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A cost–benefit analysis methodology for assessing product adoption by older user populations

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Abstract

A methodology for assessing perceptions of a product through cost–benefit analysis is demonstrated in an experimental study involving use of one of two products for supporting interaction with telephone voice menu systems. The method emphasizes ratings of constructs related to costs and benefits considered relevant to decisions regarding product adoption, and the use of the analytic hierarchy process technique to derive subjective importance weights associated with those constructs. Twenty-five younger subjects (18–39 years of age) and 27 older subjects (60–82 years of age) interacted with simulated telephone voice menu systems supported by either a screen phone or a graphical device. Although analysis of the benefit–cost ratios revealed that benefits were perceived as more important than costs, the analysis of the constituent item ratings and importance weights provided potentially more useful information for predicting product adoption.

Keywords: User-centered design; Cost–benefit analysis; Older populations; Telephone voice menu systems

1. Introduction

Current trends in product engineering and business enterprise have resulted in rapid development, deployment, and obsolescence of products in the marketplace, resulting in a much greater diversity of products to choose from than ever before. Unfortunately older people are less likely to benefit from this phenomenon given that they are generally more reluctant to adopt new products, especially products involving unfamiliar concepts or procedures (Marquié et al., 1994; Freudenthal, 1998). For example, Rogers and colleagues (Rogers et al., 1996) found that older people are less likely to use Automatic Teller Machines (ATMs) than younger people and recent data (US Department of Commerce, 2002) indicates that use of the internet is relatively low among older people as compared to other age groups. Ironically, older adults can benefit from many of these products, particularly in ways that can enhance their independent living and quality of life. As an example, the internet may be used by older people for communicating with family and friends, performing routine tasks such as banking or shopping, and accessing information on health, community resources, and a variety of other topics.

In user-centered design cost–benefit analysis is sometimes performed during the later stages of the product design cycle (Nielson, 1993). The primary purpose of this analysis is to determine if the costs associated with implementing particular functions can be justified by the benefits in product use. An example is justifying the cost of adding additional functions to a cell phone such as access to the internet. Generally, costs are measured in terms of resources invested and benefits are measured in terms of enhanced usability or monetary savings. However, for technology-based products an additional cost–benefit issue that designers need to consider is the cognitive resources required to learn how to use the product. This is particularly true when targeting older user populations given age-related declines in cognitive abilities (Park, 1999).

This paper presents a relatively simple scheme for performing a cost–benefit analysis that includes components such as cognitive effort that may be particularly relevant to older populations. The potential utility of the

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approach is demonstrated using data that examined the usefulness of two products in facilitating interactions with telephone menu systems: a screen phone and a graphical device. These products were tested on a group of younger and older adults who performed information search and retrieval tasks using simulated telephone voice menu applications. Although telephone menu systems can potentially provide older adults with greater independence and privacy in managing many important activities such as banking, appointment scheduling, and shopping (e.g., ordering medications), initial findings from a study (Sharit et al., 2003) indicated that older adults find it difficult to use these systems to perform routine tasks. The data also indicated that performance difficulties were related to age-related declines in abilities such as hearing and working memory. Most telephone menu systems tax working memory by virtue of their serial presentation of auditory information (Tun and Wingfield, 1997). The possibility therefore exists for older users to benefit from products that could compensate for age declines in abilities. Also, as shown in other studies (Czaja et al., 1998) design interventions that benefit older adults typically benefit users of all age groups.

The primary focus of this paper is to report on age differences in the perception of a select group of cost and benefit components associated with the screen phone and the graphical device, and determining if older adults attribute greater costs and lesser benefits to these devices as compared to younger people. The cost component consisted of three constructs: monetary cost, initial learning cost, and relearning cost (the cost of having to relearn to use a product because of infrequent use). The benefit component consisted of one construct: overall usefulness of the product with respect to the frequency of interaction with the telephone menu system. This construct was chosen as the products were conceived as support aids for systems that people interact with at varying rates of frequency. There was also an interest in determining if perceived costs and benefits associated with these products could be predicted from human information-processing capabilities and task performance. Finally, this paper will attempt to illustrate that analysis of benefit–cost ratios may be misleading, and that decomposing benefit–cost ratios into their constituent components may provide more useful data concerning age differences in the perception of costs and benefits associated with adopting new products.

2. Method

2.1. System description

Two types of telephone voice menu systems that are routinely used in daily activities were developed and used in this study: a banking application and an electric utility application (Sharit et al., 2003). Both systems were automated in the sense that there were no menu options for connecting to a company representative (e.g., to negotiate a commercial loan). The banking application was based on the on-line banking system of a major bank. The user could perform transactions such as placing stop payments on checks, determining checking and savings account balances, ordering copies of account statements, and transfers of funds between accounts. Credit card activity and mortgage information was also available. In the electric utility application, the user was able to perform activities such as stopping electric service on a particular date, reporting downed power lines, or determining the status of a claim.

Twenty-four distinct problems, divided into three problem sets of eight problems each, were designed. Within each problem set, six of the problems required calls to the banking system and two required calls to the electric utility system. On each call, the objective was to obtain information or perform some action by navigating through the voice menu system. Examples of problems pertaining to the banking system were: “Transfer $500.00 from your savings account to your checking account and obtain your confirmation number,” and “Was there any withdrawal activity on your checking account on June 1st? If so, of what type and for what amount?” Examples of problems requiring calls into the electric utility system were: “Report a downed power line that is not in the vicinity of your residence,” and “What information must you have in order to have your Florida Electric bills paid directly from your checking account.” Further details concerning system development can be found in Sharit et al. (2003).

2.2. Experimental conditions

Cost–benefit analysis was applied to the use of two distinct products intended to facilitate interactions with telephone menu systems: a screen phone and a graphical device. The products were chosen on the basis of findings from a study (Sharit et al., 2003) that indicated that age-related difficulties using these systems are linked to declines in auditory and cognitive abilities. Conventional phone interfaces rely exclusively on the auditory modality and may place heavy demands on working memory, especially for complex menu structures. By combining voice with text screens (Fig. 1) screen phones provide redundant information and thus have the potential to significantly reduce the overall cognitive effort involved in information search and retrieval from telephone voice menu systems. Providing redundant information has generally been found to benefit human performance (Wickens, 1992).