

2006-852: TESTING THE EFFECT OF SENTENCE HEADLINES IN TEACHING SLIDES

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Testing the Effect of Sentence Headlines in Teaching Slides

Abstract

For the teaching slides in engineering and science classes, instructors often follow the defaults of Microsoft PowerPoint and choose a single word or short phrase as the headline. This paper challenges that practice with experimental evidence showing that a different design using a succinct sentence headline to identify the main assertion of a slide leads to statistically significant increases in the transfer and retention of that assertion. The experimental tests occurred in a large, lecture-based geoscience course that typically had 200 students per section. For the study, the same instructor, during five class periods, used about 100 slides with mostly phrase headlines to communicate the information to two sections of students and then used the same number of slides with succinct sentence headlines to communicate the same information to two additional sections. In the slide transformations, other changes occurred such as typographical changes and conversions of bullet lists to more visual evidence. However, for the fifteen slide transformations considered in this study, the principal change was the conversion of a traditional headline to a succinct sentence headline. For example, in one transformation, the phrase headline *Placer Deposits* in the original slide was changed to *Placer deposits arise from erosion of lode deposits* in the transformed slide.

When asked to recall the main assertions of slides, the students in the sections taught with the sentence-headline slides had significantly higher recall. For the fifteen questions in the study, the average score for the students viewing the sentence-headline slides was 79% correct, while the average for the students viewing the traditional slides was only 69% correct. A chi-square analysis shows that this difference is statistically significant at the 0.001 significance level.

On seven of the fifteen questions, the students in the section with the sentence-headline slides achieved statistically significant higher scores (three at the 0.001 significance level, three at the 0.005 significance level, and one at the 0.025 significance level), while on only two questions did these same students achieve lower test scores that were statistically significant (both at the 0.01 significance level). In this classroom situation, all four sections of students not only viewed the slides during class, but also had access to the slides as notes after the presentation. The results of these tests have implications in the way that educators design not only their teaching slides, but also their research slides.

Introduction

The typography and layout defaults of Microsoft PowerPoint, which has 95 percent of the market share for presentation slide software [1], compel presenters to create headlines that are single words or short phrases. Not surprisingly, in a typical

PowerPoint presentation, the main assertion of each slide is relegated to appear in the body of the slide. For those creating slides in presentations, the question then arises: Is such a design the most effective at having the audience retain the main assertion of the slide?

According to Robert Perry of Hughes Aircraft and Larry Gottlieb [2] of Lawrence Livermore National Laboratory, the answer is “no.” Since the 1960s, Perry has argued for a succinct sentence headline on presentation slides. Following Perry’s lead, Gottlieb has come to the same conclusion at Lawrence Livermore Laboratory. Although the sentence-headline design is the standard at Lawrence Livermore Laboratory, the design is seldom used outside of that laboratory. In *The Craft of Scientific Presentations*, Alley [3] presented an argument for using succinct sentence headlines. More recently, Jean-luc Doumont [4] and Cliff Atkinson [5] have supported the use of such headlines.

Sentence headlines have several main advantages over phrase headlines [6]. First, a sentence headline such as *Placer deposits arise from erosion of lode deposits* orients the audience much more effectively to the purpose of the slide than does a phrase headline such as *Placer Deposits*. Second, using sentence headlines allows the presenter to emphasize the most important detail of the slide. Third, if well chosen, sentence headlines present the audience with the key assertions and assumptions of the presentation. Explicitly stating these assertions and assumptions in a technical presentation is advantageous because audiences are more inclined to believe the argument of the presentation if they comprehend the assertions and assumptions of that argument [7]. Finally, once the headline assertion has been determined, the presenter is in a much better position to select persuasive evidence to support that assertion.

This paper presents an experimental study on the effect of sentence headlines in four sections of a large geoscience course that typically had 200 students in each section. In the study, the four different sections of students were taught the same information from the same instructor, with the only difference being the design of the teaching slides.

Of the four sections of students, two sections viewed the information from slides that used mostly phrase headlines (note that some of these original headlines were formatted as questions, and a few slides did not have any headlines). The remaining two sections viewed the same information from slides that used succinct sentence headlines. In the slide transformations, other changes occurred such as typographical changes and conversions of bullet lists to more visual evidence. However, for the fifteen slide transformations considered in this study, the principal change was the conversion of a traditional headline to a succinct sentence headline.

After each class period, all four sections of students had access to copies of the slides that the instructor had projected. Then after the five class periods, the students were asked to recall a set of assertions from those slides. For those in the two sections taught from the traditionally designed slides, the assertions resided in bodies of the slides, while for the students in the sentence-headline sections, the same assertions resided in the sentence headlines of the slides. The course’s final examination, which occurred a few days after the final class period, served as the recall test.

This case of an audience viewing a set of slides and then having access to those slides as a set of notes is common in engineering and science classes, and the results

presented here have implications in the way that instructors should design teaching slides. For instance, if the students who were taught from the slides with the sentence headlines recalled significantly more information than those students who were taught from slides with phrase, question, or no headlines, then instructors should consider using sentence-headline designs. In such a case, given that the overwhelming majority of instructors currently use short phrase headlines, the increase in the amount of technical information communicated in engineering and science could be large.

The next section of this paper describes the design of the study. Included in this section is a justification of the particular sentence-headline design selected for the study, the control method used to assess the relative strengths of the four student groups, and a key assumption about the tests. Following this section are the results of the study. At the heart of this section is an explanation, from a communication perspective, of why the students who viewed the sentence headlines recalled the key assertions of the slides at levels that were different from those who viewed slides with phrase, question, or no headlines.

Experimental Methods

This study considered the effect on audience retention of using a sentence-headline design for the teaching slides in a large geoscience course at Virginia Tech. The course was an introductory course that discussed the origin, distribution, and use of the earth's mineral resources. Because the course satisfied one of the university's general education requirements, it was a popular course for non-majors, attracting students from all branches of science and engineering as well as those from liberal arts, agriculture, and business. The course was excellent for this pilot study because the instructor used computer-generated projections of slides as the principal visual aid in most class periods. For that reason, the slides played an important role in the instruction. Other reasons that the course was excellent for this study were that the examinations had multiple-choice questions, the students took examinations on sheets that could be computer scored, and the instructor had examinations graded through the university testing center, where much historical data exists on the results of prior examinations. Given that, we were able to extract statistics directly linking test questions to presentation slides from earlier semesters. Shown in Figure 1 is a visual depiction of how the study was performed.

For the study, we transformed about 100 teaching slides from the fourth and final portion of the course to the sentence-headline design. Not all the transformations involved the same types of changes. In the instructor's original design of slides, about 80 percent of the slides had phrase headlines—the remaining 20 percent either had no headlines or had headlines written as questions. In the transformed versions, 100 percent of the slides, except for the title slide of each class period, contained succinct sentence headlines.

In addition, about 40 percent of the original slides consisted of the traditional bullet list in the body, with the remaining 60 percent having at least one image. In the transformed versions, 100 percent had the evidence of its slide bodies presented in a visual way without any bullet lists being used. No doubt these visual changes to the slide bodies affected audience recall [8]. However, *for the fifteen slide transformations tested*

for this study, the principal change was the conversion to a succinct sentence headline. Moreover, for those fifteen transformed slides, the assertions that the students had to recall resided in the sentence headlines, while for the corresponding traditional slides, those assertions resided in the bodies of the slides.

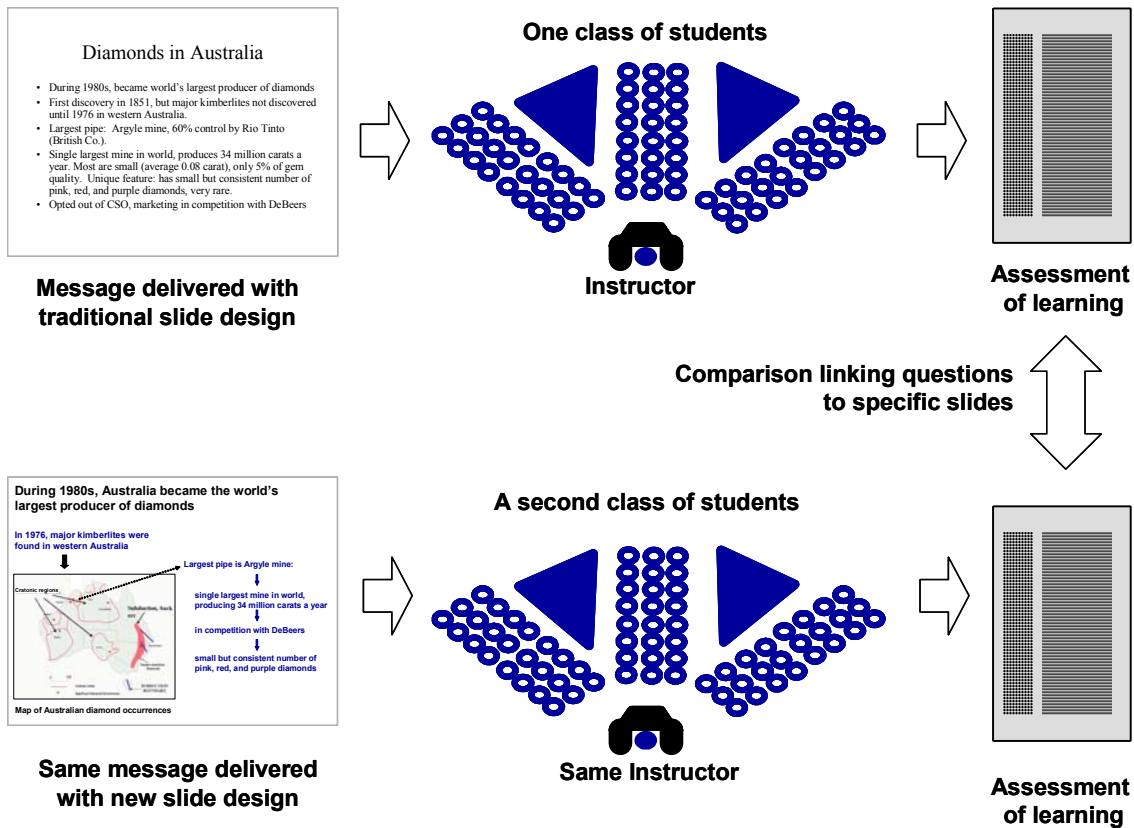


Figure 1. Visual depiction of the strategy for the study. The isolated difference between the presentations of the information was the design of the slides.

Using the transformed slides, the instructor taught the classes in the same way that she had done in past semesters. Of particular importance, as she had done in past semesters and in the other lectures that semester, she posted her slides on the web so that students could download the slides after the lectures to use as study aids.

Justification of Selected Design. The sentence-headline design chosen for this study has achieved much anecdotal success [6]. One feature of this design is its set of specific guidelines for typography [9]. For instance, one such guideline is that the sentence headline be restricted to no more than two lines. This guideline agrees with Doumont's recommendation for text blocks on a presentation slide [4]. A second typography guideline is the use of a bold sans serif typeface for the headline. This guideline arose from our own observation that a boldface sans serif typeface is easier to read, in a large room, than either a normal sans serif or a normal or boldface serif formatted *at the same type size*. In assessing the ease of reading for different typefaces in the room, we positioned ourselves both at the back-row seats most distant from the screen

and at the front-row seats with the sharpest angles to the screen. Yet a third typography guideline is left justifying the headline with a beginning position in the upper left corner of the slide. This guideline agrees with the recommendations of Gottlieb for sentence headlines [2].

A second feature of the slide design chosen for this study is that the headline be supported by visual evidence, as opposed to a bullet list. This aspect agrees with one of Richard Mayer’s principles for multimedia [10]—namely, that students learn better from words and representative images than from words alone. The slide design chosen for our study also follows two more of Mayer’s principles: (1) that students learn better when images are placed near rather than far from the corresponding text; and (2) that students learn better when images and corresponding text are presented simultaneously rather than successively. The slides of Figure 2 show the differences between the traditional design (left) and the sentence-headline design selected for this study (right).

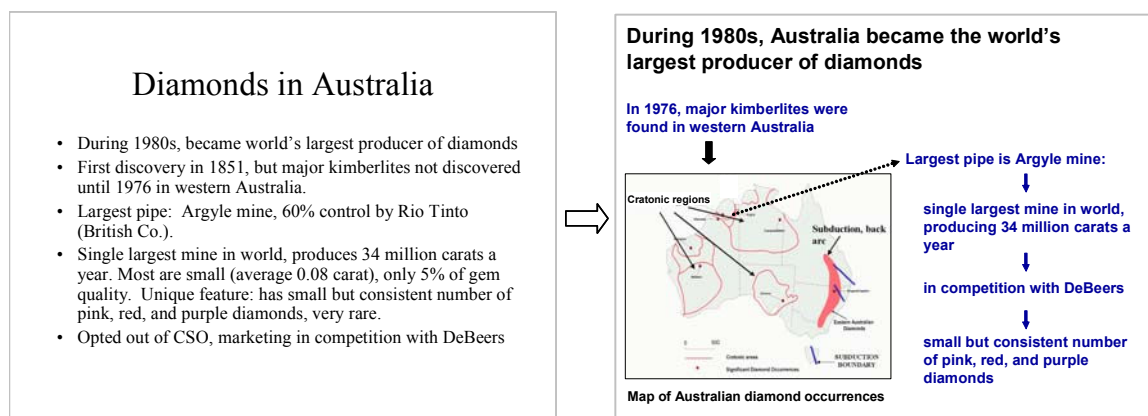


Figure 2: Transformation of one of the traditionally designed slides, shown at the left, to the sentence-headline design shown at the right [11].

Control Group for the Study. The final examinations for the four different sections of the course consisted of 100 questions: 60 questions based on the content for the course’s fourth and final portion, and 40 questions drawn from the 180 questions already posed to the students on the semester’s three earlier tests. Given this structure, we chose the average score that each class had on the 40 questions from the previous tests as a means for controlling the relative effort of each section. Choosing the average scores for these 40 questions as the control measure was done because students in all four sections prepared for this portion of the examination by studying the previous tests of the semester rather than by studying the slides that accompanied that material. For that reason, the results on this section of the exam provided an excellent window into the effort given by each section of students.

Presented in Table 1 is a summary of the averages obtained by each of the four sections for those 40 questions. As seen in Table 1, the Fall 2004 and Spring 2005 sections achieved lower scores than the Fall 2003 and Spring 2003 sections did. For that reason, we concluded that the two later sections, which were the sections taught with sentence-headline slides in the fourth and final portion of the semester, did *not* have an academic advantage over the two earlier sections, which were taught the same material from slides designed in a traditional way. If anything, the results of these control

questions show that the sentence-headline sections did not put forth as much effort in preparing for the exam as the traditional-headline sections.

Table 1. Scores for Different Sections on Control Questions.

Section's Semester	No. of Students	Class Time	Class Score: Control Questions
Spring 2003	200	2:30–3:45 PM	87.9%
Fall 2003	202	12:30–1:45 PM	86.1%
Fall 2004	201	12:30–1:45 PM	82.5%
Spring 2005	136	8:00–9:15 AM	79.1%
Average			83.9%

Key Assumption in the Study. Richard Mayer [10] has performed several experimental studies on the effect of multimedia on learning—learning from words and pictures as opposed to learning from just words. In Mayer's studies, each learner received exactly the same words (either written, spoken, or both) because the spoken words were narrated, rather than presented. Mayer's studies provide a valuable base of knowledge on how words (written and spoken) and images affect how much people understand and recall. However, the communication situations of Mayer's studies are quite different from the communication situations that most technical professionals face.

For instance, because the speech in Mayer's studies was recorded and played to the audience, the speech was perfect—exactly what the presenter wanted the audience to hear. In contrast, in a typical technical presentation such as the presentation of scientific research at a conference or an engineering design to managers, the presenter speaks from points or slides. Because not every word is scripted, the wording is not exactly the same from one presentation of the material to another. Moreover, the speech is sometimes influenced by the audience—either the presenter reacting to the expressions of the audience or, during informal presentations, the speakers responding to questions interjected by the audience. In addition, in most technical presentations, the presenter not only has to inform the audience about the information, but has to persuade the audience of that information. For that reason, the presenter has to build credibility with the audience. In building that credibility, the presenter often includes details that are beyond what the audience needs to understand the content—a strategy that goes against Mayer's principle of excluding extraneous words [10].

The study presented in this paper is much more like the typical situation that technical presenters face in that the presenter delivered her class live, rather than taped. Given that live element, though, each section did not experience exactly the same speech. Moreover, in our study, students in different sections asked different questions, which caused some points to be emphasized more than others. Finally, full attendance did not occur during every class, which meant that some students learned portions of the material just from the posted slides, as opposed to learning the material from both the classroom presentation and the posted slides.

Despite these irregularities in the speech experienced by the audience, a key assumption of this paper is that the design of slides was the major difference in the learning that occurred among the four sections: the Spring 2003 and Fall 2003 sections that learned from slides mostly with phrase headlines, and the Fall 2004 and Spring 2005 sections that learned from sentence-headline slides. Put another way, the students in these large sections experienced, on average, the same speech. Supporting this assertion is the overall consistency in test scores in which the different sections witnessed the same information presented on the slides in essentially the same way and answered the same questions that arose from those slides.

Examples of consistency include the six exam questions that required the students to recall information *from slide images* that could be found on both the traditional slides and the sentence-headline slides. For these questions, the scores were close, with an average correct score of 86% for those students learning from the traditional slides and 87% for those students learning from the transformed slides—a difference that is not statistically significant. That the scores were so close is not surprising, because the transformations did not make as much of a difference on these slides. The information to be recalled was not directly stated in the sentence headline, and the images were the same.

Other examples of consistency include seventeen exam questions that required the students to recall information from text that was in the bodies of both the traditional slides and the sentence-headline slides. In the transformations corresponding to these seventeen questions, although sentence headlines were added to the transformed slides, those headlines did not contain the information to be recalled. In addition, these transformations did not involve significant reworking of text into visual arrangements—the images already existed on the slides. Moreover, the amount of text on the transformed slides was about the same as on the original slides. For these questions, the scores were also close, with an average correct score of 73% for the students learning from the traditional slides and 74% for the students learning from the transformed slides—a difference that is not statistically significant.

What these two sets of data reveal is that when students from the different sections were asked to recall information that was in the slide's body and incorporated about the same way—as an image or as body text—the test scores were about the same. These two sets of data also support the earlier assertion that the two sentence-headline sections did not have an academic advantage over the two traditional-headline sections.

Results and Discussion

Fifteen questions from the final exams required the students in either the Fall 2004 or Spring 2005 sections to recall information that existed in one of the slide's sentence headlines. For the Fall 2003 or Spring 2003 sections, the questions required students to recall the same information—the difference for these two earlier sections was that information existed within the text of a slide's body. The average score for the students taught from the traditional slides was 69% correct, while the average for the students taught from the slides with the sentence headlines was 79% correct. A chi-square

analysis shows that this difference is statistically significant at the 0.001 significance level.

On seven of the fifteen questions, the students viewing the sentence-headline slides achieved higher scores that were statistically significant (three at the 0.001 significance level, three at the 0.005 significance level, and one at the 0.025 significance level), as opposed to achieving lower test scores that were statistically significant on only two questions (both at the 0.01 significance level). Moreover, larger sample sizes might have yielded significant differences on several other questions.

Table 2 presents a comparison for those fifteen questions of the test scores between a section that was taught from slides with the traditional headlines and a section that was taught from slides with sentence headlines. Note that three questions appear twice in the table: questions 3 and 5 are the same, questions 6 and 7 are the same, and questions 8 and 15 are the same. These questions were posed either to two different sections that viewed the sentence-headline slides or to two different sections that viewed the slides with the traditional headlines. Figure 3 presents a graph of this same data. As shown, for seven of the fifteen questions, the group learning from the sentence-headline slides achieved test scores that were significantly higher than the scores achieved by the group viewing the slides with phrase, question, or no headlines.

For ten of the fifteen questions, the transformation involved changing a phrase headline to a sentence headline. Such transformations correspond to Questions 3-10, 13, and 15 in the data. Shown in Figure 4 is a comparison of test scores for one such transformation. In this case, the students taught from the traditional slide were asked to recall the information given in the first bullet point, while the students taught from the transformed slide were asked to recall the information given in the sentence headline. The test score for the student group taught from the phrase-headline slide was 46%, while the raw score for the student group taught from the sentence-headline slide was 63%—a statistical difference at the 0.005 significance level.

Table 2. Comparison of Test Scores for Those Taught from Traditional Headlines Versus Scores for Those Taught from Sentence Headlines.

Question	Original Form of Headline	Percentage Correct for Traditional Headline	Percentage Correct for Sentence Headline	Significance Level of Statistical Difference
1	None	23%	57%	0.001
2	Question	24%	58%	0.001
3	Phrase	61%	85%	0.001
4	Phrase	46%	63%	0.005
5	Phrase	71%	85%	0.005
6	Phrase	75%	89%	0.005
7	Phrase	79%	89%	0.25
8	Phrase	79%	86%	not significant
9	Phrase	80%	85%	not significant
10	Phrase	74%	79%	not significant
11	None	67%	72%	not significant
12	Question	96%	99%	not significant
13	Phrase	86%	81%	not significant
14	Question	96%	89%	0.01
15	Phrase	79%	63%	0.01
Average		69%	79%	0.001

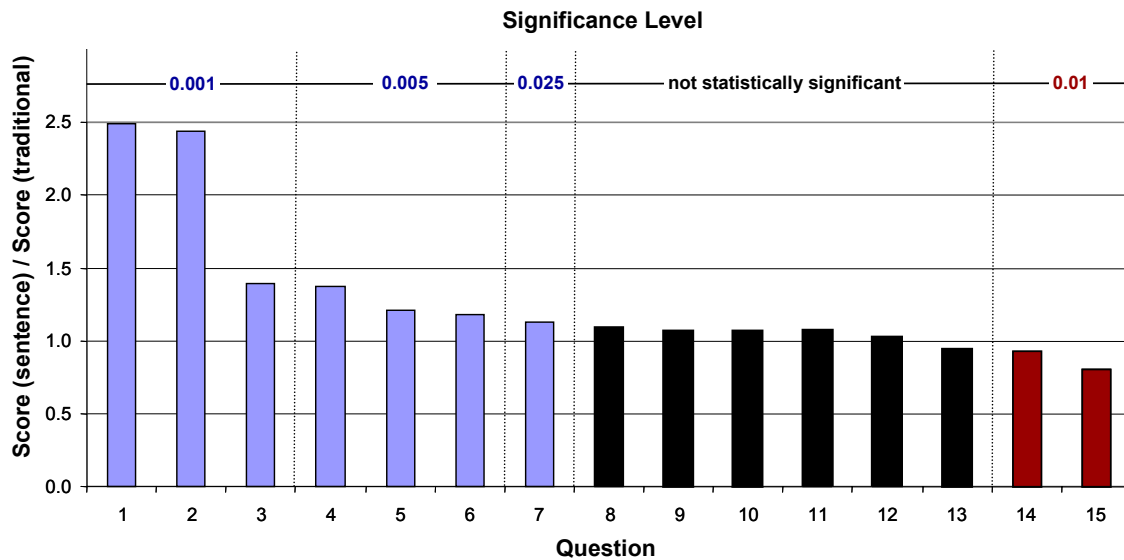


Figure 3: Ratio of the test scores for group that were taught from the sentence-headline slides over the raw test scores of the group that were taught from slides with traditional headlines. Blue bars represent significant increases, black bars represent differences that were not significant, and the red bars represent significant decrease (significance levels given above).

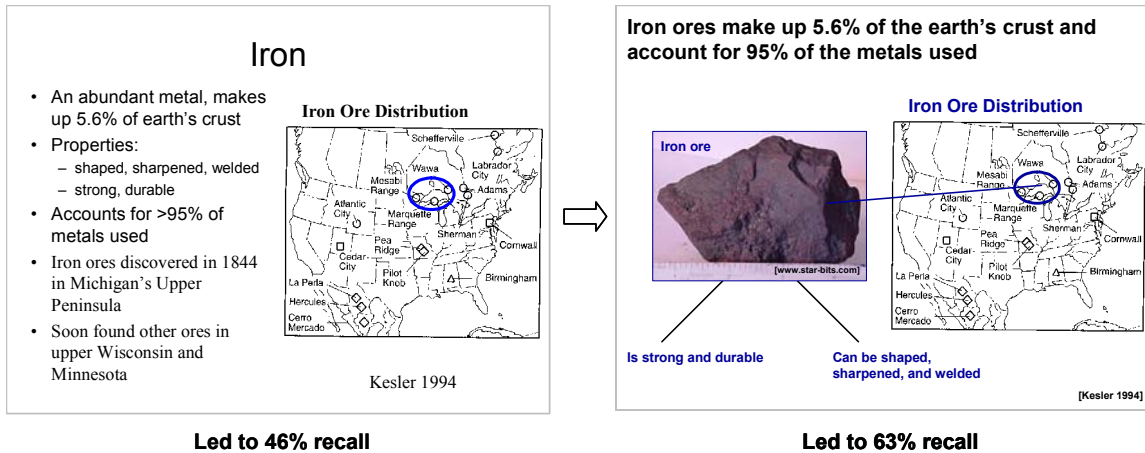


Figure 4: Comparison of test score of 46% for a slide with a phrase headline, shown at the left, with a test score of 63% correct for the sentence-headline slide on the right [11]. The test question asked the students to recall how much iron is in the earth's crust.

What led to such a difference? Certainly contributing to the increased recall was the greater typographical emphasis given to the information in the sentence headline as opposed to the information provided by the body text of the slide with the traditional design. The larger type size (28 points versus 24 points), the use of boldface, the placement of the detail at the top of the slide—all of these led to more emphasis being placed on the detail in the sentence headline. In addition, on the traditional slide, the placement of the detail in a bullet list reduced emphasis on that detail, even though the bullet point was the first one listed. As Shaw, Brown, and Bromiley assert [12], bullets serve to remove hierarchy given to details. For that reason, the detail for the concentration of iron in the list was emphasized about the same as the less important details in the list, such as the discovery date of ores in Michigan's Upper Peninsula.

Yet a third reason for the increased recall in the transformed slide was subordination of two less important details to the presenter's speech. Although the students learning from the bottom slide heard all the details from the original slide in the presentation, those students were not burdened with those less important details when viewing the posted slide after the presentation. This design choice of having the subordinate information removed from the slide does follow Mayer's principle that students learn better when extraneous work is excluded [10].

Also perhaps contributing to the increased recall for the students taught from the sentence-headline slide was the way in which the students catalogued the detail in their memories. Because the students' orientation to the slide was through an assertion that contained the detail, that is perhaps how they catalogued the information—anchored to that detail. In other words, the detail was catalogued as a first-level detail. That sort of cataloguing would contrast with the way that the students viewing the phrase-headline slides might have catalogued the information. The phrase-headline students might have catalogued the detail as a second-level detail beneath the first-level heading of *iron*. As a second-level detail, it was less likely to be recalled.

For five of the ten questions that involved transformations of phrase headlines to sentence headlines, the students taught from the sentence-headline slides achieved higher scores that were statistically significant. In turn, on only one question did these students achieved lower scores that were statistically significant. The one question for which there was a significant decrease in recall occurred with the Spring 2003 section (phrase headline) achieved a significantly higher score than the Fall 2004 section did (sentence headline). Interestingly, on that same question, the Spring 2005 section (sentence headline) actually achieved a higher score than did the Spring 2003 section (phrase headline). In effect, although the Fall 2004 and Spring 2005 students were taught from the same slide on this question, the Spring 2005 students scored much higher than the Fall 2004 ones did. As mentioned, when students from different sections viewed the same slides and were asked to recall the same information from those slides, the scores were generally about the same. However, this case was clearly an exception.

For two of the fifteen questions, the transformation involved changing a slide with no headline to a sentence headline. Such transformations correspond to Questions 1 and 11 in the data. Shown in Figure 5 is the difference in recall that occurred in the transformation corresponding to Question 1. In this case, the students taught from the slide with no headline were asked to recall the information given in the body of the slide, while the students taught from the transformed slide were asked to recall the same information given in the sentence headline. The test score for the student group taught from the slide with no headline was 23%, while the raw score for the student group presented with the sentence-headline slide was 57%—a statistical difference at the 0.001 significance level.

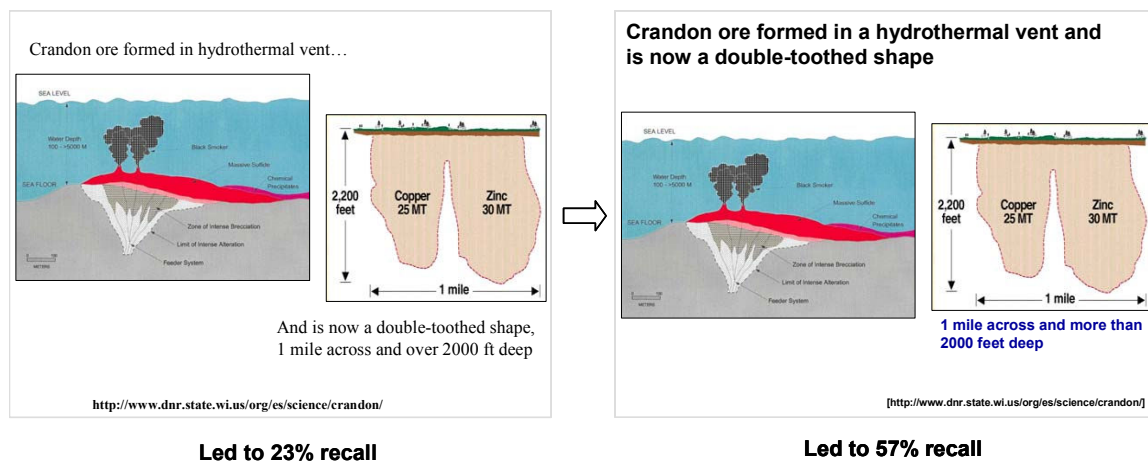


Figure 5: Comparison of test score of 23% for a slide with no headline, shown at the left, with a test score of 57% correct for the sentence-headline slide on the right [11]. The test question asked the students to recall where the Crandon ore formed.

What led to the difference in recall in this slide was certainly the increased typographical emphasis given to the detail in the sentence headline. Perhaps also contributing was that the students taught from the sentence-headline slide catalogued the detail in the sentence-headline slide as a first-level detail, while the students viewing the slide without a headline did not have a memory anchor for this detail.

For three of the fifteen questions, the transformation involved changing a slide with a question headline to a sentence headline. Such transformations correspond to Questions 2, 12, and 14 in the data. Shown in Figure 6 is the transformation for the slide corresponding to Question 2. In this case, the students taught from the slide with the question headline were asked to recall the information given in the text, while the students taught from the transformed slide were asked to recall the information given in the sentence headline. The raw score for the section learning from the question-headline slide was 23%, while the raw score for the section learning from the sentence-headline slide was 57%—a statistical difference at the 0.001 significance level.



Led to 24% recall

Led to 58% recall

Figure 6: Comparison of test score of 24% correct for a slide with the question headline, shown at the left, with a test score of 58% correct for the sentence-headline slide on the right [11]. The test question asked the students to recall what caused color in diamonds.

In comparison with arguments for using a phrase headline or having no headline, the argument for using a question headline is stronger: a question headline leads the presenter to introduce the topic in an active way. In other words, if the presenter poses the question headline to the audience, the audience is challenged to seek the main assertion of the slide. However, on Question 2, the students taught from the question-headline slide performed much worse than did the students taught from the sentence-headline slide. One likely reason was that much synthesis was required of the students who viewed this particular question headline. In effect, these students had to recall three details from the body, and one of those details (the detail about irradiation) was not grouped with the other two (impurities and defects). For the students viewing the slide with the sentence headline, though, those three elements were grouped into one assertion.

On the surface, the original slide appears to be weak, since the positions of the main assertion's details are fragmented in the slide's body. However, such fragmentation is not uncommon for slides that rely on traditional headlines. It is not until the presenter identifies the main assertion—a step that creating sentence headlines ensures—that the presenter can clearly see what those details are and whether those details are arranged effectively.

Although this particular question headline was much less effective than the sentence headline, situations arise in which a technical presenter might consider using a question headline in series with a sentence headline. One such situation would be when

the presentation would benefit from the audience examining the evidence in the body of the slide before seeing the assertion, as in the presentation of an assertion for which the audience has a hostile reaction. Another case would be in a teaching situation in which the presenter wants more participation from the students. In such a use, the question headline would appear first, and then after the students have addressed the question by examining evidence in the body of the slide, the presenter would animate in the sentence headline. In this way, the audience would benefit both from the active learning of the question headline and from the precision of the sentence headline. Given those two benefits, future plans in the geoscience course are to use question headlines when the slide is first projected and then to have sentence headlines animate in after the students have addressed the questions.

Conclusions

According to Microsoft [1], an estimated 30 million PowerPoint presentations occur everyday. As anyone who has recently attended a conference knows, the overwhelming majority of those presentations have headlines that are either single words or short phrases. This paper, though, has presented experimental evidence that using succinct sentence headlines are more effective. In our study, using sentence headlines of no more than two lines led to statistically significant increases in recall from the audience on details that were contained in those sentence headlines. A chi-square analysis shows that this difference is statistically significant at the 0.001 significance level. The main conclusion is that if a technical presenter desires to emphasize assertions in a presentation, that person would do well to place those key assertions in succinct sentence headlines.

For a presenter desiring to design slides with such sentence headlines, however, the typography and layout defaults of PowerPoint pose a hurdle. In other words, someone who simply opens up PowerPoint must make many keystrokes to change the size, position, and alignment of the headline's text to accommodate a sentence appropriate for a technical presentation. However, help does exist. For instance, available at the first Google listing for the topic of *presentation slides* are templates to overcome the cumbersome headline defaults of PowerPoint [13]. For many technical presenters, these templates have made the adoption of a sentence-headline design much easier [6].

This pilot study has focused on slide transformations in which the principal change on each slide was to place the main assertion of the slide into a succinct sentence headline. The research question for this study was how well the audience has retained that assertion. Further testing is needed to isolate completely the effect of changing the sentence headline from other aspects modified in the design of the slide—the typography of the slide or the way in which evidence in the body of the slide was designed. Moreover, further research is needed to determine whether changes in slide design can affect deeper levels of understanding such as synthesis or application.

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