# The Impact of Spoken Instructions on Learner Behavior Following Multimedia Tutorial Instruction

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## Abstract

*The choice of what to include in educational software is an issue with which instructional designers are regularly concerned. Multimedia capacity, standard on today's desktop computers, gives designers the opportunity to provide learners a more exciting learning experience than simply looking, clicking, and then looking some more. One feature that can make multimedia software different than such conventional media as books is the technological capacity to include sound. This capacity is already available to educational software developers regardless of whether they are producing instruction in fixed media or networked form. Recent interest in the use of sound to enhance learning (Bishop and Cates, 2001a) suggests, however, that although there is reason to believe that sound can enhance learning, that sound is used infrequently.*

*One reason given for the scarcity of software that incorporates sound is a lack of experimental evidence indicating a significant learning improvement when sound is present. While some experimental evidence supports combining sound with other media (Lai, 2000; Moreno & Mayer, 2000; Nocente, 1996), few experiments have directly compared textual and spoken presentations while maintaining content and visual information. For instructional designers seeking to accommodate different learning preferences by offering products that facilitate multiple learning modalities, or for those seeking to accommodate learners with reading or visual impairment, it makes sense to examine whether learning by listening can match or surpass learning by reading.*

*This paper presents a different point of view. Instead of looking for significant learning improvements in the presence of sound, it looks instead at differences in the ways learners behave when sound is introduced. With this kind of information, it becomes possible to plan to take advantage of the strengths of sound for accomplishing different parts of the instructional mission.*

*Another reason that sound is not often included in educational software is that it simply costs more in terms of time, money, and computer resources to include it than to leave it out. Sound is an investment that can only weakly point to learning improvement, and then usually only in combination with other interventions. So, unless it can be shown that sound can lead to some kind of improvement in learning, there is little reason to include it.*

*This paper investigates the effect of sound as a presentation modality on the way students review procedures learned at the moment the procedures are first being applied. It reports on a series of three experiments conducted at various times in the one and a half years before October of 2004. The findings of each experiment generated the questions investigated in subsequent experiments, with the result that the experiments form a series. The outcome of the series is that there appears to be an effect on student reviewing habits that is influenced by the modality in which the review material is presented. This takes the form of a preference for listening to the presentation when the desire to complete the task makes it important to know how it is done and when learning on the first time through was incomplete.*

## Introduction

As educators, we'd like to make learning more likely to occur for our students. We introduce educational software in the hope that it will be instrumental in bringing about the changes that we identify with learning having taken place. The changes frequently take the form of increases in the ability to provide answers to questions about some aspect or aspects of the subject matter of the instruction. In other cases, the changes we seek to bring about are new or improved proficiencies in the performances of various tasks. When the learning we desire falls into this latter category, it makes little sense to measure it as if it were the ability to answer questions. If we wish to measure the ability to perform procedures, we need to measure how well or frequently the procedures are performed after the learning experience.

When we teach people to perform tasks in the context of using computer programs, their learning is rightly measured by setting up the conditions in which the tasks are performed and turning the learners loose to do what they've been taught. A suggestion that learning hasn't taken place because the learners are unable to answer some questions is irrelevant to the purpose for which the instruction was undertaken in the first place.

A perennial discussion in Educational Technology classes is about whether media choices impact learning. Richard Clark's (1981) claim that the media that delivers content has no influence on the learning of that content is substantiated by a meta-analysis that is based on a shortage of consistent valid studies that, in some way, show that any one delivery medium outperforms any other delivery medium at delivering the same content. A set of studies I conducted comparing a spoken with a textually presented lesson is subject to the same criticism. But by shifting attention away from learning and focusing on behaviors, they provide a small amount of evidence that media influences how students act in the light of learning without showing that they learn more from one medium than the other.

There exists with any procedural learning a brief instant in which the learning of the procedure is completed and the application of the procedure is not yet tried. This is a moment in which we hope that the learning we have been anticipating has, indeed, been produced. If, for instance, a learner is instructed in the business of tying knots and is then handed a rope, the time interval between when the rope is introduced and the first knot is tied is a moment of hopefulness. What the learner does at this moment is an indication of the effectiveness of what we have put forward as a learning experience. The studies I conducted all share an examination of this moment after the textual or auditory learning experience has taken place. They do so in the belief that a difference in what the learner does at this point is as surely a difference in learning as a difference in outcome examination scores.

## Experiment 1

In the first study, each of 29 educational technology undergraduate students completed one of three versions of an interactive software tutorial before attempting to apply the learned procedure. The three treatments differed by presenting the instructions for the procedure only with text, only with spoken audio, or with an available choice between text and audio. At the end of the lesson about recording sentences and arranging them so that clicking a hidden button activated them, many students concluded the lesson with a sense of having forgotten the earlier parts of the procedure while learning the later parts. It was clear that being able to go back into the material to review it was a feature that many students expected. The option of reviewing was not yet included in the design of the software at the time. Because the students were intent on succeeding with the procedure, they followed a path to review the material by reopening the tutorial program. They were completely unaware that a timer was running in the original tutorial program to monitor their performance over time. When they re-opened the program, they reset the timer. The experiment, for all practical purposes, was useless. But I didn't know this until I talked with the students a week later.

In the intervening week, analysis of the data pointed in the direction of concluding that the reading-only treatment resulted in a higher number of procedure completions than the listening-only treatment. When I approached the students with this result, students in the listening-only version suggested two plausible explanations. The first was that as college students, they were in a group for whom reading was a well-executed strategy for learning. They felt that there is a natural progression from listening to reading modality built into the structure of academic institutions. In other words, college admissions and retention naturally select strong reading skill as a trait.

The other explanation was that the reading version students appeared to have more time. This was not a part of the design of the experiment, and clearly invalidated any conclusions that could be reached about how the treatments affected performance. But it appeared that many more of the students randomly assigned to learn by reading made efforts to review when compared with those randomly assigned to learn by listening. 21 students were in these two groups. The other 8 were in the switchable version of the software. Of 11 students who were assigned to learn by listening, only 2 initiated procedures to review the program. On the other hand, 7 of the 10 assigned to learn by reading initiated procedures to review. The distribution of students to groups and their tendency to reset the timer is shown in table 1. Chi-Square analysis of data related to this phenomenon, and shown in table 1, indicates that the likelihood that chance could account for this difference is less than .05. (Chi-Square = 5.47, Asymp. Sig. = .019)

Table 1: *Students who reset the timer by unanticipated reviewing*

| Version | N | Students resetting timer | Anticipated # resetting timer |
|---|---|---|---|
| Reading | 10 | 7 | 4.5 |
| Spoken | 11 | 2 | 4.5 |
| Switchable | 8 | NA | |

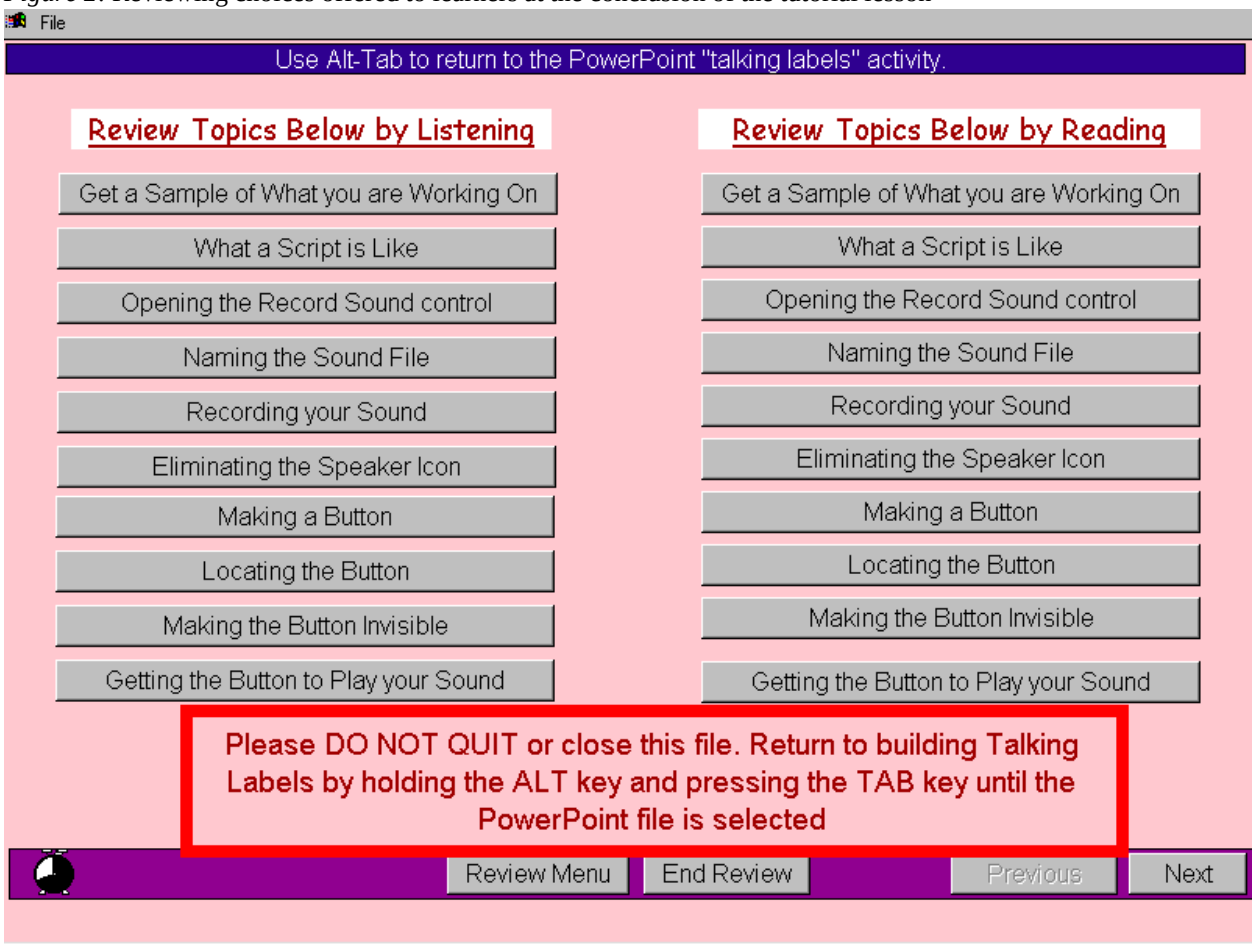
There was no reason not to notice that while students in either treatment group had equal opportunity to reset the program timer by attempting to review, nearly all students who did so had experienced the reading modality treatment. The ability to review by going back to the presented text is a natural affordance of reading - something we expect to be able to do. Although we have the technological means to do so, when we hear a speaker talk, we do not expect to be able to recapture what we heard in other instances. This is a major difference between a temporal medium like speech and a non-temporal medium like printed text. The use of a non-temporal medium leads to a stronger expectation that reviewing is supposed to be allowed.

## Experiment 2

The second experiment arose from the first explanation that college students were a selected group of strong readers who would naturally favor learning by reading. It sought to investigate the effect reading level had on learning from different modalities. Studies conducted by the US Department of Education in the 1970s (Taylor, 1972) established the general guideline that children favor listening over reading as a learning modality through the 6$^{th}$ grade. Beyond this age, high levels of practice with the encoding and decoding of text make text a more efficient learning modality, and one that most learners prefer because they can learn more quickly by reading rather than by listening. Because 7$^{th}$ graders were thought to be near the transition point where text becomes the dominant modality, I felt that they were likely to still regard learning by listening in a favorable light. This experiment set out to compare modality effects in two populations, one of college undergraduate students and the other of 7$^{th}$ graders. The expected learning superiority of undergraduates showed up and was significant. But what was being measured was the relative advantage of the listening modality between groups. Although the 7$^{th}$ graders measured showed a higher mean benefit from the listening modality than did the undergraduates, this difference failed to reach a significant level.

The software used for this experiment had been modified from the previous version to keep track of reviewing habits. At the conclusion of the tutorial, the user was informed that there was access to a way to review while engaged in the task. This way to review exposed both the listening and reading modality material to the learner. The reviewing choices offered to students are shown in figure 1.

*Figure 2:* Reviewing choices offered to learners at the conclusion of the tutorial lesson




Learners who had leamed by reading could choose, if they wished, to review in the listening mode. Similarly, learners in the listening modality treatment group could, if they desired, choose to review by reading their previous instruction as text on a screen. Because of the exposure to the alternative presentation modality in the reviewing mode, the rate at which the task was performed after the tutorial could not be attributed to the mode in which it was presented. However, the entire group of students who used the reviewing feature at all, regardless of whether they were part of the 7$^{th}$ grade or the undergraduate population, chose to review the majority of the time in the listening modality. Data related to this phenomenon is shown in table 2. The choice to do most of the reviewing as a listening experience was significant at the pre-determined alpha = .1 level.

Table 2: *Reviewing choices made by reading level*

| Reading Level | N | LM Chosen | RM Chosen | Chi-square | Asymp. Sig. |
|---|---|---|---|---|---|
| Below Median | 14 | 10 | 4 | 2.571 | .109 |
| Above Median | 18 | 11 | 7 | .889 | .346 |
| Total | 32 | 21 | 11 | 3.125 | .077* |

* Significant at $\forall$ <.10

## Experiment 3

Because of a low confidence in the previous finding, I replicated the previous study. 25 undergraduate students enrolled in an introductory educational technology course completed a tutorial designed to teach them the same linear label-making procedure. As before, at the completion of the tutorial, they were given a scenario in which they were asked to complete the task multiple times. As they began the tas k, they were also instructed

that they could review by looking at the original program. The reviewing menu (Figure 1) consisted of two lists of all the available steps in the procedure, one of which was in a column indicating that they could re-read the step, the other of which was in a column indicating that they could listen to the step. So a choice of reviewing presentation mode was always offered to students at the time they needed to retrieve procedure information. Of the 25 students who completed the project, 17 reviewed while engaged in the task. 14 of the 17 conducted the majority of their reviewing of the procedure's steps in the listening modality (Chi-Square = 7.118, Asymp. Sig. = .008). This result is shown in table 3.

Table 3: *Favored (majority) reviewing modality used by student*

| | | N | Reading | Listening |
|---|---|---|---|---|
| Completed Presentation in Switchable Modality | | 25 | | |
| | Favored for Reviewing | 17 | 3 | 14 |
| | Initially Chosen for Reviewing | 17 | 1 | 16 |

Because the learners could freely choose between listening and reading mode presentations while they reviewed, their initial choice of reviewing modality may not have coincided with their majority choice. The initial choice to review in the listening modality occurred 16 of the 17 times that reviewing occurred (Chi-Square =13.235, Asymp. Sig. = .000). Regardless of the path they chose for going through the tutorial, at the point where they first sought help before beginning to apply their knowledge, their choice was consistently to have somebody tell them how something is done rather than read how something is done.

## Discussion

Does the media have an impact on the learning experience? Robert Kozma (1991), in responding to Clark claimed that media are an integral part of the design process. He elaborated that the whole instructional package is designed to include specific media because the designers anticipate the user acting and reacting with that media. Reviewing at the beginning of the task is a critical point where the interaction of the user and the media takes place. Hannifin and Land (1997) advocated using technology to give students choices in their learning process. The choice of how reviewing material is to be presented is a choice that can be included and uses the capacity of multimedia to facilitate review.

At the end of a tutorial about a computer procedure, the best guarantee that the student has learned the procedure is to observe the procedure being put into action without further guidance. Unfortunately, students do not always end the tutorial with sufficient confidence to expect to complete the procedure successfully. Reminders at the point where the procedure is being applied can be helpful. Such reminders can take may different forms. Job aids, for instance, exist for the sake of reminding performers what they already know but may not immediately remember.

When a computerized tutorial is immediately followed by a computerized task, the learner is being asked to demonstrate the learning in the exact environment where the learning took place. This is why computerized multimedia learning is an ideal teaching tool for teaching computer-related procedures. Except for possible savings of computer memory – which by now is a non-issue – there is little reason to close the tutorial. Keeping it open makes it convenient as a support to the performance just learned. In effect, the learning material switches its function to that of an electronic performance support tool. And at the point where this switch occurs, learners consistently choose to have the instruction presented to them in auditory form.

Students in the classes concerned, when asked for their opinions about why these results were obtained, offered very few potential answers. Among the suggested explanations was a greater sense of security with a speaking voice. We ought not to forget that language is a spoken representation of the phenomena observed in reality, and printed text is an abbreviated form of language. Text gains its non-temporal advantages at a cost of leaving out inflection and accent. It appears, from the results obtained, that when students want critical small bits of the information about a procedure they just learned, they want it in a way that delivers as much of the meaning as possible.

## References

Bishop, M. J. & Cates, W. M., 2001, A framework for researching sound's use in multimedia instruction to enhance learning, Paper presented at American Educational Research Association, Seattle, WA, ERIC document #ED453243

Hannafin, M. J. & Land, S. M., (1997), The foundations and assumptions of technology-enhanced student - centered learning environments. Instructional Science, 25, 167 - 202

Lai, S., (2000), Influence of Audio Visual Illustration on learning abstract concepts. Journal of Instructional Media, 27(2), 199-206

Mann, B. L., (1998), Shifting attention in multimedia: Stochastic roles, design principles and the SSF model. Innovations in Education and Training International, 34(3), 174-187

Moreno, R. & Mayer, R. E., (2000), A Coherence Effect in Multimedia Learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. Journal of Educational Psychology, 92(1), 117-125

Nocente, N. M., 1996, The effects of digitized voice and learner characteristics on learning trigonometry with CAI. Dissertation: University of Toronto. AAT: NN11974

Tripp, S.D. & Roby, W. B.,(1996), Chapter 28, Auditory Presentations and Language Laboratories. In David H. Jonassen (ed.), Handbook of Educational Technology, 1996: Simon and Schuster. Online at: https://www.aect.org/Intranet/Publications/edtech/28/28-07.html