

# Utilising Capability Approach for Adoption of Assistive Technologies among Seniors: Conceptual Model

*(Research in Progress)*

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## Abstract

*In this paper, we argue that the existing adoption theories lack a sufficient level of attention to the context of the everyday lives of seniors and as such have been incapable of successfully explaining adoption concepts specifically related to seniors. The study highlights the concept of empowerment and relates it to assistive technologies that may assist in training and improving the functional abilities of the elderly with respect to their capabilities to undertake daily activities e.g. driving. The paper looks at empowering capabilities and utilises the capability approach to explain the constructs involved in the adoption technologies among seniors. In order to clarify the proposed constructs and the utilisation of the capability approach, the article presents an exemplar in adopting Xbox Kinect video games that combine physical, visual and cognitive abilities and can be used to help seniors to improve their driving. The paper is research in progress and invites experts to collect in-depth empirical evidence for the proposed model.*

## Keywords

Adoption, Assistive Technology, Empowerment, Capability Approach.

## INTRODUCTION

The world's population is ageing rapidly and the cost of caring for older people is also rising. In 2012, 6.9% of the world population were more than 65 years old, and this is estimated to increase to around 20% by 2050 (OECD 2012). This has increased the necessity for innovative approaches in the aged care sector in order to reduce the cost of care. Recent advancements in Information Technology (IT) have resulted in low-cost off-the-shelf products that have potential to assist older people in their daily life activities at their home, i.e. assistive technologies. The literature has taken two approaches to define assistive technologies for aged care related purposes:

- *Supportive*: The traditional approach defines an assistive technology as a technological product that aids older persons to perform their daily activities that they would not be able to do without the functional

support of the technology. For instance, the Administration of aging in USA (Department of Veterans Affairs 2009) defines assistive technologies in the context of aged care as “any service or tool that helps the elderly perform their everyday activities that they have always performed, but must now do differently”. The above definition focuses on supportive technologies that aid elderly in their daily activities in an attempt to overcome their functional disabilities, i.e. cognitive, physical, visual or communicational.

- *Empowering*: Recently research in this area has enhanced the concept of assistive technologies to technological products that train seniors and empower their functional capabilities to maintain their independent living (S. Vichitvanichphong et al. 2014). Empowerment in this context means to gain physical or educational training that helps older people to maintain their capabilities with respect to their daily activities and accordingly be able to live independently. This definition has extended the use of assistive technologies to the products that facilitate seniors in their daily life activities through training.

Having taken the above-mentioned definitions into account, this paper argues that the existing adoption theories lack of sufficient attention to the context of empowering technologies. Taking empowering of capabilities into account, this paper aims to utilise the capability approach (Sen 1990) in the context of adoption of empowering technologies to train seniors for their daily activities e.g. driving. The Capability Approach states the empowerment of capabilities essentially provides freedom for people to choose one type of life over others in order to achieve the functionings that they value. To clarify the concepts, the paper provides an exemplar in the application of Xbox Kinect video games to help seniors in improving their driving skills.

Section 1 presents a systematic literature review on effectiveness and fitness of existing adoption theories in the context of aged care. Section 2 introduces the Capability Approach and how it can be used in adoption studies. Section 3 applies the Capability Approach into adoption of empowering technologies. Section 4 provides an exemplar. Section 5 concludes the paper.

## **HOW EFFECTIVE ARE ADOPTION THEORIES IN THE CONTEXT OF ASSISTIVE TECHNOLOGIES?**

A systematic literature review was conducted to evaluate the application of existing adoption theories in the context of assistive technologies. Since the classification of empowering as opposed to supportive technologies is a new approach, the systematic review was conducted on the adoption of assistive technologies among seniors in order to identify empowering technologies. This method has been previously used in (Li et al. 2013; Amrollahi, Ghapanchi, and Talaei-Khoei 2013; Suchada Vichitvanichphong et al. 2013).

The review customised the guidelines for systematic review laid down by (Keele 2007). Springer, Wiley, Since Direct, IEEE, ACM, Scirus, PubMed and Google Scholar were searched using the following search keys.

- Technology AND
- [aged care” OR “aged” OR “aging” OR “senior” OR “old” OR “elderly” OR “elder” OR “older” ] AND
- [“adoption” OR “acceptance” OR “use” OR “behavioural intention” OR “behavioural intention” OR “attitude” OR “believe” OR “belief” OR “usefulness” OR “diffusion” OR “user”].

The search considered titles, keywords, abstracts and full texts of papers published since 2000, inclusive. Due to the large number of papers, publications in 2000 and after have been targeted to ensure timeliness of the results.

Among 723,944 papers searched in the above mentioned databases, 420 papers were remaining after analysis of their titles and irrelevant articles were excluded. 138 articles were remained after abstract filtering and 104 papers were identified as final list of relevant papers after reading the full texts. Articles that have one of the following exclusion criteria were removed:

- Did not focus on assistive technologies for aged care
- Did not have any empirical evidence
- The definition of elderly does not fall into 65 years old or greater
- Were in languages other than English
- Were not in the relevant fields or could not be applied to relevant fields
- Were not peer reviewed
- Were not available online

The final list of the relevant papers can be found in the link below:

<https://onedrive.live.com/redir?resid=7D934CF0AC729F11!417&authkey=!ACWap84EbOEhchE&ithint=file%2cdocx>.

From the 104 relevant papers, the type of the technology i.e. supportive or empowering and the theoretical perspective used for adoption were extracted.

### Theoretical Perspectives utilised for Adoption of Assistive Technologies among Seniors

The review identified thirteen theories as theoretical foundations on which the adoption studies have been grounded. The major theories used to adopt assist technologies among seniors are Technology Adoption Model (TAM) (Davis, Bagozzi, and Warshaw 1989), (Davis 1989), Diffusion of Innovation (DoI) (Rogers 1962), and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003). Other theories have attracted less attention; such as Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1980), Theory of Planned Behaviour (TPB) (Ajzen 1991), Seniors’ Technology Acceptance Model (STAM) (Conci, Pianesi, and Zancanaro 2009), Motivation Theory (MT) (Cofer and Appley 1964), Learning Theory (LT) (Illeris 2004), (Ormrod 2012), (Laver et al. 2011), Activity Theory (AT) (Bedny and Meister 1997), Theory of Disengagement (ToD) (Cumming and Henry 1961), Parsimonious Technology Acceptance Model (pTAM) (Sharp 2006), Ubiquitous Computing-service Acceptance Model (UCAM) (Shin 2010), Attribute of Technology (AoT) (Jaspars, Fincham, and Hewstone 1983); See Figure 1.

It was found that most of the papers in adoption of assistive technologies among seniors have not used any theories to frame the research or elucidate their results. This demonstrates the need for more attention to be paid with respect to theoretical support for the studies and to improve the reliability of the results. In a closer look at the theories and their utilisation in empowering and supporting technologies, it is seen that the application of adoption theories in empowering technologies is even poorer than supportive technologies; See Figure 1.

The review found that there is no overwhelming widespread model for adoption of assistive technologies among seniors but rather it was noted that the adoption theories have not been effective in the context of aged care (62 papers did not mention any theory). There is a very limited use of theoretical perspective in adoption of empowering technologies in literature (25% used theories while 75% avoided). This in turn has led to a degree of disillusionment in the theories available and (based on the systematic review undertaken here) appears to have resulted in a large amount of research (almost 51% in Supportive technologies and 25% in empowering technologies) being conducted devoid of any theory.

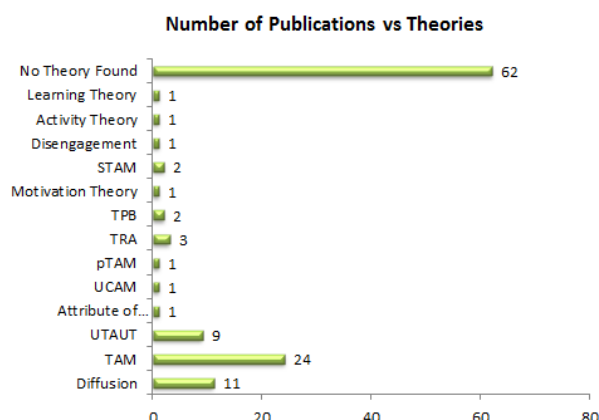


Figure 1 Distribution of the number of papers used adoption theories in the context of assistive technologies among seniors

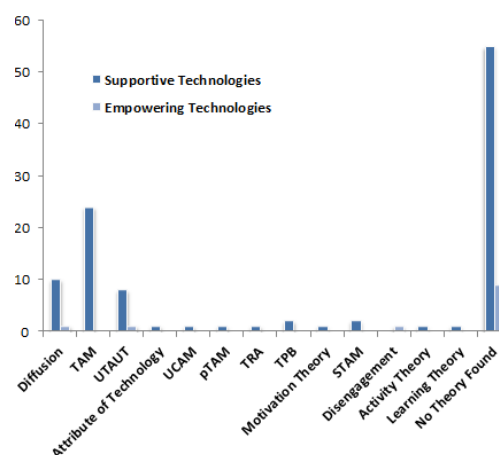


Figure 2 Application of Theories for Adoption of Supportive versus Empowering Technologies

Although there has been a growing body of literature about the adoption of assistive technologies for aged care, less is known on the differentiation of adoption theories for technologies that provide direct support for seniors’ daily activities and indirect support through empowering technologies that help the elderly through skills training to assist them with independent living; refer to differentiation of supportive and empowering assistive technologies in the introduction section. We suggest that the research environment is contextually different when adopting an empowering technology. This can be related to the objectives of adoption in aged care, namely encouraging the users to be empowered through the use of the technology.

Standard adoption theories usually relate to an entirely different context, namely work situation in an organisation. In the organisational context, for example, factors such as the number of existing illnesses of cognitive abilities do not have to be considered. The lack of known theories such as Actor Network Theory makes this argument more relevant in that authors that have difficulties in applying adoption theories generally avoid using them. Gary Johns (Johns 2001; Johns 2006) suggests that context in an organisational research environment is not “sufficiently recognised or appreciated by researchers” and we contend that these contextual problems in an organisational setting will be further exacerbated in non-organisational environments like assistive technologies for seniors. In addition, the adoption literature shown earlier in this paper indicates that the existing models show an emphasis on information systems usage from a job perspective. The evaluation of information systems in relation to assistive technologies for aged care is a very much different context and may require a different approach. This contextual problem appears to be confirmed in the systematic literature review where the level of theory usage was found to be restrictive.

In this paper we have identified major limitations in using existing theories of adoption with respect to empowering technologies for seniors. This is related to many factors and perhaps the major one is the lag that invariably occurs in benefits realisation through the use of empowering technologies. The existing theories of adoption appear to be much more suited to supportive technologies for aged care, mainly because the technology can be used and an immediate benefit can be seen. We are suggesting that adoption studies in aged care should account for the two different categories of supportive and empowering and that serious consideration should be given to an alternative approach when researching adoption with empowering technologies. It appears that the capability approach can be very helpful in this regard. To this end, we are recommending that the capability approach be considered as an appropriate framework for studies that are looking at the feasibility or usefulness of empowering technologies for seniors.

In response to adoption concerns related to empowering technologies, the term “empowerment” has been defined as any process whereby people can gain increased capability over the freedom for the choice that may wish for their lives (Cornish 2006). The concept of capability thus needs further consideration in adoption of empowering technologies. In this paper, we recommend researchers in this area to pay greater attention to capability empowerment concept in empowering technologies, which leads us to the use of Capability Approach as an innovative and fit-to-purpose theoretical foundation in this context.

### CAPABILITY APPROACH

The Capability Approach argues that the empowerment of capabilities essentially provides freedom for people to choose one type of life over another in order to achieve the functionings that they value. Capability in this approach has been defined as “what people are effectively able to do and be” (Sen 1990). Functionings is called by Sen as “what people value” (Sen 1990). Therefore, one would try to empower her/his capability to be able to choose his own valuable functionings (Robeyns 2005). The concept of “empowerment” has been defined as any process whereby people can gain increased capability over the freedom for the choice that may wish for their lives (Silva 1997); See Figure 3.

#### Enhanced Model of Capability: Conversion of Services to Capability and Freedom to Functionings

The question of operationalisation of this view has, understandably, received quite some attention (Robeyns 2005), (Cummings 2006) and the question is how do people empower their capability. Robeyns (2005) claims that empowerment heavily depends on an individual’s perception and whether he can convert goods or services to a capability. He defines the conversion as a perceived process which depends on characteristics of individual him/herself, his/her opinion about the good or service and social context such as what others think about the goods or services, social norms etc.; see Figure 3. Robeyns (2005) takes an example of someone who is interested in a bicycle (good) because she/he believes that he can use it to become faster (individual conversion) and thus it provides him mobility around the town (capability), which consequently makes it possible (freedom) for him to visit his/her friends more often (functionings). In this belief it is important that the person is physically able to ride the bicycle (individual characteristics), otherwise it would not make sense for the person to believe a bicycle can help in this way. His belief also depends on the fact that he thinks that the bicycle is fun (individual’s opinion about good), otherwise he would think that bicycle is boring and would not bother to ride it. It is also important that others do not think that bicycles is for children only (social context); otherwise he would not believe that he can use it to move around the town.

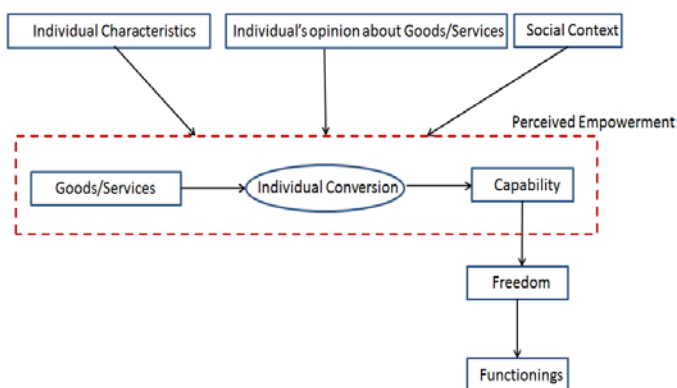


Figure 3 Enhanced Model of Capability Approach Borrowed from (Robeyns 2005)

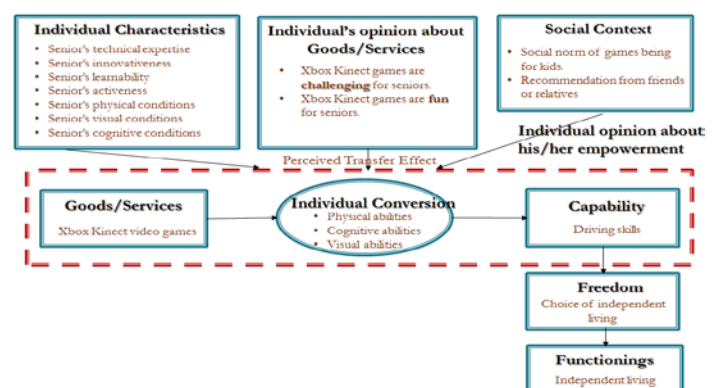


Figure 4 Utilising Enhanced Model of Capability Approach in the Exemplar Research

#### Capability Approach and Adoption of Technology

From a common sense point of view, utilising the Capability Approach immediately seems to be strongly compatible with how people adopt technologies. Gigler (2004) utilises the Capability Approach in ICT adoption and argues that a technological product or service will be used by people if they believe that utilising the

technology will provide or maintain a capability that makes them able to choose one type of life that they value. This is obviously borrowed from Robeyns' perspective (Robeyns 2005) and his conversion model i.e. Figure 3.

Hence, people adopt a technology when they perceive the empowerment of the technology or in other words when they believe that the technology improves or maintains their capability, which gives them a freedom of choice to a functionings that they value. This perception can be positively or negatively influenced by their opinion about the features of the technology, their demographic characteristics and the social context.

## **UTILISING CAPABILITY APPROACH FOR ADOPTION OF EMPOWERING TECHNOLOGIES BY SENIORS**

As discussed in Section 2, empowering technologies train older adults to empower their capabilities and maintain their independent living (S. Vichitvanichphong et al. 2014). Empowerment in this context means to gain physical or educational training that helps older people to maintain their capabilities with respect to their daily activities and accordingly be able to live independently. Comparing this definition with the Silva's (Silva 1997) understanding of empowerment in the Capability Approach, namely, any process whereby people can gain increased capability over the freedom for the choice that may wish for their lives. This allows us to utilise the Capability Approach as a theoretical foundation for adoption of empowering technology.

Looking at the basic model of the Capability Approach (Sen 1990) consisting of functionings, freedom of choice and capability, the starting point to utilise the Capability Approach is where we realise independent living is a significant issue among seniors and it is what they value as the type of life that they wish to achieve (Sen 1990), (M. Nussbaum 2003), (M. C. Nussbaum 2001). Having said that, independent living demonstrates the functionings that the elderly value. Seniors would adopt technologies if they believe that using the technology can improve or maintain their capability for performing an everyday activity which makes it possible for them to live independently.

Moving towards the enhanced model of the Capability Approach proposed by Robeyns (2005) and its application in adoption of technologies, perceived empowerment is where the compatibility of the approach shows promise. In utilising the approach for adopting assistive technologies among seniors, good or services are defined as technological products that can provide training to functional (e.g. physical, cognitive or visual) and non-functional (e.g. knowledge) abilities of elderly. In this approach, individual conversion can be seen as functional and non-functional abilities that are being trained by technologies. Elderly would adopt a technology if they believe the training provided by the technology improves their functional or non-functional abilities such as physical, visual and cognitive abilities that empower their capability of doing an everyday activity such as driving. Being able to perform the everyday activities such as driving consequently provides the choice to live independently. Therefore, the elderly would adopt the technology for the purpose of his/her ultimate goal of an independent life. In other words, the elderly adopt a technology if they can perceive the transfer effect of the technology to improve their capability of doing an everyday activity. For this purpose, a *transfer effect* is defined as the process in which an intervention has a positive impact on something that itself has a synchronous impact on something else (Jensen 1956), (Elmes, Kantowitz, and Roediger III 1992).

In what follows, an exemplar of empowering technologies will be provided to clarify the concepts described above. For instance of empowering technologies, utilisation of the Capability Approach in adoption of Xbox Kinect video games to help driving performance of older adults will be presented.

## **EXEMPLAR: UTILISING THE CAPABILITY APPROACH IN ADOPTION OF XBOX KINECT VIDEO GAMES TO HELP DRIVING PERFORMANCE OF OLDER ADULTS**

Xbox Kinect video games are an inexpensive and enjoyable method of combining physical, visual and cognitive exercises that may improve senior' driving skills. The adoption of this technology among seniors would provide an exemplar in order to clarify the utilisation of the Capability Approach.

### **Independent Living and Driving from Seniors' Perspective**

#### ***Seniors value their independent living.***

Bedaf et al. (2013) define seniors' independent living as not doing everything oneself but having control over it and choosing what to do. Independence therefore is very much related to the notation of people's freedom of choice used in the Capability Approach. Seniors highly value their independent living (Leeson, Harper, and Levin 2004; Porteus and Brownse 2000), because they prefer doing things that they are familiar and comfortable with (Barnard et al. 2013). Huang and Dong (2014) studied 51 seniors and they believe in later life, continuing to live independently is important for most elderly people.

***Seniors believe maintaining their driving would help them to maintain their independent living.***

A large proportion of older adults, particularly in Australia, currently live in the suburbs or remote areas with very limited public transport facilities (Australian Bureau of Statistics 2005). Accordingly, driving private vehicles has become the primary mode of transportation among elderly aged 65 and older. In this cultural context of auto-mobility, driving cessation may be a marker of the transition of elderly from the active retirement and ageing to the age of increasing frailty, dependence, isolation and the resulting psychological consequences (Adams, Roberts, and Cole 2011). In such a situation, not surprisingly, seniors do not like to give up their driving and consider that as the first step to the ageing life (Liddle et al. 2012).

From the Capability Approach perspective, an older adult believes that the driving capability provides him/her freedom of choice to live independently as he values. In this theoretical ground, driving is defined as a capability where independent living is viewed as a functionings.

**Adoption: Individuals’ opinion about empowerment**

Adoption of an intervention here is defined as perceived empowerment of a capability by the intervention, where capability provides freedom of choice to a functionings aspect of one’s life. People adopt a technology when they perceive in the empowerment of technology or in other words when they believe that the technology enhances or maintains their capability, which gives them a freedom of choice to a functionings of what they value or have reasons to value. Therefore, an older individual would adopt an empowering technology if she/he believes that the use of the technology strengthens or maintains her/his capability of performing a day to day activity that allows him/her to live independently.

***Individuals’ opinion about empowerment: Perceived Transfer Effects of Xbox Kinect video games on Driving***

A possible outcome of this exemplar from this theoretical approach is that an older person will adopt using physically, cognitively and visually engaging video games like Xbox Kinect if she/he believes that it maintains her/his driving, which makes it possible for her/him to live independently. In this theoretical ground referring to the enhanced model of the capability approach proposed by (Robeyns 2005), driving is defined as a capability where Xbox Kinect is viewed as the good/service and the individual’s conversion would be improving physical, cognitive and visual abilities required in the driving capability. In this exemplar of research, empowerment is defined as the transfer effect where the positive impact of playing Xbox Kinect video games on physical, visual and cognitive abilities of elderly can be transferred to improve the driving skills.

In a systematic review (Suchada Vichitvanichphong et al. 2014), the mapping between the age-related functional declines among elderly and seniors’ risky driving behaviours reported by the literature was studied. This was followed by a self-reported experiment (Sue et al. 2014) on plying Xbox Kinect video games revealing the impacts of the functional abilities of elderly; See Table 1.

Table 1 Transferred Effects of Xbox Kinect Video Games on Driving Capabilities of Older Adults.

<b>Xbox Kinect</b>	<b>Seniors’ Conversion Factors</b>	<b>Perceived Empowered Capability of Seniors</b>
<i>Player’s Engagements</i>	<i>Functional Abilities</i>	<i>Driving</i>
Physically	Physical	Decision making Direction and lane control
Visually	Visual	Lack of regulation compliance and awareness Visual checking and physical control
Cognitively	Cognitive	Recognizing and responding to signs Skills of turns and parking

However, it is still unknown that whether elderly would have similar perspective to above-described transformation process or not, i.e. perceived transferred effect from seniors’ perspective. This has led authors to work on the following outcomes and collect qualitative in-depth interviews with elderly.

- Perceived Physical Transfer Effect: Seniors believe that physical engagements whilst playing Xbox Kinect video games enhance their driving by training their physical abilities.
- Perceived Cognitive Transfer Effect: Seniors believe that cognitive engagements whilst playing Xbox Kinect video games enhance their driving by training their cognitive abilities.
- Perceived Visual Transfer Effect: Seniors believe that visual engagements whilst playing Xbox Kinect games enhance their driving by training their visual abilities.

**Seniors’ Characteristics and Perceived Transfer Effects**

***The Perceived Transfer Effect is positively related to the seniors’ Technical Expertise.***

Level of technology expertise is the seniors’ perspective on technology, experience, familiarity with technology, difficulty and need for technology assistance (Wilkowska and Ziefle 2009). The role of technology expertise on adoption has been considered from the literature such as (Mahoney 2010), (Umemuro 2004), (Smarr et al. 2012), (Mallenius, Rossi, and Tuunainen 2007). Particularly in older adults, it was proven by Peeters et al. (2012), and



***The Perceived Transfer Effect is positively related to the seniors' Innovativeness.***

The individual's innovativeness captures one's readiness to try a new technology and relates to early, laggard, and non-adopter patterns (Mahoney 2010). The literature suggests that older adults' innovativeness is one of the influencing factors in the adoption of assistive technologies among seniors.

***The Perceived Transfer Effect is positively related to the seniors' Learnability.***

Learnability defines ability to learn and try new techniques (Häikiö et al. 2007) and is one of the major barriers to older adults' technology adoption (Stojmenova et al. 2013).

***The Perceived Transfer Effect is positively related to the seniors' Activeness.***

Being active is one of the individual characteristics of older adults which has consequential impacts on adoption (Sum et al. 2008). Selwyn et al. (2003) has come up with a set of questions about everyday activities that measure the activeness of individuals. The findings from the literature confirm that if seniors are being active, they will be encouraged to try or use new technologies.

***The Perceived Transfer Effect is positively related to the seniors' Physical, Cognitive and Visual Conditions.***

Physical and visual ability to use the technology obviously is a must for technology acceptance, particularly among seniors that may suffer physical disabilities (Gill et al. 2002) and visual impairments (Greenfield et al. 1994). Another barrier for seniors to adopt a technology is the fact that a significant number of the elderly are facing some sort of decline in their memory performance, which would directly impact on their skills needed to use technologies (Czaja et al. 2006; Czaja and Lee 2007). The impact of physical, cognitive and visual conditions of elderly becomes bolder when they require these abilities to play Xbox Kinect video games. Ijsselsteijn et al. (2007) review the successful design approaches that fit to physical, visual and cognitive abilities of seniors for their better adoption.

**Seniors' Opinions about Xbox Kinect Video Games and Perceived Transfer Effects**

***The Perceived Transfer Effects are positively related to Xbox Kinect being Fun and Challenging for seniors.***

Opinions of seniors about Xbox Kinect video games more likely influence on their perception of the transfer effects of the games. Interestingly, it was found in the literature that older adults tend to adopt a technology, if the games are fun to play (Theng, Chua, and Pham 2012) (Heerink et al. 2008), (Conci, Pianesi, and Zancanaro 2009) (Heerink et al. 2010) and challenging (Gamberini et al. 2006). Elderly will use or continue using a technology if using that technology can put them in a challenging situation (Neven 2010). Being challenging does not refer to the difficulty or complexity of the technology, but the sense of improvement. For example, when seniors play games, the feedback received from the game as the score can be considered as a challenge (Ijsselsteijn et al. 2007). However, Kyriacou (2012) uses Xbox Kinect video games to increase physical activity and believes that this can be very challenging and fun to play.

**Social Context and Perceived Transfer Effect**

***The Perceived Transfer Effects are negatively related to the social norm of games being for kids.***

There is a negative perception of senior playing games; that is playing video games is just for kids; seniors are too old to play video games (Bronikowska, Bronikowski, and Schott 2011). If playing games is not appreciated by older people, particularly from social norm perspective, the seniors' attitude towards playing video games would be quite negative. However, this can be different from one culture to another.

***The Perceived Transfer Effects are positively related to recommendation from friends or relatives.***

If seniors are advised to not use a technology by family or their friends, they might stop using the technology (Smith et al. 2002). This also can be involved in the perception of games being for kids as explained above. For instance, older adults might have negative perception about the transfer effect of playing games if people around them say, "games are for kids, not for you".

**CONCLUSION**

Adoption theories have been around for over three decades now and they have provided excellent assistance in helping us understand the many issues in deployment of technologies. However criticism of technology adoption theories has been quite extensive over recent years. The systematic literature review presented in this paper showed that the lack of context consideration in turn has led to a degree of disillusionment in the theories available and appears to have resulted in a large amount of research being conducted devoid of any theory. This potentially would mean another re-vamp of the existing models- already tried as STAM (Seniors technology

acceptance model) (Conci, Pianesi, and Zancanaro 2009). We suggest that this consistent changing and additions to the model is becoming increasingly problematic not only for the individual researchers but for the Information Systems discipline as a whole and really indicates a lack of an ability to handle different contexts. Therefore, making them weaker each time, they are found to be lacking. However the Information Systems discipline appears to still be a strong proponent of adoption technology theories, and there appears to be little recognition of the context under which the research is conducted. As Benbasat and Barki (2007) stated “The efforts to patch-up TAM in evolving IT contexts have not been based on solid and commonly accepted foundations, resulting in a state of theoretical confusion and chaos.” In fact, many add-ons to the initial model have been more associated with retrospective analysis of existing studies and have not appeared to be associated with a predictive analysis of what requirements may be needed. Therefore, this paper is the expansion of the concerns expressed by Benbasat and Barki (2007) and extends them to contextual differences in adopting technologies that maintain functional abilities of elderly to empower their capabilities to do everyday activities independently; that is empowering technologies (S. Vichitvanichphong et al. 2014).

The notation of empowerment led this paper to utilise the Capability Approach in this context. One of the most significant elements of seniors' life is the value they place on living independently. However, when getting older, people are faced with age-related functional declines (physical, cognitive and visual abilities) that make them incapable of performing their everyday activities such as driving. The approach is based on the perception of seniors on the effect of technology on improving their functional abilities that make them capable of doing some of their daily activities. Therefore, they would have a choice to live independently. The Capability Approach argues that people use a service when they believe that the service increases or maintains their capability, which gives them a freedom of choice to a functionalities that they value. As such, this paper states that an older individual would adopt an empowering technology if she/he believes that the use of the technology strengthens or maintains her/his capability of performing a day to day activity that allows him/her to live independently, which she/he values.

The paper clarifies the utilisation of the capability approach in adoption of empowering technologies and has provided an exemplar on the use of Xbox Kinect video games to physically, visually and cognitively engage seniors. Thus, the games would help them to improve their driving by empowering their functional abilities (physical, visual and cognitive). This is a commonly used method in the literature (Talaie-Khoei et al. 2011; Talaie-Khoei et al. 2012).

Authors acknowledge that the work at this stage is research in progress and thus limited in empirical support. However, they have designed qualitative in-depth interviews that would collect evidence on the possible potential of the Capability Approach as a context-aware theoretical perspective in adoption of empowering technologies among seniors. Although qualitative studies provide in-depth understanding of concepts, they are not as strong as quantitative approach in statistical generalization of the results. This study is no exception; however, this work can be considered as a development to raise the awareness in applicability of Capability Approach in adoption of empowering technologies whilst future quantitative studies are required.

## REFERENCES

- Adams, Kathryn Betts, Amy Restorick Roberts, and Marilyn B. Cole. 2011. “Changes in Activity and Interest in the Third and Fourth Age: Associations with Health, Functioning and Depressive Symptoms.” *Occupational Therapy International* 18 (1): 4–17.
- Ajzen, Icek. 1991. “The Theory of Planned Behavior.” *Organizational Behavior and Human Decision Processes* 50 (2): 179–211. doi:10.1016/0749-5978(91)90020-T.
- Amrollahi, Alireza, Amir Hossein Ghapanchi, and Amir Talaie-Khoei. 2013. “A Systematic Literature Review on Strategic Information Systems Planning: Insights from the Past Decade.” *Pacific Asia Journal of the Association for Information Systems* 5 (2): 4.
- Australian Bureau of Statistics. 2005. *Year Book Australia, 2005*. 1301.0. Canberra. <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/34D953A480314A82CA256F7200832FE0>.
- Australian Nursing Federation. 2012. *Aged Care Can't Wait Report*. Australian Nursing Federation.
- Barnard, Yvonne, Mike D. Bradley, Frances Hodgson, and Ashley D. Lloyd. 2013. “Learning to Use New Technologies by Older Adults: Perceived Difficulties, Experimentation Behaviour and Usability.” *Computers in Human Behavior* 29 (4): 1715–24. doi:10.1016/j.chb.2013.02.006.
- Bedaf, Sandra, Gert Jan Gelderblom, Dag Sverre Syrdal, Hagen Lehmann, Hervé Michel, David Hewson, Farshid Amirabdollahian, Kerstin Dautenhahn, and Luc de Witte. 2013. “Which Activities Threaten Independent Living of Elderly When Becoming Problematic: Inspiration for Meaningful Service Robot Functionality.” *Disability and Rehabilitation: Assistive Technology*, no. 0: 1–8.
- Bedny, G., and D. Meister. 1997. *The Russian Theory of Activity: Current Applications To Design and Learning*. Series in Applied Psychology. Psychology Press.
- Benbasat, I., and H. Barki. 2007. “Quo Vadis, TAM?” *Journal of the Association for Information Systems* 8 (4).
- Bronikowska, Małgorzata, Michał Bronikowski, and Nadja Schott. 2011. “‘You Think You Are Too Old to Play?’ Playing Games and Aging.” *Human Movement* 12 (1): 24–30.
- Carpenter, Brian D., and Sarah Buday. 2007. “Computer Use among Older Adults in a Naturally Occurring Retirement Community.” *Computers in Human Behavior* 23 (6): 3012–24. doi:10.1016/j.chb.2006.08.015.
- Cofer, Charles Norval, and Mortimer Herbert Appley. 1964. “Motivation: Theory and Research.”
- Conci, Mario, Fabio Pianesi, and Massimo Zancanaro. 2009. “Useful, Social and Enjoyable: Mobile Phone Adoption by Older People.” In *Human-Computer Interaction – INTERACT 2009*, edited by Tom Gross, Jan Gulliksen, Paula



- 25<sup>th</sup> Australasian Conference on Information Systems – Capability Approach & Seniors' Adoption of Technology  
8<sup>th</sup> -10<sup>th</sup> Dec 2014, Auckland, New Zealand Vichitvanichphong et al.  
Kotzé, Lars Oestreich, Philippe Palanque, Raquel Oliveira Prates, and Marco Winckler, 63–76. Lecture Notes in  
Computer Science 5726. Springer Berlin Heidelberg. [http://link.springer.com/chapter/10.1007/978-3-642-03655-2\\_7](http://link.springer.com/chapter/10.1007/978-3-642-03655-2_7).
- Cornish, Flora. 2006. "Empowerment to Participate: A Case Study of Participation by Indian Sex Workers in HIV  
Prevention." *Journal of Community & Applied Social Psychology* 16 (4): 301–15. doi:10.1002/casp.866.
- Cumming, E., and W. Henry. 1961. *Growing Old: The Process of Disengagement*. New York: Basic Books.
- Cummings, Mary L. 2006. "Integrating Ethics in Design through the Value-Sensitive Design Approach." *Science and  
Engineering Ethics* 12 (4): 701–15.
- Czaja, Sara J, Neil Charness, Arthur D Fisk, Christopher Hertzog, Sankaran N Nair, Wendy A Rogers, and Joseph Sharit.  
2006. "Factors Predicting the Use of Technology: Findings from the Center for Research and Education on Aging  
and Technology Enhancement (CREATE)." *Psychology and Aging* 21 (2): 333–52. doi:10.1037/0882-  
7974.21.2.333.
- Czaja, Sara J., and Chin Chin Lee. 2007. "The Impact of Aging on Access to Technology." *Universal Access in the  
Information Society* 5 (4): 341–49. doi:10.1007/s10209-006-0060-x.
- Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." *MIS  
Quarterly* 13 (3): 319–40.
- Davis, F. D., R. P. Bagozzi, and P. R. Warshaw. 1989. "User Acceptance of Computer Technology: A Comparison of Two  
Theoretical Models." *Management Science* 35: 982–1002.
- Department of Veterans Affairs. 2009. *What Is Assistive Technology? US Veteran's Administration on Aging*.
- Elmes, David G., Barry H. Kantowitz, and Henry L. Roediger III. 1992. *Research Methods in Psychology*. Cengage  
Learning.
- Fishbein, M., and I. Ajzen. 1980. "Predicting and Understanding Consumer Behavior: Attitude-Behavior Correspondence.  
Understanding Attitudes and Predicting Social Behavior", 148–72.
- Gamberini, Luciano, Mariano Alcañiz Raya, Giacinto Barresi, Malena Fabregat, Francisco Ibanez, and Lisa Prontu. 2006.  
"Cognition, Technology and Games for the Elderly: An Introduction to ELDERGAMES Project." *PsychNology  
Journal* 4 (3): 285–308.
- Gigler, Björn - Sören. 2004. "Including the Excluded- Can ICTs Empower Poor Communities? Towards an Alternative  
Evaluation Framework Based on the Capability Approach." In Pavia, Italy.
- Gill, Thomas M., Dorothy I. Baker, Margaret Gottschalk, Peter N. Peduzzi, Heather Allore, and Amy Byers. 2002. "A  
Program to Prevent Functional Decline in Physically Frail, Elderly Persons Who Live at Home." *New England  
Journal of Medicine* 347 (14): 1068–74.
- Greenfield, Patricia M., Patricia DeWinstanley, Heidi Kilpatrick, and Daniel Kaye. 1994. "Action Video Games and Informal  
Education: Effects on Strategies for Dividing Visual Attention." *Journal of Applied Developmental Psychology* 15  
(1): 105–23. doi:10.1016/0193-3973(94)90008-6.
- Häikiö, Juha, Arto Wallin, Minna Isomursu, Heikki Ailisto, Tapio Matinmikko, and Tua Huomo. 2007. "Touch-Based User  
Interface for Elderly Users." In *Proceedings of the 9th International Conference on Human Computer Interaction  
with Mobile Devices and Services*, 289–96. MobileHCI '07. New York, NY, USA: ACM.  
doi:10.1145/1377999.1378021.
- Heerink, Marcel, Krose Ben, Vanessa Evers, and Bob Wielinga. 2008. "The Influence of Social Presence on Acceptance of a  
Companion Robot by Older People." *Journal of Physical Agents* 2 (2): 33–40.
- Heerink, Marcel, Ben Kröse, Vanessa Evers, and Bob Wielinga. 2010. "Assessing Acceptance of Assistive Social Agent  
Technology by Older Adults: The Almere Model." *International Journal of Social Robotics* 2 (4): 361–75.  
doi:10.1007/s12369-010-0068-5.
- Huang, Shan, and Hua Dong. 2014. "Understanding Independent Living Requirements: A Study of Shanghai Seniors." In  
*Universal Access in Human-Computer Interaction. Aging and Assistive Environments*, 88–97. Springer.
- Ijsselstein, Wijnand, Henk Herman Nap, Yvonne de Kort, and Karolien Poels. 2007. "Digital Game Design for Elderly  
Users." In *Proceedings of the 2007 Conference on Future Play*, 17–22. Future Play '07. New York, NY, USA:  
ACM. doi:10.1145/1328202.1328206.
- Illeris, K. 2004. *The Three Dimensions of Learning*. Malabar, Fla: Krieger Pub. Co.
- Jaspars, J. M. F., F. D. Fincham, and M. Hewstone. 1983. *Attribution Theory and Research: Conceptual, Developmental, and  
Social Dimensions*. Academic Press. <http://books.google.com.au/books?id=85y4AAAAIAAJ>.
- Jensen, Barry T. 1956. "What about Transfer?" *Peabody Journal of Education* 34 (2): 71–77.
- Johns, Gary. 2001. "In Praise of Context." *Journal of Organizational Behavior* 22 (1): 31–42. doi:10.1002/job.80.
- Johns, Gary. 2006. "The Essential Impact of Context on Organizational Behavior." *Academy of Management Review* 31 (2):  
386–408. doi:10.5465/AMR.2006.20208687.
- Keele, Staffs. 2007. *Guidelines for Performing Systematic Literature Reviews in Software Engineering*. Technical report,  
EBSE Technical Report EBSE-2007-01.
- Kyriacou, George. 2012. "Serious Games For Increasing Physical Activity."
- Laver, Kate, Julie Ratcliffe, Stacey George, Leonie Burgess, and Maria Crotty. 2011. "Is the Nintendo Wii Fit Really  
Acceptable to Older People?: A Discrete Choice Experiment." *BMC Geriatrics* 11 (1): 1–6. doi:10.1186/1471-  
2318-11-64.
- Leeson, George W., Sarah Harper, and Sonya Levin. 2004. *Independent Living in Later Life: Literature Review*. 137.  
London, UK: Department of Work and Pensions (DWP).
- Li, Junhua, Amir Talaei-Khoei, Holly Seale, Pradeep Ray, and C. Raina MacIntyre. 2013. "Health Care Provider Adoption of  
Ehealth: Systematic Literature Review." *Interactive Journal of Medical Research* 2 (1).
- Liddle, Jacki, Louise Gustafsson, Helen Bartlett, and Kryss McKenna. 2012. "Time Use, Role Participation and Life  
Satisfaction of Older People: Impact of Driving Status." *Australian Occupational Therapy Journal* 59 (5): 384–92.  
doi:10.1111/j.1440-1630.2011.00956.x.
- Mahoney, Diane Feeney. 2010. "An Evidence-Based Adoption of Technology Model for Remote Monitoring of Elders'  
Daily Activities." *Ageing International* 36 (1): 66–81. doi:10.1007/s12126-010-9073-0.
- Mallenius, Seppo, Matti Rossi, and Virpi Kristiina Tuunainen. 2007. "Factors Affecting the Adoption and Use of Mobile  
Devices and Services by Elderly People – Results from a Pilot Study."

- 25<sup>th</sup> Australasian Conference on Information Systems – Capability Approach & Seniors' Adoption of Technology  
8<sup>th</sup> -10<sup>th</sup> Dec 2014, Auckland, New Zealand Vichitvanichphong et al.
- Neven, Louis. 2010. “‘But Obviously Not for Me’: Robots, Laboratories and the Defiant Identity of Elder Test Users.” *Sociology of Health & Illness* 32 (2): 335–47. doi:10.1111/j.1467-9566.2009.01218.x.
- Nussbaum, Martha. 2003. “Capabilities as Fundamental Entitlements: Sen and Social Justice.” *Feminist Economics* 9 (2-3): 33–59.
- Nussbaum, Martha C. 2001. *Women and Human Development: The Capabilities Approach*. Vol. 3. Cambridge University Press.
- OECD. 2012. *World Population Ageing: 1959-2050*. Paris.
- Ormrod, Jeanne. 2012. *Human Learning (6th Ed.)*. Boston: Pearson.
- Peeters, José M, Anke J E de Veer, Lucas van der Hoek, and Anneke L Francke. 2012. “Factors Influencing the Adoption of Home Telecare by Elderly or Chronically Ill People: A National Survey.” *Journal of Clinical Nursing* 21 (21-22): 3183–93. doi:10.1111/j.1365-2702.2012.04173.x.
- Porteus, J., and S. J. Brownse. 2000. *Exploring Technologies for Independent Living for Older People*. Anchor Trust.
- Robeyns, Ingrid. 2005. “The Capability Approach: A Theoretical Survey.” *Journal of Human Development* 6 (1): 93–117. doi:10.1080/146498805200034266.
- Rogers, E. M. 1962. “Diffusion of Innovations (1st Ed.)” *New York: Free Press*.
- Selwyn, Neil, Stephen Gorard, John Furlong, and Louise Madden. 2003. “Older Adults’ Use of Information and Communications Technology in Everyday Life.” *Ageing & Society* 23 (05): 561–82. doi:10.1017/S0144686X03001302.
- Sen, Amartya Kumar. 1990. *Development as Capability Expansion*.
- Sharp, J. H. 2006. “Development, Extension, and Application: A Review of the Technology Acceptance Model.” *Director* 07.
- Shin, Dong-Hee. 2010. “Ubiquitous Computing Acceptance Model: End User Concern about Security, Privacy and Risk.” *International Journal of Mobile Communications* 8 (2): 169–86. doi:10.1504/IJMC.2010.031446.
- Silva, Leiser. 1997. “Power and Politics in the Adoption of Information Systems by Organisations: The Case of a Research Centre in Latin America”. Phd, The London School of Economics and Political Science (LSE). <http://etheses.lse.ac.uk/273/>.
- Smarr, Cory-Ann, Akanksha Prakash, Jenay M. Beer, Tracy L. Mitzner, Charles C. Kemp, and Wendy A. Rogers. 2012. “Older Adults’ Preferences for and Acceptance of Robot Assistance for Everyday Living Tasks.” *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 56 (1): 153–57. doi:10.1177/1071181312561009.
- Smith, Robyn, Susan Quine, Julie Anderson, and Kirsten Black. 2002. “Assistive Devices: Self-Reported Use by Older People in Victoria.” *Australian Health Review* 25 (4): 169–77.
- Stojmenova, Emilija, Matjaž Debevc, Luka Zebec, and Bojan Imperl. 2013. “Assisted Living Solutions for the Elderly through Interactive TV.” *Multimedia Tools and Applications*, 1–15. doi:10.1007/s11042-011-0972-1.
- Sue, D., P. Ray, A. Talaei-Khoei, J. Jonnagaddala, and S. Vichitvanichphong. 2014. “Assessing Video Games To Improve Driving Skills.” *Journal of Medical Internet Research, Serious Games*.
- Sum, Shima, R. Mark Mathews, Ian Hughes, and Andrew Campbell. 2008. “Internet Use and Loneliness in Older Adults.” *CyberPsychology & Behavior* 11 (2): 208–11. doi:10.1089/cpb.2007.0010.
- Talaei-Khoei, Amir, Terje Solvoll, Pradeep Ray, and Nandan Parameshwaran. 2011. “Policy-Based Awareness Management (PAM): Case Study of a Wireless Communication System at a Hospital.” *Journal of Systems and Software* 84 (10): 1791–1805.
- Talaei-Khoei, Amir, Terje Solvoll, Pradeep Ray, and Nandan Parameshwaran. 2012. “Maintaining Awareness Using Policies; Enabling Agents to Identify Relevance of Information.” *Journal of Computer and System Sciences* 78 (1): 370–91.
- Theng, Yin-Leng, Puay Hoe Chua, and Tan Phat Pham. 2012. “Wii as Entertainment and Socialisation Aids for Mental and Social Health of the Elderly.” In *CHI’12 Extended Abstracts on Human Factors in Computing Systems*, 691–702. ACM.
- Umemuro, Hiroyuki. 2004. “Lowering Elderly Japanese Users’ Resistance towards Computers by Using Touchscreen Technology.” *Universal Access in the Information Society* 3 (3-4): 276–88. doi:10.1007/s10209-004-0098-6.
- Venkatesh, Viswanath, Michael G. Morris, Gordon B. Davis, and Fred D. Davis. 2003. “User Acceptance of Information Technology: Toward a Unified View.” *MIS Quarterly* 27 (3): 425–78. doi:10.2307/30036540.
- Vichitvanichphong, S., A. Talaei-Khoei, D. Kerr, and A. H. Ghapanchi. 2014. “Assistive Technologies for Aged Care: Supportive or Empowering?” *Australasian Journal of Information Systems*.
- Vichitvanichphong, Suchada, Amir Talaei-Khoei, Donald Kerr, and Amir H. Ghapanchi. 2013. “Adoption of Assistive Technologies for Aged Care: A Realist Review of Recent Studies.” In .
- Vichitvanichphong, Suchada, Amir Talaei-Khoei, Donald Kerr, and Amir H. Ghapanchi. 2014. “What Happen to Our Driving When We Get Older.” *Trnsport Reviews* Under Review.
- Wilkowska, Wiktoria, and Martina Ziefle. 2009. “Which Factors Form Older Adults’ Acceptance of Mobile Information and Communication Technologies?” In *HCI and Usability for E-Inclusion*, edited by Andreas Holzinger and Klaus Miesenberger, 81–101. Lecture Notes in Computer Science 5889. Springer Berlin Heidelberg. [http://link.springer.com/chapter/10.1007/978-3-642-10308-7\\_6](http://link.springer.com/chapter/10.1007/978-3-642-10308-7_6).

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