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Artificial Intelligent Technologies and Elderly: Decoding the Stimuli towards the Artificial Intelligent Technology Adoption

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Abstract
Technology has overtaken our lives, and we are bounded by the immense layers of digital and technology. It makes our lives easy-going and convenient, but it is far more complicated for those who cannot even imagine getting used to such an environment and are unfamiliar with them. Here the study gives a broad understanding of the insight of the elderly towards innovative, intelligent technologies. It also explores and explores the stimuli that motivate and encourage them to adopt AI-based advanced technologies. The study used a quantitative approach and applied Structural Equation Modelling to validate and establish the identified constructs. A total of 238 respondents were considered for the study. The findings will enable both the researchers and the practitioners to broaden their vision and acknowledge that technological innovations are possible across cohorts.
Keywords – Elderly, AI-based Technology, Innovations, Technology Adoption.

Introduction

The older adult population globally is further projected to reach 2.1 billion by 2050 (UN World Ageing Report,2019). However, population ageing is most advanced in Europe and North America. The population in other regions is also growing very fast (Shrestha, 2000). As per the United Nations report, Asia comprises 24 percent of the elderly people, out of which close to 104 million older population are in India, close to 10 percent of the global share (Department of Economics and Social Welfare, 2019). The current statistics around us give us enough reason to recognize this section of people's necessity and comfort. They are an integral part of our society and community. Time is changing very fast, and the elderly interests are also evolving with time. With the advancement of technology and the gradual

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shift of our basics in the digital platforms, the elderly are also using and embracing technology more and more (Francis, et al., 2019). Older people have started using digital media or digital applications/apps to search for information, connect with friends and family, learn health-related services, shopping, planning travels, and pension-related works and investments (Anderson & Perrin, 2017). The digital platforms also help them create a network with their peers and most significantly serve them to fight the isolation due to age or age-related conditions. Thus, some word of mouth/recommendations from the peer, or some compulsions either professional (pension, investments, etc.) or personal (staying in touch with friends and family, learning, etc.) adoption of technology or digital platforms has happened (Wang, et al., 2019). The problem lies in the next phase. Although acknowledgement, understanding, and adoption of digital technologies have somewhat happened, they are not very keen on adopting something beyond the existing platforms. Digital innovations such as Artificial Intelligence (AI), Ambient/ Active Assistant Living (AAL), Internet of things (IoT) have great potential to improvise further and assist their lives by making them more independent and by also improving their quality of life.

Here the challenge is when it comes to understanding and adopting AI embedded platforms, they are a little hesitant. They feel vulnerable to adapt to speedily evolving technologies (Lancaster, 2018). AI primarily works by building systems that behave intelligently as per the surrounding and process things based on understanding, analyzing, and then acting accordingly for the best possible result (Advani, 2020). With this generation of Baby boomers, the attitude of "technology being difficult" is challenging, which has developed in their minds due to lack of familiarity. They feel that technology is not something they are born with. The platform's complexities and the tech terminology make it tricky to accept or come to terms with the technology. The acceptance of technological innovations will happen throughout and across ages when made simple, accessible, and affordable. For the older population, the familiarization process with AI-based technology should be step by step. The assistive gadgets, portability helps, and systems support should be the first step to these innovative technologies. Later, when they start acknowledging AI's presence in their lives around them, the same can be progressively taken into the next level of acceptance and adoption, such as using AI-based devices to monitor their health and track their home activities.

This study emphasizes and highlights the prospects that can augment the drive towards acceptance and adoption of AI-based technology among the elderly and their impediments with the rapidly changing digital environments. Through this research, the researcher aims to answer the following research questions

RQ1: How do the elderly perceive when we expose them to AI devices or technology?

RQ2: Are they motivated to use AI-based technology devices? If yes, what are the variables that influence or motivate them to adopt advanced technology?

The following section will discuss the variables derived from the literature supporting and aids in establishing the influencers/motivators, especially when it comes to acceptance and adoption of advanced AI-based technology.

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Utilitarian benefits

AI-based technologies are conceptualized to offer individual ease and also convenient ways to complete tasks. These tasks can range from doing basic daily stuff such as searching information, repurchasing products, assisting customer service, and service-related information (Hoy, 2018). The utilitarian benefits incorporate mainly influencing the adoption of technology and validated by researchers in the past (Venkatesh et al., 2012). Recently, researchers also charted several mobile application roles for people with utilitarian assistances (McLean, Al-Nabhani, & Wilson, 2018). AI-based advanced technologies have immense potential to interact with people without any physical involvements, preferably with only a voice-based interface that is adequate in aiding a multi-tasking environment. Considering all these situations, the researcher speculates that hands-on and everyday benefits are crucial and will also influence the elderly and motivate them to adopt AI-based technology.

Hedonic Benefits

Many studies earlier discussed how individuals interconnect with technology for pleasure-seeking and self-indulging purposes (Wu et al., 2010). Hedonic benefits discuss an individual's dynamic experiences, such as fulfilment or enjoyment or desire. This enjoyment entails using or adopting technology (Schuitema, Anable, Skippon, & Kinnear, 2013). For example, research on an online shopping environment suggested that an individual does not have an enjoyable experience; it is improbable that the person will use the facility in the future (Martin, Mortimer, & Andrews, 2015). Feng et al. (2017) further discussed that although practical benefits are a fundamental aspect of adopting any technology, the hedonic benefit is crucial to gauge its success. Thus, the hedonic benefit is an essential variable in the adoption of AI-based advanced technology.

Social Influence

Social Influence is described as one's belief that is influenced or built by the peers and family's perception vital to them and their lives. In this case of digital adoption, social influence is a powerful motivator. Their close groups can be their friends and family, directly create a substantial impact on life decisions. The technology is helpful for them and will ease their work, and life is something that can be quickly built if the same is perceived through their closed group. It is a favourably mentioned factor in the acknowledged literature. Three types of social influence impact and influence the decision a) influence of social networks (friends), b) influence of family and c) influence of organizations. (Giger, et al., 2015), (Sebastiaan, et al., 2015), (Tseng, et al., 2013), (Dupuy, et al., 2016). The elderly get more inclined to adopt technology and stick to it for a longer time when recommended by their closed circle. They feel it to be more genuine and authentic (Giger, et al., 2015). The seniors are willing to adopt technology when suggested by their children or grandchildren (Luijkx, et al., 2015). As per the study by Tseng et al. (2013), behavioural intention is a critical factor

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that gets predisposed by the opinions of the social circle, which indirectly drives the views of the elderly. Thus, generating a negative or a positive attitude toward technological intervention and then adoption is also directly or indirectly governed by social influence.

Social Presence

Humans' eagerness to talk with computers or technology started from computers' evolution (Hoy, 2018). The growth in robotic research makes social presence from technologies very apparent (Chattaraman, Kwon, Gilbert, & Ross, 2018). The mechanized social company makes an individual feel the presence of another entity. Hence, they feel attracted to such technology (Heerink, Krose, Evers, & Wielinga, 2010). As the AI-based technologies use natural language, murmur, showcasing politeness, curtsy, pausing before responding, all these unique features leads to treating the users even treat the technologies as social beings (Lombard & Ditton, 2000). Since humans are usually social beings, intermingling with technology fascinates and appeals to an individual (Moon. 2000). These human-like social responses provoke a logic of another's company in their cognizance. After a certain point in time, they started getting comfortable with machines' artificial personification, similarly to any conversation with human beings (Risse, 2019). Since people are habitually fascinated by pleasant demeanour, the advanced technologies' social presence will encourage people to participate with the AI-based technology just like they would with other human counterparts (Perakakis, Mastorakis and Kopanakis, 2019).

Adoption of AI-based technology

The next phase is of creating a willingness to adopt the technology. In the identified literature, it was reported that ease of use leads to the adoption of technology by the elderly and also generates a positive experience among the elderly (Demiris, et al., 2013), (Giger, et al., 2015), (Sebastiaan, et al., 2015), (Reeder, et al., 2013), (Pecina, et al., 2011), (Tseng, et al., 2013), (Chen, et al., 2013), (Saracchini, et al., 2015), (Vaziri, et al., 2016) (Fischinger, et al., 2016). Although privacy in using the technology acts as an intrusion in recent time, the elderly are not anymore much afraid that the use of technology will jeopardize their privacy (Sebastiaan, et al., 2015), (Ravishankar, et al., 2015), (Hoof, et al., 2011), (Garg, et al., 2014), (Pino, et al., 2015). Usefulness (the extent to which one perceives something to be helpful) is another factor that positively influenced seniors' acceptance of the technology. Giger et al. (2015) also pointed out an interesting finding in their research, which states that elderly engagement and technology adoption is increasing due to social influences around them.

Existing Theories and Models

When we talk about technology adoption and acceptance, then the Technology Acceptance Model (TAM) developed initially by Davis (1989) has got been wider acceptability across several disciplines (Rese, Baier, Geyer-Schulz, & Schreiber, 2017). TAM2 (Venkatesh and Davis, 2000) and TAM3 (Venkatesh and Bala, 2008) were later introduced, further integrating supporting variables, particularly social norms (TAM2) and enjoyment (TAM3),

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as a critical component in the model. The Unified Theory of Acceptance and Use of Technology (UTAUT) and the subsequent variations of UTAUT, namely, UTAUT2, include hedonic motivation and habit. These broadly fit the current study context (Venkatesh, Morris, Davis, & Davis, 2003; Arenas Gaitán, Peral Peral and Ramón Jerónimo, 2015). Although the models were extensively used in technology adoption and usage, the attributes may not be merely distinctive to understand the unique features of advanced technologies such as Artificial Intelligent technology and the underpinning motivators towards adoption. Understanding the motivation towards adopting or accepting any medium is well established through the Users and Gratification (U&GT) theory. U&GT equally plays a crucial role in understanding the push towards the new technological territory. Thus, U&GT is a theoretical model that comprehends the variables influencing or motivating technological adoption (Ruggiero, 2000). The broad diversity of the theory in the past and recent past makes U&GT a vital basis for this study.

The more significant relevance of U&GT usage in diverse media is already discussed in past literature concerning mediums such as radio, television and newspaper, social networks, online games, and augmented reality (Bantz, 1982; Leung & Wei, 1998; Rauschnabel, Wu, Wang, & Tsai, 2010, Rossmann, & Dieck, 2017; 2018; Osei-Frimpong & McLean, 2018). Thus, the theory's broader acceptability provides a distinctive lens in understanding the motivators influencing or driving AI-based technology adoption along with the other technology adoption theories.

Proposed Framework

The literature helped us to identify and structure the variables to be considered in the study. All these variables put together to propose a conceptual framework (Figure 1) given below. The proposed model is further intended to help us clarify how all of them can influence and push the adoption of Artificial Intelligent technology for the elderly.

Hypothesis

H1: The Utilitarian benefits will significantly impact the elderly Adoption of Artificial Intelligent Technology

H2: The Hedonic benefits will significantly impact the elderly Adoption of Artificial Intelligent Technology

H3: Social Influence significantly impact the elderly Adoption of Artificial Intelligent Technology

H4: The Social Presence will significantly impact the elderly Adoption of Artificial Intelligent Technology

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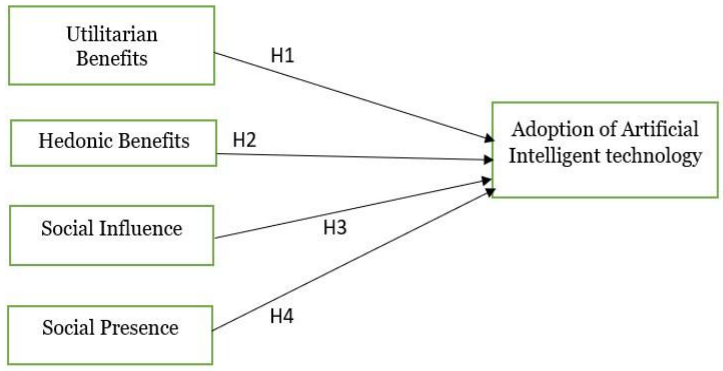
Figure 1: Framework depicting the Variables Influencing the Adoption of Artificial Intelligent Technology



Source: Author's Findings

Methodology

The research is restricted to comprehend and decode the variables influencing the adoption of Artificial Intelligent technologies through a quantitative approach. An online questionnaire is inducted to gather the information to assess and validate the hypothesized model in Figure 1. Data is collected from 300 respondents across Pune and Mumbai city of Maharashtra, India. Following the data cleansing process, the sample finally covers 238 respondents, closing the overall response rate of 79.33 percent. Since the data was gathered mainly during the pandemic time, and both the cities were on high alert for the pandemic, the data was collected through convenience and snowball sampling. The elderly are the most vulnerable groups at this time, so it was ensured that the data is gathered while maintaining social distancing norms. Wherever it was possible, the survey tool was inducted via some reliable intermediaries who channelled the data collection's facilitation. The respondents are primarily in the age group of 60 – 75 years of age of any gender. The criterion used to consider them as a part of the survey are

a. The respondents are avid users of smartphones, various mobile applications in their daily lives. They are aware of know-hows in their smartphones, such as Google Assistant and Apple's Siri.

While inducting the survey, it was interesting to note that many of them are aware of AI technologies and were also using assistive devices such as Alexa and Google Home. They have happened using the same for the past one or two years. Others were yet to use such devices but are aware of AI-based devices and assistants in their smartphones and around them. The scales used in this investigation were adapted from the existing works of literature.

Findings

An array of preliminary analysis is done to gauge the data. The scale reliability is assessed through the Cronbach Alpha coefficient. As shown in Table 1, each scale reliability has

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surpassed the value of 0.7, confirming that the considered scales are consistent in evaluating the variable (Gliem and Gliem, 2003). An Exploratory Factor Analysis (EFA) was done, which confirmed sampling adequacy through KMO sampling adequacy value as 0.838, and an equivalent significant value for Bartlett's sphericity test. The Confirmatory Factor Analysis (CFA) validated the measurement model. The variables considered in the study represent the goodness of fit for the scale. The Structural model is further validated using Structural Equation Modelling (SEM) in AMOS Graphics. The SEM in AMOS allowed testing the conceptualized relationships in the concurrent analysis. First, the CFA of the entire model is performed. The results of the CFA confirm the goodness of fit of the data - $\chi 2$ = 269.863, p = 0.000; CFI = 0.961, GFI = 0.968, RMSEA = 0.0252. In addition to that, each of the regression values shows statistical significance ($p < 0.05$).

Additionally, convergent and discriminant validity is also fulfilled. The same results are put in Table 2. The Average Variance Extracted (AVE) value is above 0.50, thus confirming the convergent validity. The square root of AVE values was also more substantial than the latent variable's correlation, thus supporting discriminant validity. Before conducting the SEM process, common method bias (CMB) and multicollinearity test were also conducted. The researcher used a structured questionnaire, so the Common Method Bias (CMB) test is done using the Harman Single Factor test, which accounted for 20.958 percent of the variance, thus negating CMB's effect. Since the value falls below 50 percent, we can quickly negate the CMB's effect (MacKenzie and Podsakoff, 2012). The multicollinearity effect is assessed through the Variance Inflation Factor (VIF). The result outlined that no variable has a value above the critical value of 3.0, thus negating the effect of multicollinearity (Hair et al., 2010).

Results of SEM

Given below in detail are the structural equation model results estimated to test the hypothesized model and the relationship above in Figure 1. The structural model confirmed goodness of fit $\chi 2$ = 273.863 with $p < 0.05$, RMSEA = 0.064, CFI = 0.960, GFI = 0.951 shows and supports the hypothesized relationship and the model. Table 3 indicate in detail the framed hypothesis and provide evidence in support of the four hypotheses. The results indicated all the significant values. They validated the framed hypothesis, thus affirming that they are among the few important and crucial influencers that motivate the elderly to think about adopting AI-based technologies.

Discussion & Conclusion

Worldwide the innovations have made considerable progress but through the span of more conventional older lifetimes. The older people with us have seen everything from men arriving on the moon to emotional therapeutic advances and the ascent of an Internet-subordinate society. They have also witnessed how society has changed using new gadgets and tech; cash replaces by plastic cards, and many more. Thus, their fondness and trust towards these highly assisted advanced technologies will happen when the technology is simple, affordable, user-friendly, practical, enjoyable, and trustworthy (Ghosh, 2019). It can

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also be incorporated into their lives through some stimuli, which will accelerate the adoption of such innovative technologies. The researchers, through this study, tried to identify those stimuli that can augment the adoption of such as AI-based technology and improvise their daily living. It was evident in the preceding discussion in the literature review above that the elderly do value the Internet's role in their daily lives as much as their younger counterparts. The study also clearly reveals specific facts where it is clear that there is awareness of these platforms and also of AI-based technologies. The increasing age is predominantly playing a crucial role. However, the framework depicted above (Figure-1) indicates that the acceptance of technology (AI-based platforms) primarily happens when they find any technology enjoyable, fascinating, helpful, and the same as a strong recommendation by their close circle. The adoption primarily happens if they feel the value and the need for that specific technology in their lives. The experience that they incur while engaging with the technology or the platform holds a substantial value. While exploring if the experience, such as practical benefits of the technology, access with the interface is positive and enjoyable, it creates a positive intention leading to adoption. This intention for the adoption is directly dependent on the hedonic benefits, such as if the experience is enjoyable and fascinating. The involvement and the adoption of technology are also very much grounded on the utility as the elderly similarly feel that such advanced technology has limited utility in their lives. Apart from these two benefits, the study also highlighted and validated a key variable of social presence, which drives the adoption.

Along with Social Presence, social influence is also very crucial. The cognizance and curiosity about advanced technology are due to their social influence or the social circle. The elderly need some validations before they venture into something new. These validations are meaningful for them because it comes from their reliable sources, their social circle. Thus, social influence is a strong motivator and a crucial influencer to drive AI-based technology adoption.

Since the AI-based technologies are primarily voice-based, and the elderly generally stay alone, the voice substitutes human interaction. It helps combat loneliness and social isolation, which has become very prominent during the pandemic and social distancing. AI-based technology is also helping them engage with them as human, and hence they can feel the presence of someone around them. They perceive its presence as a human presence around them and therefore feel attracted or motivated to use it.

The current study is built on a comprehensive conceptualization of understanding the stimuli behind technological engagements and how they can impact the adoption. This conceptualization helped to understand the studies' potentialities in older adults, primarily when we associate AI-based technology and their understanding and adoption. Embedding AI-based innovative technologies does not mean the use of only superintelligence robots or tech; it can be as simple as the use of small and compatible voice – assistants or, for that matter, even their smartphones, sensors, or gadgets that make life simple without any threat as well make their lives more pleasant and friendly. AI is gaining much traction in the area of health care, especially for older adults. This advanced technology should extend its reach

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beyond health care and should also focus on the daily care of the elderly. Concerning the current pandemic situation and the lockdown, these technologies, if used and built optimally considering the variables established in this research, can contribute hugely to the lives of the elderly. Mostly, the older people stay alone. These technologies can expose older adults' current cohort to ease accessing such devices daily and make them more comfortable, easy, and straightforward.

Meanwhile, there always exists an acceptable nature of technology where the elderly first participate enthusiastically, reject or hesitate to come back, and then re-engage another time, leading to a state of unpredictability concerning engagement and adoption of advanced technology. These variations will exist because it is always intended to promote their access and simplistic usage approach. In contrast, the acceptance or adoption of technology is entirely dependent on the preference and the personal understanding of that interface/technology. Hence, the notion of inconsistency also evolved as an essential dimension of technological adoption and engagement, especially when the target group are the elderly.

Theoretical Implication

AI-based technologies are dominating the market, and the growth in terms of their usage is ever increasing. Since artificial intelligence technologies are primarily self-functioned and controlled by voice, the adoptions replicas available are not all-inclusive enough to enlighten and rationalize adoption, especially when adopting AI-based technology for the elderly. Prior research in this area discussed and contributed primarily to the Internet's adoption and various engagements of the elderly with the digital platforms. The current study is a step higher than that. Firstly the research established and validated variable such as "Social Presence" how this is equally impactful in influencing AI-based technology adoption related to AI-built devices. The research-validated the standing of Social presence and tangled it with benefits such as utilitarian and hedonic benefits, thus further validating each of its significant influence even for the AI-based technology adoption. This is a crucial finding as this helps us understand the social benefits of the association of the elderly with advanced technology. The study adds the dimensions of these variables as a valid component in advanced technological adoption.

Practical Implication

The marketers should actively acknowledge that shortly the task will be not to increase and invent innovative technologies; rather, the emphasis should be more on persuading people on the usage and adoption of technologies, especially the elder cohorts. The developers or the designers who are developing the AI-based technology can look into the variables identified and established in the study to make it also more viable and friendlier systems for the elder cohorts. As the elderly constitute a significant and sizeable portion of our society, this research's findings will make the marketers think about tapping this segment with more compatible AI - devices and technologies. The pandemic hit market also increased more

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opportunities for the marketers and brands to think specifically about the elder cohort. Since the vulnerability at this age is more so, considering and catering for their needs at the pandemic hit a time or any other future crisis is even more critical. It is high time that the marketers realize that engagement with smart technologies like AI is to enhance their standard of life, improve their wellbeing, and give them independent living options and, most notably to combat their loneliness.

Limitations and Future Scope

Although the study tried to decode only a few of the key motivators that drive the adoption of AI-based technology and is taken considering the Indian context, future lessons can refer to this to build on some more factors that can help understand it in a better way. The study is limited to a quantitative approach and one region or geography. Future studies can also consider some other areas or geographies and undertake mixed-method procedures to further extend the research. A mixed-method system will help gain an in-depth understanding of the identified variables, especially when discussing the motivators. The critical influencers highlighted here can be a reference point for researchers to conduct further studies. The marketers can also consider these stimuli while working in the future on any technology-based product innovations. This will help them probe deeper into their existing products and services and refine them further for better reach and engagement of the elderly too.

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Appendix

Table 1: Measures of Reliability

Variable	Reference	Cronbach Alpha
Utilitarian Benefits	Taylor and Todd (1995)	0.862
Hedonic Benefits	Davis et al. (1992)	0.857
Social Influence	Lu.et.al 2019; Gursoy et al., 2019; Venkatesh et al. (2012)	0.855
Social Presence	McLean & Osei-Frimpong (2019)	0.858
Adoption of AI-Technology	Lu.et.al 2019; Gursoy et al., 2019;	0.881

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Table 2: Convergent and Discriminant Validity

	CR.	**AVE**	**UB**	**HB**	**SI**	**SP**	**ADAIT**
Utilitarian Benefits (UB)	0.862	0.5534	0.7439				
Hedonic Benefits (HB)	0.857	0.5598	0.43989	0.7481			
Social Influence (SI)	0.855	0.8715	0.104407	0.211094	0.9333		
Social Presence (SP)	0.858	0.8076	0.149182	0.304841	0.601693	0.8986	
Adoption of AI-Technology (ADAIT)	0.881	0.7515	0.020421	0.202243	0.251307	0.585861	0.8669
CR - Construct Reliability; AVE - Average Variance Extracted							

Table 3: SEM Standardised Regression Path Analysis

			Standardized Estimates (β)	**P**	**Hypotheses**
Adoption_of_AI_Tech	<---	Utilitarian _Benefits	.093	.022**	H1 supported
Adoption_of_AI_Tech	<---	Hedonic_ Benefits	.185	.000**	H2 supported
Adoption_of_AI_Tech	<---	Social_ Influence	.507	.015**	H3 supported
Adoption_of_AI_Tech	<---	Social_ Presence	.135	.008**	H4 supported