EFFECTIVENESS OF AUDIO AND VISUAL TRAINING PRESENTATION MODES FOR GLUCOMETER CALIBRATION

Anne C. McLaughlin, Wendy A. Rogers, & Arthur D. Fisk
Georgia Institute of Technology
Atlanta, Georgia

This experiment investigated whether different presentation modes of instructional materials are differentially effective for older and younger adults learning to calibrate a glucometer. Glucometers are complex and require serial, sequential steps to calibrate them successfully. Some previous studies have failed to find a difference for older adults between instructions presented via audio and instructions presented with both audio and video (e.g. Stine, Wingfield & Myers, 1990); others have even found audio superior to video for presentation of instructions (Meline, 1976; Hale, 1998). In the current study, 12 older and 12 younger adults each received one type of training (audio or audio plus video) then were instructed to calibrate the glucometer using the information they received in the training. Overall, the presentation mode the groups received did affect their performance when later using the device, showing that for complex, sequential, spatial tasks, the addition of video to audio instructions improves performance for both younger and older adults.

INTRODUCTION

One might at first believe that video instruction would always produce better performance than audio instruction. Common sense might predict that using video plus audio is better than audio by itself because with video there is no need to imagine procedures involved in a task. The literature, however, tells a mixed story. Experiments evaluating instructional effects as a function of media type yield conflicting results. Audio plus video instructions sometimes produce better performance (Boyle, Anderson, & Newlands, 1994; Veinott, Olson, Olson, & Fu, 1999), sometimes performance is equivalent to audio only (Anderson, Newlands, Mullin, Fleming, Doherty-Sneddon, &Van der Velden, 1996; Doherty-Sneddon, Anderson, O'Malley, Langton, Garrod, & Bruce, 1997; Raphael & Wagner, 1974), and sometimes audio instructions are superior to audio plus video instructions (Hale, 1998; Meline, 1976).

The dissent over audio and video instructions in the literature is likely due to methodological as well as conceptual issues. Many of the studies cited earlier used tasks such as problem solving or memory tasks which are not tasks that take advantage of the differences video has to offer. Moreover, asking if one media type is "better" than another is not asking a useful question. Comparisons of audio alone versus video will not be fruitful: each medium displays different information. The critical question researchers should be asking is under what conditions is a certain presentation medium better and for whom. Answers to these questions will form productive guidelines to those developing instructional materials.

One field in need of such guidelines is that of medical device design and training. This is an area where the delivery of asynchronous training is not uncommon. Video or audio tapes are often used to instruct patients on how to use and/or assemble medical devices. One example of a prescribed medical device is a glucometer, used by people with diabetes to measure the glucose levels in their blood and adjust their diet or medication accordingly. In many cases, people develop diabetes when they are older, which means that they need to learn to use this device as an older adult. Glucometers often come with video tapes which instruct the users on how and when to use the meter. Use of this device can be a matter of life or death, and it is important that the device itself be calibrated correctly.

Even the initial calibration of a glucometer is a complex spatial task that consists of 24 sequential steps (Rogers, Mykityshyn, Campbell, &

Fisk, 2001). This task has requirements (complexity, spatial ability, sequential steps) that are particularly well-suited to testing the possible advantages of video instruction. In particular, we hoped to gain insight into what types of task benefit most from video instruction and to begin to define guidelines as to when the use of more expensive video instruction is most appropriate. Our desire is to optimize instruction, information, and media presentation type so that patients will use the glucometer correctly.

For this experiment, we hypothesized that glucometer calibration performance of older and younger adults would be differentially affected by the type of training media; specifically, that the calibration task would bring out the expected benefits of video more for older adults than for younger adults. This prediction is based on findings that older adults can handle less cognitive load (Bäckman, Small, & Wahlin, 2001), benefit from environmental support (Nichols, 2001), and decreased working memory ability (Bäckman, Small, & Wahlin, 2001).

METHOD

Participants

Twelve older (aged 65 to 80, mean age = 73.7 years, SE = 1.58) and 12 young (aged 19 to 22, mean age = 21.1 years, SE = .26) adults participated in this study. Older participants were compensated $25 for their time. The younger participants were undergraduate students at the Georgia Institute of Technology and received course credit. All participants were native English speakers and screened prior to the experiment to ensure that they had never before used a glucometer.

Materials

The participants performed three calibration procedures on a glucometer: coding the meter, using a check strip to check the meter, and performing a glucose control solution test.

The glucometer consisted of several parts, the meter itself, a vial of test strips, one plastic check strip, and a bottle of glucose control solution. A videotape of training to calibrate a glucometer was used for this study. This videotape was developed locally (Mykityshyn, Fisk, & Rogers, in press). Participants in the audio only condition heard the videotape but did not see the screen. A scoring sheet developed for the calibration tasks was used to code the steps performed in the calibration, the order of the steps, errors, and the time to complete the tasks. All participants were videotaped during the trials to enable the experimenter to review and make sure the scoring sheet was coded correctly.

Each participant was screened for 20/40 vision or better via the Snellen eye chart and acceptable hearing via an audiometer. Other materials included an initial demographics survey, a written exit interview, and a knowledge test of the blood glucose calibration procedure administered at the end of the study.

Procedure

Participants were given general instructions about the study, namely that they would receive instruction on how to calibrate a glucometer either via audio or audio plus video and would then perform the calibration. They were told this would be repeated a total of three times.

Participants then watched or listened to the instructional tape and then rated their confidence in performing the calibration. Then they performed the three procedures in order when instructed by the experimenter. The experimenter recorded the time to complete each procedure using a stopwatch and recorded the steps and errors of the participant. When the participant finished the three calibration procedures, he or she watched or heard the videotape again. These steps were repeated three times.

RESULTS

Participants completed three calibrations over the course of the study, plotted on the X axis as "trial"(Figure 1). Between each trial they received the training again.

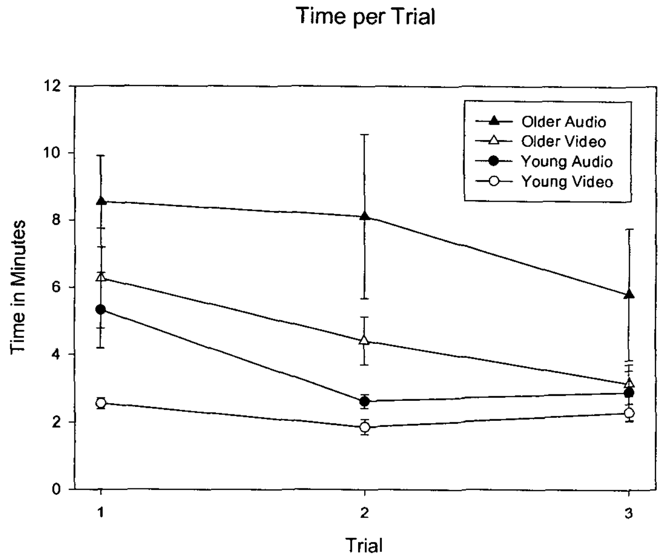

Figure 1. Time per trial. Bars represent standard error.

An Age (young, older) x Media Type (audio, audio plus video) x Trial (1, 2, 3) ANOVA performed on time per trial yielded a significant main effect of media, $F(1, 10) = 7.15, p < .05$, Age, $F(1, 10) = 15.5, p < .01$, and Trial, $F(1, 10) = 4.13, p < .05$. For the younger and older adults, participants in the video condition performed the calibrations more quickly on all trials. Older adults took longer to complete the calibrations. However, there was no interaction of age x media type *($p > .05$)*; older and younger adults benefited equally from the addition of video.

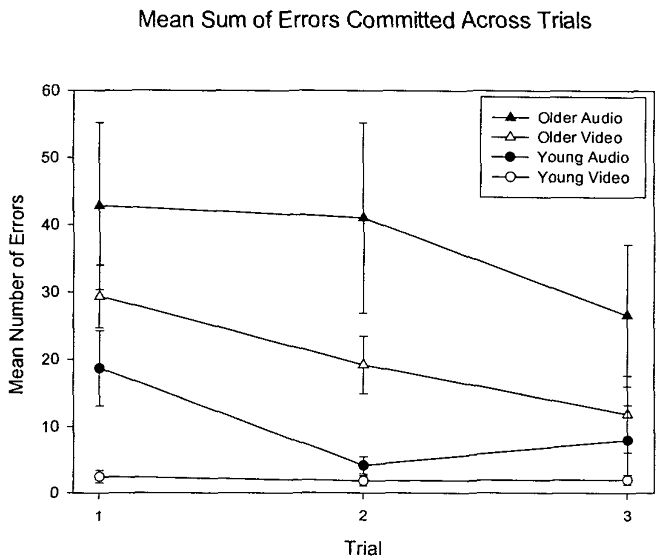

Figure 2. Mean sum of errors committed across trials. Bars represent standard error.

An Age (young, older) x Media Type (audio, audio plus video) x Trial (1, 2, 3) ANOVA performed on sums of errors yielded a significant main effect of media, $F(1, 10) = 6.35, p < .05$, Age, $F(1, 10) = 20.41, p < .01$) and Trial, $F(1, 10) = 3.28, p < .05$. Older and younger adults in the video condition had fewer errors than those in the audio condition (Figure 2). There was no interaction of age x media type ($p > .05$). Participants did not make differential errors according to the training they received.

DISCUSSION

From a human factors perspective, knowing what type of instruction to provide will go a long way toward producing accurate performance on asynchronously trained tasks. There are, of course, other factors affecting compliance, such as motivation and attitude, but once we outline the types of task for which video or audio training is more beneficial, training will not fail because of the type of instruction provided.

Most likely, previous studies found conflicting results because they did not identify or classify the tasks for which one presentation mode or the other would be beneficial. This study first explored the nature of the task and hypothesized whether performance could be improved via video instruction based on task specifics. This moves the literature a step forward in the quest for an understanding of when and for whom it is better to instruct via audio plus video. Our hypothesis was maintained by our findings that video helped with this task because it facilitated knowledge in a task required spatial visualization. When the task is complex, sequential, and spatial in nature, both younger and older adults benefit from the addition of video to audio instructions. Tasks that might fall under this umbrella include navigation, car repair, and certainly the calibration of a glucometer. Given such a task, instruction should be provided via audio plus video.

We did not find an interaction of age and media type as we expected. We thought that providing video in this task for older adults would show a greater benefit for them, as it seems to capitalize on the deficiencies older adults commonly experience. However, older and younger adults were affected similarly by the media types. We conclude from this finding that the video supported only some aspects of performance on the task (e.g. spatial orientation of system parts). However, this complex task had other components such as memory demands that were not supported by the video.

It is true that the video instructions were made with the benefits of video in mind; that is, they clearly demonstrated what was to be done with the meter by pointing out features and buttons. One might argue it was the quality of the instruction that caused the effect, perhaps because the audio instructions made mention of buttons not shown to the participant. Other research suggests this is not so. Sierra (in press) found in a similar study that though the quality of the instruction mediated the benefit of video, the best and poorest instructions showed the same effect.

Future research should investigate more types of tasks, such as memory tasks and also outline tasks where the more inexpensive medium of audio is as good as or better than audio plus video.

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