

Senior citizens' acceptance of information systems:

A study in the context of e-Government services

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Abstract

The turn of the century has seen a rapidly graying population concurrently with increasingly ubiquitous IT. The elderly population being less familiar with IT implies that issues pertaining to their acceptance of information systems (IS) deserve special attention. However, the IS and gerontology literatures seldom explore IS acceptance among the aged. Attempting to address this gap, a research model is developed by integrating relevant antecedents from previous literature and empirically tested in the context of an e-Government service tailored for senior citizens. Our findings reveal that consistent with previous technology acceptance studies, senior citizens' use intention is driven by their perceived usefulness and perceived ease of use of the service. Additionally, their Internet safety perception impacts the acceptance of this online financial service. Furthermore, resource savings and self-actualization determine senior citizens' usefulness perception, whereas computer anxiety and computing support are antecedents of perceived ease of use. Of these antecedents, self actualization and computer anxiety appear particularly relevant for the elderly as compared to younger working professionals in most previous literature for whom these antecedents have not been important. The study contributes by providing an integrative model of IS acceptance among the aged, which may facilitate theory development and practice.

Keywords: E-Government, information systems acceptance, senior citizens, perceived usefulness, perceived ease of use

1. Introduction

Societies around the world are witnessing a rapidly graying population. It is estimated that the world's elderly population will increase by more than three times by 2050 [U.S. Census Bureau 2004]. This signifies that population aging has become a preeminent phenomenon that cannot be ignored. Simultaneously the ubiquity of information technology (IT) is seen in a multitude of areas, ranging from providing personal entertainment for individuals, improving business processes of organizations, to enabling enhanced services from government. The last instance is termed e-Government, which refers to the strategic application of IT, particularly the Internet, to provide citizens and organizations with more convenient access to government information and services; and for government to interact with business partners and transact internally [Gronlund 2002; UNPAN 2003].

When providing e-Government services to citizens, government's political mandate requires it to serve all sections of the public. For achieving this objective, it is vital that e-Government services encompass the rapidly growing population of senior citizens. However, such initiatives are not without challenges. Being born at least 55-60 years ago when personal computers were not yet commonplace, it can be expected that the elderly population have less familiarity with IT as compared to the younger generation [Morris and Venkatesh 2000]. Serving the elderly population through IT based applications, such as e-Government, thus requires understanding the behavior of this population as well as the factors that influence their acceptance and usage of IS.

Based on the above motivation, this study aims to develop an integrative model of senior citizens' acceptance of IS, particularly e-Government services. Towards this end, we review literature in gerontology and IS in order to identify potential antecedents of senior citizens' acceptance of these services and integrate them into a model. The resultant model and hypotheses are validated through a survey of users of an e-Government service. We focus on a specific e-Government service that is targeted at senior citizens, called the Central Provident Fund (CPF¹) e-Withdrawal. CPF e-Withdrawal allows senior citizens over 55 years old to withdraw their CPF online and transfer it to their bank accounts electronically. It is a full-fledged electronic service that consists of several components, including authentication (a login function for identity verification), account overview (for checking CPF account balance), fund transfer (for specifying the bank account to receive transferred funds), telegraph (for senior citizens staying abroad to transfer their CPF to foreign countries), and payment service (for using CPF to pay medical expenses, insurance, etc.). The website interface has several features which attempt to make it friendly for senior citizens. These include use of large font size, contrasting colors, and placement of

¹ CPF is a government-run social security savings plan. Both employers and employees make monthly contributions to employees' CPF account during their employment. On reaching age 55, citizens can withdraw their CPF for various purposes e.g., to cover healthcare expenses, children's education, and property purchase.

buttons at easy-to-see locations. The service aims to gradually replace the paper-based CPF withdrawal procedures at the CPF offices. The results of the study aim to inform theory and practice about senior citizens acceptance of IS, particularly in the context of e-Government services.

2. Conceptual Background

We review the literature in IS and gerontology fields that is related to IS acceptance and usage. The aim of the review is to explicate the potential antecedents of senior citizen’s acceptance of e-Government services and integrate them into a model (see Figure 1).

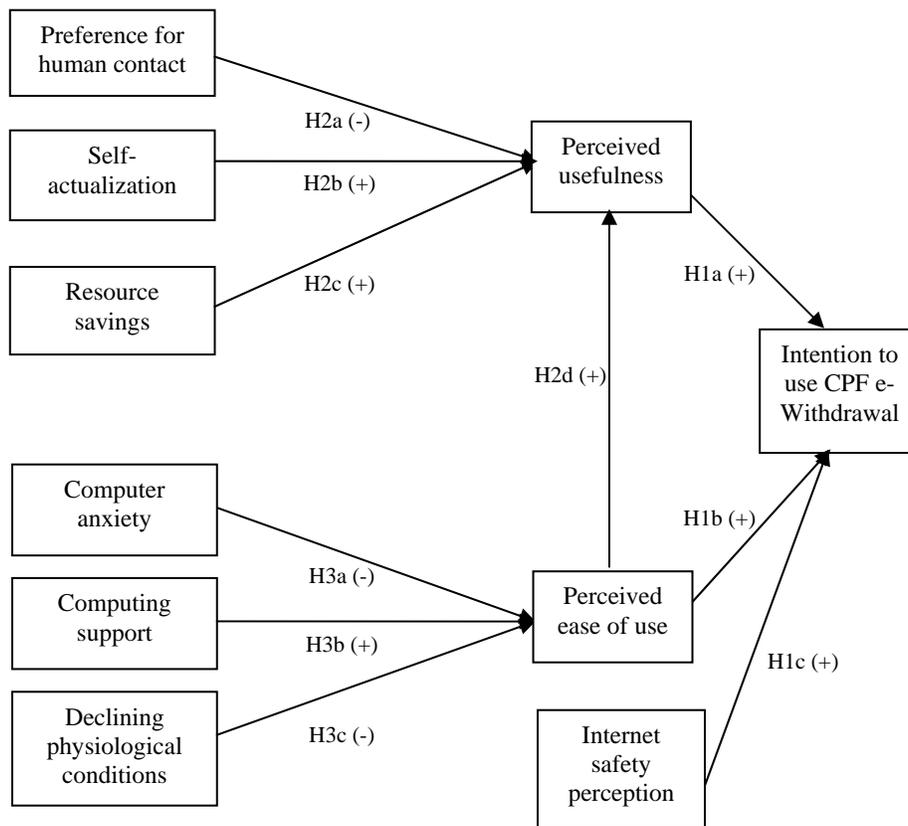


Figure 1. Research model

2.1 Relevant IS literature

A particularly popular stream of IS research has focused on identifying the conditions that facilitate IS acceptance. This research has yielded a number of determinants of IS use and several theories that have been applied to investigate IS acceptance, the major ones being technology acceptance model (TAM) [Davis et al. 1989], innovation diffusion theory [Rogers 1995], and theory of planned behavior (TPB) [Ajzen 1991]. TAM is a widely cited theory in IS research that has been supported by a large number of

empirical studies [Legris et al. 2003]. TAM posits that two specific perceptions about the technology i.e., perceived ease of use and perceived usefulness, determine one's behavioral intention to use a technology and subsequent usage of the technology [Davis et al. 1989].

Innovation diffusion theory has also been widely applied [e.g., Karahanna et al. 1999; Moore and Benbasat 1996; Plouffe et al. 2001] and found to explain IS acceptance. The theory outlines the characteristics of an innovation, such as a new IS, that can influence its acceptance. These characteristics include the relative advantage, complexity, image, visibility, compatibility, results demonstrability, and voluntariness of use of the innovation [Rogers 1995]. Certain key constructs in innovation diffusion theory are analogous to the constructs in TAM i.e., relative advantage is similar to perceived usefulness and complexity is similar to perceived ease of use.

TPB [Ajzen 1991] and decomposed TPB [Taylor and Todd 1995] are other theories that have been employed to examine IS acceptance and use. TPB considers attitude, subjective norms, and perceived behavioral controls as predictors of behavioral intention. Perceived usefulness and perceived ease of use are considered as determinants of attitude towards the technology in the decomposed version of the TPB model [Taylor and Todd 1995]. While subjective norms capture social influences on individual's acceptance behavior, perceived behavioral controls are (external or internal) facilitating or inhibiting conditions for individual's IS acceptance.

Venkatesh et al. [2003] synthesized the existing theories that have been applied to explain IS acceptance and use and proposed a unified model called the Unified Theory of Acceptance and Use of Technology (UTAUT). The theory holds that technology use is influenced directly, or indirectly through intention, by performance expectancy (perceived usefulness), effort expectancy (reverse of perceived ease of use), social influence (subjective norms), and facilitating conditions (such as compatibility of the technology with existing values, needs, and experience of potential adopters).

Thus it can be seen that existing theories and past studies in IS acceptance have consistently identified perceived usefulness (or related constructs such as relative advantage and performance expectancy) and perceived ease of use (or related constructs such as complexity and effort expectancy) as the two most significant antecedents in explaining individual's intention to use an IS. To the extent that these two antecedents are applicable to IS in general, we consider them important to determine senior citizens' acceptance of e-Government services.

Additionally, since CPF e-Withdrawal is an electronic service that is delivered through the Internet, we also propose Internet safety perception as a potential antecedent of senior citizens' intention to use the service. Internet safety perception has been a common concern highlighted in studies of online service acceptance [McKnight and Chervany 2001]. It has been shown that individuals' perception of whether the

Internet is a secure and robust medium has a significant impact on their intention to use e-Government services [Lee et al. 2003]. Hence it is expected that perceptions pertaining to the security of transacting on the Internet may play an important role in the context of this study.

While perceived usefulness and perceived ease of use have been identified as salient perceptions about an IS that influence its acceptance, since these constructs are not directly observable and controllable, they have limited utility for making prescriptions on how to enhance acceptance [Taylor and Todd 1995]. Therefore, a number of IS acceptance studies [e.g., Venkatesh 2000] and theories such as TAM2 [Venkatesh and Davis 2000] have extended TAM backwards to include antecedents of perceived usefulness and perceived ease of use. These external variables bridge the various individual traits, controllable interventions, and/or situational constraints impinging on behavior and individuals' perceptions (perceived usefulness and perceived ease of use) of the technology [Davis et al. 1989]. Past studies have identified motivations, emotions, and controls as possible external variables [Venkatesh 2000; Venkatesh and Davis 2000]. In the context of our study, we seek to understand these external variables that may influence senior citizens' perceptions of the perceived usefulness and perceived ease of use of the CPF e-Withdrawal service.

Our review of the external variables that may impact perceived usefulness and perceived ease of use, indicated that most antecedents identified in IS acceptance studies have been defined and operationalized for workplace settings. This is because the majority of IS acceptance studies, with few exceptions [e.g., Venkatesh and Brown 2001], have been conducted in workplace settings in order to investigate the integration of IS into business [Legris et al. 2003]. Nonetheless, certain antecedents are not workplace specific and may be applicable to the context of senior citizens' acceptance of e-Government services. Two such factors are computer anxiety and computing support.

Computer anxiety refers to individual's apprehension when faced with the possibility of using computers [Simonson et al. 1987]. This construct of individual's emotion may be used to explain the effort senior citizens perceive towards technology use. The significance of this construct in IS literature has been demonstrated in a number of studies (e.g. Anderson 1996; Bozionelos 2004; Igbaria and Chakrabarti 1990). Particularly, studies comparing computer anxiety among senior citizens and younger adults show that older adults displayed significantly higher computer anxiety [Laguna and Babcock 1997]. Computer anxiety is likely to impact IS use through its influence on perceived ease of use [Venkatesh 2000].

Apart from computer anxiety, computing support in the form of resources and knowledge [Igbaria 1990; Igbaria et al. 1997] may also be a salient antecedent of perceived ease of use in the context of this study. Computing support can serve as an external control or facilitating condition that reduces effort

expectancy or increases perceived ease of use. As senior citizens may be relatively unfamiliar with computers, they may value support available from surrounding people to solve the problems that they face in their effort to use computers.

In the context of online services such as for e-Commerce or e-Government, resource savings by using the IT may be an important antecedent of perceived usefulness. This extrinsic motivator is particularly salient in IS acceptance studies where the use of IT may lead to savings of cost and time. For instance, convenience in terms of saving time and money is often considered as a motivator for use of e-Commerce websites for online shopping [Bhatnagar et al. 2000; Koufaris 2002]. Similarly, if senior citizens think that use of e-Government services will result in resource savings, they may perceive the service as more useful.

2.2 Relevant Gerontology literature

Gerontology is broadly defined as the study of aging [National Institute on Aging 1986]. There are three major streams of gerontology research: biological perspective, psychological perspective, and sociological perspective of aging. In the biological and psychological perspectives, the main focus is on the physical and mental faculties of individuals as they enter old age. The sociological perspective, on the other hand, attempts to explain the social behavior of individuals during the aging process.

Both the biological and psychological perspectives of aging underscore the influence of declining physiological conditions of senior citizens (such as hearing, vision, speech, locomotion, and memory capabilities) on their physical and cognitive capabilities [Grundy et al. 1999]. The declining physical and cognitive capabilities may cause senior citizens to experience more difficulties in using computers [Eilers 1989; Timmerman 1998]. Thus, declining physiological conditions can serve as internal controls or inhibiting conditions that increase effort expectancy to use IS. Hence we expect senior citizens' declining physiological conditions to be an antecedent of perceived ease of use in the context of our study.

Two potential antecedents of perceived usefulness from the psychological and social perspectives are self-actualization and preference for human contact, respectively. According to Erikson's eight stages of life model [Erikson et al. 1986], the last stage of human life (i.e., old age) centers on the development of ego integrity. Ego integrity refers to the appreciation of the meaning of one's life in the overall context of recognizing that one's life does not permit reliving [Gatz and Zarit 2001]. The implication of this is that a sense of fulfillment becomes a crucial element in successful adjustment in later life for senior citizens [Coleman 1993]. Such emphasis on attaining fulfillment in old age is in line with Maslow's [1970] hierarchy of needs, which suggests that higher-order motivations, such as self-actualization, tend to be salient in later adulthood. Self-actualization refers to the intrinsic motivation to become everything that

one is capable of becoming. It is related to achieving a sense of fulfillment, seeking personal growth, and realizing personal potential. Higher self-actualization motivation makes people open to new experiences and learning new ideas and skills [Heylighen 1992]. In the context of this study, learning to use new IS applications, such as the CPF e-Withdrawal, could mean embarking on something that senior citizens have not tried before. Learning to use the IS application may thus present an opportunity for them to actualize their personal capacity.

The construct representing preference for human contact is derived from continuity theory. Continuity theory suggests that senior citizens make adaptive choices in an effort to preserve ties with their own past experiences [Atchley 1989]. As people grow old, they develop habits that become an integral part of their personality. They will tend to continue with these habits when they are faced with situations that require them to take action. Such tendency for continuity serves to achieve certain purposes. In particular, the behavior of sticking to habits developed from past experience can serve to lower environmental uncertainty that may be encountered. This continuity behavior may include the persistence of a personal structure of ideas based on preferences [Atchley 1989]. Being a population that grew up when IT was not yet commonplace [Lawhon et al. 1996; Morris and Venkatesh 2000], senior citizens are likely to be more used to human contact in obtaining services. Consequently, they may have developed a preference for human contact when they want to obtain services, a factor that may act as de-motivator and negatively affect their perceived usefulness of e-Government services.

Note worthily, a few constructs are elucidated in both IS and gerontology research streams in relation to IS acceptance. For example, computing support was also referred to in the gerontology literature as social support obtained by senior citizens for their use of IT [Lesnoff-Caravaglia 1998]. Such support, in the form of encouragement and help received from their friends and family, is believed to significantly influence senior citizens' use of IT. Table A1 in the Appendix provides a summary of factors commonly explored in IS acceptance and use studies, and the justification for the factors selected in this study.

3. Research Model and Hypotheses

Based on our review of the IS and gerontology literatures related to IS acceptance and use, we identified perceived usefulness, perceived ease of use, and Internet safety perception as antecedents of senior citizens' intention to use e-Government (CPF e-Withdrawal) service. The emotions, motivators, and controls (external and internal) that are likely to influence perceived usefulness and perceived ease of use are also included in the model. Specifically, computer anxiety, computing support, and declining physiological conditions are considered as potential antecedents of perceived ease of use. For perceived usefulness, preference for human contact, self-actualization, and resource savings are considered as

determinants. Since the target IS service (CPF e-Withdrawal) is relatively new and not many senior citizens have used it, behavioral intention is taken as the dependent variable of this study instead of actual usage as has been done in past studies [e.g., Taylor and Todd 1995; Venkatesh and Morris 2000].

Perceived usefulness refers to the degree to which a person feels that using a particular system would enhance his or her job performance, whereas perceived ease of use is the degree to which a person feels that using a particular system would be free of effort [Davis et al. 1989]. In the context of our study, perceived usefulness is the degree to which a person feels that using the CPF e-Withdrawal service will be useful to him or her, while perceived ease of use is the extent to which a person feels that using the CPF e-Withdrawal service will be free of effort. Based on the findings that perceived usefulness and perceived ease of use are the two most significant predictors of use intention [Legris et al. 2003], we hypothesize that:

H1a: *Perceived usefulness is positively related to senior citizen's intention to use the CPF e-Withdrawal service*

H1b: *Perceived ease of use is positively related to senior citizen's intention to use the CPF e-Withdrawal service*

The term Internet safety perception, adapted from the concept of structural assurance [McKnight and Chervany 2001; Shapiro 1987], refers to individual's perception that structures like guarantees, regulations, legal resources, or other procedures are in place to ensure that the use of Internet for transactions is safe and free from danger. Previous research has shown that perception of Internet safety has a significant impact on e-Government service use intention [Lee et al. 2003]. Having low Internet safety perception, which means feeling uncertain that there are adequate structures and procedures to protect one from the possible risks of transacting on the Internet, may thus negatively impact senior citizens' intention to use the CPF e-Withdrawal service. Conversely, we hypothesize:

H1c: *Internet safety perception is positively related to senior citizen's intention to use the CPF e-Withdrawal service*

3.1 Antecedents of Perceived Usefulness

Factors that are proposed as antecedents of perceived usefulness are preference for human contact, self-actualization, and resource savings. Preference for human contact is defined as the liking for obtaining services such as withdrawing CPF through humans rather than using machines. For many service encounters, interactions arising from human contact are considered important in evaluating the service

[Bitner et al. 1990; Solomon et al. 1985]. People may feel that the use of machines in a service encounter dehumanizes the interaction [Nissenbaum and Walker 1998; Zeithaml and Gilly 1987].

As the CPF e-Withdrawal service is an IT application that enables self-service through the medium of computers, it can dehumanize the process of obtaining services by eliminating the need for human contact. For senior citizens, using the CPF e-Withdrawal service would imply changing their familiar way of obtaining services over the counter. Specifically, computerized services such as CPF e-Withdrawal are made intangible and abstracted because of the digitization process [Featherman and Wells 2004], thus causing uncertainties. This may be especially salient in the context of the senior citizens as they were found to have a higher need for assurance before they act [Botwinick 1973]. In contrast, human contact, as the likely familiar way for senior citizens to obtain services, can minimize such uncertainties. Consequently, preference for human contact may diminish the perceived usefulness of the computerized service to them. Therefore,

H2a: *Preference for human contact is negatively related to senior citizen's perceived usefulness of the CPF e-Withdrawal service*

Self-actualization refers to the motivation to achieve everything that one is capable of [Maslow 1970]. It involves achieving a sense of fulfillment, seeking personal growth, and realizing personal potential. The CPF e-Withdrawal service, being a new technology application that stems from the Internet age, may help senior citizens to fulfill their self-actualization motive by keeping up with innovative ideas. In this light, the CPF e-Withdrawal service may serve as an instrument that can help them achieve a sense of self-actualization. In such circumstances, they will likely perceive the service as a useful tool for them:

H2b: *Self-actualization is positively related to senior citizen's perceived usefulness of the CPF e-Withdrawal service*

Apart from the factors above, resource savings in the form of time and money can act as a potentially salient antecedent to perceived usefulness. Convenience provided by technology has been found to be one of the important factors influencing use of IS innovations [Zeithaml and Gilly 1987] such as e-commerce services [Bhatnagar et al 2000; Koufaris 2002]. The CPF e-Withdrawal service is expected to bring convenience to senior citizens in the form of time and money savings by eliminating the need to go to the CPF office and queue up to withdraw their CPF. Such convenience provided by the service will likely raise senior citizens' perception of its usefulness. Thus,

H2c: *Resource savings is positively related to perceived usefulness of the CPF e-Withdrawal service*

As per TAM, perceived ease of use influences intention both directly and through its effect on perceived usefulness [Davis et al. 1989]. Other things being equal, the easier an IS is to use, the more useful it can be [Venkatesh 2000]. In the context of this study, the perceived ease of use of the CPF e-Withdrawal service may increase its usefulness for senior citizens. Hence,

H2d: *Perceived ease of use is positively related to perceived usefulness of the CPF e-Withdrawal service*

3.2 Antecedents of Perceived Ease of Use

Factors that are modeled as antecedents of perceived ease of use are computer anxiety, computing support, and declining physiological conditions. Computer anxiety refers to individual's apprehension when he or she is faced with the possibility of using computers [Simonson et al. 1987]. The relationship between computer anxiety and perceived ease of use has been theoretically justified and empirically tested [Venkatesh 2000]. The theoretical underpinnings for this link can be derived from the classical theory of anxiety perspective [Philipi et al. 1972]. The theory suggests that anxiety has a positive impact on effort expectancy, which is inversely related to perceived ease of use. In the context of our study, senior citizens who are more anxious about using computers are less likely to find the CPF e-Withdrawal service easy to use. Hence, we hypothesize

H3a: *Computer anxiety is negatively related to perceived ease of use of the CPF e-Withdrawal service*

In the context of our study, computing support refers to the support provided by others in the form of resources and knowledge to senior citizens in their use of computers. According to Venkatesh [2000], perceived ease of use takes into account constraints placed by system characteristics as well as by external controls such as availability of IT resources and support of end-user computing. Such perception of external control may serve as a situational anchor in the formation of perceived ease of use of the IT application. In the context of workplace settings, computing support has been positively linked to perceived ease of use [Igarria et al. 1997]. Similar findings were obtained for senior citizens' use of Internet applications in non-workplace settings [Richardson et al. 2002]. Thus, we hypothesize that

H3b: *Computing support is positively related to perceived ease of use of the CPF e-Withdrawal service*

Declining physiological conditions refers to the reduction in the state of bodily functions such as hearing, speech, locomotion, and memory capabilities. Research has shown that as physiological capabilities decline with age, older people are less able to perform information processing tasks [Birren et al. 1980] and allocate attention to information on the job [Plude and Hoyer 1985], both of which may be necessary when using an IT application [Venkatesh et al. 2003] such as CPF e-Withdrawal service. As their

physiological condition is declining, senior citizens may perceive the use of the CPF e-Withdrawal service as requiring more effort to perform. Hence, we postulate that

H3c: *Declining physiological conditions is negatively related to perceived ease of use of the CPF e-Withdrawal service*

The model and hypotheses developed above are shown in Figure 1.

4. Research Methodology

Survey methodology was employed for this study as it aims to increase generalizability, facilitate replicability, and provide statistical power [Dooley 2001].

4.1 Instrument Development

Our survey instrument was constructed based on established measures of constructs from the literature with adaptations. All items were anchored on a 7-point Likert scale (1=strongly disagree; 7=strongly agree). Additionally, data was collected for several control variables that may influence our findings i.e., gender, educational level, age, and Internet experience of respondents. Face and content validity of all items were assessed. First, the items were examined by three colleagues with expertise in methodology and the subject area to identify problems due to framing and wording of questions. Second, all items were tested for conceptual validity by conducting labeled sorting sessions with four judges [Moore and Benbasat 1991]. Minor modifications were made based on the sorting results.

The survey was conducted in an Asian country experiencing a rapid growth of its elderly population [Kinsella and Velkoff 2001]. Chinese constitute the largest ethnic group in this country and Mandarin is the main language spoken. Most senior citizens in this country did not receive English education and only speak or write Mandarin. Therefore, the questionnaire was first translated into Mandarin by two Chinese graduate students. Next, the translated questionnaire was translated back into English by another two Chinese graduate students. Based on this double translation process, minor corrections were made to the Mandarin version of the questionnaire to ensure that the meanings of all items had been preserved during translation. Two academics conversant in both languages were asked to review the survey questionnaires in both languages for clarity of instructions, content validity, and semantic consistency before a pilot study was conducted.

4.2 Pilot Study

The pilot study involved a convenience sample of 27 senior citizens who were asked to participate in the survey voluntarily. After they agreed to participate, the senior citizens were given a demonstration of the

CPF e-Withdrawal service (e.g., website interface, features and functionalities offered, and the steps involved in performing a typical transaction). Previous literature [Chin and Gopal 1995] suggests that the initial interest in an IS can be gauged by providing such demonstrations. Intentions in such situations have been shown to be indicative of future intention and use of IS [Davis et al. 1989].

Based on the feedback from the pilot study, minor revisions were made to the instrument. Particularly, some participants were confused by negatively worded items. They commented that it is taxing for them to differentiate between positively and negatively worded items. For instance, a problematic item measuring preference for human contact read “Personal attention from service personnel is not important to me when I can use a computer to obtain the service”. To reduce confusion, the item was rephrased as “Personal attention from service personnel is important to me even when I can use a computer to obtain the service”. The issue of negatively-worded items has been raised before [Marsh 1996]: “...the potential advantages of including negatively worded items seemed to be offset by associated problems in the present investigation, and these results may generalize to other applications” (p. 817). With senior citizens as respondents, this issue seems to be more salient due to their cognitive limitations.

Additionally, some senior citizens also complained about similarly phrased items as they found them tedious and time consuming to respond to. In response to their concerns, we deleted the similarly phrased items on the condition that such deletion would not affect the content validity of the scales. Again, such feedback revealed cognitive limitations that appear to be more salient for senior citizens and need to be considered when designing questionnaires for them. The resultant survey instrument used in the field survey contained 41 items (see Table 1).

4.3 Field Survey

Due to the specific population of subjects that we targeted, we used a directory of eldercare services that is available on the country’s government website as our sampling frame. The directory includes the description and contact information of 161 senior citizen service centers. These activity centers are set up by either grassroots organizations (e.g., community centers) or civil organizations (e.g., retiree societies and voluntary bodies). Among them, some are healthcare centers whose responsibility is to take care of old people in poor health condition, while others are membership activity centers that are responsible for organizing activities for senior citizens. After filtering out the healthcare centers, we contacted the twelve largest and most well known activity centers in order to get their support for our study. At each center, we proposed that we would organize a briefing session on the CPF e-Withdrawal service for the senior citizen members, followed by administration of the survey. Six of the organizations we contacted agreed to participate.

Construct Items and Source
<p>Intention to use CPF e-Withdrawal [Taylor and Todd 1995]</p> <ol style="list-style-type: none"> 1. Use CPF E-Withdrawal service today, if possible (INTN1) 2. Use CPF E-Withdrawal service as soon as I can (INTN2)
<p>Perceived usefulness [Taylor and Todd 1995]</p> <ol style="list-style-type: none"> 1. CPF E-Withdrawal service is useful (PUSE1) 2. CPF E-Withdrawal service will be beneficial (PUSE2) 3. CPF E-Withdrawal service is valuable (PUSE3) 4. CPF E-Withdrawal service will be advantageous (PUSE4)
<p>Perceived ease of use [Taylor and Todd 1995]</p> <ol style="list-style-type: none"> 1. Easy to learn how to use the CPF E-Withdrawal service (PEOU1) 2. Easy to use the CPF E-Withdrawal service (PEOU2) 3. No difficulty in using the CPF E-Withdrawal service (PEOU3) 4. Not much effort to learn to use the CPF E-Withdrawal service (PEOU4)
<p>Internet safety perception [McKnight and Chervany 2001]</p> <ol style="list-style-type: none"> 1. Enough safety measures to perform transaction (SAFE1) 2. Adequate laws and regulations to protect me from problems on the Internet (SAFE2) 3. Current technology makes it safe to perform transactions on the Internet (SAFE3) 4. Internet is a safe environment to perform transactions (SAFE4)
<p>Preference for Human Contact [Dabholkar 1996]</p> <ol style="list-style-type: none"> 1. Human contact is more enjoyable than using a computer (PREF1) 2. Like interacting with service personnel more than using computers (PREF2) 3. Personal attention is important (PREF3) (<i>rephrased to non-reversed</i>) 4. Prefer human contact than to use a computer (PREF4)
<p>Self-actualization [Porter 1963]</p> <ol style="list-style-type: none"> 1. Learning to use new applications gives me opportunity for personal growth (<i>deleted due to repetition</i>) 2. Learning to use new applications gives me opportunity for personal progress (SELF1) 3. Learning to use new applications gives me opportunity for personal development (SELF2) 4. Learning to use new applications increases my feeling of self-fulfillment (SELF3) 5. Learning to use new applications gives me a feeling of accomplishment (SELF4)
<p>Resource Savings</p> <ol style="list-style-type: none"> 1. Using CPF E-withdrawal service saves me time in going to the CPF office (SAVE1) 2. Using CPF E-withdrawal service saves me time in queuing up at the CPF office (SAVE2) 3. Using CPF E-withdrawal service is less time-consuming (SAVE3) 4. Generally speaking, using CPF E-withdrawal service saves me time (<i>deleted due to repetition</i>) 5. Using CPF E-withdrawal service saves me effort in going to the CPF office (SAVE4) 6. Using CPF E-withdrawal service is convenient (SAVE5) 7. Generally speaking, using CPF E-withdrawal service saves me effort (SAVE6) 8. Using CPF E-withdrawal service will be less costly (SAVE7) 9. Generally speaking, using CPF E-withdrawal service saves me money (SAVE8)
<p>Computer anxiety [Venkatesh 2000]</p> <ol style="list-style-type: none"> 1. Computer makes me nervous (ANXT1) 2. Computer makes me uncomfortable (ANXT2) 3. Get worried when I think of using computers (ANXT3) 4. Computer makes me feel uneasy (ANXT4)
<p>Computing Support [Igarria 1990]</p> <ol style="list-style-type: none"> 1. Have someone to help solve computer related problems (CSUP1) 2. Have friends and family to help with computer related problems (CSUP2) 3. Supported by those around me when I have difficulty to use computers (CSUP3) 4. Have friends / family to provide necessary help to use computers (CSUP4)
<p>Declining physiological condition [McDowell and Newell 1996]</p> <p>e.g., problem in hearing, speech, moving, and memory</p> <ol style="list-style-type: none"> 1. Requires me to exert more effort to perform daily activities (DPCN1) 2. Limits the kind of activities that I can perform (DPCN2) 3. Causes me to have difficulty in performing daily activities (DPCN3)

Table 1. Construct operationalization

Data collection sessions were conducted at each of the six centers during a two-week period. Each session was managed by a group of three graduate students. The activity centers informed their members about the event beforehand and encouraged them to attend. Since none of the attendees had used the service before, a demonstration of the CPF e-Withdrawal service was given to them² at the start of each session. They were shown the series of steps to complete a typical CPF withdrawal transaction using the service. The features and functionalities offered by the service were explained. Following the demonstration and a question-and-answer period, the attendees were encouraged to look at the CPF e-Withdrawal website using computers in the centers. However they did not use the system or carry out any transaction. Subsequently, the survey forms were distributed and instructions were provided on how to fill up the questionnaire. Though participation was voluntary, a token gift was offered to the respondents as incentive.

Altogether 365 senior citizens attended the six sessions out of which 179 filled in our survey. We excluded the remaining 186 senior citizens because they were not the target group of the service for three reasons i.e., (1) they were not literate; (2) could not see clearly such that using computers is impractical for them; (3) they have no funds left in their account, which makes the CPF e-Withdrawal service irrelevant to them. Of the 179 collected responses, 40 had missing data. These responses were discarded since the missing data could not be recovered due to the anonymous nature of our survey. The remaining 139 responses were used in the data analysis. The demographic information of our respondents is shown in Table 2. The average Internet experience of respondents is 1.31 years.

Demographic Variables	Category	Frequency (N=139)	Percent
Gender	Male	59	42.4%
	Female	80	57.6%
Educational Level	Primary School	48	34.5%
	Secondary School	46	33.1%
	Junior College	7	5.0%
	Polytechnic	1	0.7%
	University	24	17.3%
	No formal education	13	9.4%
Age	50-60	60	43.2%
	61-70	54	38.8%
	71-80	20	14.4%
	81-90	5	3.6%

Table 2. Demographic Information

5. Data Analysis and Results

Partial Least Squares (PLS), a structural equation modeling technique, was used for our analysis. PLS was chosen because it allows the measurement model, reflecting the psychometric properties of the

² In centers where both English-speaking and Mandarin-speaking groups were present, the demonstration was conducted in both languages.

questions, to be assessed within the context of the theoretical model. Additionally, PLS can be used for prediction-oriented studies and is appropriate for early stages of theory development [Fornell 1982]. Given that this study represents an initial attempt to explore the factors influencing senior citizens' acceptance of IS, PLS was deemed appropriate. Table 3 shows the means and standard deviations of the model variables.

Construct	Code	Number of Indicators	Mean	Standard Deviation
Intention	INTN	2	3.63	2.07
Perceived Usefulness	PUSE	4	4.67	1.87
Perceived Ease of Use	PEOU	4	3.85	1.80
Internet Safety Perception	SAFE	4	3.89	1.59
Preference for Human Contact	PREF	4	5.24	1.36
Self-actualization	SELF	4	4.32	1.78
Resource Savings	SAVE	8	4.96	1.74
Computer Anxiety	ANXT	4	3.82	1.90
Computing Support	CSUP	4	4.01	2.05
Declining Physiological Condition	DPCN	3	3.76	2.05

Table 3. Descriptive Statistics

5.1 Test of Measurement Model

The measurement model links each construct in the theoretical model to indicators of the constructs. The strength of the measurement model can be demonstrated by means of convergent and discriminant validity [Hair et al. 1998]. Except for the control variables (gender, age, educational level, and internet experience) that were measured using single indicators, all other constructs were measured using multiple perceptual indicators and had to be assessed for convergent and discriminant validity.

Convergent validity reflects the extent to which the indicators of a construct are similar to the other indicators of the same construct. The convergent validity of each construct was assessed by computing the reliability of indicators, composite reliability of constructs, Cronbach's alpha, and average variance extracted by the construct [Hair et al. 1998]. Table A2 in the Appendix presents the convergent validity results for the constructs. Reliability of indicators was determined by examining the loadings of indicators on their intended constructs. All indicators satisfied the minimum 0.50 level for reliability [Hair et al. 1998]. All composite reliabilities of constructs and Cronbach's alphas exceeded the criterion of 0.70 [Nunnally 1978] while the average variance extracted by constructs were all above the recommended threshold of 0.50 [Hair et al. 1998].

Component	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
INTN1	0.27	0.31	-0.22	0.22	0.33	0.39	0.26	-0.08	-0.07	0.60
INTN2	0.29	0.31	-0.19	0.28	0.34	0.36	0.24	-0.03	-0.10	0.60
PUSE1	0.34	0.12	-0.06	0.11	0.78	0.21	0.29	0.07	-0.06	-0.06
PUSE2	0.41	0.18	-0.05	0.12	0.79	0.28	0.16	0.05	-0.06	0.06
PUSE3	0.39	0.19	-0.01	0.07	0.81	0.18	0.17	0.05	0.01	0.16
PUSE4	0.37	0.19	-0.06	0.03	0.83	0.17	0.17	-0.02	0.00	0.12
PEOU1	0.28	0.23	-0.21	0.16	0.22	0.77	0.24	-0.02	-0.07	0.14
PEOU2	0.29	0.26	-0.19	0.17	0.22	0.78	0.19	-0.02	-0.14	0.08
PEOU3	0.22	0.20	-0.18	0.20	0.20	0.81	0.20	-0.04	-0.06	0.03
PEOU4	0.24	0.26	-0.21	0.20	0.21	0.79	0.20	-0.10	-0.06	0.08
SAFE1	0.20	0.84	-0.05	0.13	0.21	0.19	0.07	-0.04	-0.02	0.09
SAFE2	0.26	0.85	-0.06	0.06	0.12	0.20	0.18	-0.01	-0.01	-0.03
SAFE3	0.28	0.85	-0.06	0.13	0.09	0.17	0.23	-0.01	0.06	0.05
SAFE4	0.25	0.87	-0.08	0.09	0.14	0.15	0.15	-0.05	0.06	0.11
SELF1	0.30	0.23	-0.08	0.17	0.22	0.19	0.79	0.02	-0.17	0.11
SELF2	0.25	0.23	-0.06	0.24	0.20	0.24	0.81	0.01	-0.17	0.07
SELF3	0.32	0.19	0.01	0.18	0.21	0.22	0.79	-0.02	-0.21	0.05
SELF4	0.35	0.17	-0.06	0.20	0.20	0.20	0.79	-0.02	-0.20	0.04
ANXT1	0.00	-0.12	0.89	0.01	-0.01	-0.12	0.07	0.14	0.12	-0.03
ANXT2	-0.14	-0.01	0.93	0.01	-0.07	-0.11	-0.04	0.14	0.14	-0.03
ANXT3	0.00	-0.07	0.96	-0.04	-0.02	-0.11	-0.06	0.07	0.07	-0.04
ANXT4	-0.07	-0.02	0.93	-0.03	-0.04	-0.14	-0.10	0.04	0.10	-0.04
DPCN1	-0.06	0.03	0.13	-0.03	-0.01	-0.09	-0.14	0.16	0.93	-0.03
DPCN2	-0.07	0.04	0.14	-0.08	-0.03	-0.05	-0.15	0.16	0.94	-0.02
DPCN3	-0.04	0.01	0.16	-0.11	-0.04	-0.06	-0.16	0.15	0.93	-0.01
SAVE1	0.85	0.10	-0.09	0.29	0.17	0.14	0.15	0.01	-0.06	-0.01
SAVE2	0.86	0.08	-0.11	0.26	0.15	0.11	0.21	0.04	-0.06	0.00
SAVE3	0.89	0.18	-0.03	0.21	0.12	0.12	0.19	0.05	-0.02	0.01
SAVE4	0.84	0.20	-0.04	0.24	0.25	0.16	0.18	0.02	-0.03	0.09
SAVE5	0.85	0.21	-0.05	0.20	0.20	0.19	0.17	0.05	-0.08	-0.01
SAVE6	0.82	0.26	0.00	0.21	0.24	0.19	0.12	0.02	-0.05	0.07
SAVE7	0.81	0.22	-0.06	0.20	0.31	0.15	0.14	-0.02	-0.02	0.15
SAVE8	0.77	0.26	0.00	0.19	0.26	0.14	0.14	-0.03	-0.02	0.14
CSUP1	0.35	0.11	0.00	0.85	0.05	0.13	0.19	0.08	-0.02	0.08
CSUP2	0.37	0.12	-0.03	0.85	0.07	0.18	0.20	-0.01	-0.09	0.05
CSUP3	0.42	0.10	-0.02	0.81	0.11	0.15	0.11	0.01	-0.11	0.07
CSUP4	0.40	0.13	-0.02	0.83	0.08	0.20	0.16	0.00	-0.09	0.02
PREF1	0.01	-0.02	-0.01	0.00	0.06	-0.09	-0.05	0.89	0.09	-0.08
PREF2	-0.05	-0.02	0.07	0.00	0.03	-0.03	-0.01	0.95	0.09	-0.01
PREF3	0.13	-0.04	0.12	0.04	-0.05	0.04	-0.04	0.90	0.08	0.05
PREF4	0.02	-0.01	0.19	0.02	0.03	-0.01	0.10	0.85	0.19	0.01

Table 4. Results of Factor Analysis

Discriminant validity reflects the extent to which the indicators for each construct are distinctly different from indicators of other constructs, and is generally assessed in two ways. First, all indicators were subjected to factor analysis to ensure that the indicators measuring each construct load more highly on their intended constructs than on other constructs [Thompson et al. 1991]. Second, each indicator should correlate more highly with other indicators measuring the same construct than with other indicators

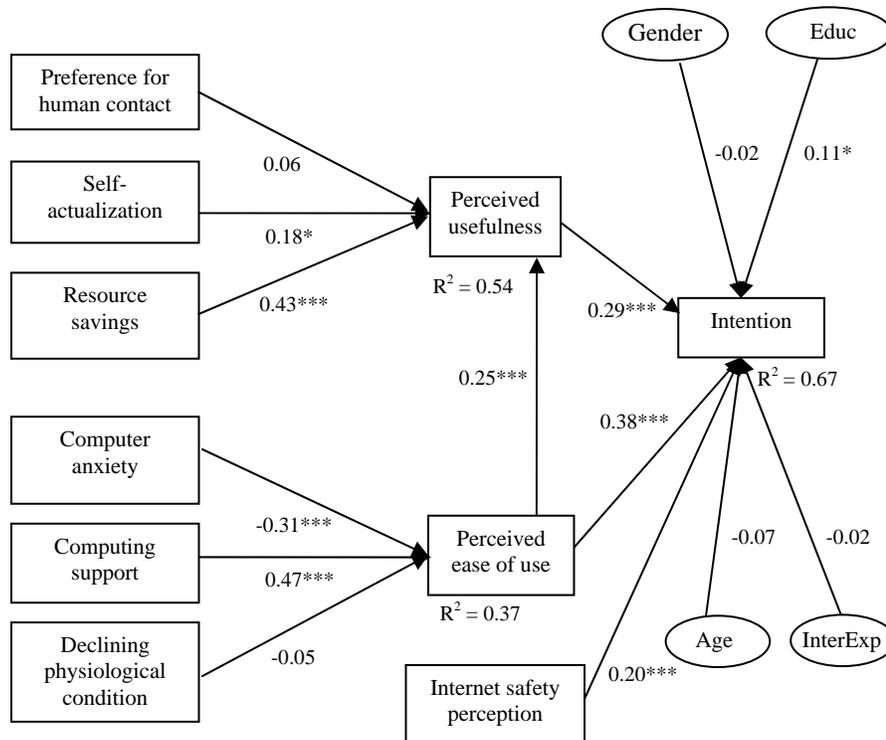
measuring other constructs. This could be determined by examining whether the squared correlations between constructs (their shared variance) are less than the average variance extracted for a construct [Igbaria et al. 1994]. For our study, factor analysis was carried out using principal component analysis and varimax rotation (see Table 4). Table A3 in the Appendix reports the results of discriminant validity testing, which is checked by comparing the diagonal to the off-diagonal elements. Results in both tables reveal that all constructs in this study fulfilled the requirement of discriminant validity.

5.2 Test of Structural Model

Following the validation of the measurement model, the PLS structural model was assessed to determine its explanatory power and the significance of the hypothesized paths. The explanatory power of the structural model was determined by the amount of variance in the dependent variable (intention) that the model could account for. Our model could explain 67% of the variance in intention, 54% of the variance in perceived usefulness, and 37% of the variance in perceived ease of use³. Each hypothesis corresponded to a path in the structural model. Bootstrapping procedure was used to estimate the significance (T-value and corresponding p-value) of the path coefficients. All statistical tests were assessed at 5 percent level of significance. Figure 2 and Table 5 present the results of the structural model testing.

Figure 2. Structural Model Testing Results

*Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.005$



³ The explanatory power is considerably above the adequate level of 10% [Falk and Miller 1992].

Based on the analysis, eight out of the ten hypotheses in the model were supported. Perceived usefulness, perceived ease of use, and Internet safety perception were significantly related to intention to use CPF e-Withdrawal services (H1a, H1b, and H1c were supported). Self-actualization, resource savings, and perceived ease of use were significantly related to perceived usefulness (H2b, H2c, and H2d were supported) but preference for human contact was not (H2a was not supported). Computer anxiety and computing support were significantly related to perceived ease of use (H3a and H3b supported) but declining physiological condition was not (H3c was not supported). One of the control variables, i.e. educational level, was found to be significantly related to the dependant variable.

Hypothesis	Path Coefficient	T-Value	Supported ^a
H1a: PUSE → INTN	0.29	3.26***	Yes
H1b: PEOU → INTN	0.38	4.11***	Yes
H1c: SAFE → INTN	0.20	2.95***	Yes
H2a: PREF → PUSE	0.06	0.82	No
H2b: SELF → PUSE	0.18	1.73*	Yes
H2c: SAVE → PUSE	0.43	4.72***	Yes
H2d: PEOU → PUSE	0.25	3.44***	Yes
H3a: ANXT → PEOU	-0.31	-3.69***	Yes
H3b: CSUP → PEOU	0.47	6.42***	Yes
H3c: DPCN → PEOU	-0.05	-0.61	No

^aAt 5% level of significance

Table 5. Results of Hypothesis Testing

6. Discussion and Conclusion

Several key findings emerge from the study. As hypothesized, there was significant support for perceived usefulness, perceived ease of use, and Internet safety perception as determinants of use intention. Among the proposed antecedents of perceived usefulness, support was found for resource savings and self-actualization as motivators. This shows that the usefulness perception of senior citizens can be driven by both tangible benefits such as resource savings and intangible benefits such as self-actualization.

Interestingly, preference for human contact was not found to be related to perceived usefulness. A possible reason is that senior citizens no longer place much value on human contact as a familiar way of obtaining services. This may be due to the general deterioration in the level of respect that they receive during the process of interacting with service personnel. From the perspective of modernization theory [Cowgill and Holmes 1972], today's modernized and scientifically-oriented society can trigger a loss of social status of senior citizens because knowledge from the book is now valued higher than knowledge acquired through personal experience [Brown 1990]. The implication of this declining social status is that senior citizens may receive lower quality treatment from service personnel when obtaining services

compared to when they were younger or compared to the current younger generation. In this light, senior citizens' preference for human contact over computers in obtaining services may diminish and thus, this construct may not have a significant impact on the perceived usefulness of the CPF e-Withdrawal service. This explanation was offered by a few of the respondents interviewed after the survey.

Among the proposed antecedents of perceived ease of use, support was found for computer anxiety (emotion) and computing support (external control). This echoes the findings from previous literature (e.g., Venkatesh 2000). Contrary to hypothesis, declining physiological condition was not found to be significant in predicting perceived ease of use. This may be due to several reasons. First, the insignificant effect could be due to the adaptive behavior of senior citizens. While increase in age indeed leads to declining physiological conditions, aging is also a creative process of continuous adaptation [Brown 1990]. For example, studies comparing senior citizens with younger adults doing information processing tasks showed that even though the older subjects were slower, they often compensated for their slowness by using cues from their surroundings or by taking advantage of advanced information, or both [Perlmutter and Hall 1992, p.186]. Due to such adaptive behavior, declining physiological condition may not have affected the perceived effort required to use the CPF e-Withdrawal service. Second, the insignificant effect of this factor on perceived ease of use could be an artifact from our sample selection, i.e. the attendees with acute physiological problems were excluded. However, it appeared that the respondents had at least somewhat reduced physical and cognitive capabilities since they required multiple repetitions of instructions, repeated explanations during the demonstration, and complained about the readability of the presentation slides. Hence, further investigation may be required to obtain a better understanding of this construct.

Apart from educational level, the control variables investigated in this study were not found to affect the dependent variable. The findings show that educational level plays a part in explaining senior citizens' acceptance of e-Government services. Higher educational level is often associated with higher IT literacy. Those with higher IT literacy may have a more positive perception towards IS in general, and may thus be more likely to accept e-Government services such as the CPF e-Withdrawal service. The link between education and use of technology has found support in previous literature [Rogers 1995].

6.1 Limitations and Future Work

When interpreting the findings from this research, several limitations need to be recognized. First, there may be a response bias in our measurement. Our subjects are mainly from grass-root associations and civil organizations. The senior citizens who attend activities organized by these organizations are likely to be more sociable and active than those who do not. Future research may strive to obtain responses from less socially active senior citizens e.g., in their homes, to see if the results obtained are the same. Second, the sample size can be increased in future studies to obtain better statistical power. Nevertheless, the high

R^2 (0.67) for the dependent variable suggests good explanatory power. Third, the research findings were obtained from a single study under a single national culture. Hence caution needs to be exercised in generalizing our results to other settings. Future research may conduct the study in other countries to investigate if country specific and cultural factors play a part in influencing senior citizens' acceptance of IS. Last, the actual usage behavior of the service can be measured in future studies. However, with considerable support found for intention as a predictor of actual behavior (e.g., Taylor and Todd 1995; Venkatesh and Morris 2000), this issue may be less critical.

6.2 Theoretical Contributions

In a preliminary effort to explore the antecedents of senior citizens' acceptance of IS, this study attempts to synthesize relevant work from IS and gerontology fields. Such integrating efforts can expand our understanding of aging and IT related phenomena. Within the IS acceptance research, this study confirms the significant roles of perceived usefulness and perceived ease of use in predicting IS use intention. In concurrence with previous TAM studies [Legris et al. 2003], perceived ease of use is also found to influence perceived usefulness. Additionally, Internet safety perception and resource savings that have been found to be significant antecedents of e-commerce adoption are also found significant for e-Government service adoption. Two exogenous factors, i.e., computing support and computer anxiety, are found to be significant predictors of perceived ease of use for the senior citizens in our study.

Within the gerontology field, this study illuminates the aging-related factors that can influence senior citizens' acceptance of IS. Particularly, it indicates that senior citizens have a high motivation for self-actualization, which can be fulfilled through the learning and use of new IT applications. Additionally, we found that declining physiological conditions that are inherent in the process of aging do not play a significant role in determining senior citizens' perception of ease of use for our sample. This finding suggests the possibility that senior citizens may be able to compensate for their physical and mental losses by adapting their behaviors, although this finding requires further verification. Another possibility of adaptive behavior is suggested in the lack of effect of preference for human contact on senior citizens' perceived usefulness of the service. This finding suggests that senior citizens may adapt to environmental factors such as their deteriorating social status and increasing automation by de-emphasizing their preference for human contact in obtaining services. These adaptations of senior citizens may offer explanations as to why senior citizens are more capable computer users than expected [Czaja et al. 1989; Ogozalek 1994].

In comparison to most previous IS acceptance studies conducted in workplace settings [Legris et al. 2003], this study highlights some of the differences in terms of antecedents for individuals in non-

workplace situations. First, the motivators for perceived usefulness appear different from those in workplace settings. Factors such as job relevance and role with regard to technology (see Table A1) do not apply in the context of this study. They are replaced by motivators such as resource savings (including convenience of online services) and self-actualization (relevant for the aged). Also factors such as participation or involvement in IS development and developer responsiveness (see Table A1) appear less relevant for such mass scale IS services as the CPF e-Withdrawal that are not implemented in organizational settings. Further, antecedents such as computer anxiety may be less salient and therefore not commonly studied for educated and IT literate employees' acceptance of IS. However, computing support in our study is likely to play an analogous role to training and assistance provided to employees for IS acceptance in the workplace.

Apart from these theoretical implications with reference to previous TAM and ecommerce service adoption studies and differences of this study sample from working professionals or younger users, this study also contributes to emerging e-Government research. Specifically, the study highlights the need to cater to the growing population of senior citizens, as they will be one of the largest groups of e-Government users in years to come. As a preliminary research on senior citizens' acceptance of e-Government service, the study can assist in future research as well as practice of providing e-Government services for the aged.

In terms of methodology, the study suggests insights into how survey instruments can be designed to cater to the reduced cognitive capabilities of the elderly. First, reverse phrased items may be confusing for this group and should probably be avoided. Second, similarly phrased items added for reliability may prove onerous for senior citizens. Therefore a balance needs to be struck between scale reliability requirements and senior citizen's cognitive load. Last, instrument length considerations are particularly heightened for the elderly. Therefore, the length of the survey questionnaire must be kept manageable for senior citizens even more so than for younger age groups.

6.3 Practical Implications

Several practical implications from this study may assist e-Government practitioners in gaining higher acceptance of their e-services amongst the elderly. First, ease of use of the IS application can be enhanced by following the general prescriptions outlined in the National Institute on Aging's checklist for web-designers (large, plain typefaces; avoiding the juxtaposition of color combination that can be difficult to discriminate) (Coyne and Nielsen 2002). These practices are adhered to in the application under study and are found to enhance respondents' acceptance of the service. Additionally, the CPF e-Withdrawal service automatically populates all fields of the online forms with relevant information (e.g., name, identity card

number, bank account number) except the amount of money to be transferred. Such features can reduce the effort senior citizens require to use the service.

Second, e-Government practitioners can strive to assure users that obtaining e-Government services through the Internet will be safe. This may be achieved by providing certain mechanisms (e.g., agencies to handle fraudulent transactions) against possible financial losses to senior citizens who use the service, especially since the e-Withdrawal service or any similar retirement fund can involve large amounts of electronic funds transfer.

Third, knowing that senior citizens desire to keep up with innovative ideas as a means of realizing self-actualization, e-Government practitioners can promote awareness of this benefit of learning to use new e-services. For example, the government can conduct public sessions where senior citizens testify their fulfilling experience of learning to use e-Government services. Through such testimonials from their fellow senior citizens, non-users may start to feel more certain that learning and use of e-Government services can indeed offer opportunities for them to realize self-actualization.

Fourth, although senior citizens' self actualization motivation may promote their perceived usefulness of e-Government services, knowledge and resources to support their computer use efforts are still important to them. In particular, computing support can heighten senior citizens' perceived ease of use of e-Government services, which in turn, increases their perceived usefulness of the services. Thus, governments can collaborate with grassroots and civil organizations in providing necessary support to senior citizens in their use of e-Government services. This can be in the form of manpower to guide senior citizens in using e-Government services, as well as computer and Internet facilities for them to access the services. An additional insight into providing computing support to the elderly can be obtained from comments made by some of our respondents. They mentioned that when they seek support in using computers, they prefer someone who is of similar age to them to teach them. Some of the reasons they mentioned for this are "young people often use jargon that we do not understand", and "young people are impatient in teaching us".

Computer training sessions can have the additional effect of reducing senior citizens' computer anxiety. By exposing senior citizens to computing knowledge and holding sessions that let senior citizens share their positive experiences of using a computer with their peers, senior citizens' computer anxiety may be alleviated. Another issue related to computer anxiety is that senior citizens, when faced with error messages, tend to panic. This is in contrast to working professionals who may understand the error messages and to children who will just ignore the error messages or close the window (Gilutz and Nielsen 2002). Thus, e-Government services for senior citizens should try to make error messages more constructive and friendly (e.g., "Please contact the [agency] officer at [phone number]") instead of what is

usually displayed (e.g., “Illegal operation”). This may reduce the anxiety of senior citizens with respect to using the system. The reduction in computer anxiety can increase perceived ease of use, perceived usefulness, and intention to use e-Government services. Last, governments should make the resource savings benefits from use of e-Government services more visible to senior citizens. This can be done through brochures and advertising campaigns in various media that can reach this segment of the population. Awareness of time, monetary, and effort savings of using the e-services can increase perceived usefulness and acceptance of these services.

This research attempts to enhance our understanding of the factors contributing to senior citizens’ acceptance of IS, particularly e-Government services. Overall the results serve as a reminder that IS acceptance among senior citizens needs to be studied both from the IT and aging perspectives. Such cross-disciplinary studies can provide a more holistic picture of senior citizens’ acceptance of IS.

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APPENDIX

Antecedents of IS acceptance	Examples of studies () denotes the exact term used for the construct in the study	Justification for inclusion / exclusion in our study
Channel accessibility	Rogers and Shoemaker [1971]	Access to internet is available in the context of this study
Comfort	Jay and Willis [1992] * as one of the dimensions of their Attitude towards computer construct	Captured using computer anxiety
Compatibility	Karahanna et al. [1999]; Moore and Benbasat [1996]; Plouffe et al. [2001]	We expect incompatibility to exist between the CPF e-Withdrawal and senior citizens' familiar way of obtaining services (i.e. through face-to-face human contact). Thus we instead measure preference for face-to-face human contact to find out how important such preference is to their perceived usefulness of the CPF e-Withdrawal. By doing so, more direct insights may be provided compared to measuring the degree of compatibility
Complexity	Karahanna et al. [1999]; Moore and Benbasat [1996]; Plouffe et al. [2001]; Roberts [2001]	Captured in the study by perceived ease of use
Computer anxiety	Igbaria and Chakrabarti [1990]; Venkatesh [2000]	Used in our study.
Computer experience	Czaja and Sharit [1998]; Jay and Willis [1992]; Richardson et al. [2002] (Unfamiliarity with technology)	We measure Internet experience (modeled as a control variable) because experience of using Internet is perceived to be more pertinent to the use of the CPF e-Withdrawal service
Computer playfulness	Venkatesh [2000]	As senior citizens are expected to be less familiar with computers, we expect this factor to be less salient
Computing support	Igbaria [1990] (organizational support); Igbaria et al. [1997] (internal computing support, management support, external computing support); Lesnoff-Caravaglia [1988] (social support)	Used in our study.
Control	Jay and Willis [1992]	Similar to external control and is captured using computing support
Dehumanization	Jay and Willis [1992]	Captured by the preference for face-to-face human contact construct
Experience (specific to a target system)	Agarwal and Prasad [1998] (prior similar experience); Davis et al. [1989] (direct experience); Jackson et al. [1997] (prior use); Venkatesh and Morris [2000]	Not applicable to our study as the target e-Government service is relatively new
Financial cost	Richardson et al. [2002]	Captured by resource saving, particularly the money saving dimension
Gender	Venkatesh and Morris [2000] Jay and Willis [1992] (gender equality)	Modeled as control variable
Hedonic outcomes	Davis et al. [1989] (enjoyment); Venkatesh and Brown [2001] (hedonic outcomes)	As the e-Government service involves monetary transactions (allowing them to withdraw their hard-earned money), it is unlikely that senior citizens will expect any hedonic outcomes from using the CPF e-Withdrawal. Hence the factor is not included in this study
Image	Karahanna et al. [1999]; Venkatesh and Brown [2001] (social outcomes); Venkatesh and Davis [2000]	The function of the CPF e-Withdrawal itself, i.e., withdrawing CPF, is unlikely to be something that can bestow prestige to senior citizens.
Involvement	Jackson et al. [1997] (situational involvement, intrinsic involvement)	Not applicable as the senior citizens are not involved in the development of the CPF e-Withdrawal service
Job relevance	Venkatesh and Davis [2000]	Not applicable as the factor is workplace specific. Majority of the senior citizens have already retired
Level of education	Agarwal and Prasad [1998]	Modeled as control variable

Output quality	Davis et al. [1989]; Venkatesh and Davis [2000]	Defined as “how well the system perform jobs that match their job goals” [Venkatesh and Davis 2000]. Captured under perceived usefulness in our study.
Participation (similar to involvement)	Agarwal and Prasad [1998]; Hartwick and Barki [1994]	Not applicable as the service is already launched and the senior citizens were not asked to participate in the development process of the CPF e-Withdrawal
Perceived behavioral control	Mathieson [1991]; Taylor and Todd [1995]; Venkatesh and Brown [2001] (barriers to adoption)	Defined as “the perceived ease or difficulty of performing the behavior” [Ajzen 1991, p.188]. A finer delineation reveals that perceived behavior control encompasses both internal control (e.g. knowledge to use the technology) and external control (e.g. technology resources available). Internal control is captured by declining physiological condition, which is included in our model. External control is captured by computing support that one is believed to have in using the CPF e-Withdrawal.
Physical and cognitive difficulties in using computer	Eilers [1989]; Timmerman [1998]	Captured by declining physiological conditions
Perceived developer responsiveness	Gefen and Keil [1998]	Not applicable as it is organization-specific
Personal innovativeness in IT domain	Agarwal and Prasad [1998]	Self-actualization is used to capture this factor because being innovative is one of the ways for senior citizens to attain self-actualization.
Result demonstrability	Karahanna et al. [1999]; Venkatesh and Davis [2000]	There is no convincing reason for senior citizens to demonstrate the result of using the service, i.e. having CPF withdrawn, to other people because it involves the personal issue of money. Hence the factor is expected to be less important.
Role with regard to technology	Agarwal and Prasad [1998]	Not applicable as it is workplace-specific
Security anxiety	Richardson et al. [2002]	Captured by Internet safety perception
Self-efficacy	Davis et al. [1989]; Jay and Willis [1992]; Timmerman [1998] (Personal belief e.g. too old to learn computer)	Closely related to perceived ease of use. In fact, perceived ease of use is partly derived from self-efficacy in Davis et al.’s [1989, p.987] formulation of the technology acceptance model (TAM). For parsimony, we decided not to include the construct
Subjective norms	Venkatesh and Brown [2001] (social influences); Venkatesh and Davis [2000]; Lucas and Spitler [1999] (social norms)	Less salient as the percentage of senior citizens who have used the CPF e-Withdrawal is still relatively small. The presence of significant social influence to their use of the service is thus unlikely.
Training	Igbaria et al. [1997] (internal computing training, external computing training) Richardson et al. [2002] (instruction)	Captured by computing support in the form of knowledge provided with regard to using the CPF e-Withdrawal
Trialability	Karahanna et al. [1999]; Moore and Benbasat [1996]; Plouffe et al. [2001]	Not applicable as the CPF e-Withdrawal is targeting a large population of users -- it is impractical to have trial of the service for all senior citizens
Utility	Jay and Willis [1992]; Czaja and Sharit [1998]; Eilers [1989] (Understanding of the possible benefits of technology use)	Similar to perceived usefulness
Visibility	Karahanna et al. [1999]; Moore and Benbasat [1996]; Plouffe et al. [2001]	Not applicable as use of the CPF e-Withdrawal that involves the personal issue of money is likely to be under private settings
Voluntariness	Karahanna et al. [1999]; Moore and Benbasat [1996]; Plouffe et al. [2001]; Venkatesh and Davis [2000]	Not applicable as the use of the system is voluntary

Table A1. Summary of common antecedents of IS acceptance and use

Construct and Indicators	Reliability of Indicators	Composite Reliability	Cronbach's Alpha	Average Variance Extracted (AVE)
Intention		0.99	0.97	0.97
INTN1	0.99			
INTN2	0.98			
Perceived Usefulness		0.98	0.97	0.91
PUSE1	0.93			
PUSE2	0.97			
PUSE3	0.95			
PUSE4	0.96			
Perceived Ease of Use		0.98	0.97	0.92
PEOU1	0.96			
PEOU2	0.97			
PEOU3	0.95			
PEOU4	0.96			
Internet Safety Perception		0.97	0.95	0.88
SAFE1	0.92			
SAFE2	0.93			
SAFE3	0.95			
SAFE4	0.96			
Self-actualization		0.98	0.98	0.94
SELF1	0.96			
SELF2	0.98			
SELF3	0.97			
SELF4	0.97			
Computer Anxiety		0.97	0.96	0.90
ANXT1	0.91			
ANXT2	0.96			
ANXT3	0.97			
ANXT4	0.96			
Declining Physiological Conditions		0.99	0.98	0.96
DPCN1	0.97			
DPCN2	0.99			
DPCN3	0.98			
Time/effort/money Saving		0.98	0.98	0.89
SAVE1	0.94			
SAVE2	0.93			
SAVE3	0.95			
SAVE4	0.97			
SAVE5	0.95			
SAVE6	0.95			
SAVE7	0.95			
SAVE8	0.90			
Computing Support		0.98	0.97	0.93
CSUP1	0.95			
CSUP2	0.98			
CSUP3	0.95			
CSUP4	0.98			
Preference for Human Contact		0.94	0.93	0.81
PREF1	0.85			
PREF2	0.91			
PREF3	0.90			
PREF4	0.93			

Table A2. Results of Convergent Validity Tests

Construct	INTN	PUSE	PEOU	SAFE	SELF	ANXT	DPCN	SAVE	CSUP	PREF	Gender	Education	Age	InterExp
INTN	0.99													
PUSE	0.66	0.95												
PEOU	0.74	0.60	0.96											
SAFE	0.60	0.48	0.56	0.94										
SELF	0.63	0.59	0.61	0.51	0.97									
ANXT	-0.34	-0.15	-0.37	-0.17	-0.17	0.95								
DPCN	-0.23	-0.13	-0.24	-0.03	-0.36	0.28	0.98							
SAVE	0.60	0.68	0.57	0.54	0.61	-0.16	-0.16	0.94						
CSUP	0.54	0.40	0.51	0.38	0.54	-0.10	-0.20	0.67	0.96					
PREF	-0.09	0.06	-0.08	-0.03	0.01	0.24	0.30	0.04	0.04	0.90				
Gender	0.07	0.05	0.14	0.01	0.07	-0.09	-0.12	0.02	0.05	-0.16	1.00			
Education	0.44	0.27	0.43	0.32	0.30	-0.29	-0.25	0.33	0.29	-0.17	0.18	1.00		
Age	-0.39	-0.29	-0.42	-0.21	-0.45	0.16	0.35	-0.38	-0.41	0.06	0.06	-0.33	1.00	
InterExp	0.37	0.21	0.47	0.14	0.25	-0.40	-0.30	0.21	0.27	-0.09	0.17	0.56	-0.39	1.00

Note: Diagonal elements are the SQRT (AVE) and all off-diagonal elements represent the correlations among the constructs

Table A3. Discriminant Validity of Constructs