Evaluating the Effectiveness of a Multimedia Program on Home Safety

David A. Chiriboga, PhD, Mary Anne Sweeney, RN, PhD
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Purpose: This study was designed to test the effectiveness and acceptance of multimedia home safety programming by community-dwelling seniors. Design and Methods: A prototype CD-ROM was produced that required no reading or computer skills because the program included an audio narration of content and directions for operating the program on a touchscreen computer monitor. Volunteers (N = 126) from a senior center aged 55 and older were randomly assigned to (1) a multimedia group that used the interactive program to learn about home safety, (2) a traditional learning group that read well-established booklets on home safety, and (3) a control group that received no instruction on safety between the pre- and posttests. Results: Repeated-measures multivariate analysis of variance showed that the multimedia group was the only group to improve in knowledge. The group was also very satisfied with the approach. Implications: Multimedia formats can effectively and economically provide information to older clients.

Key Words: Touchscreen computers, Home safety, Health promotion

This article reports on a project designed to test the effectiveness of a “user-friendly” interactive multimedia program on home safety for senior citizens. The need for such programs is highlighted by the prevalence of injuries in this age group. Unintentional injuries in the home cause over 4 million disabling injuries each year, with more than 110,000 resulting in permanent impairment and more than 20,000 resulting in death (Centers for Disease Control [CDC], 2001; National Safety Council, 2001). Studies have shown that seniors are at high risk for morbidity and mortality for injuries related to falls, residential fires, liquid scald burns, adverse drug reactions, environmental hazards, and alcohol-related problems. For instance, falls cause more than 60% of the emergency room visits by older adults. One third of those over 65 fall each year, and falls are the most frequent cause of hip and pelvic fractures (CDC, 2000). Most falls (79%) occur at home and are caused by tripping, slipping, or a postural change (Nevitt et al., 1991). The largest percentage of falls occur in the garden, bedroom, bath, and kitchen (Connell & Wolf, 1997; Cummings & Klineberg, 1994).

Because of its prevalence and significance, prevention of unintentional injuries has been listed as an objective under the Health Protection category in the National Health Promotion and Disease Prevention Objectives of Healthy People 2000 (U.S. Department of Health and Human Services [DHHS], 1991) and Healthy People 2010 (DHHS, 2000). Within the category of unintentional injuries, falls remain the most prominent cause of injuries and hospitalizations for trauma in elderly persons. The hospital admission rate for hip fractures remains consistently above baseline levels, indicating that little progress has been made to date toward this prominent Year 2000 target (DHHS, 2000). Approximately 212,000 hip fractures occur each year in the United States among adults age 65 and older, and the toll they take has far-reaching consequences. Half of those hospitalized cannot return home or live independently after the occurrence of the fracture (National Center for Health Statistics, 2001). Even more sobering, half of those who are 75 or over who break a hip as a result of a fall die within 1 year of the injury (Rawsky, 1998).

New Strategies for Health Promotion

One path toward the prevention of falls and other unintentional injuries at home is for older adults and...
their family members to develop an understanding of the many factors that contribute to such injuries. An emerging challenge facing health care providers concerns how to transmit relevant health promotion information most effectively to an increasingly diverse population of consumers. Transmitting such information effectively to divergent groups of people with different learning styles and variable language fluency is difficult, but may be facilitated by the use of new multimedia technologies. Such technologies have the potential of overcoming many of the difficulties involved with traditional learning methods, such as printed educational materials and classroom lecture sessions, but to date there is a paucity of information concerning their actual effectiveness for older adults (Echt, 2002; Wetle, 2002).

The growing potential of multimedia builds on the increased availability of computers not only in public places but in homes. In 1998, for example, one survey reported that 40% of Americans aged 50 and over owned a personal computer—an increase of 11% from 1995 (SeniorNet, 2001). Of those using the Internet, nearly 40% reported visiting health-related sites. Today, experts estimate that a greater percentage of older adults own computers and access the Internet through libraries and senior centers, although computer access drops dramatically among the Old-Old and Older groups (Wetle, 2002).

Of particular relevance is that computer-based multimedia approaches can create a relatively individualized learning session for a client. Several authors have pointed out that the challenge is to properly use and apply the technology for patient learning and that the patient–provider relationship should be enhanced, not replaced (DeLeeuw, 1990). The provider can build on the basic learning such as in case examples described by Ellis (1985), in which dietitians were able to emphasize review and counseling in areas that were recorded or “flagged” as problematic for diabetic patients during a computer session. The overall goal is to reduce the length of time required for the client–provider interaction while not decreasing the quality (Ellis, 1985) or outcome (Summer, 1990; Sweeney, 1994).

### The Advantage of Multimedia

Multimedia technology is effective with a variety of learners. This is true in part because the technology allows users control over the interaction: The learner can make choices about the topic, the order of presentation, and the pace and duration of the instructional material. Learners are more likely to stay involved with the programs because participation is required at multiple decision points along the way. Complex and extensive information is broken down into manageable components, and the use of a variety of mixed media, including sound and video, make the experience more interesting (Boller & Clark, 1994). Users “navigate” through the choices about the information, so attention and responses are required of them every few minutes. This feature helps to keep them engaged with the programs despite the distractions of busy, noisy health care settings.

The interactivity of multimedia has at least two advantages. First, users generally find the interactivity more exciting and become more involved in the process. This is an important shift from traditional educational settings in which relative passivity of learners has long been the way things were always taught (Knowles, Holton, & Swanson, 1998). The second advantage of multimedia interactivity is to reduce efficiently and accurately a large array of information down to an appropriate amount to meet the specific needs of individual learners. The potential use of multiple audio tracks provides additional flexibility by giving learners a choice over the language they will be exposed to during the session. Finally, because approaches involving touchscreen technology with multimedia require no familiarity with computers or even the written language, and only an ability to touch relatively large areas of the computer monitor, such approaches have an unusual potential to transcend barriers to learning. Touchscreen-driven multimedia programs have proven effective in teaching elders and have garnered high ratings from subjects as effective learning tools (Mercer, Chiriboga, & Sweeney, 1997).

The present investigation involved the development and evaluation of a comprehensive multimedia program about the key safety hazards in the homes of older adults. The computer-based instructional program provided a potentially more dynamic and personally relevant experience than the three commonly used booklets we included for comparison. Designed to provide practical solutions to decrease the potential for injuries by promoting safer health practices, the interdisciplinary project had the broad goal of decreasing the need for long-term health care by intervening in the key factors precipitating common injuries that often lead to medical treatment and institutionalization.

### Methods

#### The Prototype Program

The investigation used a preliminary version of software being developed for an intervention project. The software, a multimedia-based CD-ROM program on home safety and injury prevention for elderly persons entitled *Making Homes Safe for Seniors*, utilized a home motif to present the information. The “setting” is a classic Victorian house with many of the same household features that seniors have lived with over the years, but can become dangerous as the inhabitants grow older.
Structurally, the prototype software consisted of nine segments: introduction, navigation instructions, credits, references, main menu and three submenus, a portion of a “virtual” shopping trip for safety devices, a home exploration segment in several areas of the house, an introduction and simulated connection to the Internet, and a software tracking program that recorded the time and order of the items selected from initiation of the main menu through exit from the program. Subjects selected the portion of the home that they wanted to explore, such as the living room. Computer-generated safety messages were narrated whenever an object with an active touchpoint was selected.

Field Testing Activities.—These activities were carried out in the Galveston County Senior Citizens Center. The multimedia computer equipment was set up on a moveable computer cart so that it could be stored in a safe location when not in use and could be transported into the library/meeting room when the location was available for booking for project testing purposes. Because of time constraints, it became clear that evaluation of the Internet simulation was beyond the scope of our project, and we therefore collected only observational data on use of the Internet simulation.

Equipment.—A Dell Inspiron 7000 computer with a CD-ROM drive, a Mitsubishi Precise Point 8705 17” CRT Touch Monitor, and Bose MediaMate speakers were set up on a sturdy AnthroCart. A set of headphones with large padded earpieces was available, but all participants declined use of the listening device. A point to emphasize is that all participants took the Home Safety Program Quiz on the computer, during the pre- and posttest phases, rather than a paper-and-pencil version. Thus, all 126 subjects had a minimum of two sessions on the touchscreen computer and were able to make comments about the interactive technology and be observed during those sessions.

Subject Pool.—The target population consisted of all older adults who attended the Galveston County Multipurpose Senior Center during approximately 1 month of data collection. The senior center is an 11-year-old facility that is centrally located in downtown Galveston and attracts a diverse group, consisting of approximately equal numbers of African Americans, Hispanic Americans, and Anglo Americans. Although no records are kept at the facility regarding daily attendance, the annual number of separate individuals who participate is estimated to be approximately 250 (J. Penrod Glenn, program director, personal communication, 2001). Notices were posted on bulletin boards, and project staff made several presentations at events, such as bingo and lunch.

Subjects.—The project was open to all who were interested, with no exclusions beyond being aged 55 or over, and no effort was made to oversample or encourage volunteers from any particular group. Based on the work of Cohen (1992), our goal was to obtain 120 subjects, with inputs for calculation being an estimated medium effect size, an alpha of .05, and a power of .85 (estimates based on findings from a previous study of the same population: Mercer et al., 1997). At a point in which the number of volunteers exceeded our sampling goal by 15, we terminated the recruitment effort.

Of the 135 volunteers, 3 experienced scheduling problems that precluded completion of the data collection process, 1 was unable to participate because of a language barrier, 1 wanted to study the consent form at home and never returned, and 4 decided they were not interested in the program. It is difficult to calculate the refusal rate because there was no way to identify the number of separate individuals who attended the center during the data collection period. We do know that 126 of the 135 individuals (93%) who talked with us about participating in the study actually completed the tasks involved. We also know that the 135 initial volunteers represented 54% of the target population. Given that a random sampling strategy was not used either in selecting the site or the subjects within the site, the generalizability of the findings is limited to the subjects we studied. Our purpose in selecting the senior center was to contact community-dwelling subjects from diverse housing situations, economic situations, and ethnic/racial backgrounds.

Demographic characteristics of the final sample were not unusual for subjects drawn from a Senior Center. The age range was 55–99, with 57.1% being aged 74 or under (i.e., the Young-Old group), 30.9% aged 75–84 (i.e., the Old-Old group), and 11.9% aged 85 and over (Oldest Old group). The gender distribution reflected that of the older population as a whole, with 87 females (69%) and 39 males (31%). With regard to ethnicity, the group demonstrated considerable diversity: 31 (24.6%) were African Americans, 67 (53.2%) were Caucasians, 25 (19.8%) were Hispanics, and 3 (2.4%) were in the “other” category. The educational background of participants at the Senior Center varies widely, and this fact was reflected in the sample. On the one hand, one third had not gone beyond junior high school: A small group (2.4%) reported no school experience, some (11.1%) had experience in elementary grades only, and others had completed junior high (19.8%). In contrast, two thirds had attained higher levels, including high school (34.1%), vocational or technical programs (7.1%), 2 years of college (13.5%), 4 years of college (6.3%), and postgraduate education (5.6%).

Subjects were asked about the number of people who lived in their immediate household. A substantial portion (60.3%) of the subjects lived alone,
Instruments.—Data were collected both by trained bilingual observers and a computer-based process. Six instruments were used for data collection, with data collection set up to allow full participation by subjects without regard for reading or technical skills. The only part of the data collection process in which reading skills would be needed was in the Traditional Learning Group, in which subjects were offered their choice of three safety booklets to study. The booklets consisted of simple graphics and pictures accompanied by written comments, but by our calculations all three booklets were written at the 7th or 8th grade reading level (based on McLaughlin, 1969), so data collectors were instructed to watch Traditional Learning Group subjects closely for signs of trouble with reading. The technology-oriented data collection by computer was set up with an easy-to-use, touch-sensitive monitor. Two subjects stated they were experienced in using a mouse and requested that option instead. Our program was designed to recognize both touch and mouse input so their preference was easily accommodated.

Home Safety Program Quiz. The 14-item Home Safety Program Quiz covered information provided to both the Traditional and Multimedia Learning Groups. Examples of the content covered in the quiz included questions related to smoke detectors, electrical cords, causes of falls (such as scatter rugs, clutter, and low-slung chairs), the sites of frequent falls, the prevalence of fires, and scald burns from having the temperature of hot water heaters set too high. Questions were printed on the screen with an overlay while the narrator read each item and the possible choices for answers. Each test item was presented by the computer in random order to increase the attention level of subjects and reduce the position effect from pre- to posttest. All responses were made directly by the subject by touching the computer screen and were stored immediately in a digital file. As noted, the quiz was administered to all subjects twice, once as a pretest and once as a posttest. Overall test-retest correlation was .66, but the correlations by group show an apparent intervention effect: The correlation was .82 for the controls, .65 for the Traditional Learning Group, and .58 for the Multimedia Learning Group.

Results.—The main finding was that 74% of the subjects judged their living conditions to be Safe. On the other hand, 11.1% reported that their homes to be Unsafe. Whereas another 24.6% lived with one other person (on average, 1.7 persons lived in the household, but the median number was 1.0). When asked to identify the type of residence they lived in, the most common type was a single family home (48.4%), followed closely by an apartment (46.8%). When asked about home safety, results suggested that overall our subjects perceived their homes to be safe: 23.8% declared it to be Very Safe, and a full 63.5% felt it to be Safe. On the other hand, 11.1% reported that their home environment was only Minimally Safe, and 1.6% judged their living conditions to be Unsafe.

Home Safety Program Rating Scales. Two versions were administered after the intervention period. Scale A consisted of a series of nine items rating various facets of the multimedia program that was administered by computer only to the Multimedia Learning Group (Cronbach’s alpha = .71). Subjects were asked to rate their satisfaction with various aspects of the learning experience, such as the quality of the narration and graphics. Participants designated a rating on the computer ranging from 0 (very low) to 10 (highest rating); whereas the range may seem large, we have found in previous research that providing an extended range, but with clear anchor points, helps spread out the distribution (Mercer et al., 1997). All items and possible responses were displayed on the screen and narrated. Responses were stored in a digital file. The subjects in the Traditional Learning Group who utilized the Safety Booklets responded to the Home Safety Rating Scale (B). The latter contained four items (Cronbach alpha = .88) pertinent to the content of their traditional learning module that were also included in the Scale A version.

Home Safety Program Demographic Survey. The seven-item survey was administered to all subjects in an interview format by the research assistants. All responses were multiple choice or actual numbers.

Home Safety Program Observation Checklist and Log. The checklist consisted of 10 “true-false” items completed by the research assistants while they observed the ability of each subject to interact with the software and hardware (content areas are noted in Table 1). Both research assistants were advanced graduate students who were completing masters degrees in health promotion and gerontology. They were trained for 3 hours before initiation of the study by the principal investigator and the faculty member in charge of the data collection activities. To determine whether the two raters were consistent with one another, we used a pragmatic criterion for interrater reliability: the percentage of exact agreement. The exact agreement between ratings of the two assistants was 83%, which is within the generally accepted 80%+ range (e.g., Hall, 1992; see also Dittmar & Gresham, 1997). In addition to ratings, the assistants used an Observation Log to record questions or comments by the subjects and to enter notes about how the subjects dealt with the learning situation. Because relatively few subjects actually made comments, data from the logs were used only as a means of fleshing out the more quantitative findings.

Finally, a Software Tracking Program file was embedded in the multimedia program to record the choices made by multimedia learning group subjects at all menus and touchpoints during their interactive session.

Procedure.—During the sign-in process, all subjects were randomly assigned to either a control,
traditional learning, or multimedia learning group after signing the consent form to participate in the study. The control group received no intervention; instead, a bilingual research assistant simply talked to each control group participant for a specific time period about anything but home safety. Each member of the traditional learning group was provided with three top-of-the-line brochures that have received extensive development and are well established and widely used. In contrast, the multimedia program created for the experimental condition was developed in a 6-week time period and was a relatively “rough-cut” prototype.

After subjects completed the study sign-in process, they were asked to take the 14-item Home Safety Program Quiz on the computer. The directions, the test items, and the true-false choices were all narrated (by the computer) as they were displayed on the touchscreen monitor. Thus, the standard procedure required subjects from all three groups to use the computer at the outset. The requirement served the purpose of having computer use in all groups to help minimize perceptions of differences among the three groups on the part of the subjects. It also helped to increase the amount of information we acquired on how older persons in general respond to the new interactive technologies represented in the study.

Each subject was tested individually in the library/meeting room at the Senior Center. Next, the subject provided information for a demographic data form that was completed by the research assistants. From this point, subjects moved on to activities specific for their group assignment as follows:

**Group 1: Multimedia Learning Group.**—The multimedia group (n = 42) took two modules of the CD-ROM program developed for this project entitled, Making Homes Safe for Seniors. Subjects were told to spend as much time as they needed using the program. The CD-ROM program included an interactive session simulating an Internet connection (i.e., subjects could select icons and interact as if they were surfing the net, although in fact they were “surfing” a computer representation of the net). Then, subjects completed Rating Scale A on the computer in which they were asked to rate the impact of the hardware and software design on their learning experience. Then, they took the 14-item Home Safety Program Quiz for the second time as a posttest.

**Group 2: The Traditional Learning Group.**—This group (n = 41) learned about home safety with traditional instructional materials. Members of this group were asked to look over three booklets of printed information on home safety for older adults that were placed on a table in front of them. The well-established educational booklets were produced and distributed by a well-known organization championing concerns of elderly people (AARP) and a government agency charged with fostering consumer safety. The booklets were as follows:


As with the multimedia group, subjects were encouraged to take as much time as they needed. After completing their task, this group took Rating Scale B to indicate their appraisal of the print-based learning materials followed by the administration of the 14-item Home Safety Program Quiz on the computer as a posttest.

**Group 3: Control Group.**—This group (n = 43) took the 14-item Home Safety Program Quiz, provided demographic data, and talked to a research assistant in an open-ended conversation in lieu of experiencing either of the two types of learning activities about home safety. The assistants were instructed to avoid the discussion of home safety issues with the subjects during the interview time. The discussions were timed to last approximately the same amount of time as the other two activities. Subjects were then asked to take the 14-item Home Safety Program Quiz as a posttest.

**Findings**

Although subjects were randomly allocated to test condition, the first step was to consider possible differences between the three groups. One of the ways in which all three groups could differ was on the amount of time each spent on their assigned task (i.e., talking to the research assistants, reading the booklets, and taking the experimental intervention). One-way analysis of variance (ANOVA) results indicated a significant group difference. A posteriori tests (Duncan’s Multiple Range, using harmonic mean of the group sizes because of unequal Ns) indicated that the control group was significantly lower (p = .05) than the other two groups, which themselves did not differ in the amount of time they spent on task. The controls spent an average of 10.14 minutes on task, compared with 16.15 minutes for the booklet group and 15.55 minutes for the multimedia group.

One-way ANOVAs were also calculated for group differences on age, education, ethnicity, and number of people living at the subject’s primary residence. The only difference that reached a statistically significant (p = .05) level was for number of people living at the residence. Duncan’s Multiple Range tests indicated that the control group (mean = 2.05)
had more people living at home than did the booklet (mean = 1.46) and CD-ROM (mean = 1.55) groups.

Research Questions and Hypothesis

Question 1.—How successful were subjects in using the interactive multimedia technology in learning about injury prevention?

Software/Hardware Interface. To provide experience with the computer technology, all 126 subjects used the touchscreen-driven software program when completing the Home Safety Program Quiz at pretest and posttest. The directions, the test items, and the response choices were narrated at the same time that words appeared on the screen. Each subject touched his or her answer to that question, and the screen advanced to the next item. Table 1 summarizes the observer ratings (i.e., by research assistants) for how subjects reacted at the pretest, when they were first confronted by the need to use the computer. It should be kept in mind that only a small percentage of subjects had ever used a computer.

As shown in Table 1, less than one fifth of the respondents demonstrated any hesitation about using the computer. Perhaps more importantly, there were no differences across experimental conditions in observed hesitation. A significant difference was found, however, in terms of whether subjects in the three groups promptly touched the screen to begin the testing. The multimedia and control group members were more likely than the booklet group to touch the screen without the need for prompting. Finally, with regard to whether subjects seemed uncomfortable with the speed of the program, there were no group differences: More than three fourths in all groups seemed to feel comfortable. At the same time, the fact that nearly 24% exhibited some discomfort with the pace of the programming (some found it too slow) suggests that our multimedia approach needs refinement!

Ratings by Observers on Information Access. Table 2 includes the observers’ ratings on seven variables tapping how readily the subjects used the multimedia and more traditional approaches to obtain information on home safety. Based on the unblinded observational ratings, the CD-ROM group seemed to fare slightly better in the ease of using the learning tool they were provided. Despite its unusual nature, they were rated as being less likely to need prompting or to ask for directions. This may be because of the organizational structure, voice prompts from the computer, and even the potentially more compelling nature of the learning tool itself. On the other hand, the booklet group was more likely to use their more familiar learning approach as expected.

Question 2.—How satisfied were subjects with the printed and computer-based learning materials that they were given?

Use of the CD-ROM Program. Participants in the multimedia group were asked to rate the program on nine different characteristics covered by the Home Safety Program Rating Scale A. Average scores on the 11-point scales suggested that

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental Group Averages and (SD)</th>
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<tbody>
<tr>
<td></td>
<td>Multimedia CD-ROM</td>
</tr>
<tr>
<td>Knows how to use menu (vs. table of contents)</td>
<td>1.66 (.48)</td>
</tr>
<tr>
<td>Uses appropriate method to find material*</td>
<td>1.76 (.43)</td>
</tr>
<tr>
<td>Doesn’t need prompts*</td>
<td>1.74 (.44)</td>
</tr>
<tr>
<td>Isn’t frustrated*</td>
<td>1.17 (.38)</td>
</tr>
<tr>
<td>Doesn’t ask for directions***</td>
<td>1.24 (.42)</td>
</tr>
<tr>
<td>Finds content on their own</td>
<td>1.67 (.48)</td>
</tr>
<tr>
<td>Uses as expected**</td>
<td>1.90 (.30)</td>
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*p = .10; **p = .05; ***p = .01.
the majority of subjects felt quite positive: (1) average overall satisfaction with technology = 8.66; (2) average satisfaction with using computer technology = 8.68; (3) average satisfaction with getting health-related information = 8.56; (4) average perceived ease of using touchscreen = 8.76; (5) average ease of using a computer for this type of learning = 9.05; (6) average ease of using the screen buttons to move around = 8.46; (7) average usefulness of connecting to the Internet = 8.05; (8) average rating of the artwork, pictures, and video clips = 9.05; and (9) average rating of the narration = 9.12.

An examination of the frequency distributions suggested that, for most of the items, only one person (of the 42 in this group) rated items lower than the midpoint on the various characteristics. The major exception was for item 7, regarding ease of their (simulated) access to the Internet. Here, four people (9.8%) rated the program between 1 and 4. Clearly then, refinement of the program in this area will require specific attention. In general, though, given the “rough-cut” nature of our multimedia program, we were very pleased with the level of satisfaction and acceptance.

Use of the Booklets. As might be expected, given that the booklets used for the “best practices” group were established products of large and well-financed agencies, the booklet group was quite satisfied with their experience. Four characteristics were rated, using the same 11-point scale as the multimedia rating. In contrast to the multimedia group, though, none of the averages were in the “nine” range: (1) average ease of getting information = 8.22; (2) average satisfaction with using the booklets = 8.42; (3) average rating of the artwork, pictures, and graphic examples = 8.78; and (4) average satisfaction with getting health-related information = 8.60.

The frequency distributions suggest that, whereas fewer people were very pleased with the booklets compared with satisfaction of multimedia users, fewer were in any way displeased. Two individuals (7.3%) gave a lower than midpoint score to one item: Satisfaction with using the booklets. However, given that the average score even in this case was 8.42, this does not represent a serious indictment of the booklets used.

Comparison of Satisfaction Ratings by the Multimedia and Traditional Learning Groups. Three of the variables used in the two groups were directly comparable (a rating of satisfaction with using the computer technology/booklets to learn, a rating of overall satisfaction in getting health-related information from the computer or booklet, and a rating of the contribution of the artwork). The two experimental conditions were compared using independent t tests. For each of the three analyses, as well as a fourth testing a summary total across all three comparable variables, the satisfaction score for the multimedia group was higher, but not significantly so (p > .05). In short, the multimedia program, despite its very unpolished and preliminary nature, held its own against well-established “best practices” material.

Software Tracking Program. One of the advantages of using a computer-based intervention such as our multimedia program is that the software can be designed to allow tracking of consumer responses while they are using the computer. This is an important feature because it enhances one’s capability for software development and refinement without requiring additional time and effort on the part of research (or facility/agency) staff. Subjects utilized the multimedia program in their own individual way, a very positive finding for any interactive program developer. This is the real beauty of presenting learners with a variety of choices and selections and allowing them to choose the priority or order of the items within the lesson. Even though the two modules were only a portion of the proposed final program, great variation in subject selections can still be seen. The Appendix shows sequential lists or “maps” of the learning activities (extracted directly from the Software Tracking Program file) for two subjects picked at random: Subject A is a female in her early 70s, and Subject B is a male in his mid to late 70s. The lists illustrate (1) the wide individual variation in the order of selections, (2) that selections were sometimes revisited by subjects who either want to review the material again (e.g., the rug with Subject A) or simply were interested in seeing the item again for their own personal reasons, and (3) no subject selected all items available in each area.

Use of the Internet was another area for which the project provided some information. Of the 42 subjects in the Multimedia CD-ROM group, only 4 (9.52%) had ever surfed the web before. During the testing session, 31 (73.81%) used the simulated link to the Internet, whereas 11 (26.19%) did not. The Internet portion of the program also revealed great variation in choices, with the frequency of site selection being as follows: MatureMart = 26, AARP.com = 10, SeniorNet = 7, AARPHouse = 5, Senior.com = 5, and Amazon.com = 3. The bottom line is that nearly three fourths of these subjects successfully performed actions on the multimedia computer that exactly replicated the actions they would have taken if actually accessing the various websites, despite the fact that few had previously used the Internet.

Test of the Hypothesis.—It was hypothesized that learning about home safety from an interactive multimedia CD-ROM program will have a greater effect on the subjects’ knowledge about injury prevention than will learning with printed booklets or learning with no structured intervention (controls).

To test the hypothesis, data from all 14 pretest condition knowledge variables were summated, and the same was done for the 14 posttest variables. A repeated-measures ANOVA was then run. Mean total
scores on knowledge acquisition by all 126 subjects are presented in Table 3. With regard to pretest results of all three groups, no overall differences between the three groups were found (Table 4). A significant ($p < .001$) time effect was found, but the reason seems to lie in the significant ($p < .003$) interaction of time and group. A posteriori tests showed that the control and booklet groups did not change significantly over time in scores, but the CD-ROM group increased significantly in their knowledge score from pretest to posttest.

**Discussion**

Multimedia-based technologies are being used with increasing frequency for individuals of all ages who are seeking health information (Wetle, 2002). This use is not restricted to young adults: According to one estimate, by 2010 upward of 70% of older Americans will be using the Internet (McConatha, 2002). The multimedia project described in this article examined an approach to patient and family education that has the potential to provide a highly adaptable and cost-effective adjunct to person-to-person health care interventions. Kiosks running multimedia programs with a touchscreen panel for example can be located in any setting that sees a reasonable number of elders: not only Senior Centers, but libraries, stores, shopping centers, clinics, and even—with the advent of touchscreen laptops—at a patient’s home or bedside. Computer-based multimedia has proven successful in meeting the educational needs of many groups, but until now has had limited use with the elders, perhaps because its high-tech nature may seem to obviate use with older, less technologically experienced, and often less educated clients. What little research exists has used relatively educated samples of elders (e.g., Kressig & Echt, 2002; Echt, 2002).

In our research, we deliberately selected as a sampling site a Senior Center whose participants were quite diverse with respect to education and literacy, and which included relatively high proportions of African and Hispanic Americans. Our intent was to discover whether the multimedia approach worked with those who have both the least experience with technology and the greatest need for intervention. In addition, because multimedia program development is a time-consuming undertaking, we also wished to learn more about acceptance of the overall technology before undertaking substantial and formal program production.

The research approach itself was relatively straightforward: a simple pre-/posttest design with two control groups. This design allowed us to (1) detect learning effects that might accrue from simple exposure to the knowledge test and (2) compare our innovation to best practices approaches that are available. Two findings are particularly relevant from a health intervention perspective, because according to Echt (2002), there is little published research concerning the effectiveness of traditional health information delivery services, compared with emerging technologies. First, results indicated that participants were at least as satisfied with the innovation prototype as with established interventions (the booklets). Second, the repeated-measures multivariate ANOVA supported our hypothesis: (1) the controls did not change at all; (2) the traditional best practices subjects improved but not significantly; and (3) the multimedia group improved significantly in their knowledge from pre- to posttest. Although the

<table>
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<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
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<th>SD</th>
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<td>Multimedia CD-ROM group</td>
<td>42</td>
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<td>1.94</td>
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<tr>
<td>Printed Booklets group</td>
<td>41</td>
<td>21.83</td>
<td>1.90</td>
<td>22.20</td>
<td>1.93</td>
</tr>
<tr>
<td>Control group</td>
<td>43</td>
<td>22.09</td>
<td>1.86</td>
<td>22.05</td>
<td>1.94</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>21.99</td>
<td>1.89</td>
<td>22.48</td>
<td>2.05</td>
</tr>
</tbody>
</table>

**Table 3. Scores on the Home Safety Program Quiz**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within cells</td>
<td>152.28</td>
<td>123</td>
<td>1.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>18.81</td>
<td>2</td>
<td>9.40</td>
<td>1.48</td>
<td>.233</td>
</tr>
<tr>
<td>Time</td>
<td>14.96</td>
<td>1</td>
<td>14.96</td>
<td>12.08</td>
<td>.001</td>
</tr>
<tr>
<td>Group × Time</td>
<td>15.45</td>
<td>2</td>
<td>7.73</td>
<td>6.24</td>
<td>.003</td>
</tr>
</tbody>
</table>

**Table 4. Repeated Multivariate Analysis of Variance Statistics for Total Knowledge Scores at Two Points in Time and Three Groups**

Notes: SS = sum of squares; df = degree of freedom; MS = mean square.
change for the multimedia group was relatively small, the fact that a very rough draft of the intervention program had any effect was encouraging.

Regarding participant satisfaction, this point is important because, as noted, there is a widespread misconception that older persons might be either afraid of or hostile to the involvement of high-technology approaches, or they might simply be unable to use such approaches. In fact, acceptance ratings by participants indicated a very positive stance with regard to utilization of the multimedia technology for learning about safety and other health-related issues. This finding replicates previous results obtained in a study that involved using touchscreen technology as a means of teaching elders about advance directives (Mercer et al., 1997). Our conclusion, which of course must be tempered by recognition that the satisfaction results might be influenced by social desirability and by the nonrandom nature of the sample, is that relatively disadvantaged elders have no trouble accepting touchscreen multimedia programs as an educational tool.

Not all the reactions were positive, of course, and from the more negative comments we learned what to avoid or to do in the future. For example, several subjects made spontaneous comments about the software interface and design. Others were critical of the artwork (for budgetary reasons, the artwork was relatively stark in the test module) and its placement on the screen and made suggestions for improving the clarity of the point that was being illustrated. One subject suggested that the program should not recommend replacing overly stuffed chairs: “You can change those chairs to make them firm [rather than replace them]. They cost like hell.” The same participant added practical advice: “Have the dial on the hot water heater pop out to display 125 degrees. Words or short sentences can be displayed in rooms to put emphasis on certain statements.” We have drawn on comments like these in designing a just-completed study of colors, fonts, navigational aids, and content that should form part of the final software program.

Regarding the improvement in knowledge that was exhibited only by the multimedia group, this becomes especially important because we were contrasting well-developed and established printed learning tools with a very rough draft of a multimedia tool. On the other hand, a major limitation of the study was that our posttest was administered immediately after the learning intervention or, in the case of controls, after talking to a research assistant about nonsafety topics. Because of the immediacy of the retest, we have no information on how long knowledge was retained or about whether accidents in the home were actually reduced. This limitation is about to be addressed in a separate longitudinal study using a revised software program, in which subjects will be followed for 6 months after the intervention.

Finally, we have already mentioned learning much from the spontaneous comments of participants, as recorded and logged by our research assistants. Not all these comments were about the program. The largest category of comments recorded in the logs, indeed, consisted of spontaneous statements about the participants’ own injuries. Descriptions of past injuries, comments about possible future injuries, and worry about home-based safety concerns and issues were mentioned frequently. The most frequent comment concerned falls, including the location where the falls occurred and the types of injuries sustained. Many mentioned smoke and carbon monoxide detectors and that they did not have one in their homes but now recognized they needed to get them. One subject mentioned falling over a dog at home, others mentioned electrical wire hazards in their homes, and a few commented about the hot water heater temperature setting. As a group, subjects viewed the content as very useful and meaningful to their lives. One said, “The Home Safety Program is good and easy to understand.” Another said, “The Home Safety Program is helpful and I want to learn it.” Another subject commented that he had fallen on a rug at home and because of this he went through the program twice. One subject said, “The Home Safety Program is very good. Seniors should know about home safety.” We definitely agree!

References


Appendix

*Sites viewed by two subjects, as identified by the software tracking program*

**Subject A** (Female Aged 70–74)

Geriatric Safety Main Menu
Identifying Safety Hazards Menu
Entry of House
Clutter on Stairs
Rug
Light by the Door
Hot Water Heater
Smoke Detector
Night Light
Back to Identifying Safety Hazards Menu
Living Room
Rug
Chair
Lamp
Electrical Cord
Fireplace
Couch
Back to Identifying Safety Hazards Menu
Geriatric Safety Main Menu
Preventing Injuries Menu
Geriatric Safety Main Menu
Return to Main Menu
Increase Safety Level Menu
Geriatric Safety Main Menu
Exit Menu
Internet Site: Links for Safety Info; AARP.com; AARPHouse.com
Exit Program

**Subject B** (Male Aged 75–79)

Geriatric Safety Main Menu
Preventing Injuries Menu
Return to Main Menu
Geriatric Safety Main Menu
Identifying Safety Hazards Menu
Living Room
Chair
Rug
Couch
Lamp
Electrical Cord
Fireplace
Back to Identifying Safety Hazards Menu
Entry
Rug
Clutter on Stairs
Hot Water Heater
Smoke Detector
Go Back to Identifying Safety Hazards Menu
Exit
Rug
Clutter on Stairs
Smoke Detector
Back to Identifying Safety Hazards Menu
Living Room
Rug
Fireplace
Lamp
Electrical Cord
Couch
Back to Identifying Safety Hazards Menu
Geriatric Safety Main Menu
Increase Safety Level Menu
Shopping for Safety Devices
Main Menu Icons
Geriatric Safety Menu
Exit Menu
Exit Program