The Adoption of Innovative Technologies from the Perspective of Elderly Consumers

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Abstract—The research about the adoption of elderly consumers in innovative technologies twenty years ago was quite different from the same issues discussed today. Compared with most elderly consumers twenty years ago, current senior consumers more or less experience the power of and receive certain benefit from innovative technologies, so the argument from past research may not be enough for the present context. Normally, most elderly people have already retired and may spend most of their time in conditioning their body, trying to have an easy and comfortable life. They may search for interesting information online, send e-mail, use instant message software, and play some easy computer games to bring some fun and color to their ordinary life. However, the degeneration of their perceptive abilities and memories, plus “inhumane” type of the interface of traditional innovative technologies, becomes a large obstacle for them to get in touch with relevant devices or services. Yet recent researchers also contend that, contrary to the degeneration of perceptive abilities and memories, their cognitive abilities in fact degenerate in the same degree as younger generation. Besides, through proper instruction, training, practice, iteration and communication, with friendly and “humane” interface of these innovative technologies, elder people can maintain their cognitive abilities and enjoy benefit and interest of these devices or services. From viewpoints of marketers, they should transcend the stereotype toward senior consumers and treat them as the center to reengineer each element of marketing through comprehensive investigation. In the end, some potential and directions for future market research about this issue will be put forth.

Keywords—Cognitive ability, Elderly consumer, Innovative technology, Technology acceptance model (TAM)

I. INTRODUCTION

Researches about the elderly have burgeoned in the last twenties years because this demographic segment, defined as adults aged 65 and older, has expanded in size and spending power. Demographic data, estimating 20.1% of total population being the elderly in 2025, present a sharp trend of increase in the number of older adult in Taiwan [1]. Although income and expenditures are lower per capita in this segment, the aggregate spending power is still impressive.

Nevertheless, the research about the adoption of elderly consumers in innovative technologies twenty years ago was quite different from the same issues discussed today. At that time, innovative technologies, especially personal computer (PC), are not as prevalent as today. Most people, not mentioning the elderly, have rare chance to use PC in the everyday life. They may use it in their daily businesses or academic studies, mostly calculation or words processing under rough operation system of DOS compared with current Windows frameworks. The motive, incentive, and accessibility for the elderly to use PC are rather low and difficult in fact, so the objects treated as innovative technologies for the elder consumers at that time are scanner-equipped grocery stores, electronic funds transfer, automated teller machines, custom telephone calling services, etc. [2], some of which we would not use “innovative technology” to describe and the other may have disappeared at present.

Compared with the current elderly, most elderly consumers twenty years ago were not familiar with the utilization of PC. In contrast, current senior consumers more or less experience the power of and receive certain benefit from innovative technologies. In other words, technologies already become parts of their life, so the argument from past research may not be enough for the present context. However, under this changing context, there is still something remaining the same or improving less, for instance, the mindset and physical condition of senior generation.

Most people above the age of 65 have retired and they may spend most of their time in conditioning their body, trying to have an easy and comfortable life. It is impossible for them like computer programmers, avid online game players, or some young addicts of social networks, staring at the monitor of computer or the small screen of smartphone for long time. They still want to use these innovative technologies to assist them in coping with daily life, but under their slow tempo and step.

Without time limit and pressure, senior people need not hurry to prepare any kind of report or follow and reply the latest e-mail. They use Internet to search for the information about health and recreation, use e-mail to transfer information, mostly in the way of forwarding, to their friends, relatives, especially younger members of them, or use instant message software, e.g., MSN or Skype to contact with their grandchildren far away. They also play computer games, e.g., solitaire card game, chess, mahjong, and so on, not online games, to bring some fun and excitement in their ordinary life. Subject to the degeneration of ears and spinal column, they could not sit by the computer for too long, although they may take more time to operate these innovative technologies, due to the degeneration of response and insensibility as well. This paradox may become the obstacle for them to adopt innovative technologies.

The purpose of this study is not only to investigate the...
attitude, the subjective norm, and the perceptual behavioral control of the elderly toward innovative technology, but also to explore the antecedent causing these constructs through literature reviews. In the end, a conceptual framework about adoption of innovative technologies for the elderly will be proposed.

II. LITERATURE REVIEWS

A. Diffusion of Innovations and the Elderly

Gilly and Zeithaml [2] investigate the adoption of the elderly for several selected technologies, including scanner-equipped grocery stores, electronic funds transfer, automated teller machines, and custom telephone calling services. They suggest that the adoption of innovation is a process rather than an instantaneous event so a five-stage model, proposed by Rogers [3], becomes the foundation of their proposition. These five stages are listed as the following:

1) Knowledge: the consumer is getting aware of the existence of innovation and understanding its function.
2) Persuasion: the consumer develops a favorable or unfavorable attitude toward the innovation according to the acquired information.
3) Decision: the consumer engages some activities to decide whether to adopt or reject the innovation.
4) Implementation: the consumer really uses the innovation.
5) Confirmation: the consumer seeks to reinforce the decision about the innovation.

Gilly and Zeithaml [2] suggest that the firm should emphasize the communication about the superior efficiency and effectiveness of technologies with elderly consumers because this kind of communication can help speed their adoption and diffusion process. Besides, the firm also should contact elderly consumers directly, especially through the print media targeted to the elderly, rather than rely on publicity or word-of-mouth only. Based on the result of their investigation, elderly consumers do accept advanced technologies as long as these technologies can meet their needs and the benefit these technologies bring can be effectively communicated to them. In contrast with publicity or word-of-mouth, senior consumers spend more time in and believe more from reading print media.

Notwithstanding, some results of their study and their initial predictions are discrepant. For instance, according to previous studies, the elderly group of respondents should treat mass media and family as the source of innovation more frequently than friends and neighbors. Yet, despite mass media appearing to be very important sources as prediction, friends and neighbors outrank family members as the most frequently used sources. It should be noticed that although the result, from research almost twenty years ago, shows that senior consumers believing more in the information from printed media targeted to the elderly does not mean current senior consumers behaving in the same way. Similarly, the aforementioned discrepancy, i.e., friends and neighbors rather than family, in the source of information about innovation could be reversed under current context. This uncertainty should be investigated and make sure again through the case study or questionnaires.

B. Physiological Condition, Cognitive abilities, and Memory of the Elderly

Sorce [4] admits that the memory performance of the older adult will decline with age but argues that cognitive competence may not. She challenges the cognitive questions used by previous researches in the field of gerontology and contends that most of these questions are testing fluid abilities, which reflect a person’s ability to reason, form concepts, and solve problems, instead of crystallized abilities, which reflect knowledge of a specific problem or operations necessitated to solve a problem. The difference between fluid and crystallized abilities is that the former will decrease with age but the latter may be stable or increase with age.

Sorce [4] also points out the disadvantage of interpreting the results from cross-sectional studies using age as an independent variable because different groups of ages may have dissimilar experiences and distinct knowledge accepted, which may lead to cohort effect. By reviewing previous researches, she finds out that the amount of longitudinal study about the decline of cognitive ability with age is less than the amount of cross-sectional study. The cross-sectional studies may overstate the deficits in cognitive competence of older adults.

Besides, she further maintains some issues to be noticed when comparing the cognitive competence of the elderly with younger adults. For instance, extend training effects will render the elderly to improve their performance with practice, even though their performance is still worse than the younger. The reason may be that the older adult has a lower maximum cognitive capacity than younger adults. However, this kind of research also should necessitate heeding the task being investigated. Some tasks centers on the ability to encode and remember new or meaningless information where the role of long-term memory is minimal, probably more highly correlated with short-term memory encoding. Different kinds of the tasks, emphasizing long-term or short-term memories, will cause different results.

Rousseau, Lamson, and Rogers [5] explore age-related variables affecting someone noticing, encoding, comprehending, and complying with warnings. These age-related variables includes a variety of changes in the visual system, e.g. acuity, contrast sensitivity, and color discrimination, and cognitive function, e.g. working memory and reading comprehension. They suggest the firm should consider the abilities of these elder users while designing warnings on the product, preventing damage caused by their misusage and should try to minimize the impact due to these age-related changes.

Rousseau, et al. [5] also propose many practical suggestions for designers to improve the perceptual and cognitive abilities of elder users. For examples, older adults are difficult to discriminate between colors, especially for the shorter wavelengths, such as the violet, blue and green range. In addition, they have trouble to distinguish between adjacent areas differing in light intensities, or high level of illumination,
usually causing glare. In order to compensate for contrast sensitivity declines, the text and background should be of high contrast, and avoiding printing reading materials on shiny and glossy surfaces.

As to cognitive abilities, they indicate the importance of working memory, language comprehension, prospective memory, and symbol comprehension. Working memory is the ability to keep information active in memory, which will decline with age. For instance, consider some technological device in which multiple steps must be operated in order to perform smoothly. The user may have difficulty maintaining all the information active in working memory when the process involves many steps. As the result, product users may need to re-examine the manual, or they may forget to perform one of the key procedures.

Working memory capacity limitations also seriously affect the language comprehension. According to the most prominent text-processing models proposed by Kintsch and van Dijk [6], text is read and brought in to memory as information packet. The maintenance of the information packet, containing important and less important propositions, in working memory depends upon its relevance to text. Important propositions will be easy to be maintained and less important ones will fade from memory. However, according to the researches continuing afterwards, older adults not only will have difficulty in keeping far apart but associating propositions in their memory, but also have obstacle to keep extraneous, irrelevant information out of working memory, further decreasing its capacity. With respect to the design of technological device, the firm should construct simple and explicit directions for consumers, avoiding further inferences or references.

Even when a product user notices, encodes and comprehends all the directions to operate certain technological device or system, this user still must remember to take appropriate procedures to operate the device or system. This kind of ability is referred by cognitive psychologists as prospective memory, also declining with aging, both young and old adults. Prospective memory is related to time-based tasks, in contrast with event-based tasks. Time-based tasks are those actions must be performed after a certain period of time has passed, whereas event-based tasks are those cues, which are used as signals to perform actions. With aging, no matter the young or the elderly, the difficulty to handle time-based tasks is more apparent than even-based tasks. In other words, if time-based tasks can be transformed into event-based tasks through the introduction of existing salient cues in the environment, age differences in prospective memory may be reduced.

Symbols, typically the graphical representations of concepts, have become a popular means of conveying information when the hindrance of developing appropriate texts happens. Consumers usually have different degrees of experience, familiarity, and language abilities to comprehend the text, so symbols become a better way for those with low degree of comprehension. Although symbols can improve the understanding of older users, some working memory limitations that affect language comprehension may also affect symbol comprehension. Rousseau et al. (1998) suggest that the comprehension of older adults can reach maximum through testing and redesigning the symbol in iterations.

C. Technologies and the Elderly

Oppenauer [7] maintains that older people have more problems than younger in dealing with new technology because technology adoption is a complex issue involving many factors, including education, socioeconomic status, attitudes towards technology, access to technology, and the cost. Therefore, older adults are less able to benefit from new technology, negatively impacting the quality of their daily lives. She further enumerates factors leading to lesser usage of computer and Internet, i.e., higher age, lower education and socioeconomic status, minorities, and people with disabilities. Notwithstanding, she cites the study of Broady, Chan, and Caputi [8] and claims that the older adult will perform as well as younger persons in computer use if the former receives adequate training and is given enough time to master relevant types of skills. Besides, she also quotes the study of Charness, Kelly, Bosman, and Mottram [9] and confirms that the age difference will be absent if the level of computer experience is similar between young and old group. Thus, compared with age and age related attitudes, the level of experience and skill training about new technology seem to have more influence on the adoption of innovative technology. Additionally, cognitive abilities such as attention, memory, speed of processing, and problem solving also positively impact the successful usage of technology, especially the technology of which the usage ratio is high.

Ellis and Allaire [10] corroborate a negative correlation between age and computer knowledge and interest. They also verify a positive correlation between age and computer anxiety. However, because computer knowledge and computer anxiety can not explain some of the age related variances, they argue that self-efficacy could be a mediator. Of course, as Sorce’s [4] argument, the unexplained may be caused by cross-section methodology.

D. Technology Acceptance Model (TAM) and Relevant Models

Davis [11] puts forth the technology acceptance model (TAM), which is well known for explaining technology usage especially in the workplace. TAM is developed based on the theory of reasoned action (TRA) [12], which is asserted that attitudes towards an action and subjective norm influence individual behavioral intention, and individual behavioral intention subsequently influences the actual behavior. Theory of planned behavior (TPB) [13], extending original TRA, is claimed that the additional construct of perceived behavior control, impacting actual behavior directly, should need to be considered. There are two differences between TRA and TAM that the first is inclusion of two antecedents, and the other is omission of the construct of subjective norm. Davis [11] argues that the construct of subjective norm has less impact on the behavior of consumers, plus the difficulty in and uncertainty
about measuring this construct, so the construct of attitudes towards an action becomes the core of TAM without subjective norm.

As the aforementioned, perceived usefulness (PU) and perceived ease of use (PEOU) are those two antecedents of attitudes towards an action. PU is defined as the extent to which an individual believes that using a system will enhance job performance, whereas PEOU is defined as the extent to which how much effort an individual uses a technology. The original TAM assumes that PU is also influenced by PEOU. Although many empirical studies adopt TAM as their fundamental framework, few of them verify each relationship among these constructs in the context of common consumers. A meta-analysis conducted by Schepers and Wetzels [14], reviewing 63 articles, discovers that the majority of studies focused on the contexts such as employees and managers in companies, professionals or students. King and He [15] conclude that the relationships among TAM show considerable variability, and presumed the existence of moderator, such as the experience level of users and the type of technology. They also point out that the results of the study about adopting Internet are different from the results of the adoption of technology in job task applications, office application, and general use.

Since the TAM accounts for only slightly more than 40% of variance, other variables should be examined for their contribution [16]. TAM has been revised and applied under different kinds of contexts, but empirical studies about senior consumers are still rare. Therefore, present study will include some constructs about psychological condition and cognitive abilities, and other influences discussed previously to extend the original TAM as following Figure 1.

![Fig. 1 Conceptual Framework](image)

The cognitive ability of older consumers is determined by two types of abilities, fluid and crystallized abilities. If the older person has previous experience of using innovative technologies and understand the benefit of using these technologies, the crystallized ability of this older person could be maintained and continue to accumulate, even with the detriment of fluid ability. In other words, increasing crystallized ability, enough offsetting the impact of fluid ability, represents a healthy cognitive ability. Then, a healthy cognitive ability could further contribute the positive perception about PU, PEOU, and perceived behavior control. By the same reasoning, healthy perceptual ability may facilitate the good perception of the elderly about PU and PEOU and effective communication about the benefit of technologies with neighbors and friends, and finally keep the capacity of crystallized ability from deterioration. Although neighbors and friends are the sources of most elder adults, the subjective norm derived from them could also become pressure to make the elderly, especially those having rare experience or chance to keep in touch with innovative technologies, to move forward and enhance the likelihood to adopt technologies.

### III. CONCLUSION

In this study, through literature reviews, some plausibility about older adult will be challenged. For example, their cognitive ability may not decline and by appropriate iterative practices, their ability to use computer or Internet can be as good as younger generation. In contrast, the perceptual ability, working memory, prospective memory, and language comprehension do become attenuated subject to the limitation of physiology and capacity of brain. By facilitation and amelioration of technological friendly environment, and by providing sufficient communication about the benefit the technology will bring, older generation, in fact, will also embrace the new technology.

For manufactures and service providers, this model can give them the cornerstone or some directions about the research and development of their product or service, and a variety of methods for promoting them. In recent years, different kinds of touch control devices or application become the mainstream of competition in IT industry. The instinctive procedures of operation and simplified interfaces make this type of product swiftly sweep the market and form a fad, sort of fashionable social phenomena. In fact, these innovative devices offer great opportunities for firms to enter the segment of senior consumers owing to their distinctive and “humane” features. For instance, due to degeneration in muscle and spinal column of lower back, most elder people can not sit by the computer for long time, can not last the fixed posture to type the keyboard, and can not keep the eyes straightly toward the monitor. However, if they are able to utilize these devices cunningly, they would enjoy the same benefit, even bigger, by holding the light tablet PC, for example, with one hand, and slide agilely on the vivid monitor with one finger of another hand.

Senior consumers also can perceive great convenience and benefit from the instinctive and simplified interface. As previous discussion, their capacities of working memory and prospective memory may not allow them to follow the complicated procedure, but this kind of touch control device can be operated easily with instant responses. By contrast, with traditional PC, elder consumers are very easy to feel frustrated because they just do not know or can not remember what should be done next. Indeed, this type of device dramatically change the traditional configuration of the interface for input and output, in spite of that the basic frameworks is still the same. Nevertheless, for elderly consumers, these kinds of devices are still not “perfect” enough and not enough as to their categories. After all, they are not designed for them originally and for firms,
this market segment is always being underestimated. With increasing growth of this part of population and the analyses in this study, companies should change their stereotype and reconsider pertinent marketing, including “4P”, for them.

As to the channel of information, traditional media, e.g., newspaper, magazine, and television, have been the largest source for senior consumers for a long time. Yet for early adopters, which, we believe, do exist in the segment of elderly consumers, browsing web pages and sending e-mail may have become one of their routines. All these early adopters want to do may try to look for better, more convenient, more interesting functions and devices. Thus, it is worth comprehensive investigation for market researchers to understand the percentage of early adopters and late majority respectively in the segment of senior consumers. For latter, conforming to our stereotype, that most of these senior consumers have no chance or do not want to use innovative technologies or services. What marketers need to do is also to change another stereotype, derived from traditional PC. The stereotype is that innovative technologies or services are complicated to operate and senior customers themselves are easy to make mistake in operation. Marketers should emphasize more on the features of low perceived risk, which just the late majority is concerned most, whereas for early adopters, perceived benefit should be emphasized. Besides, word-of-mouth (WOM) is another important channel for communication. No matter friends and neighbors, who previously have been validated as the biggest source of information, or family, toward whom the influence of children could be enormous, marketer should conduct overall investigation for specific product of service without relying too much on various results of previous researches. As to the influence of children, on one hand, most elderly want to close the distance with children, who may cause them feel young, and on the other hand, when the elderly observes that children also can utilize and enjoy the functions of, for example, the tablet pc, it may evoke a kind of feeling such as that even the children can and why I can not. The application and effect of behavioral WOM [17] have certain potential to study further.

It can not be denied that the younger generation is more familiar with innovative technologies and it raises another question who is the provider of innovative technologies to elderly consumers. If the end purchaser, not the end user, belongs to the younger generation, e.g. sons or daughters, who will be the target that marketers should position accordingly? In addition, the price of innovative technologies is also a critical aspect marketers should consider when they make relevant decisions. It could be the case that the price is acceptable for senior customers, i.e., the end user, but too expensive for their offspring, i.e., the end purchaser, and it could be another case of total reverse. Marketers should conduct an overall investigation about senior consumers from all kinds of perspectives, not only elderly consumers themselves, but also their neighbors, friends, relatives, and family, especially younger members.