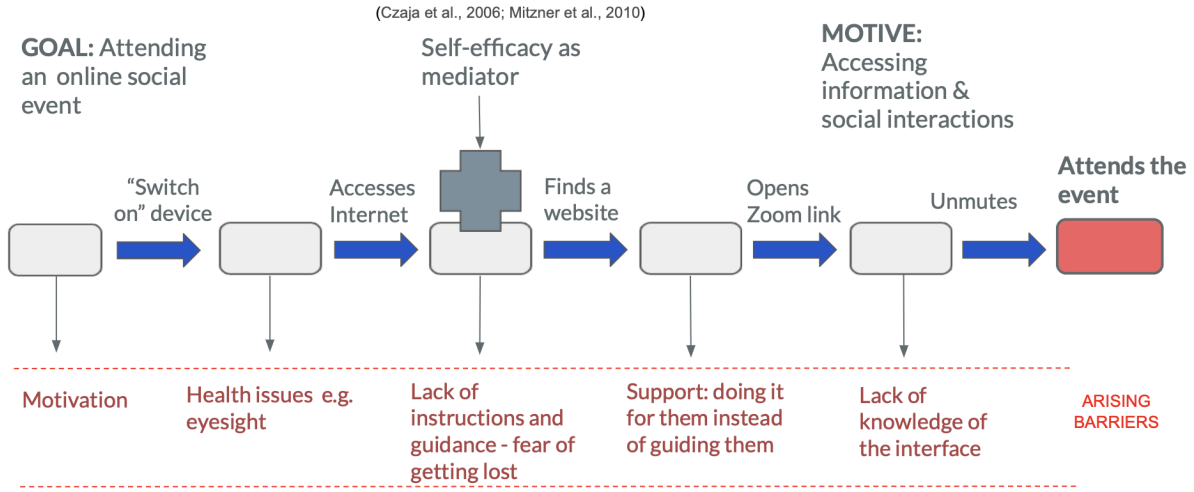

Figure 1. The social event customer journey

3. *Problems and Installation Theory*

Once the barriers are identified we can further investigate the underlying roots of the problem and factors that impact its magnitude. This problem is a complex one and involves more aspects to consider than age. Inarguably, just because a person is older does not predict that he or she will have troubles using technology. Indeed, Czaja et al. (2006) find that, compared with the age factor, factors of fluid intelligence (abstract problem-solving ability), crystallised intelligence (cultural knowledge), computer anxiety, computer efficacy (beliefs about ability to use computers), education, ethnicity, etc. can predict technology use more strongly. This implies that the barrier of age is not insurmountable.

To discuss behaviours of elderly related to not using the technology we use Installation Theory. Installation Theory suggests that installations help to predict behaviour, and consist of three different components: physical affordances, embodied competences, and social institutions (Lahlou, 2018). It explains that our activity is guided by the components available at that time and place, hence this analysis will allow us to understand why elderly are often unable to navigate around digital technologies. First, we discuss physical affordances which in this case also take the form of a virtual space.

i. Inappropriate physical design

As Norman (1988) defines, affordance is to make how a device may be interacted with readily perceivable by the users, which is as important as aesthetics in the design of new technology.

Charness & Boot (2009) note that normative age-related ability changes should be considered when designing digital products and related skill training programs for ageing adults. These changes are related to perceptual, cognitive, and motor systems, etc (Fisk et al., 2009). For instance, senior people's visual acuity, colour perception, and glare susceptibility are weakened; high-pitched noises (including key speech components) are more difficult to perceive among elderly, and background noise is more distracting for them. Changes in motor control, such as greater difficulties with fine motor control and coordination, as well as the beginning of disease processes like arthritis, might impact how older people engage with technology. These aspects are all related to the first barrier we identified in the previous section.

However, the space extends beyond its physical bounds now. By clicking on a website, you travel to another place but only virtually. This intuition to navigate around those virtual spaces is not so much the "learned response that is not the outcome of deliberate processes" but a distributed cognition, a coordination among agents. Therefore, it introduces that element of analysing how cognition is off-loaded into the environment through social and technological means - with agents that are human and machine.

ii. Underdeveloped embodied competences

In terms of cognition, there is a difficulty in acquiring the embodied competences that are necessary in the digital world among the elderly. The signs of a general slowdown of cognitive processes involve diminished memory capacity, decreased attentional control, and trouble maintaining goals. Many systems nowadays rely on a person's ability to keep information active in the working memory, however this is unrealistic for older users unless they are proficient users (Caprani & Gurrin, 2012). The summary of age-related changes that have implications on interactions with technology is shown in Figure 2. As older people interact with technology that was not designed according to their capabilities in mind, these changes in function can limit their performance, lead to a higher frequency of mistakes, and even reduce their interest, willingness, and confidence in learning to use new technology, as well as raise the level of nervousness concerning technology. The problem has its origins in the way elderly learned during their lives, as most of them had no opportunity to interact with modern digital technology. Therefore, feeling that they are outsiders in terms of the digital culture became a part of their personality (Blažič & Blažič, 2020). Although previous related experience can help when older people learn new skills, it usually takes them longer to acquire new skills than younger people, particularly for those who have a brain injury or physical disability (Charness

& Boot, 2009; Czaja et al., 2019). Furthermore, according to Kim et al. (2016), one of the major impediments to older folks embracing new technology is their perception of the effort required to understand it. At the early stage of using technological appliances, simplicity, and ease of use (if there is), is the major benefit that older people as novice users focus on the most, and then as they transit to competent users, the convenience of operating and not worrying about making mistakes are more likely to benefit their skills (Kim & Choudhury, 2021). Research shows that when interacting with digital technologies multiple skills are being learned simultaneously, which makes the learning process even more challenging and additionally difficult (McDougall et al. 2018).

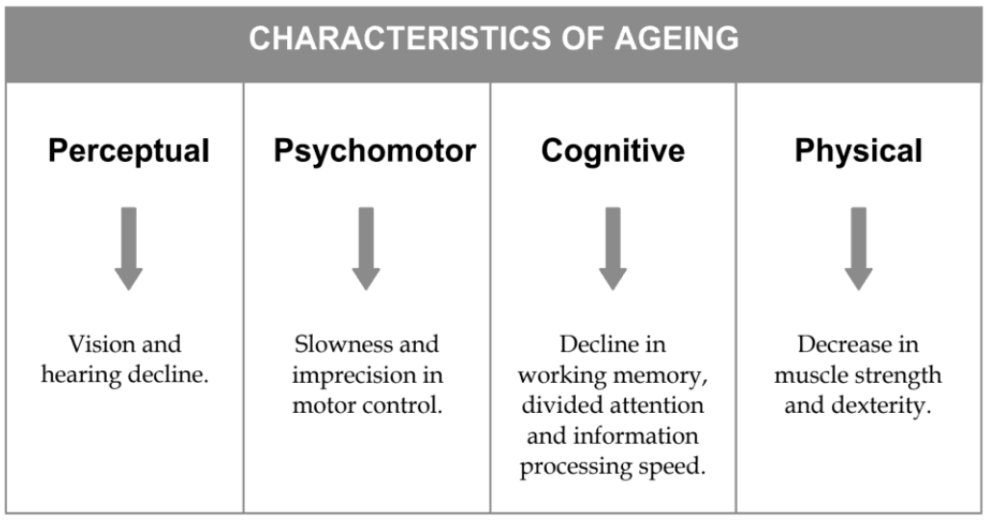

Figure 2. Summary of age-related changes that have implications on interactions with technology (Caprani & Gurrin, 2012)

iii. Evolution of social institutions

There are also the social spaces encapsulated in digital constructs that are hostile to technological non-conformity. Many places hold assumptions of innate technological skills which nowadays includes a lot of services like QR codes at restaurants, mental health or financial apps and appointments, etc. As aforementioned, the strength of a social contract is correlational with the motivation to overcome barriers - and today with tech adoption it seems that traditional ways of reaching institutions that would provide a strong social contract become less convenient. Therefore, the social norms are shifting - it is especially affecting seniors who are experiencing it at the later stages of their lives where it was not an issue till now.

iv. Analysis of stakeholders

Based on this scrutiny we have identified various stakeholders that might be interacting with discussed factors and circumstances relevant to digital exclusion. They were analysed through a brainstorming method, combined with existing references; and organised in the framework of Installation Theory (Table 2).

The layer of the Installation Theory	**Stakeholders**
1. Objective Material Environment	-Hardware producers -Internet service providers (particularly designers) -Businesses adopting the Internet -Creative inventors/Entrepreneurs (Smart home technology)
2. Embodied Interpretive Systems	-Media -Infrastructures i.e., Libraries -Educating institutions -Researchers/Research institutions -Excluded adopters themselves (Senior, disabled, etc.)

3. Social Regulation	-Non-internet-users' connections -Communities -Care homes -Legislation and Law enforcement agencies -Non-profit organisations/Funds/Charities (i.e., Age UK) -Medical systems (Carers, GP, etc.) -System designers -Policymakers -Leadership -KOL (Key-opinion Leader) s

Figure 3: The stakeholders of digital divide issues (organised in the framework of Installation Theory)

v. Key Takeaways

- The barrier of age is not insurmountable.
- The social spaces encapsulated in digital constructs that are hostile to technological non-conformity
- Older age groups report lower technological self-efficacy
- Technological design changes must be related to perceptual, cognitive, and motor systems, etc

4. Solutions:

Given the above key takeaways, we conclude that there are two main issues facing the ageing population:

- Lack of esteem (due to lack of guidance, hostile social space, and lower technological self-efficacy).
- Lack of accommodating digital features.

Therefore, our solution will involve two solutions that use Installation Theory as a guiding framework. We aim to create embodied competencies by scaffolding interventions surrounding the objective material environment and social regulations. Our first intervention targets social regulations regarding institutions and peer to peer learning. Traditional institutions are of particular salience because older generations are comparatively more trusting towards them and their reputation. Our second intervention involves technological interface and acquisition. User training and technology redesign are key strategies for ensuring a better person–technology fit. According to Rogers et al. (1998), a combination of improved design and training might reduce roughly half of the difficulties that older persons encountered with everyday tasks. Combined, these interventions will develop intuitive embodied competencies for the ageing population.

a. Social Regulation Intervention:

Our first intervention is a social, non-digital initiative aimed at creating a social contract with greater uptake. Since 2020, the NHS has recruited over 70,000 people to assist in the administration of the COVID-19 vaccine (NHS, 2022). However, with the vaccination rate declining, the quantity of these volunteers can be drastically reduced. 92% in the UK have had at least one dose with first and second dose vaccination rates declining in late 2021 (BBC, 2022). Clinics are not expected to be overwhelmed with an influx of vaccination requests, as currently forecasted.

Therefore, we propose repurposing volunteers from the NHS vaccine scheme and create a specific task force with the aim of helping the senior population become more comfortable with technology. In fact, over 11,000 volunteers from the Covid vacation scheme have remained with the NHS in some volunteer capacity (NHS, 2022). Special focus will be given to volunteers of the target age range who themselves have adequate technological skills or are

willing to learn the technological skills and teach them. Indeed, those volunteering, especially those who are in retirement themselves, have valuable free time. These volunteers can conduct technology lessons at local libraries, care homes, or community centres. Lessons will include basic computer literacy including connecting to the internet, setting up appointments, sending emails, internet safety, and socialisation. Besides the main coaching activities specifically in the domains of cognitive and social contain quizzes, daily activity reminders, positive engagement and conversations with a companion or real, multi-user games (Khosla & Chu, 2013; Morris, 2007), storytelling and conversations to improve speaking and memory (Sansen et al., 2016), memory games or interactive video games (e.g., Fasola & Mataric, 2012; Jimison et al., 2015). At a certain point, there will be remote participation in activities (e.g., through a remote companion) or promoting the use of social connections via phone, email, Skype, or visits (Morris, 2007), in order to simulate remote socialisation for family and friends. Once a participant masters these skills and feels comfortable enough, they will then have the option to volunteer and assist these lessons.

Logistically, this intervention is extremely efficient, as these volunteers have already been screened and are in the current NHS database. Furthermore, there are already routine points of contact between the NHS and elderly. For example, there are routine check-ups and reminder phone calls. Most importantly, the NHS has a reliable reputation – this will foster stronger social contracts than an arbitrary volunteer service. This would be of additional value to the NHS, as it now would allow patients to book appointments and consultations online, rather than use in person resources.

As stated previously, ageing populations face less resilient self-efficacy in regard to technological challenges. Indeed, Ellis and Allaire (1999) found, in a sample of seniors, that interest in technology was negatively predicted by technologically induced anxiety and age. Self-efficacy is instrumental in successful behavioural change (Chudzicka-Czupała & Zalewska Łunkiewicz, 2020). According to Bandura (1997), there are four influences towards self-efficacy, one being social modelling. For example, social modelling occurs when a person observes someone similar to them (or comparable) able to attain a certain achievement. This creates a sense that such achievement is attainable - similar to how participants will see their own peers teaching, learning, and succeeding in technical activities. This also has the added benefit of peer-to-peer learning, which fosters mirroring, in turn leading into increased receptivity. This is outlined in Bandura's social learning theory which implies the importance

in observing behaviours and emotional reactions of others to imitate them oneself. Additionally, people's beliefs about their ageing experience are associated with better cognitive performance, hence might influence how they behave toward computer technology; therefore, interventions that promote positive ageing self-perceptions may help middle-aged and older persons become more digitally included (Mariano et al., 2021).

Nevertheless, digital inequalities are not only experienced by those who have difficulty in navigating the online sphere but also by those whose desire or skill has become obsolete. Studies have shown that many once proficient internet users have since halted their online activities (Katz J. E.; Emmanouilides and Hammond, 2000; Dutton and Blank, 2011; Young et al., 2012). Some have coined this behaviour as the "fourth digital divide." (Damodaran & Olpher, 2013 cited in Damodaran & Sandhu, 2016). It is of particular salience because it cannot be explained by a reductionist lack of access or ability as this population had formerly been proficient Internet users. 1 in 10 people have reported to abadanoned computer usage, a majority of them being a part of the ageing population (Dutton and Blank, 2011).

Indeed, our intervention has taken this into account by building an incentive to continue using technology. The goal of this intervention is increased digital literacy. However, that goal is null if the skills are not used thereafter. In a study done by Damodaran et al., (2014) intrinsic motivation and social support were found to be key in enabling older people to overcome challenges they reported when using digital technologies. Therefore, our intervention is embedded within increased social interaction and community building. This resonates with Social Capital Theory (Machalek & Martin, 2015) for concerns of the network extent and quality of relationships that elicit interpersonal knowledge exchange to development and accumulation of human capital. Hence, make the behavioural interventions of social-support reporting facet effective. Nevertheless, Blažič & Blažič (2020) emphasised that while trying to reduce the digital divide, there should be more due regard for the preparation of the training session. They highlight that as elderly interacted with digital devices in group activities, they tended to ask questions, however the support provided by the group members was not always correct. Therefore, facilitators must be educated and prepared to work with the elderly and hence, screening should be enforced.

Digital literacy is now tied to elements of connecting with others in real life, as real-life engagement in activities improving social interaction (e.g., Blusi et al., 2018). Researchers also found that the peer support process in senior peer to peer learning included "general enthusiasm

to learn from each other and to share their expertise, skills, and discoveries." Indeed, as one participant stated, 'A culture has been fostered where people help people. Everyone in the group knows the rest of the group well and could contact and help each other if necessary.' This addresses the hostile social spaces identified in key takeaways above. Therefore, in order to incentivize attendance and using technological skills thereafter, our intervention embeds socialisation within the institution of the NHS and community life into the process of learning.

b. Objective Material Environment Intervention:

Recall that Charness & Boot (2009) notes that normative age-related ability changes should be considered when designing digital products and related skill training programs for aging adults. These changes are related to perceptual, cognitive, and motor systems, etc. (Fisk et al., 2009). Our second intervention is more digitally focused, with emphasis on interface and physical design. We propose our approach to senior friendly technology in order to create an objective material environment to complement our NHS peer to peer intervention. With these tangible effects, we aim to create pronounced embodied competencies of online abilities.

Visually and perceptually, interfaces must consider the biological state of the ageing population, primarily poorer eyesight and decline in muscle control. Iancu and Iancu (2020) reiterate that ideally, computer screens must be wide enough to display icons of 9.6 mm diagonally, 11mm diagonally if a mouse is used, and font parameters upwards of size 16. The space between related elements should be approximately 0.2 cm and the space between unrelated elements should be 1cm apart. Additionally, peripheral vision usage must be decreased, complemented by higher colour contrast and brightness. Although background noise should be avoided, there is evidence suggesting that a combination of sensory cues can be effective (Kim et al., 2007). For example, if a warning is shown on screen, a tactile and audible reaction such as a vibration and long duration sound may be most effective (Fisk, 2009). This is supplemented best by speech recognition, voice-command technology at 140 words per minute and adequate pauses in speech. Tangibly, deterioration of motor skills makes devices harder to grip. Therefore, non-slippery material is required to aid grip support (Kim et al., 2007).

Cognitively, technology must avoid overwhelming the user and therefore, dividing attention between tasks or on a single screen is discouraged. This includes minimum items on screen and task relevant information (Fisk, 2009). In order to decrease digital anxiety, it is also

beneficial to demonstrate an outline of tasks at hand and show a senior's status when completing the task (Fisk, 2009).

The market offers several mobile devices that are considered appropriate for elders. These models use many of the above minimalist features but lack advanced social functions (Klimova & Maresova, 2016). There is the assumption that seniors are satisfied with almost obsolete phones with restricted functions (Renaud et al., 2008). However, although many are reported knowing they will not need complex functions, there is still demand for more sophistication in phone design (Kim et al., 2007). Therefore, there is a need for a device that incorporates minimalist features but with more functionality. Therefore, although it is out of scope of this paper, a large part of this solution includes the persuasion of mobile phone manufacturers to properly capture the senior market space. The ageing population has large potential for the technology industry.

These are simple digital interface changes that address the biological perceptual, motor, and cognitive impairments that will aid seniors in developing embedded competencies. Related to this, is the field of study known as Gerontechnology. Conceptually recognised as an amalgamation of technological product design with the knowledge of the ageing processes (Chen & Chan, 2014), innovations are growingly applied to communication devices for retaining independent elderly living and social interactions (Fernández- Caballero, González, & Navarro, 2017).

c. Other Gerontechnological Interventions

We additionally propose using conclusions from the user journey analysis via Behavioural Informatics Systems formed by device usage, and physical adaptation to technological devices mediating social interactions. This will likely be done in small samples to give feedback to those leading the technology learning processes or for consumer insights.

Precursory to referencing the user journey of attending an online social event, emergent pre-installed sensor technologies of digital devices including pressure, motion, video sensors (Golant, 2017), and activity usage can be constructed to monitor health-related determinants (Pavel et al., 2015) across activity, mobility, social isolation, and cognitive impairments

(Berrocal, Garcia-Alonso, Murillo, & Canal, 2017) and physiological and behavioural signals through the IoT (Spruijt-Metz, et al., 2015).

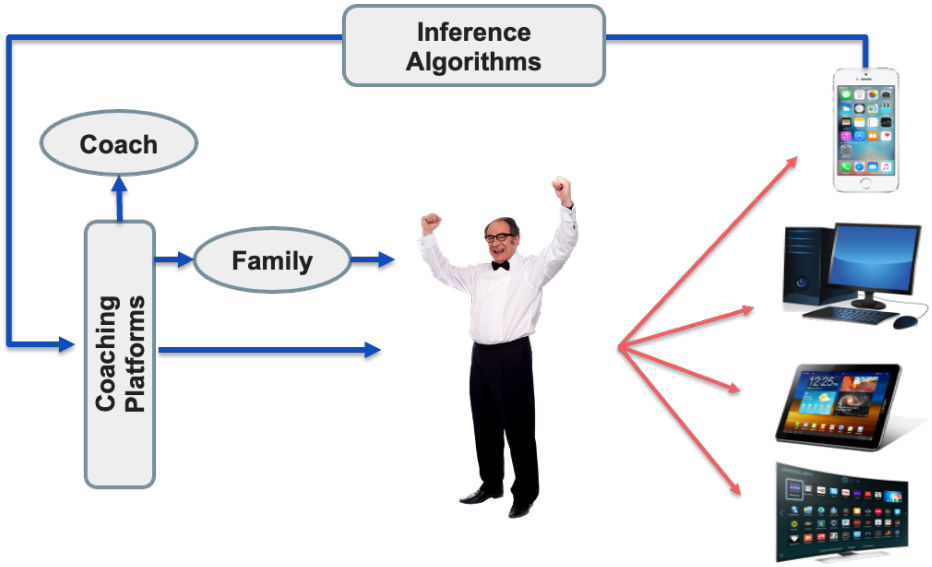

Figure 4: Behavioural Informatics Platform

i. Individual/Social-Network Reporting

Applying this to the exemplified user journey, the first solution seeks to utilise these data usage logs along a user path with efficient data collection in smart devices (Piwek & Ellis, 2016) monitoring elderly device contact, attempts in accessing the internet, when socially engaged actions are abandoned, search performance accuracy, and manual data-gathering in self-reporting on goal success. Intentions through compiling this data, ideally through configuration of an app, establishes and computationally refines a profile from behavioural patterns (Krpan & Urbaník, 2021) in reporting embodied capacities back to the user, or linking to a wider community of caregivers if authorised; reports can produce behavioural self-intervention or be integrated in the social volunteers & peer support solution to feedback on difficulties experienced for a user. Important considerations evidence privacy as the primary concern in elderly groups for digital devices (Yusif, Soar, & Hafeez-Baig, 2016) therefore autonomy is paramount in support-network reporting.

Regarded individual/social-network reporting solutions are fundamentally promulgated in the Theory of Planned Behaviour (Ajzen, 1985) where informatics is effective in exhibiting past behaviours and self-efficacy to report predictive future actions (Fu & Wu, 2018). This can be

concordant with Social Cognitive Theory (Bandura, 1986) tenets emphasising self-efficacy and outcome expectations as integral for human functioning (Chiu, Hsu, & Wang, 2006), of which are exposed through this individual activity reporting solution. In alternative consideration, informatics for reporting to user social-networks can evoke Social Capital Theory (Nahapiet & Ghoshal, 1998) for concerns to the network extent and quality of relationships that elicit interpersonal knowledge exchange (Lane & Lubatkin, 1998) to make the behavioural interventions of this social-support reporting facet effective. Paradoxical threats for attempts to socially re-engage the elderly via social-network reporting can be avoided if adopted synchronously with the earlier social volunteer/peer support solution to create a fully packaged digital care system, ensuring interpersonal exchange options when self-intervention is ineffectual. Individual/social-network reporting expresses the confluence of physical and social layers on greater affordances in eliciting embodied skills growth through digital interactional success.

ii. Virtual Assistance

Whilst prior multi-domain interventions can provide solutions to regressive cognitive performance (Baltes, 1993), loss of social network (Raban & Brynin, 2006), or mental-health risks (Petermans & Piau, 2017) to evidence improvements for community-dwelling users (Chen, 2020), behavioural informatics can be alternatively applied in robotics technologies for lacking international social-care coverage (Chen et al., 2020). Applied to the exemplified user journey, this solution offers a screen-based virtual tutor in personalised pop-up visual displays/videos and verbal feedback for difficult tasks, bridging the intention-behaviour for attending an online social event. Utilising behavioural sensors for intervention (in addition to those above) can include mapping digitally based motion, delays, and chronemics (Nunamaker et al., 2011) in selecting appropriate verbal responses or visuals. This virtual assistant can be preliminarily installed with ideal actions and taught expected outcomes (Görer, Salah, & Akın, 2016) through such imitation learning and robotic process automation (RPA); pre-installed paths adapting to elderly user intentions allow for greatly personalising responses over time. Ideally configured through an app/web extension user interface, a virtual assistant will appear on webpages with a visual display of a humanoid character completing tasks for elderly users to learn and mimic, with data input being the goal context, page content and identified area lacking competence. Whilst retaining user autonomy in actions, the artificial intelligence of RPAs for digital virtual assistance arguably constructs a closed loop (Pavel et al., 2015) through

an adaptable workload on user cognitive capacities through repetitive structures (Von Uexküll, 1992).

Virtual assistance through intelligent technologies underline Self-Determination Theory (Deci & Ryan, 1980) for interventions affording user autonomy, competence, and relatedness (Deci & Ryan, 2000) shown for achieving greater technological acceptance (Rosli & Saleh, 2022). This virtual, assistant can elicit a Zone of Proximal Development for internalising knowledge (Vygotskiĭ & Cole, 1978) achieved with expert assistance to scaffold competences (Lahlou, 2017) in leveraging structurally repeated and tailored e-learning (Rosli & Saleh, 2022) through RPAs. Mediation in a personified virtual assistant, perceived as an elderly-aged peer, also finds greater receptivity of elderly users to information (Burmeister et al., 2016), reduce technologically related stress, and build trust (Smrke, Plohl, & Mlakar, 2022) whilst retaining a sense of independence (Bowman et al., 2013). Interventions formulated for visual displays ultimately confer a constructivist learning theory (Zhang et al., 2006) through associative learning of an assistant by mentalisation and imitation (Catmur & Heyes, 2006) to progressively reproduce self-sufficient behaviour (Pea, 2004) resulting from gradual internalisation of proximal development. Virtual assistance therefore engages the mental layer, compensating a lack of self-efficacy (Alvseike & Brønnick, 2012) to provide physically and socially isolated elderly a long-term learning aid on the path for human re-connection.

5. Limitations

Despite the attempt to investigate the digital divide among elderly holistically, the limited scope of the project inevitably results in methodological and conceptual limitations. From a conceptual perspective, while each intervention has a strong theoretical backing, it is imperative that the user sets appropriate goals which require a level of self-awareness. The motivations and feedback of the user are recorded according to collected data of their use, hence a limited range of options. Therefore, when their experience is not included, the digital intervention cannot successfully map their behaviour pattern or suggest appropriate training and response actions. Other limitations consider the ability to engage the intended users in solutions for gaps emerging in events of no social ties, such as family, friends, or use of community spaces.

Methodologically, this paper heavily relies on empirical research and secondary data for both problem identification and potential solutions. Yet, because of the novelty and uniqueness of the above-presented solutions, which stem from a combination of various theoretical concepts and streams of thoughts, some still require empirical validation. Thus, the opportunity for future research is to test the above solutions for feasibility and their efficacy. Moreover, further research could look at the productive use of gamification. The restructuring of tasks to increase intrinsic motivation and extrinsic environmental motivation (Hamari et al., 2014). Gamification would allow users to set explicit targets, track progression over time, receive feedback, ideally through a voice assistant (Rodriguez et al., 2021), and have better engagement as games are considered as having “great potential in accepting” digital game-based learning among elderly (Damodaran & Sandhu, 2016). Furthermore, interventions should be considered to keep being adapted to coming generations as the underdeveloped capabilities might solve naturally as generations renew, however the issue of cognitive loss and handicap will stay.

6. Conclusion

The objective of this essay was to come up with solutions to holistically address gaps in Internet-dependent communities where excluded participants are truly incompatible with the set of behaviours a greater number of installations are channelling. This problem has various underlying issues that are too ample for the scope of this project, hence our research focused on the behavioural side of the matter. Activity Theory was applied to break down the process of elderly's exemplary attempts on the Internet into identifiable stages which served as a basis for further analysis. Installation Theory was subsequently used to navigate around underlying barriers and aimed to distinguish extrinsic versus intrinsic elements and how it connects to elderly's competencies and capabilities more holistically. The interventions were designed to create embodied competencies by scaffolding interventions surrounding the objective material environment and social regulations. By making tactful and realistic changes to the tangible systems in question, the intangible can be properly nurtured.

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