Enhancing the recall of presented material

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**ABSTRACT**

Many educators distribute either complete or incomplete handouts so students can follow along with their lectures. This research examines a teaching system that combines computer-generated graphics presentations and detailed outline handouts with blanks added. An experiment found that this system produced significantly higher short-term recall of a presentation when compared with note-taking on lined paper and with no note-taking. Visual design variables, specifically slide typefaces and type, were also manipulated to examine whether they had independent effects on short-term recall or influenced the benefits from note-taking. No significant main effects or interactions were found for the visual aid variables.

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1. Introduction

Educators usually want students to remember a number of key points from their lectures. Teachers may employ various techniques such as enthusiasm (Stewart, 1989), cuing (Scherb, Warm, Dember, & Grasha, 1992; Titworth & Kiewra, 2004), organizational statements (Titworth, 2004), imagery (Thrailkill & Ormrod, 1994), immediacy (Titworth, 2001), questioning (Campbell & Mayer, in press), pausing with written summaries (Davis & Hult, 1997; Siter, 1997), and visual aids (Cothran, 1989) to help students improve their recall of key points. As instructors started developing and delivering lectures using computers, many started providing printouts of the computer-generated slides or letting students download and print the slides before each lecture and bring them to class. These handouts freed up some class time for covering additional topics, providing more examples, or using other techniques to help students remember more information from lectures. Handouts have also been associated with higher student satisfaction (Montis, 2007; Murphy & Cross, 2002).

One question is how this complete handout technology contributes to learning. Experiments using videotaped lectures found that providing handouts with complete details produced better performance than having students take their own notes (Kiewra, 1985b; 1985c; Kiewra & Benton, 1987). Students who downloaded instructor notes performed better on exams than those who did not use the notes (Grabe, 2005; Grabe, Christophrson, & Douglas, 2004/2005). However, complete handouts probably reduce student note-taking and the value of note-taking appears to be particularly strong for encoding or enhancing short-term recall (Kiewra, 1989). Studies have also found that note-taking can interact and synergistically increase the benefits of other techniques (e.g., Rickards, Fajen, Sullivan, & Gillespie, 1997; Stewart, 1989). With the increased use of computers to develop and deliver lectures, teaching productivity may be enhanced if there is an approach that combines the benefits of note-taking with the value of computer-generated graphics presentations.

Several studies of note-taking systems have found that skeletal, incomplete outlines (with 50% or less of key lecture details) increased recall more than either having the students take their own notes or giving them complete printouts of the instructor notes (e.g., Austin, Lee, & Carr, 2004; Cornelius & Owen-Deschryver, 2008; Montis, 2007; Neef, McCord, & Ferreri, 2006). These skeletal outlines may be quite different from the slides being presented, adding to lecture preparation time. Because these handouts only contained about 50% of the lecture material, speakers must pause and wait for listeners to write out long sections of information. If handout content is increased, instructors would need to pause as long for students to complete their notes, freeing up time for describing more examples or reinforcing the key points. Perhaps there is a compromise that encourages student involvement in class, utilizes some of the encoding value of note-taking, simplifies handout preparation, increases flexibility during lectures through better time use, and still boosts information recall.

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This study focuses on the benefits of having students take notes on incomplete outlines that contain much more details than those tested in prior research on note-taking. The handouts are developed from the text outline option in computer-generated graphics software and a few key words are deleted. Because font design and the layout of printed material can affect recall, reading speed, readership, and comprehension of printed information, this study will also examine whether variations in the common typefaces (e.g., Times Roman or Helvetica) and type (i.e., letters that are darker or lighter than the background) could directly affect the short-term recall of lectures or could influence the benefits from note-taking. After reviewing previous research on note-taking, typefaces, and type, an experiment is proposed to examine the effects of note-taking and visual aid design on short-term recall. After the results of the experiment are summarized, conclusions and implications are highlighted.

2. Previous research

A large body of literature describes how note-taking contributes to the recall of information. In theory, note-taking helps encode information and notes serve a storage function. Although a few studies have found that note-taking was associated with lower recall (e.g., Peters, 1972), literature reviews have concluded that note-taking has considerable value for most listeners (e.g., Hartley, 1983; Kiewra, 1989; Kobayashi, 2006; Williams & Egbert, 2002b). Exceptions may be due to the task being measured (e.g., note-taking appears to be more helpful in some subjects than in others (Einstein, Morris, & Smith, 1985; Peper & Mayer, 1978, 1986)) or listener characteristics (e.g., size of working memory seems to affect the benefits from note-taking (Cohn, Cohn, & Bradley, 1995; Hadwin, Kirby, & Woodhouse, 1999; Hegarty & Steinhoff, 1997)). In the college classroom, taking complete notes is correlated with better grades (Baker & Lombardi, 1985; Kiewra, 1983; Kiewra & Benton, 1988; Locke, 1977; Peverly, Brobst, Graham, & Shaw, 2003; Williams & Egbert, 2002a). Students may be aware of their skills and prefer note-taking styles that complement their abilities (Annis, 1981; Collingwood & Hughes, 1978; Fisher & Harris, 1974).

Much of the work on giving students handouts prior to lectures traces the basic concept back to research by Ausubel (1960, 1968) on “advance organizers” that were intended to facilitate learning from written materials. Research on advance organizers for text has produced mixed results (Barnes & Clauwson, 1975; Corkill 1992; Mayer, 1979). However, incomplete outlines for lectures, containing less more than topic headlines, seem to help organize notes and produce higher recall than either providing complete details or providing no structure for notes. Table 1 shows thirteen different names that have been given to this skeletal, incomplete outline system for lecture note-taking by college students. The lack of a standard name for this teaching technique may have slowed the recognition of its value. Still another term, graphic organizer, is sometimes used to describe partial outlines for note-taking from text (e.g., Katayama & Crooks, 2003; Robinson et al., 2006). These studies suggest that giving listeners some structure for note-taking and still involving them in the lecture tends to increase recall of key points.

Previous research on incomplete handouts tested the provision of no more than 50% of the lecture material. The assumption seems to be that students must write at least half the lecture down to learn the material. Recall can be affected by the detail of the incomplete outlines. Morgan, Lilley, and Boreham (1988) compared the recall of presentations that had very abbreviated skeletal outlines, partial outlines containing about 50% of the information, complete handouts, and no handouts (e.g., students took their own notes). They concluded that the level of detail is a critical factor in handout effectiveness. This research tests whether handouts with a few blanks, having much more detail than the handouts in previous studies, can improve the short-term recall of presented information over having the students take notes on lined paper or having the students take notes. The first two hypotheses are:

**Hypothesis 1.** Having students take notes on handouts with blanks will produce higher short-term recall scores than having them take notes on lined paper

**Hypothesis 2.** Having students take notes on handouts with blanks will produce higher short-term recall scores than having them take notes

**Marketeters have learned that combining the wrong typeface with a logo or a package can hurt a product’s image and memorability (Childers & Jess, 2002; Doyle & Bottomley, 2004, 2006; Henderson, Giese, & Cote, 2004). Besides influencing the recall of the presentation, the typefaces in a lecture slide could affect the benefits of note-taking because they can influence reading speeds. When typefaces have perceptual qualities inconsistent with the words, the response to the words tends to be slower (Lewis & Walker, 1989). One study compared the reading speeds for two similar typefaces: Lucinda Sans and Lucida Serif (McCarthy & Mothersbaugh, 2002). The only difference**

<table>
<thead>
<tr>
<th>Name for technique</th>
<th>Selected references</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive lecture notebooks</td>
<td>Stencel (1998)</td>
</tr>
<tr>
<td>Note-taking guides</td>
<td>Thompson and Lee (1991)</td>
</tr>
<tr>
<td>Partial handouts</td>
<td>Russell, Caris, Harris, and Hendrixon (1983)</td>
</tr>
<tr>
<td>Seminotes</td>
<td>Hosain (1994)</td>
</tr>
<tr>
<td>Skeletal notes</td>
<td>Kiewra (1985a), Kiewra and Frank (1988)</td>
</tr>
<tr>
<td>Skeletal outlines</td>
<td>Perich and Montague (1981)</td>
</tr>
<tr>
<td>Skeleton notes</td>
<td>Klemm (1976)</td>
</tr>
<tr>
<td>Structured worksheets</td>
<td>Green, Klauser, and Urquola (1986)</td>
</tr>
</tbody>
</table>
was that one typeface had serifs (i.e., small brush strokes at the tips of some letters). The sample was divided in half based on reading speed. For the smaller 8-point type size in the study, those who were fast readers read significantly more words with the serif typeface. With the larger 10-point type size, the reading speeds of fast and slow readers were unaffected by the typeface. They concluded that typographic effects are likely to be highly interactive with other variables. Because information recall might be affected by typefaces, this study will test for main effects from typefaces and interactions between typefaces and note-taking. This leads to two more hypotheses:

**Hypothesis 3.** Using a typeface with serifs (e.g., Times Roman) will produce higher short-term recall scores than using a typeface without serifs (e.g., Helvetica)

**Hypothesis 4.** Using a typeface with serifs when notes are taken (either on lined paper or on handouts with blanks) will produce higher short-term recall scores

Another variable that can affect communication is type. Positive type has dark-colored letters on a light-colored background and reverse type has light-colored letters on a dark-colored background. Paterson and Tinker (1931) measured reading speeds for black-on-white and white-on-black and found black-on-white had a 10.5% advantage. Color combinations can also influence reading speeds. Tinker and Paterson (1931) found that the positive type combinations of black-on-white, green-on-white, blue-on-white, and black-on-yellow produced higher reading speeds than seven other color combinations. Garcia and Caldera (1996) measured reading speeds on computer terminals and found that text in black-on-white, yellow-on-blue, black-on-gray, and yellow-on-black (reverse type with high contrast) were read significantly faster. Case studies on reverse type in color advertisements suggest that it tends to reduce reader interest and readership (Readex Inc., 1998). Therefore, reverse type with low contrast between letters and the background could lower the audience’s reading speed, comprehension, and recall of the presented information. This study will test whether visual aid design, either directly or through note-taking, influences information recall. Two hypotheses are proposed:

**Hypothesis 5.** Using positive type (e.g., black letters on a light gray background) will produce higher short-term recall scores than using reverse type (e.g., white letters on a blue background)

**Hypothesis 6.** Using a positive type when notes are taken (either on lined paper or on handouts with blanks) will produce higher short-term recall scores

3. Methodology and data

In this study, two typefaces (bold Times Roman and bold Helvetica), two types (positive and reverse), and three note-taking treatments (no notes, taking notes on lined paper, and filling in outlines with blanks) were varied during a series of four lectures on negotiating skills. This topic was chosen because most undergraduates in the sample population were unfamiliar with the presented concepts. Each of the four presentations consisted of 7–12 slides and lasted between 6 and 8 min. The first Presentation A explained different negotiation goals. The second suggested some guidelines for aggressive negotiations. Presentations C and D discussed various negotiating tactics and possible counters.

Four multiple-choice questions about each of the four presentations were developed. Each question listed five possible answers. The methodology and questions were pretested with students and several improvements were made for the final experiment. None of the participants in the pretest were included in the experiment. One concern from the pretest was that the percentage of correct answers seemed low. In addition, many subjects wanted to know how many questions they answered correctly. To address these issues and to help motivate the subjects, they were told during the instructions that they could voluntarily bring their survey forward after the experiment and have their 16 questions scored. If they answered at least 12 of the 16 questions correctly, they were given their choice of several prizes (e.g., notebooks, snacks, soft drinks etc.). Although the pretest was not fully comparable to the final experiment, the resulting percentage of correct answers, 65.7%, was higher than in the pretest.

To make the handouts match the slide text, the words shown in the computer-generated graphics software outline option were copied and pasted into word processing software. A few key words were replaced with underlines (the “blanks”). Some computer software also makes it possible to export the outline as a file directly into a word processor. The presentation also included a diagram which was copied to the clipboard from the slide and then pasted into the handout. These handouts generally required less paper than printing 3 or 6 computer slides per page.

The sample consisted of 179 students from one of the largest undergraduate business schools in the Midwest region of the United States. Subjects were recruited from sophomore-, junior-, and senior-level business school classes (although not all were majoring in business). Some students received extra credit in their classes and others participated to learn negotiating skills. At the beginning, subjects read a consent disclaimer and the directions for the experiment. Then the instructions were verbally explained and questions were answered. Seventeen of the students did not complete every question in the survey or did not follow the directions on note-taking (e.g., took notes on Presentation A) and were dropped from the sample.

An audio tape containing the verbal portion of the lectures was played for each subject group while slides were advanced. Most slides contained bullet points that were revealed individually without animation. In the verbal presentation, some bullet points were rephrased, others were elaborated on, and a few examples were added that were not shown on the slides. After each presentation, students answered four multiple-choice questions about what they had just seen and heard to measure short-term recall. This methodology is similar to the one used in the study by Larson (2004) which concluded that complex backgrounds in visual aids could reduce short-term recall of presented information. All of the slides in this study had plain backgrounds.

The subjects were divided into four treatment groups. Some groups were given the opportunity to take notes on Presentations B and C. When this treatment group was in the room, students at one table were given two pages of lined paper as part of their survey handout to take notes on Presentation B and two pages for Presentation C. Students at the other table were given detailed outlines that contained the
Table 2
Experimental design (sample divided into four groups, each saw four presentations).

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (N = 42)</th>
<th>Group 2 (N = 38)</th>
<th>Group 3 (N = 36)</th>
<th>Group 4 (N = 46)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation A</strong></td>
<td>Times Roman</td>
<td>Times Roman</td>
<td>Helvetica</td>
<td>Helvetica</td>
</tr>
<tr>
<td><strong>Negotiation goals</strong></td>
<td></td>
<td>Positive type</td>
<td>Positive type</td>
<td>Positive type</td>
</tr>
<tr>
<td></td>
<td>No notes = 42</td>
<td>No notes = 38</td>
<td>No notes = 36</td>
<td>No notes = 46</td>
</tr>
<tr>
<td><strong>Presentation B</strong></td>
<td>Helvetica</td>
<td>Reverse type</td>
<td>Positive type</td>
<td>Reverse type</td>
</tr>
<tr>
<td><strong>Aggressive negotiation guidelines</strong></td>
<td></td>
<td>No notes = 20</td>
<td>No notes = 21</td>
<td>Times Roman</td>
</tr>
<tr>
<td></td>
<td>Lined paper – B = 12</td>
<td>Lined paper – B = 9</td>
<td>Lined paper – B = 8</td>
<td>Lined paper – B = 13</td>
</tr>
<tr>
<td></td>
<td>notes = 10</td>
<td>notes = 3</td>
<td>notes = 4</td>
<td>notes = 8</td>
</tr>
<tr>
<td></td>
<td>Blanks = 10</td>
<td>Blanks = 9</td>
<td>Blanks = 7</td>
<td>Blanks = 16</td>
</tr>
<tr>
<td><strong>Presentation C</strong></td>
<td>Times Roman</td>
<td>Times Roman</td>
<td>Helvetica</td>
<td>Helvetica</td>
</tr>
<tr>
<td><strong>Aggressive negotiation tactics I</strong></td>
<td></td>
<td>Positive type</td>
<td>Reverse type</td>
<td>Positive type</td>
</tr>
<tr>
<td></td>
<td>No notes = 20</td>
<td>No notes = 20</td>
<td>No notes = 21</td>
<td>No notes = 17</td>
</tr>
<tr>
<td></td>
<td>Lined paper – C = 12</td>
<td>Lined paper – C = 9</td>
<td>Lined paper – C = 8</td>
<td>Lined paper – C = 13</td>
</tr>
<tr>
<td></td>
<td>notes = 6</td>
<td>notes = 2</td>
<td>notes = 5</td>
<td>notes = 7</td>
</tr>
<tr>
<td></td>
<td>Blanks = 10</td>
<td>Blanks = 9</td>
<td>Blanks = 7</td>
<td>Blanks = 16</td>
</tr>
<tr>
<td><strong>Presentation D</strong></td>
<td>Helvetica</td>
<td>Helvetica</td>
<td>Times Roman</td>
<td>Times Roman</td>
</tr>
<tr>
<td><strong>Aggressive negotiation tactics II</strong></td>
<td></td>
<td>Positive type</td>
<td>Reverse type</td>
<td>Positive type</td>
</tr>
<tr>
<td></td>
<td>No notes = 42</td>
<td>No notes = 38</td>
<td>No notes = 36</td>
<td>No notes = 46</td>
</tr>
</tbody>
</table>

The same words (in Times Roman typeface, 12-point type size) as the slides with a few blanks. Students receiving the incomplete outlines had 16 blanks in the two-page handout to fill in for Presentation B, usually one or two words per blank, and 10 blanks in the two-page handout for Presentation C. All 42 of the students in the blanks treatment chose to fill in the blanks during both presentations.

Table 2 shows the experimental design. A total of 42 students (Group 1) saw Presentation A with a serif typeface (Times Roman) and positive type. After answering four questions about Presentation A, the group saw Presentation B with a sans serif typeface (Helvetica) and positive type. Twelve were given lined paper and ten chose to take notes. Ten were given the handouts with blanks. Students were not given time to review their notes or mentally review what they learned before answering questions about each presentation, so only encoding effects from note-taking on recall were tested.

Group 2 saw Presentation A with a Times Roman typeface and reverse type. Of the 38 subjects in this group, nine were given lined paper for note-taking on Presentation B and three chose to take notes. Some subjects who took notes on Presentation B may not have taken notes on Presentation C and those who did not take notes on Presentation B may have done so for Presentation C. Those who did not take notes were added to the “no notes” group.

Below is one of the questions from Presentation B. The presentation covered many guidelines for concessions and mentioned that it is not recommended to offer to split the difference in negotiations. Therefore, the correct answer is “C”.

When making concessions, which of the following is NOT advisable?

A. Be willing to make the first concession.
B. Concede slowly and call concessions “concessions”.
C. Offer to split the difference.
D. Consider bracketing counterpart’s offer.
E. Suggest that few other concessions are possible.

There was no “blank” in the handout near this statement. Most of the questions did not ask students to remember the words that they wrote in the blanks.

After Presentation D, the subjects were also asked to complete eight additional questions about themselves. These questions were intended to help control for differences between subjects and identify characteristics that could account for variations in test scores. Students were asked their major, year in school, and grade point average. It was assumed that marketing majors, more experienced students, and academically-stronger students might perform slightly better in this experiment. Nearly 10% of the sample was international students and it was assumed that they may have more difficulty remembering information presented in English. Another variable that might influence a student’s short-term recall ability is how much they read. Gender was considered because some note-taking research found significant differences between men and women (e.g., Cohn et al., 1995; Fisher & Harris, 1973). It was also assumed that students who had some training in negotiation or who took more courses that used computer-generated graphics might do better on the test. By splitting the questions on grade point average and on reading as a hobby or for leisure into two variables, the eight questions became ten variables (Table 3). The entire experiment took about 45 min.

Each response to the test questions was coded with a 1 if the subject’s answer was correct or with a 0 if the answer was incorrect. The visual aid variables were coded with ones (e.g., Times Roman typeface, positive type) and zeros (e.g., Helvetica typeface, reverse type).

Because 162 students each answered 16 questions, there were 2592 observations. A binary logistic regression model was used to predict the probability that the answer to a question was correct. Independent variables were added to the model to control for differences in the question difficulty and for differences in the students. The initial model included dummy variables for 15 of the 16 questions, the 10 subject characteristic variables, the two note-taking variables “(took notes on lines and filled in blanks)”, the visual aid variables, and interaction terms between the visual aid variables and the note-taking variables. Dummy variables for the questions were important because the percentage correct ranged from 85.8% to 40.7% for the 16 questions.
4. Results

The initial model had 33 independent variables and a constant term. Results for the question dummy variables and the students characteristic variables were examined. Three question dummy variables and three of the subject characteristic variables were insignificant at the 10% level. It was a bit surprising that people with previous negotiation training or with more experience taking classes that used computer-generated graphics were not more likely to answer questions correctly. Perhaps these experiences did not improve short-term recall. The 3.0–3.49 GPA ("B") variable was also insignificant. These six variables were dropped, creating a revised model.

The results for the visual aid variables were examined in the revised model. The main effect variables (Times Roman and positive type) did not have significant effects. Only one of the four visual aid interactions with note-taking "(Times Roman × took notes on lines)" reached the 90% confidence level. The two main effect and three insignificant interaction variables were dropped and the model was rerun.

The variables in the final model are shown in Table 4. The overall fit of this model was considered adequate. The Cox and Snell R² was 0.104 and the Nagelkerke R² was 0.144, both in the range of values typical for cross-section analyses. The "took notes on lines" variable was insignificant, suggesting that encoding from note-taking on lined paper did not improve short-term recall in this test above the level for no note-taking. The "filled in blanks" variable was positive and significant, suggesting that filling in handout blanks improved short-term recall and supporting Hypotheses 1 and 2.

Hypotheses 3–5 were not supported. The Times Roman and positive type variables were insignificant and three of the four interactions were insignificant at the second stage. The last interaction variable, "Times Roman × took notes on lines", was not significant in the final model ("dropping this interaction did not make took notes on lines significant").

Seven subject characteristic variables were significant. Marketing majors tended to have lower scores on the test questions. This is contrary to expectations. However, many of the non-marketing majors were management majors who might have more insights into negotiation strategies and tactics. Juniors were less likely to correctly answer questions. Most of the subjects were seniors and one might expect students with more college experience to do better on a short-term recall test. International students tended to have lower scores on the questions, as expected. Reading habits were positively associated with correct answers. Perhaps reading increases working memory capacity or people with larger working memories enjoy reading as a hobby or for leisure. Interactions between the "reading often" variable and the two note-taking variables were added to the model to test whether "reading often" might improve note-taking benefits. This did not appear to be true because the coefficients were not significant. Females had a significant, negative coefficient. This is a bit surprising. Interactions between gender and the note-taking variables were added to the model to explore the possibility of gender effects on note-taking benefits. However, both were insignificant. More than 86% of those who read often as a hobby or for leisure were women. Other
research may want to explore whether reading is linked with working memory and isolate gender differences. Finally, having a grade point average of at least a “B+” was associated with a higher probability of answering questions correctly.

5. Conclusions and implications

A teaching system of computer-generated graphics and detailed handouts with blanks appears to be another useful technology educators can employ to help students remember key points from their presentations. Prior research found that complete lecture handouts were better than having the students take their own notes and incomplete handouts were better than complete handouts. This study confirms the value of incomplete outlines as a tool to improve the short-term recall of listeners who use them to take notes. These handouts contained more details than those tested in other studies and are relatively easy to make with computer-generated graphics and word processing software. Filling in a few blanks in a handout appears to significantly increase the recall of presented information beyond what is expected without note-taking. When listeners took notes on lined paper, their short-term recall did not improve. By freeing up class time, handouts make it possible for teachers to employ other techniques to further increase the recall of presented information. Future research could attempt to identify the optimal number of blanks in a handout and explore tradeoffs between handout detail and different class time uses.

The author has used detailed handouts with blanks in presentations in the college classroom and with business audiences. If the handouts are explained at the beginning, both groups tend to rate the technique quite high. Emphasis for important words and key numbers can be increased by blanking them out in the handout.

Note-taking may help keep students engaged and focused on a lecture. Although note-taking tends to have synergies with some presentation tools and visual design variables often interact with other factors, the typeface and type variables did not independently affect audience recall or interact with note-taking to affect recall.

Overall, if educators want to improve student recall of key points, to develop handouts with minimal effort, and to use class time more efficiently, combining computer-generated graphic presentations and detailed handouts with blanks appears to be a valuable option to consider.

References


