Digital Inclusiveness—Longitudinal Study of Internet Adoption by Older Adults

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ABSTRACT: In order to build a digital inclusive society, both government and nongovernment organizations in countries such as China, Japan, Korea, Singapore, Taiwan, the United Kingdom, and the United States have been offering training programs to the general public and establishing communitywide public access computer facilities in recent years. However, offering training programs and enabling access to facilities are not sufficient on their own if, due to other reasons, the socially disadvantaged groups do not choose to make use of the facilities. As an exploratory investigation, this study focuses on the voluntary adoption of these facilities (typified by the Internet) by one such disadvantaged group—older adults. In particular, this study investigates the role of Internet self-efficacy and outcome expectations in older adults' usage of the Internet through a three-part longitudinal study, involving almost 1,000 participants. A theoretical model based on social cognitive theory was developed and empirically tested through both surveys and lab experiments. Behavioral modeling training courses were offered to adults age 55 or older in the study over a one-year period. Questionnaire surveys and cognitive knowledge assessments were conducted. In general, the findings in the longitudinal study (including three repeated measures) validated the affects of Internet self-efficacy and outcome expectations on usage intention, and the important roles of support and encouragement in the formation of self-efficacy and outcome expectations. Limitations and implications are discussed.

KEY WORDS AND PHRASES: behavioral modeling, computer training, digital divide, digital inclusiveness, information systems adoption, Internet self-efficacy, social cognitive theory.

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MANY COUNTRIES NOWADAYS ARE FULLY AWARE of the phenomenon commonly known as "digital divide." It is broadly defined as the gap between the information and communication technology (ICT) "have" and "have-nots." The have-nots are the socially disadvantage groups who have less of an opportunity to use ICT. For instance, in Hong Kong, the socially disadvantaged groups include (1) people with lower economic advantage; (2) people with lower education attainment; (3) adults age 55 or older; (4) unemployed women age 45 or older as well as housewives in low-income households; (5) people with disabilities; and (6) new immigrants from the mainland [22]. On the other hand, the vision of a "digital inclusive society" is to create a society where every citizen is able to (1) explore the potential and benefits of new technologies, (2) access and share information and services freely, and (3) effectively participate in the community through the use of ICT. In other words, a digital inclusive society is a place where all people are able to access and use ICT, first from schools, public facilities, homes, and workplaces, and then extending the adoption of ICT to all public and business activities. It is a place where all people have the skills and knowledge to access what they need online and to use ICT effectively to improve their life experiences [38]. In order to build a digital inclusive society, both government and nongovernment organizations in countries such as China, Japan, Korea, Singapore, Taiwan, the United Kingdom, and the United States have been offering training programs and establishing computer facilities to the general public in recent years [30]. However, offering training programs and enabling access to facilities are not sufficient on their own if, due to other reasons, the socially disadvantaged groups do not choose to make use of the facilities. As an exploratory investigation, this study thus focuses on the voluntary adoption of these facilities (typified by the Internet) by one such disadvantaged group—adults age 55 or older. This target group is particularly worthy of attention as some recent studies have indicated that the Internet penetration rate in this age-group can be as low as 3 percent [22].

The Scope of the Study

THIS STUDY WAS A COLLABORATIVE WORK with the Cyber Senior Network and Development Association Limited, Internet Professionals Association, Hong Kong Senior IT Advocates, and indirectly with the Social Welfare Department (SWD) of Hong Kong. As far as we are aware, it is the first empirical study of this kind and the largest scale yet conducted in the city of Hong Kong. As previous work on this aspect of the digital divide is rare in the information systems (IS) research literature, the investigators chose to conduct this study using research approaches similar to those implemented by the MIT AgeLab in the study of related issues.[1] The first approach is field research that consists of surveys and interviews with older learners and social workers as well as observations of behavior in existing computer training classes. The second research activity is the development of theoretical models that may account for observed phenomena in the field research. The third approach is laboratory experiments with older learners that provide the opportunity to study various questions

in a controlled environment. We concur with AgeLab's approach. These three research activities are interrelated and necessary in carrying out our study. Field data are used to generate predictions for lab experiments, and to lay the foundation for preliminary model building. Laboratory experiments allow the investigators to replicate phenomena that are observed in the field research, and to test predictions derived from the theoretical model. In turn, the theoretical model is continually updated with data from the lab and field studies.

In the beginning, numerous meetings were held with the representatives from nongovernment organizations (NGOs) interested in the digital divide issues, and several focus groups were conducted with older adults and social workers. In general, it was considered that with a certain level of coaching and motivational encouragement, as well as the availability of hardware and software support, older adults' appreciation of ICT, their usage intention, and their perceptions of their cognitive knowledge could increase. This study was conducted during the period from June 2002 to August 2003. In the context of the target population, ICT means computers and the Internet. Specific training courses were offered to older adults, and they completed a self-reported questionnaire in measuring their confidence and capability in using a computer and the Internet before and after the training. The target population is adults age 55 or older who reside in Hong Kong. Normally, adults age 65 or older are categorized as senior citizens. However, in Hong Kong, statistics shows that adults age 55 or older have much less exposure to ICT compared to other age groups [38]. Since this age group falls into the have-nots category, people age 55 or older (i.e. "older adults") were selected to participate in this study.

Due to limited resources and other practical constraints, the investigators had to decide which factors to include in the proposed research model. Those factors that were excluded from this research may be further pursued in other types of studies in the future. The investigators were unable to measure the actual usage of a computer and the Internet by the older adults. During the time of this study, the majority of the older adults did not own a computer or had limited access to the Internet. The older adults would either go to the nearby community center or attend a computer class if they wished to use a computer. Although the older adults were tested on their understanding in the use of computers and the Internet, the main focus was to measure their perceptions on how well they thought they were able to use them. Furthermore, in this study, the investigators did not measure the impact of using computers and the Internet on the elderly (e.g., on health, whether it is physically or mentally related).

Research Motivation

THE HONG KONG GOVERNMENT AND NGOs have been subsidizing activities and making efforts to promote information technology (IT) awareness and accessibility to citizens, especially the socially disadvantaged groups, by providing training courses and establishing public computer facilities in various Hong Kong locations. In total, more than HK$2.8 billion was invested in the five-year period from 1998 to 2003 [38]. For example, the SWD launched a three-year "Opportunities for the Elderly"

scheme from 1999 to 2002 and provided funds enabling NGOs (including the multiservice centers and social centers for the elderly) to organize activities. However, does that mean the digital divide gap will be narrowed eventually? Does the government have the appropriate standard of measurement for the success or failure of these social projects? Do older adults intend to continue the usage of computers and Internet services after the trainings? How can we know whether they can master the necessary IT skills to use the computers and the Internet effectively? Has learning and adopting ICT made a difference in their lives? In view of these questions, a much more robust and rigorous research is called for. Within the IS and IT communities, understanding the intention of IT usage and evaluating user performance have been a major focus of research for decades. This line of research has produced a wealth of knowledge relevant to the study of many issues in the digital divide domain. However, target populations in this line of studies tend to be mostly organizations, professional people, and college students. It is questionable as to whether and, if so, to what extent results of these prior studies are applicable in our context, as older adults have different characteristics and face different sets of obstacles in adopting ICT. For instance, there are the stereotypes about the ability and willingness of older adults in the learning of intellectually challenging tasks in our societies. With such an impression, older adults may fear that they are incapable of learning computer-related skills and hence dare not to do so. On the other hand, Shapiro [36] indicates that with suitable applications and training, even the elderly can be energetic and enthusiastic computer users like the younger generation. Further, language and literacy level are hurdles. Many services offered through the Internet and the language used in computers are often English, prohibiting non–English-speaking older adults with low educational background from using ICT. Finally, the lack of sufficiently comprehensible information may be another reason rendering older adults hesitant about using and purchasing ICT, despite the fact that they may be economically capable of doing so. Senior citizens need to be better informed about the benefits and the usefulness of the new Internet-based services [38].

Research Objectives

This study attempts to understand and to explain the phenomenon of ICT usage among older adults in Hong Kong. One of the assumptions made in this research is that using the Internet is one of the means in encouraging a sense of well-being among the elderly, hence they will be less dependent on others. Moreover, the constructive use of leisure time might provide the elderly with opportunities to develop their skills and abilities, expand social network, and enable them to feel good about themselves. Increasing older adults' voluntary use of computers and the Internet will therefore have a significant positive social benefit. Behavioral training is one means through which the intended usage behavior may be developed. For this purpose, social cognitive theory (SCT) [2] is particularly useful as it is a widely accepted model of individual behavior explaining the interacting relationship among a person's own characteristics, environmental influences (such as behavioral training), and behavioral outcome.

Self-efficacy (i.e., the belief that one has the capability to perform a particular behavior) is a key construct in SCT, which has been explored in a number of studies on the use of computers (e.g., [10, 11]). Prior studies have indicated that older adults tend to have lower levels of self-efficacy (and a corresponding higher degree of anxiety) when confronted with the idea of doing something new [9]. Self-efficacy would therefore seem to be particularly relevant in studying ICT usage in this target population. However, prior studies involving the construct self-efficacy in relation to Internet usage has been rare and almost nonexistent for the older adult population. In addition, as depicted by SCT, the effect of cognitive variables such as self-efficacy may change in the course of time as a result of environmental influence (such as training) and usage experience. A cross-sectional study alone is unable to capture the dynamics of the evolving relationships. Thus, the specific objective of this study is twofold: (1) to develop and test a proposed research model (based on SCT and involving self-efficacy and other explanatory variables) within a specific context, that is, the use of computers and the Internet by older adults, and (2) to investigate the stability of the proposed research model through a longitudinal study.

Research Model and Hypotheses

UNDERSTANDING THE FACTORS THAT INFLUENCE an individual's use of IT has been a major goal of IS research throughout the past two decades or so. The theory of reasoned action [16] is the first theoretical model that has gained widespread acceptance in the IT adoption research area. As the theory of reasoned action is a general behavioral model, there is a demand to develop more domain-specific models to address IS-related phenomena in the hope that such models will provide better insight and explanatory power for IS-specific problems. Other researchers have addressed the demand in looking for additional explanatory variables in computer usage [11, 40, 47]. For example, Malhotra and Galletta [25] suggest user commitment as an additional variable influencing computer usage behavior. Compeau and Higgins [11] examine SCT, the work of Albert Bandura [3], and suggest a number of social cognitive variables (such as self-efficacy and encouragement by others) worthy of further examination. SCT realizes that a person's expectations of positive outcomes of a behavior will be meaningless if he or she doubts his or her capability to successfully execute the behavior in the first place. Compeau et al. [12] claim that an individual's beliefs about his or her capabilities to use technology successfully are related to his or her decisions about whether and how much to use technology, and the degree to which the individual is able to learn from training. They emphasize that the adoption of ICT is not just about convincing people of the benefits to be derived from ICT, but it is also about the coaching, teaching, and encouragement of people to ensure that they have the requisite skill and confidence to be successful in their use, especially for older adults constituting the target population of this research. The influence of SCT is also weighted in Venkatesh et al.'s [46] study. The authors assessed eight competing IS models and formulated a unified model, the unified theory of acceptance and use of technology. This model incorporates four core determinants of intention and

usage (i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions), and up to four moderators (i.e., gender, age, experience, and voluntariness of use) of key relationships.

Based on the literature review and interactions with several NGOs as well as a number of older adults, it would seem likely that SCT may serve as a relevant and important theory in explaining ICT adoption among older adults (one of the socially and technologically disadvantaged groups) in Hong Kong. Focus group sessions were held in collecting opinions from NGOs and older adults (both users and nonusers of ICT). The results from these meetings indicate that the reactions and decisions of the older adults to use computers and the Internet, as well as their outcome expectations from the computer training courses, are different from the usual participants in current IS research—that is, the knowledge workers and college students. To illustrate, some seniors expressed that the training courses they had taken before were not customized based on their capabilities. First, the lecture was too fast and too much material was covered for the older adults to comprehend. At the same time, the older adults did not have sufficient time to do the hands-on practice. Second, while observing the older adults' performance (first-time computer users) during the training session at one community center, was that they were nervous to touch the mouse and the keyboard. Besides, some older adults hesitated to follow the teacher's instruction unless there was a tutor standing beside them and to confirm with them the required steps in operating the computer. Many decided not to use the computer or the Internet because they thought they would not be good at it and had low expectations of the outcome (or consequence). In addition, many of the seniors did not believe their ICT skills could be improved by attending training courses.

Furthermore, previous literature has provided support to the findings of the focus group meetings and classroom observations. The differences between the older adults and workforce as well as college students lie in the age-related changes in basic cognitive skills such as speed of information processing, spatial abilities, memory, and perceptual and attentional processes [37]. In addition, cultural factors relating to how the elderly is perceived in society have a strong bearing on the ICT-related perceptions and behavioral reactions of older adults as compared with the other age-groups [14, 28]. Due to the cognitive, metacognitive, and emotional characteristics of the older adults, the training methods assumed to be suitable for current workforce and college students are not suitable for older adults. Furthermore, previous studies suggest that some difficulties experienced by older adults in mastering ICT are caused or mediated by noncognitive factors, such as learning anxiety of new technology, age-related negative stereotypes, attitudes, and lack of confidence—that is, poor computer-related self-efficacy [6, 9, 14, 23, 28].

Referring to the work of Compeau and Higgins [10, 11], several key constructs are integrated into the proposed model—encouragement by others, outcome expectations, and anxiety. Most of the constructs from Compeau and Higgins [10, 11] have been adopted in our model except the constructs of "other's use" and "affect," which are not particularly applicable in the context of our study. The construct of user competence [27, 29] is adopted as perceived user competence in the proposed model. It is

believed that the adapted research model is applicable for this study on the ICT usage and performance of older adults in Hong Kong (Figure 1). This study is conducted in collaboration with the Cyber Senior Network and Development Association, Hong Kong Senior IT Advocates, and the Internet Professionals Association. At the start of this research, there were numerous meetings held with the representatives from NGOs, and several focus groups were held with older adults and social workers. It is hoped that with certain levels of coaching and encouragement as well as with the availability of hardware/software supports, the self-confidence of older adults, their usage intention, and cognitive knowledge may increase. In addition, it is our intention to capture the changes in older adults' Internet self-efficacy, their usage intention, and competency in three separate studies. This longitudinal study ran from June 2002 to August 2003.

Longitudinal Research Study Approach

Longitudinal research study in the IS literature is relatively rare. However, there are a number of important recent ones that have influenced our research design. Venkatesh and Speier [44] carried out a longitudinal study (12-week period) on how positive, negative, or neutral employee moods during training sessions influence motivation, intention, and the usage of new technology. They found that there were only short-term increases in intrinsic motivation and intention to use the technology among users in the positive mood intervention. On the other hand, intrinsic motivation and intention were reduced among users in the negative mood condition. Later on, Venkatesh and Davis [43] developed and tested a theoretical extension of the technology acceptance model that explained perceived usefulness and usage intention in terms of social influence and cognitive instrumental processes. Longitudinal data (three-month period) was collected and the extended model was strongly supported. Their findings suggest that both social influence processes (i.e., subjective norm, voluntariness, and image) and cognitive instrumental processes (i.e., job relevance, output quality, result demonstrability, and perceived ease of use) significantly influence user acceptance.

Venkatesh et al. [45] investigated gender differences in users' adoption and usage of technology in the workplace using the theory of planned behavior over a five-month study period. Venkatesh [42] further conducted a three-month period study to understand how "perceived ease of use" forms and changes over time. The author tested an anchoring and adjustment-based theoretical model of the determinants of system-specific perceived ease of use. The model suggests that internal and external controls (i.e., computer self-efficacy and facilitating conditions, respectively), intrinsic motivation (i.e., computer playfulness), and emotion (i.e., computer anxiety) are anchors that determine early perceptions about the ease of use of a new system. With increasing system usage experience, users are expected to adjust their perceived ease of use of the system. In particular, the roles of computer self-efficacy and computer anxiety are expected to continue; but the degree of their influence may change. The role of computer playfulness is expected to diminish over time, while system-specific perceived

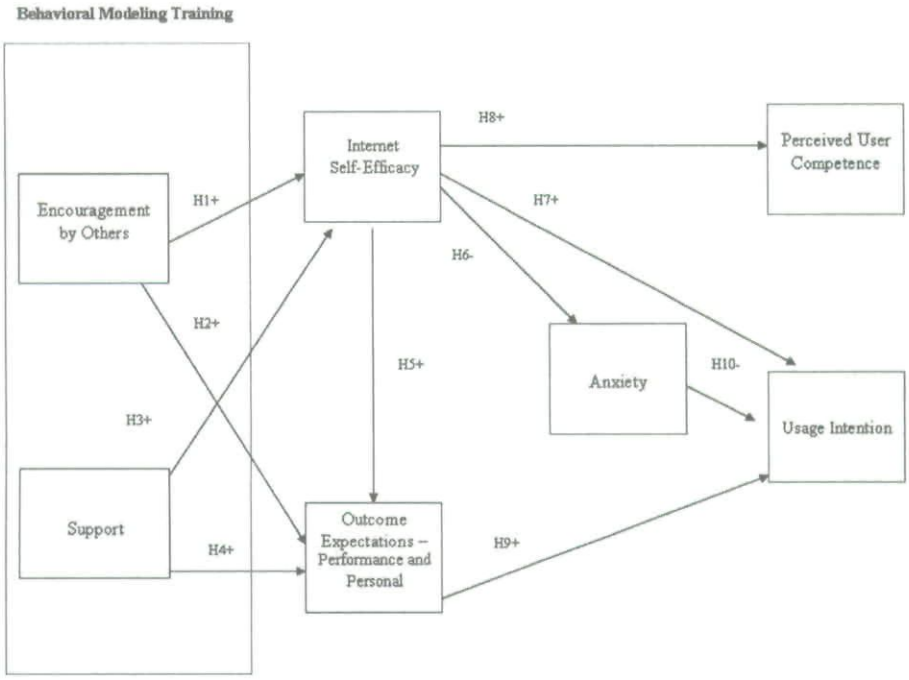

Figure 1. Proposed Research Model

enjoyment is more stable over time. Objective usability is regarded as a moderator for internal control and computer anxiety. In addition, facilitating conditions is expected to shift from being general perceptions and expectations of the system and organizational environment to being system-specific. The proposed model was strongly supported at all points of measurement during the three-month test period.

Another longitudinal study by Compeau et al. [12] confirms the results of their earlier cross-sectional study [11] that computer self-efficacy and outcome expectations show continuing predictive power, even when measured one year prior to affective (affect and anxiety) and behavioral (usage) responses. Bandura [3] states the existence of a continuous reciprocal interaction between the environment in which an individual operates, his or her cognitive perceptions (self-efficacy and outcome expectations), and behavior. Therefore, self-efficacy is viewed as an antecedent to use, but successful interactions with technology (e.g., enactive mastery) are also viewed as influences on self-efficacy. Similarly, emotional responses, such as affect and anxiety, are influenced by self-efficacy and also sources of information on which self-efficacy judgments are based. Thus, an individual judgment of self-efficacy, measured at one point in time, can be viewed as both a *cause* and an *effect*. A longitudinal study approach is therefore necessary in disentangling the causes and effects of complex cognitive constructs such as self-efficacy and outcome expectation. Furthermore, studying the effects of self-efficacy and outcome expectations over time will allow a better

understanding as to whether their influences are relatively short in duration or whether they are more enduring.

Behavioral Modeling Training Method

Encouragement of use (verbal persuasion) is one source of influence on self-efficacy and outcome expectations. The actual behavior of others' (vicarious experience) use of the computing technology is a further source of information used in forming self-efficacy and outcome expectations. Learning by observation, or behavioral modeling, has been shown to be a powerful means of actual user behavior [24, 25, 35]. Behavioral modeling influences behavior in part through its influence on self-efficacy [4] and through its influence on outcome expectations [1]. In this study, behavioral modeling training method is incorporated into the research model, and its positive influence on the older adults' learning of ICT is assessed. Previous studies (e.g., [5]) have shown that prior performance exerts influence on self-efficacy, outcome expectations, and, subsequently, future performance. During all training sessions, participants had the opportunity to work on computers and to perform online tasks. Step-by-step demonstrations and guidance were given by tutors and helpers. Since an active mastery of the relevant skills is held to be the strongest source of information influencing the formation of self-efficacy [3], participants were assured that they would have a positive experience in mastering the use of computers and online activities.

Encouragement by Others

The encouragement by others within the individual's reference group (i.e., people to whom someone looks to obtain guidance on behavioral expectations) can be expected to influence both self-efficacy and outcome expectations. In a recent study, Gallivan et al. [18] show that coworkers exhibit a high level of influence on IT usage, whereas individual-level factors play only a modest role. Indeed, encouragement of use represents "verbal persuasion," one of the four major sources of efficacy information [3]. In the current case, older adults might respond to the opinions of others by forming judgments about their own abilities in using computers. Encouragement of use may also exert an influence on outcome expectations. For example, if people in the reference group (e.g., family, friends, staff at the social centers, etc.) of the older adults encourage the older adults to use computing technology, the older adults' judgments about the likely consequences of the behavior will be affected. At the very least, they will expect that their peers will be pleased by the behavior. Thus, for older adults, the first two hypotheses are as follows:

Hypothesis 1: The higher the encouragement of Internet use by members of the reference group, the higher the Internet self-efficacy.

Hypothesis 2: The higher the encouragement of Internet use by members of the reference group, the higher the outcome expectations (performance and personal).

Support

Compeau and Higgins [11] indicated that the support of the organization for computer users could be expected to influence individuals' judgments of self-efficacy. In this context, the organization will be the training institution, the community center, or the computer laboratory. Support relates to the extent of assistance available to the older adults in facilitating the use of ICT. It is believed that the availability of assistance to older adults should increase their abilities and, probably, their perceptions of their abilities. Triandis [41] defined "facilitating conditions" (which is equivalent to "support" in our context) as external resource constraints. Taylor and Todd [39] further segregated this construct into two dimensions: one relating to resource factors, such as time and money, and the other relating to technology compatibility issues that may constrain usage. In this research, support, such as organizational and technical supports, is the main focus. Support can also affect outcome expectations, because these support systems reflect the expectations of these institutions toward the behavior, and therefore may provide clues as to the likely consequences of using the computer. Thus, we present the following hypotheses:

Hypothesis 3: The better the support provided for older adults at an institution, the higher their Internet self-efficacy.

Hypothesis 4: The better the support provided for older adults at an institution, the higher their outcome expectations (performance and personal).

Internet Self-Efficacy

The concept of self-efficacy assumes a prominent role in SCT. Self-efficacy judgments are seen to influence outcome expectations since "the outcomes one expects derive largely from judgments as to how well one can execute the requisite behavior" [2, p. 241]. Current studies define Internet self-efficacy as a person's self-perceived capability on certain Internet-specific tasks such as entering URLs, creating bookmarks and folders, and using file transfer protocol (FTP) and telnet [30, 31]. Ren's [34] measure of Internet self-efficacy is tailored to searching for government information sources. Eastin and LaRosa [15], however, look at the overall Internet usage and not just the performance of a specific Internet-related task such as e-mail. Thus, Internet self-efficacy may be differentiated from computer self-efficacy as the belief that a person can utilize effectively the Internet over and above basic personal computer skills. In the context of older adults, the hypothesis is therefore:

Hypothesis 5: The higher the Internet self-efficacy, the higher the outcome expectations (performance and personal).

Self-efficacy judgments are held to have influence on the emotional responses of the individual. Individuals normally prefer and like behaviors that they feel they are good at and avoid those that they are not good at. On the contrary, individuals tend to be anxious about performing those behaviors that they think they are not particularly

good at [21]. It is more likely that older adults will experience a lot of anxiety (rather than affect) in the learning of ICT, worrying that they may cause chaos on the computers. By including the construct "anxiety" at this early stage of the study, a plausible research model for better interpretation and prediction can be obtained. For older adults, this relationship is predicted by the following hypothesis:

Hypothesis 6: The higher the Internet self-efficacy, the lower the degree of anxiety.

Usage Intention

Self-efficacy perceptions are predicted to be a significant precursor to computer use. This hypothesis is supported by research regarding computer use [8, 19] and research in a variety of other domains [4, 7, 17]. In this specific context, older adults will be offered computer training for the first time, and then, at the end of the training, their intention of future Internet use is measured. This gives rise to the following hypothesis:

Hypothesis 7: The higher the Internet self-efficacy, the higher the intention of Internet usage.

Perceived User Competence

Marcolin et al. [27] suggested that user competence is an important measure besides IT adoption and IT usage. Munro et al. [29] proposed a specific research model on user competence and its relationship with certain individual factors—self-efficacy, usage, and demographics. User competence is defined as the user's potential to fully utilize information and communication technology in order to better his or her performance of specific job tasks [29]. Thus, the authors consider user competence an antecedent to performance. No rigorous empirical research has been done on this matter; thus, in this study, the effect of self-efficacy on user competence is explored. Since, in this study, older adults are computer novices, only their perceptions on how much they know about using computers and the Internet can be measured, rather than their actual knowledge. Thus, we add this construct into the model by proposing the following hypothesis:

Hypothesis 8: The higher the Internet self-efficacy, the higher the perceived user competence.

Outcome Expectations

Outcome expectations are also an important precursor to usage behavior. According to SCT, individuals are more likely to engage in behavior they expect will be rewarded (or will result in favorable consequences). Support for this contention can be found in a study of aggressive behavior in children [1]. This contention is also supported by IS research [13, 19, 33, 40]. Accordingly, the next hypothesis is:

Hypothesis 9: The higher the outcome expectations (performance and personal), the higher the intention of Internet usage.

Anxiety

Feelings of anxiety surrounding computers are expected to negatively influence computer use. Anxiety is a state of uneasiness and apprehension about future uncertainties. Not surprisingly, people are expected to avoid behaviors that arouse nervousness. A numbers of studies have demonstrated a relationship between computer anxiety and the use of a computer [21, 48]. Similarly, people who are anxious about the Internet are more likely to avoid using the Internet. This gives rise to the following hypothesis:

Hypothesis 10: The higher the Internet anxiety, the lower the intention of Internet usage.

Research Design

THE TARGET POPULATION OF THIS RESEARCH is adults age 55 or older who reside in Hong Kong. Statistics shows that adults age 55 or older have much less exposure to computers and Internet usage compared to other age groups [38]. One hundred participants were recruited for the pilot study, and 1,000 for the main study. The target population are novices with no or very little previous computer experience, but who want to learn to use the computer to access the Internet. Advertisements on free computer training lessons were placed in several local daily newspapers and were announced over the local radio stations. Potential participants were first screened during a telephone interview to ensure that they had little prior experience with computers. Although some participants had used computers before (less than one week of total usage experience), they all considered themselves to be novices. Most importantly, they had no significant experience in using computers to access the Internet.

Pilot Study

The research questionnaire was developed from well-validated instruments used in the relevant prior studies, with appropriate adaptation in wording and style to suit the specific context and purposes of this study. Since the participants in this study could not read English well (most of them did not receive much formal education), the original script of the questionnaire was translated into Chinese. Afterward, the Chinese copies were given to three postgraduate students in the IS field and one social worker for proofreading purposes. They were asked to translate the questionnaire back into English. The researchers then compared the English version to the Chinese version so that the wordings and meanings were not lost in the translations.

A pretest of the questionnaire was conducted with eight people, including three scholars from the faculty of business at a local university, two social workers, and

three administrative staff of NGOs. Each respondent completed the questionnaire and provided feedback regarding the wording of the questions, the process, and the measures. A pilot study involving 58 participants from the sampling frame ($n = 100$) was also conducted. In this pilot study, valuable feedback on the questionnaire instrument was obtained and the wording and structure of the questionnaire were further improved as a result. The size of the sampling frame at the main survey was eventually defined at 1,000, taking into account the likely response rate and the amount of data points needed for testing our research model from a statistical perspective.

Basic Computer Literacy Training Sessions

In Studies 1 and 2, 10 tutors, previously trained by the organizers to teach participants basic computer and Internet skills, were hired to conduct the training sessions. Moreover, five student volunteers were recruited from a local high school and a university. The four-hour training course included a one and a half hour lecture/demonstration and practice session. The lecture (45 minutes) provided basic information about the computer equipment, the operating system being used, and the techniques of browsing the Internet. Participants were shown how to operate the keyboard and mouse in order to browse Web sites and exchange e-mails on the Internet. The tutors followed a fixed outline, but questions related to this course were answered as they arose. Next, participants were given 45 minutes to practice what they had learned. Training notes and preregistered e-mail log-ins, passwords, and e-mail addresses were also given to participants. Computer classes were randomly selected for videotaping the complete training process. Therefore, it was always possible to go back and observe any details that may have been missed, such as the interaction between tutors and the participants and the flow of the events during training. A daily journal was kept to note down any personal thoughts and comments gathered from the tutors and participants. In Study 1, following the practice session, a questionnaire and a knowledge assessment (multiple-choice questions and hands-on test combined) were then administered. However, in Study 2, participants only needed to fill out the questionnaire, but no knowledge assessment was conducted due to the limit of time and the length of the questionnaire. At the end of the two sessions, "certificates of completion" were presented to participants. Study 2 took place approximately six months after Study 1.

Six months after Study 2 was completed, e-mail notifications were sent to participants who had attended that study. As in Study 2, the participants were informed that a "computer and Internet knowledge" assessment would be offered. Interested participants were required to respond through e-mails (no phone call registration was accepted). It was felt that by this time, the older adults should possess the basic skills in utilizing e-mail exchange. The assessment was optional and participants were only tested on the materials that were taught in earlier classes. Those who chose to take the test and passed it were awarded a certificate of achievement. The certificate acknowledged the participant's fulfillment of the requirements of all the training courses (beginner and intermediate levels) and success in passing the knowledge test. Each participant was required to pay HK$5 for administrative charges, such as mailing and

printing. The entire process lasted two hours—the duration of the examination was an hour, after which the participants were given a questionnaire to fill out.

Findings

Study 1

A TOTAL OF 555 OLDER ADULTS ATTENDED the computer training classes, thus the response rate was 55.5 percent ($n = 1{,}000$). While this response rate could be acceptable for research of this nature, a nonresponse bias was a concern and Compeau and Higgins's [11] approach in weighing nonresponse bias was followed. Using the early (first week) and late (after four weeks) responses to the questionnaire, a multivariate analysis of variance (MANOVA) was undertaken to determine whether differences in response times (early versus late) were associated with different responses. The variation of demographic data (i.e., age, gender, and education level) of our respondents was tested. A two-way mixed (between–within) analysis of variance (ANOVA) test from SPSS indicated no significant differences in any of the variables of interest (Wilks's $\lambda = 0.999$; $p = 0.874$). Data analyses were performed using partial least square (PLS). Seven out of ten paths were found to be significant, as shown in Figure 2.

The explanatory power of the model was fair, but the model provided an understanding of behavioral outcomes. Table 1 presents the individual item loadings (reflective) of the five latent variables, and Table 2 presents the individual item weights (formative) of the two manifest variables. The reliability and discriminant validity coefficients are reported in Table 3. A summary of demographic characteristics is shown in Table 4.

Study 2

A total of 338 older adults attended the second computer literacy training classes. The response rate was 60.9 percent ($n = 555$). Respondents were identified and matched in both studies by a unique, preassigned e-mail account and an advanced class voucher. In order to assess nonresponse bias, a comparison of demographics was made on Study 1 demographic data for respondents who completed only the Study 1 survey and those who completed both Study 1 and Study 2 surveys. An independent samples t-test in SPSS revealed no significant differences for age ($p = 0.689$), gender ($p = 0.517$), and education level ($p = 0.493$), at the 0.05 level. In this study, the two constructs, "anxiety" and "perceived user competence" were removed from the proposed model. First, it became clear that "anxiety" had no direct effect on usage intention. Second, based on the older adults' feedback from Study 1, they were physically exhausted in having to answer such a lengthy questionnaire. In order to collect truthful responses from the older adults, the investigators decided to remove these two constructs and related paths in hoping to preserve the model's explanatory and predictive powers. In this study, all seven paths provided support to the hypotheses (Figure 3).

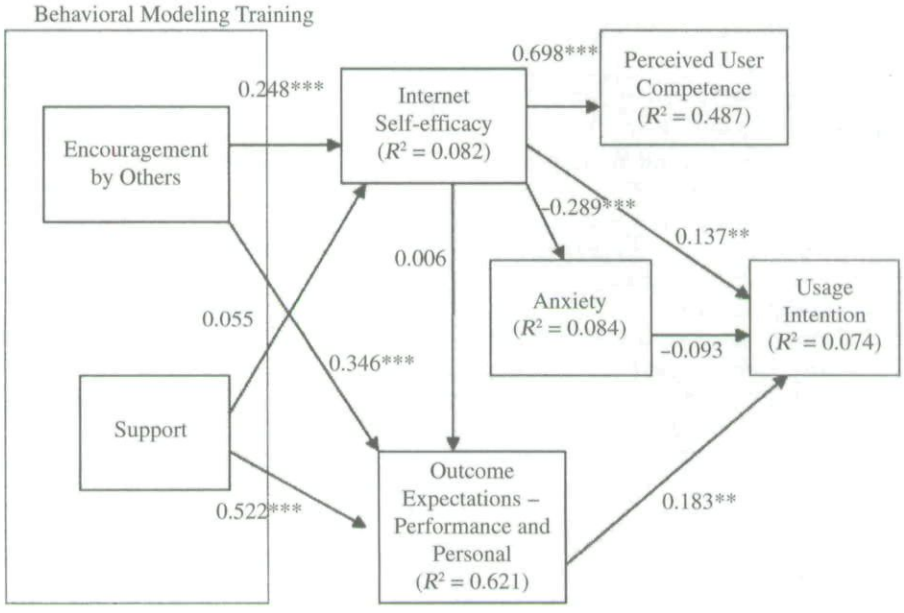

Figure 2. Study 1 Model and Path Coefficients
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 1. Demographic Characteristics of the Sample in Study 1

Demographic variable	Sample composition	Percent
Age	60 or below	28.8
	61–65	28.1
	66–70	22.0
	71 or above	21.1
Gender	Men	35.7
	Women	64.3
Marital status	Single	9.7
	Married	87.7
	Other	2.6
Education level	Elementary school or below	39.3
	Junior high school	30.7
	Senior high school	20.4
	College	7.0
	Other	2.6
Income	HK$2,000 or below	1.3
	HK$2,000–HK$4,000	1.9
	HK$4,001–HK$7,000	3.4
	HK$7,001 or above	3.8
	Retired	82.8
	N/A	6.8

Table 2. Study 1: Individual Item Loadings

Item	Factor loading
Internet self-efficacy	
Confidence in using Internet Explorer	0.8673
Confidence in typing URL	0.8886
Confidence in sending e-mail	0.8293
Confidence in browsing Web site	0.8475
Confidence in using mouse	0.8811
Outcome expectations	
Perform1—read news online	0.8314
Perform2—send e-mail	0.8510
Perform3—take online courses	0.8632
Pers5—catch up with social trends	0.7221
Anxiety	
Anxiety1	0.8538
Anxiety2	0.8743
Anxiety3	0.8872
Anxiety4	0.7481
Usage intention	
Usage1—frequency	0.8747
Usage2—duration	0.7900
Perceived user competence	
Knowledge in using mouse	0.8510
Knowledge in typing characters	0.8614
Knowledge in browsing Web site	0.8935
Knowledge in sending e-mail	0.8776
Knowledge in using MS Windows 98 English version	0.7479

Table 3. Study 1: Individual Item Weights

Item	Factor weight
Encouragement by others	
Encour1—tutors and helpers	0.3451***
Encour2—family	0.1430
Encour3—peers	0.4363***
Encour4—social workers	0.3114**
Support	
SP1—keyboard/mouse	0.1694**
SP2—computer equipment	0.4665***
SP3—lab settings	0.1747
SP4—lecture notes	0.4007***
SP5—MS Windows 98 English version	0.0781
SP6—class size	0.3007***

*** Significant at the 0.01 level; ** significant at the 0.05 level.

Table 4. Study 1: Reliability and Discriminant Validity Coefficients

Construct	Internal consistency reliability	1	2	3	4	5
1. Internet self-efficacy	0.94	0.86				
2. Outcome expectation	0.89	0.353	0.82			
3. Anxiety	0.92	–0.334	0.017	0.83		
4. Usage intention	0.82	0.241	0.337	–0.156	0.83	
5. Perceived user competence	0.93	0.725	0.289	–0.426	0.164	0.85

Notes: Diagonal elements are the square root of the variance shared between the constructs and their measures. Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

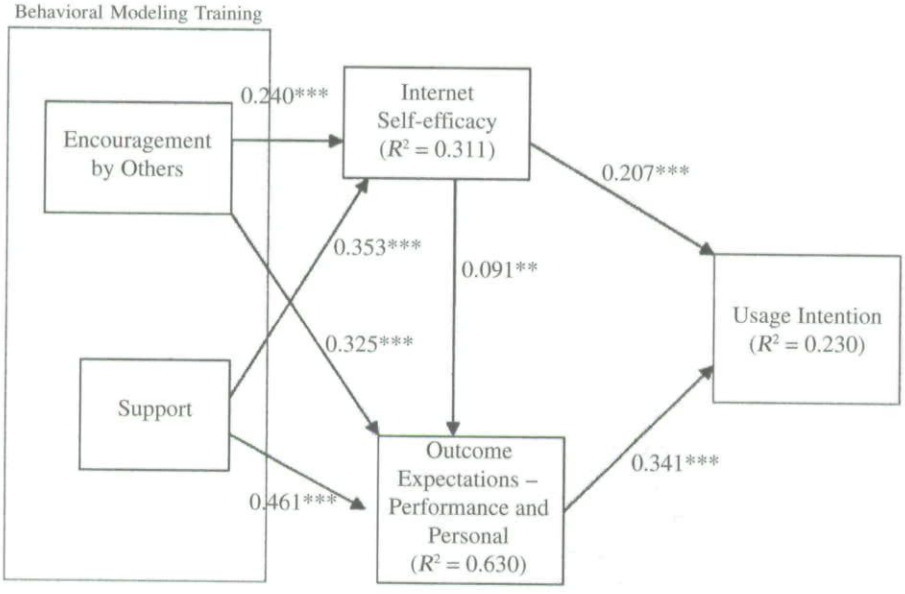

Figure 3. Study 2 Model and Path Coefficients
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 5. Study 2: Individual Item Loadings

Item	Factor loading
Internet self-efficacy	
Confidence in using Internet Explorer	0.8219
Confidence in typing URL	0.8114
Confidence in sending e-mail	0.8541
Confidence in sending e-mail attachment	0.7721
Confidence in sending e-card	0.7780
Outcome expectations	
Perform1—read news online	0.8142
Perform2—send e-mail	0.8400
Perform3—take online courses	0.7745
Pers1—feel sense of accomplishment	0.8245
Pers2—catch up with social trends	0.8344
Pers3—knowledge sharing with family and peers	0.8587
Usage intention	
Usage4—intention in using computer and Internet	1.0000

The explanatory power of the model significantly improved in comparison with Study 1 results. Table 5 presents the individual item loadings (reflective) of the three latent variables, and Table 6 presents the individual item weights (formative) of the two manifest variables. The reliability and discriminant validity coefficients are reported in Table 7.

Study 3

A total of 46 older adults responded to the e-mail invitation, came to the lab, took the assessment test, and filled out the survey. After further matching respondents' demographic data with the demographic data in Study 2, 43 valid surveys were obtained. The response rate was 12.72 percent. There were a couple of reasons that possibly led to the low response rate: (1) since only registration by e-mail was accepted, those who forgot to check their e-mail accounts in time missed the announcement; and (2) although the older adults may have been confident enough to learn the computer and Internet, they may not yet have built up sufficient confidence to take the examination. In order to assess the nonresponse bias, a comparison of demographics was made of respondents who completed only the Study 2 survey and those who completed both Study 2 and Study 3 surveys. An independent sample t-test in SPSS revealed no significant differences for age ($p = 0.768$), gender ($p = 0.932$), and education level ($p = 0.423$), at the 0.05 level.

The survey incorporated questions investigating the relationships between "Internet self-efficacy," "outcome expectations," "usage intention," and "perceived user competence." The goal was to gain not only an understanding of the influences of Internet self-efficacy and outcome expectations (short versus long term) but also an under-

Table 6. Study 2: Individual Item Weights

Item	Factor weight
Encouragement by others	
Encour1—tutors and helpers	0.3340***
Encour2—family and peers	0.5184***
Encour3—social workers	–0.0992
Encour4—myself	0.5844***
Support	
SP1—keyboard/mouse	0.3097***
SP2—computer equipment	0.2649***
SP3—lecture notes	0.2660***
SP4—MS Windows 98 Chinese version	0.3728***

*** Significant at the 0.01 level.

Table 7. Study 2: Reliability and Discriminant Validity Coefficients

Construct	Internal consistency reliability	1	2	3
1. Internet self-efficacy	0.90	0.81		
2. Outcome expectation	0.93	0.502	0.82	
3. Usage intention	1.00	0.438	0.460	1.00

Notes: Diagonal elements are the square root of the variance shared between the constructs and their measures. Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

standing of how capability and confidence develop or change (stronger versus weaker) over time. Three paths were found significant, as shown in Figure 4.

The explanatory power of the model was good. Table 8 presents the individual item loadings (reflective) of the four latent variables. The reliability and discriminant validity coefficients are reported in Table 9. As no behavioral modeling took place in Study 3, the two manifested variables for behavioral modeling included in the previous studies are not depicted.

Discussions and Conclusions

IT IS USEFUL TO BEGIN OUR DISCUSSIONS by first highlighting some pertinent aspects of our findings:

- Empirical results gave strong supports to the proposed research model.
- Encouragement by others exerted influence on Internet self-efficacy and outcome expectations in Studies 1 and 2.

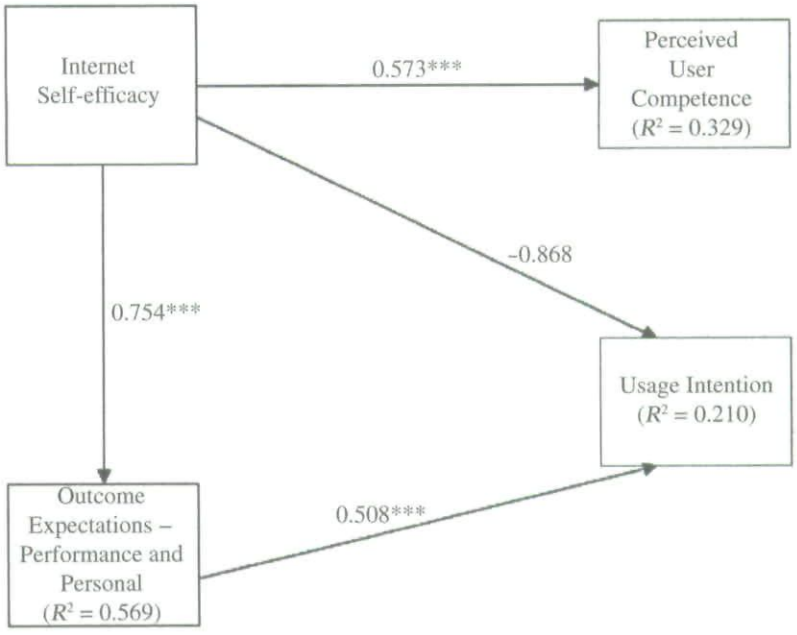

Figure 4. Study 3 Model and Path Coefficients
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 8. Study 3: Individual Item Loadings

Item	Factor loading
Internet self-efficacy	
Confidence in using Internet Explorer	0.9167
Confidence in typing URL	0.8747
Confidence in sending e-mail	0.9262
Confidence in sending e-mail attachment	0.8269
Confidence in sending e-card	0.8162
Outcome expectations	
Perform1—read news online	0.8192
Perform2—send e-mail	0.8394
Perform3—take online courses	0.8665
Pers1—feel sense of accomplishment	0.8802
Pers2—catch up with social trends	0.8274
Pers3—knowledge sharing with family and peers	0.8028
Usage intention	
Usage4—intention in using computer and Internet	1.0000
Perceived user competence	
Knowledge in using mouse	0.8056
Knowledge in typing characters	0.8025
Knowledge in browsing Web site	0.8857
Knowledge in sending e-mail	0.7575
Knowledge in using MS Windows 98 English version	0.7236

Table 9. Study 3: Reliability and Discriminant Validity Coefficients

Construct	Internal consistency reliability	1	2	3	4
1. Internet self-efficacy	0.94	0.87			
2. Outcome expectation	0.94	0.853	0.84		
3. Usage intention	1.00	0.477	0.648	1.00	
4. Perceived user competence	0.90	0.424	0.607	0.343	0.80

Notes: Diagonal elements are the square root of the variance shared between the constructs and their measures. Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

- Support had no effect on Internet self-efficacy in the Study 1 but yielded a significant impact on Internet self-efficacy in Study 2.
- The English version of Windows 98 was used in Study 1, whereas the Chinese version was used in Study 2.
- The relationship of support and outcome expectations was significant in Studies 1 and 2.
- The impact of Internet self-efficacy on outcome expectations in Study 1 was weak compared to the strong impact in Studies 2 and 3.
- Internet self-efficacy was negatively related to anxiety in Study 1, as predicted.
- Although anxiety was related to usage intention in the direction hypothesized, its effect was insignificant.
- Internet self-efficacy exerted a strong influence on usage intention in Studies 1 and 2, but not in Study 3. Participants relied less on self-efficacy in deciding whether to use computers and the Internet as they had acquired the needed knowledge and possessed the necessary skills.
- Internet self-efficacy had a significant effect on older adults perceived user competence in Studies 1 and 3.
- Outcome expectations had a significant influence on usage intention, and its path coefficient intensified from Study 1 to Study 3.
- The "anxiety" construct was removed from the model in Study 2 due to its insignificant effect on usage intention in Study 1.
- The "perceived user competence" construct was removed in Study 2 due to participants in Study 1 reporting that there were too many questions in the survey and the test, and they felt exhausted. Therefore, Study 3 was conducted separately to ensure the validity of the test results in relation to perceived user competence.
- The lecture in Study 2 was more difficult compared to the lecture in Study 1. The test results might be affected since participants did not have enough time to practice.

Overall, the findings in the studies gave strong support to the research models. Encouragement by others exerted influence on Internet self-efficacy and outcome expectations. Support had no effect on Internet self-efficacy in Study 1 compared to the result in Study 2, probably due to two reasons: (1) the English version of Microsoft Windows was used in Study 1, whereas the Chinese version of Microsoft Windows was used in Study 2; and (2) participants were still unfamiliar with typing on a keyboard and maneuvering the mouse in Study 1, and thus the participants were still not sufficiently self-confident in surfing the Internet after the classes even though support was given during the classes. On the other hand, the relationship of support and outcome expectations was significant. With better computer equipment and better technical support, students increase their expectations on what they can achieve from using the Internet, such as browsing online news, exchanging e-mail, and taking online lessons. Psychologically, they also feel a stronger sense of accomplishment, the ability to catch up with the social trend of surfing the Internet, and better communication with others, including family and the younger generation.

The impact of Internet self-efficacy on outcome expectations in Study 1 was weak compared to the strong impact in Study 2. As in Study 1, participants were computer novices and were not confident in their capabilities of engaging in various online tasks. However, over time and with adequate training and practice, the older adults' confidence was boosted, and they expected they would have the skill in performing online tasks. Internet self-efficacy was negatively related to anxiety as predicted earlier. The more confidence the older adults had, the less worried they were about using computers and the Internet.

Internet self-efficacy exerted a strong influence on usage intention in Studies 1 and 2. Outcome expectations had significant influence on usage intention, and its path coefficient intensified from Study 1 to Study 2. When older adults progress in their skills, they are more likely to engage in online activities. Although anxiety is related to usage intention in the direction hypothesized, its effect was rather weak. Simply lowering the arousal of anxiety of participants did not stimulate older adults' continuance of usage. This is because the tasks involved (e.g., reading online newspaper, sending e-mail) were of low risk compared with online transactions such as shopping and banking. However, Internet self-efficacy and outcome expectations and their antecedents played key roles in generating interest.

It is noted that over time it was possible to proceed to directly measure the link between Internet self-efficacy and actual use, and its reciprocal relationship. Previous studies have acknowledged that self-efficacy has a direct effect toward computer usage [11, 12, 20]. Bandura [3] describes the reciprocal relationship of self-efficacy and use in no unclear terms: self-efficacy is viewed as an antecedent to use, but successful prior experience with computer is also viewed as influencing self-efficacy. Also, constructs such as self-efficacy, outcome expectations, and usage intention as well as perceived user competence would need continuous fine-tuning (in terms of their measurement and interrelationships) during a longitudinal study. Otherwise, the explanatory power of the structural model could be diminished over time. As older adults progress, they thrive for new knowledge, as they perceive they have successfully

Table 10. Study 1 Descriptive Analyses—Questionnaire Part 1 Questions

Part 1: Questions related to Internet access		Frequency	Percentage
Q8.	Do you have a computer at home?		
	Yes	337	62.20
	No	205	37.80
	Total[1]	542	100.00
Q9.	Can you access the Internet from home?		
	Yes, I can	322	69.20
	No, I cannot	110	23.70
	Other	33	7.10
	Total	465	100.00
Q10.	Where do you usually go online? (please check all answers that apply)		
	At home	200	36.30[2]
	Community center/senior center	175	31.80
	Public library	24	4.40
	At relative's or friend's place	18	3.30
	Senior IT Advocates	16	2.90
	Other	18	3.30
	N/A	74	13.40
Q11.	What is/are your purpose(s) in taking a computer and Internet training class?		
	To read news through online newspaper or listen to online radio	269	48.80
	To keep contact with distant relatives and friends through e-mail	144	26.10
	To keep up with the trend in surfing the information superhighway	213	38.70
	To broaden discussion topics with my family.	135	24.50
	To broaden discussion topics with my friends and the younger generation	361	65.50
	To acquire new knowledge	30	5.40
	To increase job opportunities	11	2.00
	Other	7	1.30
	N/A	—	—

Notes: [1] For Q8 and Q9, the totals exclude missing data ($n = 551$). [2] For Q10 and Q11, the percentage is calculated based on the sample size ($n = 551$).

mastered basic computer knowledge. They can learn other online tasks, such as downloading pictures, utilizing search engines, and so on.

Other Descriptive Analyses

Besides demographics, general information about Internet access and experience in using computers and the Internet were asked among the participants in Study 1 (through a questionnaire). A summary can be found in Tables 10 and 11. The investigators conducted a number of focus groups discussions and interviews afterward to discuss the questionnaire results. The purpose was to ensure that we have clear interpretations and explanations to support the quantitative data gathered from the questionnaire.

Table 11. Study 1 Descriptive Analyses—Questionnaire Part 2 Questions

Part 2: If you have previous online experience, please answer the following questions. Otherwise, please skip this section.	Frequency	Percentage
Q1. How long have you been using the Internet?		
Less than one week	176	45.60
One week to one month	85	22.00
One month to six months	69	17.90
Six months to one year	29	7.50
One year or above	27	7.00
Total[1]	386	100.00
Q2. Have you encountered any specific problems while learning the computer and the Internet? (please check all answers that apply)		
No specific problem(s)	44	8.00[2]
No computer or Internet access at home	114	20.70
Do not know where to register for computer and Internet training class	122	22.10
Need help from tutor(s)	251	45.60
Unaffordable training fee(s)	130	23.60
Existing computer and Internet training class structure is inappropriate for older adult students	43	7.80
Other	18	3.30
Q3. On average, how many hours each week do you spend online?		
One hour or less	193	56.40
Two to four hours	96	28.10
Five to seven hours	31	9.10
Eight to ten hours	14	4.10
Eleven hours or above	8	2.30
Total	342	100.00
Q4. Are you planning to learn more about using a computer and the Internet?		
Yes	474	97.90
No	10	2.10
Total	484	100.00
Q5. Will you encourage your friends and other older adults to learn to use the computer and the Internet?		
Yes	469	98.70
No	6	1.30
Total	475	100.00

Notes: [1] For Q1, Q3, Q4, and Q5, the totals exclude missing data ($n = 551$). [2] For Q2, the percentage is calculated based on the sample size ($n = 551$).

Referring to both questions 8 and 9 in Table 10, the majority mentioned that they have computers and can access the Internet from home; however, it did not necessarily mean that they are the core computer users in the family. During the interviews, the researchers found out that family members other than the older adults were the frequent computer users at home. Family members such as sons, daughters, and grandchildren would occupy the computers most of the time. Besides, a few older adults

indicated that at home they were not allowed to touch the computers so as to avoid any computer damage or loss of information. Nevertheless, referring to question 10 in Table 10, approximately 36 percent of respondents indicated that they accessed the Internet at home. Thirty-two percent of the respondents reported that they usually accessed the Internet at the community/senior centers. Moreover, the five main reasons the older adults reported wanting to learn to use a computer and the Internet are (1) to acquire new knowledge; (2) to read news through online newspaper or listen to online radio; (3) to keep up with the trend in surfing the information superhighway; (4) to keep in contact with distant relatives and friends through e-mail; and (5) to broaden discussion topics with my family, friends, and the younger generation. These reasons are consistent with the findings in Studies 1 and 2.

After the initial screening through telephone calls in Study 1, the researchers imposed additional interviews to further screen out experienced computer users among the participants in Study 1, as shown in Table 11. The majority had used the computer for less than six months. During the interviews, the researchers confirmed that the older adults had never received proper computer training. When the older adults said they had experience in using computers and the Internet, it meant that they had "played" with the computer by clicking the mouse and hitting the keystrokes on the keyboard. Perhaps, the Web sites were already displayed by social workers for the older adults at the community centers that they usually patronized. However, they did not know how to type an e-mail address, how to open the Internet Explorer browser and type a URL, and so on. The four focal problems that the older adults found in learning to use computers and the Internet are (1) cannot find help from tutor(s), (2) unaffordable training fee(s), (3) do not know where to register for computer and Internet training class, and (4) no computer or Internet access at home. As we can see, the older adults would spend less than four hours online each week. The majority were retired and so they were not required to use the computer and access the Internet as often as the general workforce and IT professionals. In general, the older adults expressed interest in learning more about using computers and the Internet, and they would encourage others to do the same.

It was interesting to observe that the learning attitudes, behaviors, and performance of the older adults in this study were not entirely consistent with the rather stereotypical images commonly depicted by the prior literature. For instance, even though the older adults were afraid of making mistakes while learning computers and the Internet, they were highly motivated in the first place and made an effort to attend the training classes. Although the older adults might lack self-confidence in their ability and knowledge in using computers and the Internet, they were certainly not lazy. They were eager to ask questions and ask for help during training classes. When the older adults were given extra practice time and step-by-step instructions, they could perform online tasks, such as sending e-cards and reading online news, without much difficulty.

In Studies 1 and 3, the older adults were required to take the actual knowledge test (pen and paper) and to rate their perceptions of their competency level in using computers and the Internet. The test results showed that the older adults recognized several simple features of the Internet Explorer browser, e-mailing, the letters and symbols

of a URL, and so on. Also, the older adults gave themselves high scores on questions that assessed their overall perceptions on performing online tasks, such as sending e-mail and typing letters and symbols, and so on. However, when instructors asked the older adults to demonstrate the steps of sending e-mail, for example, they usually could not recall these steps on their own. They would turn to the instructors and asked for help and guidance. The older adults tended to have a short memory span and slow motor skills; therefore, additional training and practice are deemed necessary. It was interesting to see that older adults generally overestimated the knowledge they possessed in using computers and the Internet. However, this situation improved in Study 3. The 43 participants in Study 3 were skilled in tasks that instructors had taught them from the training classes. From the researchers' observation, they had demonstrated their abilities during the actual knowledge test.

In summary, the older adults are capable of using computers and the Internet and they will continue to do so because they regard computers and the Internet as tools for learning new subjects and communication with others, given the appropriate training method and structure, verbal encouragement, and technical support combined. In this study, the researchers were able to boost older adults' self-confidence, and, in turn, the older adults were eager to perform online tasks and continue to use computers and the Internet.

Limitations

Given the exploratory nature of this study, there are several limitations that can be identified. First, the differences in sample sizes could be a potential problem, although nonresponse bias was treated. Also, a convenient sampling approach was used instead of random sampling. Second, ads were placed through mass media, but participants were not randomly selected from the entire older adult population segment. Third, the assumption of the positive influence of the behavioral modeling training method in this study was made based on similar studies reported in the literature. In addition, "prior experience" was embedded into hands-on experience through training; however, between trainings and practices, participants would gain further experience, and an additional construct would need to be incorporated into the model to capture its effect. Furthermore, there was a long lapse of time between the three studies. Other exogenous variables may have come into play and affected the results, which could not be foreseen and measured.

Contributions and Implications

Theoretical Contributions

COMPEAU ET AL. [10, 11, 12] PROPOSED that longitudinal studies and experiment research methods are necessary in confirming the effects of the antecedents of self-efficacy and its influence on outcome expectations and usage, plus the relationship of self-efficacy and user competence. By conducting these series of empirical studies, it

is believed that the authors' calls have been partially answered and that the theoretical understanding of the connections of these variables could actually contribute toward addressing some of the main issues of building a digital inclusive society. To a certain extent, a new and critical viewpoint of the causal relationship of Internet self-efficacy and usage intention has been offered. A foundation for future research has been laid so that other scholars may adopt and further develop out models and measurement scales to address digital inclusiveness issues in other relevant contexts (e.g., the study of digital inclusiveness for lower-income families in rural areas of mainland China). This study has focused on studying the impact of self-efficacy on adults age 55 or older, a distinct group of computer users compared to the general workforce, having very different sets of motivational and behavioral attributes. It was by no means clear whether existing theories and findings based on research samples composing the general workforce would be applicable to this domain of users. The findings from this research indicate that existing models (e.g., [10, 12]) properly extended could be used as a good basis to study the ICT-related behavioral aspects of this type of socially disadvantaged group. Further, currently in the IS field, no study has been done in developing a new model to explain causal relationships among the above-mentioned constructs. This study points to a new group for the continuance of ICT usage—older adults. This new user group of ICT could potentially expand to a large (and loyal) virtual community. We have thus extended the scope and boundaries of existing theories and models through this research, as well as further enriching these models by crafting in new constructs and validating their relationships.

Practical Contributions

This study has made an attempt in understanding the social effects of ICT on one type of socially and technologically disadvantaged groups. It is hoped that the digital divide gap may be narrowed by continuously offering suitably tailored computer training programs to adults age 55 or older, or the "baby-boomers" in the United States. Through a better understanding of this population segment, new markets may be discovered and services and products can be tailor-made to their special needs, such as online banking, user interface designs, new adaptive software and hardware, and so on. Last but not least, the findings indicate that computer training improves the psychological state of mind of these older adults. Their self-confidence is boosted as they gain a developed sense of achievement. They feel better about themselves, for they can communicate with other groups in sharing their knowledge about a new subject area—computers and the Internet. Social programs designed to increase the life quality of the elderly in the community should therefore not overlook the role of computer training.

Implications for Future Studies

This research contributes toward a better foundation for advanced studies in the digital divide context. A new set of models are offered to explain the older adults' (i.e.,

one of the disadvantaged groups) usage intention of computers and the Internet as well as their perceived user competence. Motivating factors are identified in explaining the changes in the self-efficacy and outcome expectations of the elderly in using computers and the Internet. To further validate the generalizability of these models, they can be adopted in studying the learning patterns and behaviors of other socially disadvantaged groups. In addition, comparative studies can be conducted, such as cross-cultural analysis (e.g., China versus the United States), and users' computer capabilities (e.g., elderly versus current workforce).

Building on this body of knowledge, the next challenge is to develop a comprehensive research framework for studying digital inclusion in various global cities with demographic and economic characteristics similar to that of Hong Kong. Cities such as London, Melbourne, New York, San Francisco, Seoul, Shanghai, Singapore, Taipei, Tokyo, and Toronto are the likely targets of comparison. Under this framework, a digital inclusion index, which is composed of a set of reliable indicators, will robustly reflect the degree of digital inclusiveness in these cities. Aspects such as accessibility, affordability, usage, knowledge, and quality of ICT can be taken into consideration.

Likewise, appropriate standards of measurement of digital inclusion programs that are offered by governments and agencies should be established. Proposed evaluation criteria include, among others (1) the effectiveness of each individual program, that is, to what extent this program increase the public as well as the socially disadvantaged groups accessibility in ICT; (2) the groups usage of ICT; (3) the groups knowledge of ICT; and (4) the groups overall psychological well-being and perhaps their physical well-being.

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Note

1. AgeLab's three interrelated and mutually reinforcing research approaches (web.mit.edu/agelab/about_agelab_approach.shtml).

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