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The Use of Feedback to Help College Students Identify Relevant Information on PowerPoint Slides

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This research examined the impact of a simple feedback model on college-level students' abilities to identify relevant information presented on PowerPoint slides. In Experiment 1 we tested students individually and analyzed how different levels of feedback (general, specific, or no feedback) modified students' abilities to correctly identify relevant information on PowerPoint slides. In Experiment 2 we extended the findings of Experiment 1 to assess the feasibility of using such a model to help students in a real college classroom. Results from Experiment 1 indicate that when students receive brief, but specific, feedback on relevant word identification performance they immediately exhibit improved performance at discerning relevant from irrelevant information on PowerPoint slides compared to students who receive general or no feedback. Results from Experiment 2 indicate that this holds true when students receive specific feedback in a real classroom. These results suggest that such a feedback task, which may be implemented with ease during a real college class, may help students streamline the note taking process such that more relevant, and less irrelevant, information enters their notes, subsequently enhancing their recall for more relevant information on later assessments.

Higher education continues to be dominated by teacher-centric strategies for conveying information to students, especially in content-rich courses, despite empirical evidence for the superiority of active learning strategies (Bonwell & Eison, 1991; Doyle, 2011; Felder, Woods, Stice, & Rugarcia, 2000; Fink, 2003). One of the most common teacher-centric scenarios is the traditional lecture method during which the professor lectures while the students listen and note what they believe to be relevant information. Indeed, note taking seems to be the most common strategy used by students to capture information as most

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students believe it to be beneficial and important to their academic success (Bonner & Holliday, 2006; Dunkel & Davy, 1989; Palmatier & Bennett, 1974; Williams et al., 2013). Due to the high frequency of note taking in college classrooms and the importance placed on such a strategy by students, researchers examined its effects on retention of information and there is a plethora of empirical evidence to support both the use and encouragement of note taking.

Early researchers hypothesized two beneficial aspects of note taking for students' retention of information. One hypothesis was that note taking aids the retention of information through an encoding function. In other words, the simple act of taking notes allows students to actively engage with the presented material and elaborate the information by translating it into their own words (Di Vesta & Gray, 1972, 1973; Hartley & Davies, 1978; Howe, 1974). The other hypothesis stated that note taking is beneficial because it provides students with a record of information which may be reviewed later, the so-called external storage function (Barnett, Di Vesta, & Rogozinski, 1981; Bui, Myerson, & Hale, 2013; Carter & van Matre, 1975; Dunkel, Mishra, & Berliner, 1989; Fisher & Harris, 1973; Hartley, 1983; Kiewra, 1985). Despite empirical support for both beneficial aspects of note taking when examined individually, other studies suggested that retention performance is best when students engage in both the encoding and external storage functions, which is, in reality, the most probable way students use the note taking strategy (Knight & McKelvie, 1986; Williams et al., 2013).

Ultimately, however, both functions of note taking may only be beneficial if students are capable of effectively using limited cognitive resources during a lecture. Specifically, students need to engage their working memory to actively process incoming information (encoding function) *and* get that information into their notes for later review (external storage function), which certainly taxes the cognitive system (Bui & Myerson, 2014; Bui et al., 2013; Peverly et al., 2007). One way professors may help students reduce cognitive load during a lecture is to accompany the lecture with PowerPoint slides. With the ever-increasing technological advancements in classrooms, educators frequently use PowerPoint to enhance their lectures (Buchko, Buchko, & Meyer, 2012).

Proponents of accompanying lectures with PowerPoint argue that it helps students sustain motivation, interest, and attention during a lecture, which are all integral parts of effectively processing information (Hidi, 2001; Perry, 2003; Tang & Austin, 2009). For instance, Susskind (2005) found that student motivation declined when the instructor discontinued the use of PowerPoint slides after the first third of the course. Furthermore, students not only prefer lectures with PowerPoint, they also believe that PowerPoint assists them as they take notes and attempt to comprehend information presented during the lecture (Apperson, Laws, & Scepansky, 2006; Clark, 2008; Frey & Birnbaum, 2002; Susskind, 2005).

The question of whether lectures accompanied by PowerPoint technology are truly helpful is an important empirical question. For instance, despite students' perceptions that having PowerPoint slides with a lecture enhances their motivation, interest, note taking, and comprehension of information, results are mixed (Apperson et al., 2006; Lowry, 1999; Mantei, 2000; Susskind, 2005). Based on prior research, the effectiveness of PowerPoint varies widely as a function of the instructor's enthusiasm, skill at using PowerPoint, and even the graphics used in the PowerPoint, among other aspects (Apperson et al., 2006; Clark, 2008). However, in addition to these variables, one could also argue that students' note taking skills may affect their ability to take advantage of information delivered via PowerPoint. When presented with a PowerPoint slide concurrent with the oral portion of a lecture, students need to process the information presented on the slides in terms of what is relevant, translate it into their own words (encoding function), and get that information into their notes for later review (external storage function). Thus, the initial ability to recognize relevant information on the slides during the lecture impacts both key functions of note taking. If students have a low ability to identify relevant information, then both the quantity, but perhaps more importantly the *quality*, of notes may suffer and negatively impact information retrieval during quizzes and exams (Haynes, McCarley, & Williams, 2015; Williams et al., 2013).

Investigations into the quality of students' notes reveal support for the notion that the ability to identify relevant information is an important initial step toward more sophisticated processing of information which enhances retention and recall (Brown & Smiley, 1977; Johnson, 1970; Leutner, Leopold, & den Elzen-Rump, 2007). Indeed, what students "pick up" and note during a lecture has a significant influence on what they recall later. For instance, Einstein, Morris, and Smith (1985) found that note takers recalled significantly more important information from a lecture than non-note takers, which suggested a simple main effect of taking notes. However, they also found that the content of the notes included more high-importance information relative to low-importance information and this translated to better recall performance on high-importance information. Thus, it may be that students who note more relevant, or important, information from a lecture are likely to perform better on retention tests than students who note less relevant information.

Haynes et al. (2015) addressed such a proposal when they examined the content of notes from Williams et al. (2013) during which students listened to a lecture accompanied by PowerPoint slides. Some students took notes during the lecture, some took notes after the lecture, while others did not take notes. In the analysis of notes, Haynes et al. (2015) discovered that students who wrote more relevant, and less irrelevant, information in their notes, regardless of when they took them, performed better on a retention quiz. They also provided a more "realistic" perspective in that those students who scored with a passing grade on the quiz (≥ 60%) had significantly more relevant, and less irrelevant, information in their notes relative to those who failed the quiz. Interestingly, despite Huxham's (2010) finding that lectures accompanied by PowerPoint slides produced the highest quality student notes, Haynes et al. (2015) found that students' notes, regardless of note taking condition, contained significantly less relevant information compared to the amount of relevant information presented in the instructor's PowerPoint slides. So, despite systematic covariation in noting of relevant information and retention quiz performance, students still did not take full advantage of all relevant information presented to them via the PowerPoint that accompanied the lecture.

Haynes et al. (2015) proposed that college-level students likely need some sort of training, or direction, when presented with a lecture accompanied by PowerPoint slides in order to effectively note relevant, and ignore irrelevant, information. We know that the skill of identifying relevant information in text passages and oral-visual lectures is one that develops over time and continues through the college years (Brown & Smiley, 1977). In addition, most students report never having been taught how to effectively take notes (van Meter, Yokoi, & Pressley, 1994). Thus, strategies for identifying relevant information presented during a college-level lecture and subsequently getting that information into a set of notes may not be accessible initially and therefore, may need to be learned (Leutner et al., 2007; Ogle & Blachowicz, 2002; Pressley & McCormick, 1995; Vacca & Vacca, 2002).

In the current set of experiments, we explored the effects of providing feedback to help college students learn to identify relevant words on PowerPoint slides. In Experiment 1, we had students identify relevant words and examined their performance as a function of varied levels of feedback. In Experiment 2, we extended the findings of Experiment 1 to a real-world classroom. The work presented here revealed that a) A simple feedback scenario may be used to immediately enhance students' abilities to identify relevant words, while ignoring irrelevant words, on PowerPoint slides and b) This simple feedback scenario is straightforward enough to efficiently use in a college classroom on the first day of class.

GENERAL METHOD

Overview

In the experiments reported here we manipulated the type of performance feedback provided to participants after they engaged in a relevant word identification task with PowerPoint slides. We examined how the varied feedback impacted participants' abilities to identify relevant information and ignore irrelevant information on the PowerPoint slides.

Materials

Feedback session slides. We used two PowerPoint slides during the feedback phase of the experiments, one on the topic of Economics and the other on the topic of the History of Science, presented in a counterbalanced fashion. We selected these topics as they did not have a clear link to the information to be presented in the testing phase of the experiments, thereby reducing the potential for any information carryover effects. Both slides had a white background with black lettering. Each slide consisted of 47 total words, of which 24 were relevant and 23 were irrelevant, for a relevant to total ratio of .51. Relevant words included titles, names, content words, and words that provided the meaning or context of a content word. Irrelevant words included prepositions ("of, as, in, like…"), redundant words, and words that are implied by a content word (Haynes et al., 2015). Two of the authors, both of whom are professors, worked together to predetermine the relevant and irrelevant words on the slides.

Test session slides. We used four PowerPoint slides printed on paper during the testing phase of the experiments, all of which were on the topic of Ethology. We selected Ethology for the topic as the student participants had not yet been exposed to such information in their Introduction to Psychology course at the time of the study. All slides had a white background with black lettering. Two of the slides contained a "high" amount of relevant words. These high slides contained 47 total words, of which 33 were relevant and 14 were irrelevant, which created a relevant to total ratio of .70. The remaining two slides contained a "low" amount of relevant words. These low slides contained 47 total words, of which 14 were relevant and 33 were irrelevant, which created a relevant to total ratio of .30. We presented the high and low Ethology slides in a counterbalanced order.

Procedure

We randomly assigned participants to 1 of 3 feedback conditions: no feedback (NF), general feedback (GF), or specific feedback (SF). First, each participant engaged in the informed consent process. Then, NF participants received the packet of four Ethology slides, a highlighter, and the following instructions, "Here is a packet of four PowerPoint slides. Use this highlighter to identify what you believe to be important information on each slide. Complete these slides in the order in which they are stapled." Participants had 10 minutes to complete this task.

Participants in the GF condition began with the first feedback session, during which they received either the Economics or History of Science feedback slide, depending on counterbalancing, and the following instructions, "Here is a PowerPoint slide. Use this highlighter to identify what you believe to be important information on this slide." They had two minutes to complete this task. After the two minutes, the researcher collected the highlighted slide, stepped out of the testing room, and graded the slide. Then, the researcher re-entered the testing room and told participants the percentage of relevant words identified correctly on the PowerPoint slide. After telling the participants the percentage, the researcher presented the second feedback slide, either Economics or History of Science, depending on which one the participants saw first, and stated, "Here is a PowerPoint slide. Use this highlighter to identify what you believe to be important information on this slide." Again, they had two minutes to complete the task and after the researcher graded the slide, participants verbally received the percentage of relevant words identified correctly on the PowerPoint slide. After the second feedback session, participants received the packet of four Ethology slides and the same instructions as the NF condition.

Participants in the SF condition went through the same procedure as the GF condition except that after being told the percentage of relevant words identified correctly during each feedback session, SF participants examined their graded PowerPoint slide for one minute, thereby seeing the words they identified correctly and incorrectly. After examining the second graded feedback slide, the SF participants received the packet of four Ethology slides and the same instructions as the NF and GF participants.

After 10 minutes with the Ethology PowerPoint slides, all participants completed a short demographic questionnaire. Next, all participants engaged in the debriefing process with the researcher. The total participation time equaled 30 minutes.

Data coding and analyses

On all feedback and testing slides, we recorded the total number of relevant and irrelevant words participants highlighted. In order to capture in one measure the amount of relevant and irrelevant words highlighted, we calculated a relevance index. To calculate this index we computed the difference between the number of relevant and irrelevant words highlighted and then divided that by the sum of relevant and irrelevant words highlighted. This placed relevance indices for each slide on a scale of -1.0 to 1.0, with zero as the scale midpoint. If participants highlighted more relevant than irrelevant words, the relevance index was greater than zero whereas if they highlighted more irrelevant than relevant words, the relevance index was less than zero. On all test slide analyses, we computed one relevance index for the two high slides and one relevance index for the two low slides. To statistically analyze all relevance indices, we used ANOVAs as data met all necessary test assumptions.

EXPERIMENT 1

In this experiment we examined the impact of the three feedback levels on identification of relevant words in a laboratory environment, during which participants completed all task components individually in a single testing room.

Design

We used a 2(Slide: High vs. Low) x 3(Group: NF vs. GF vs. SF) mixed factorial design to examine the impact of the varied levels of feedback on participants' abilities to identify relevant information on high- and low-relevant slides. Slide served as the within-subjects factor while Group was the between-subjects factor. We made the following specific hypotheses: a) Participants, regardless of feedback condition, would display higher relevance indices on the high-relevant slides than the low-relevant slides, b) Participants in the SF condition would display higher overall relevance indices than those in the GF and NF conditions, c) Participants in the GF condition would display higher overall relevance indices than those in the NF condition, and d) If the SF condition leads to the best relevant word identification performance, then those in the SF condition would display higher relevance indices than those in the GF and NF conditions on both the high- and low-relevant slides.

Participants

We recruited 92 students (M_{age} = 21.21 years, SEM_{age} = 0.67) enrolled in Introduction to Psychology at a mid-size university in the southeastern United States and randomly assigned each one to either the NF (n = 33), GF (n = 29), or SF (n = 30) condition. The total sample consisted of 33 males and 59 females. Of the sample, 56 were White, 19 were Black, 6 were Hispanic, 3 were Asian, and 8 were other. Each student signed up to participate via the department of psychology online research management system and earned a half hour credit toward the research participation module of the Introduction to Psychology course.

Results

First, we used a 2(Feedback Session: 1 vs. 2) x 2(Group: GF vs. SF) mixed ANOVA with Feedback Session as the within-subjects factor and Group as the between-subjects factor to examine the relevance indices of the GF and SF feedback sessions in order to a) Ensure that the groups did not differ at the start of the study and b) Determine if the relevance indices changed over the feedback sessions for the two groups. Figure 1 depicts the mean relevance indices at each feedback session for the GF

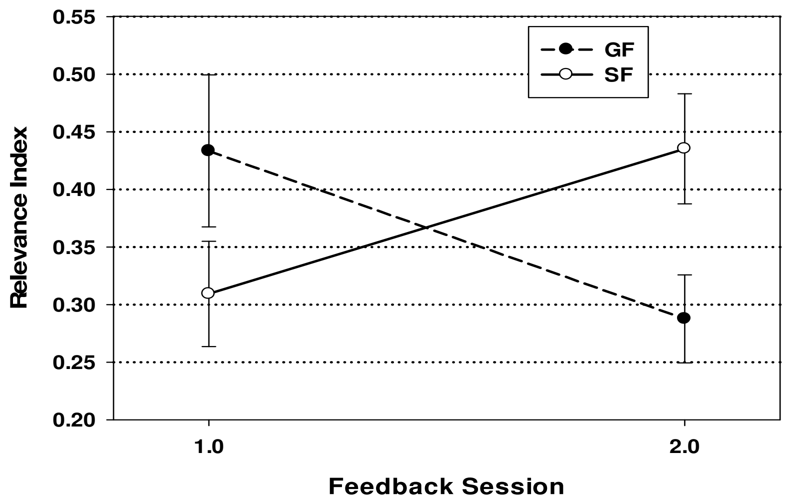

FIGURE 1 Mean Relevance Indices (± 1 *SEM*) of the General (GF) & Specific (SF) Feedback Conditions during Feedback Sessions 1 and 2 (Experiment 1).

(Feedback Session 1: M = .433, *SEM* = .07; Feedback Session 2: M = .288, *SEM* = .04) and SF (Feedback Session 1: M = .309, *SEM* = .05; Feedback Session 2: M = .435, *SEM* = .05) conditions. The ANOVA revealed no main effect of Feedback Session nor of Group, $F(1, 57) = 0.06$, $p = .811$, $\eta^2 = .001$, $F(1, 57) = 0.04$, $p = .840$, $\eta^2 = .001$, respectively. However, there was a significant Feedback Session by Group interaction with the GF condition showing a decreasing relevance index and the SF condition showing an increasing relevance index over the feedback sessions, $F(1, 57) = 10.98$, $p = .002$, $\eta^2 = .162$.

Second, we entered the test slide relevance indices into a 2(Slide: High vs. Low) x 3(Group: NF vs. GF vs. SF) mixed ANOVA. Slide served as the within-subjects factor whereas Group served as the between-subjects factor. Figure 2 depicts the mean relevance indices for the NF, GF, and SF conditions on the high-relevant (*M* = .543, *SEM* = .03, *M* = .580, *SEM* = .03, *M* = .744, *SEM* = .03, respectively) and low-relevant (*M* = -.051, *SEM* = .05, *M* = -.120, *SEM* = .05, *M* = .165, *SEM* = .05, respectively) test slides. The ANOVA revealed a significant main effect of Slide with higher relevance indices on the high-relevant slides

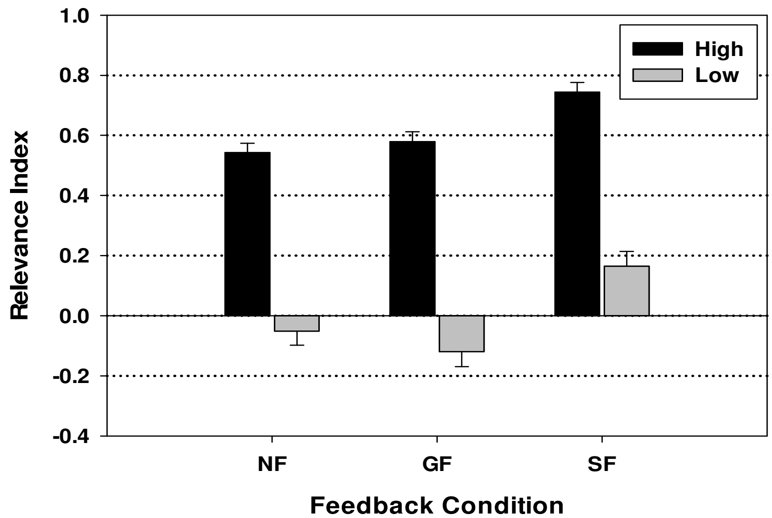

FIGURE 2 Mean relevance indices (± 1 *SEM*) of the three laboratory Feedback Conditions on the High-and low-relevant Test Slides (Experiment 1).

compared to the low-relevant slides, $F(1, 89) = 1259.85$, $p < .0001$, $\eta^2 = .934$). Also, there was a significant main effect of Group, $F(2, 89) = 10.57$, $p < .0001$, $\eta^2 = .192$. Scheffé post hoc analyses revealed significantly higher relevance indices in the SF condition than in the GF and NF conditions, $p < .0001$, $p = .001$, respectively. The relevance indices of the GF and NF did not differ, $p = .956$. There was also a significant Slide by Group interaction, $F(2, 89) = 4.45$, $p = .014$, $\eta^2 = .091$. Follow-up comparisons revealed that the SF condition had significantly higher relevance indices than the GF and NF conditions on both the high-relevant ($p = .001$, $p < .0001$, respectively) and low-relevant slides ($p < .0001$, $p = .002$, respectively). The relevance indices of the GF and NF did not differ on the high-relevant ($p = .419$) or the low-relevant slides ($p = .322$).

Discussion

In this experiment, we found support for three of the four specific hypotheses made. First, results confirmed that when more relevant information was available on test slides (high-relevant slides) participants, regardless of feedback condition, identified more relevant than irrelevant information compared to when less relevant information was available (low-relevant slides). Second, we discovered that across high- and low-relevant slides, participants in the SF condition had significantly higher relevance indices compared to the GF and NF conditions. Third, however, we did not find that participants in the GF condition had significantly higher relevance indices compared to the NF condition. Rather the indices for the two conditions were statistically equivalent. Last, data indicated that the level of feedback provided in the SF condition was best for immediate improvement in relevant word identification as participants in that condition showed significantly higher relevance indices on high-relevant slides but, more importantly, on the low-relevant slides compared to the GF and NF conditions. The SF condition was the only condition to exhibit a positive mean relevance index on the low-relevant slides, which means that they were the only group to identify more relevant than irrelevant information.

EXPERIMENT 2

In this experiment we adapted the NF and SF conditions for use in an Introduction to Psychology classroom. As the NF and GF conditions did not differ in Experiment 1, we dropped the GF condition from the experiment. To move beyond the laboratory and into the classroom, we slightly modified the procedure to have all students in a classroom engage in the task together. One procedural modification entailed the delivery of all instructions, the content of which remained the same as in Experiment 1, to the class at once rather than individually. A second key procedural modification occurred in the SF condition where instead of the experimenter individually grading each student's feedback slides, we projected the grading keys (relevant words bolded; number of relevant words identified with corresponding percent correct) onto a screen and had students grade their own slides. Thus, during the grading of their own feedback slides, they gained the specific feedback of which relevant words they correctly identified as well as those they missed. Our ultimate goal was to determine if it was feasible to use our feedback technique efficiently in the classroom and replicate the results obtained in the laboratory setting (Experiment 1).

Participants

As part of a normal first day, in-class note taking acclimation exercise in two separate Introduction to Psychology classes, we randomly assigned one class to the NF condition (n = 22) and the other class to the SF (n = 21) condition. The total sample (M_{age} = 21.74 years, SEM_{age} = 0.60) consisted of 23 males and 20 females of which 28 were White, 10 were Black, 2 were Hispanic, 1 was Asian, and 2 other. Both classes took place at the same mid-size university as in Experiment 1.

Results

First, we used a paired-samples t-test to assess change in the mean relevance index, if any, over the feedback sessions in the SF condition. The test revealed that the SF group displayed a significant increase in mean relevance index from Feedback Session 1 (M = .276, SEM = .07) to Feedback Session 2 (M = .490, SEM = .03, $t(20)$ = -2.652, p = .015 .05, d = 0.58).

Second, we entered the test slide relevance indices into a 2(Slide: High vs. Low) x 2(Group: NF vs. SF) mixed ANOVA. Slide served as the within-subjects factor whereas Group served as the between-subjects factor. Figure 3 depicts the mean relevance indices for NF and SF con-

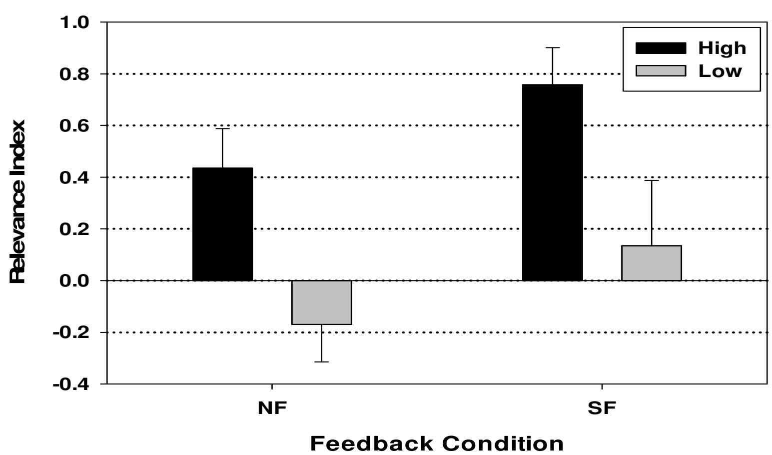

FIGURE 3 Mean Relevance Indices (± 1 SEM) of the Two In-class Feedback Conditions on the High-and low-relevant Test Slides (Experiment 2).

ditions on the high-relevant (*M* = .435, *SEM* = .03, *M* = .758, *SEM* = .03, respectively) and low-relevant (*M* = -.170, *SEM* = .03, *M* = .135, *SEM* = .06, respectively) test slides. The ANOVA revealed a significant main effect of Slide with higher relevance indices on the high-relevant slides compared to the low-relevant slides, $F(1, 40) = 478.92$, $p < .0001$, $\eta^2 = .923$. Also, there was a significant main effect of Group with higher relevance indices in the SF group compared to the NF group, $F(1, 40) = 44.25$, $p < .0001$, $\eta^2 = .525$. There was no significant Slide by Group interaction, $F(1, 40) = 0.09$, $p = .768$, $\eta^2 = .002$.

Discussion

In this experiment, we examined both the feasibility of using performance feedback conditions and the replicability of our laboratory results (Experiment 1) during real-time in a classroom setting. First, with regard to feasibility, we ran the feedback sessions in the classroom in a 30-minute session without any problems. Second, we replicated most of the key results from Experiment 1. As in the first study, when more relevant information was present on test slides (high-relevant slides), participants, regardless of feedback condition, identified more relevant than irrelevant information compared to when less relevant information was available (low-relevant slides). Also, across high-and low-relevant slides, participants in the SF condition had significantly higher relevance indices compared to participants in the NF condition. In this experiment we did not discover a significant Slide by Group interaction. However, despite not finding a significant interaction, the pattern of results was similar to that of Experiment 1, such that the SF condition was the only condition to exhibit a positive mean relevance index on the low-relevant slides, which indicated that they were the only group to identify more relevant than irrelevant information (compare Figures 2 and 3).

GENERAL DISCUSSION

In higher education, both faculty and students place high importance on note taking as a strategy for retaining information presented during oral-visual lectures (Bonner & Holliday, 2006; Dunkel & Davy, 1989; Williams et al., 2013). Empirical studies on the impact of note taking on retention of information indicate that typically, students are never trained to effectively take notes and thus, some form of training may be necessary to reap the benefits of the strategy (Leutner et al., 2007; Ogle & Blachowicz, 2002; Pressley & McCormick, 1995; Vacca & Vacca, 2002; van Meter et al., 1994). Specifically, Haynes et al. (2015), after discovering that students who tended to note more relevant information presented on PowerPoint slides scored higher on a retention quiz, suggested that students may benefit from training on how to discern relevant from irrelevant information presented during a lecture. One of the goals for our experiments was to determine an efficient way to train students to initially discern relevant from irrelevant information on PowerPoint slides. Second, we aimed to take the training into a real-world classroom and replicate the findings in a more ecologically valid manner.

In Experiment 1, we tested the impact that varied levels of feedback had on students' abilities to identify relevant information presented on PowerPoint slides. We found that in a simple feedback model, students were sensitive to the varied levels of feedback provided and modified their behavior. However, results confirmed the hypotheses that students who received specific feedback showed significantly higher relevant word identification performance on both high- and low-relevance slides. We did not find support that providing general feedback would drive higher relevant word identification relative to not receiving any feedback. Thus, it seems that if feedback is to be provided in this scenario, it needs to be specific or else not given at all.

In Experiment 2, we extended the findings of Experiment 1 by testing two of the feedback conditions (NF and SF) in an actual classroom. First, we found that with very slight procedural modifications we effectively conducted the feedback sessions for the SF condition in real-time with all students present in class. Thus, our simple feedback model seems to be feasible as an in-class activity to acclimate students to the lecture note taking environment. Second, if such a feedback model is to be useful in acquainting students with college-level note taking then we needed to replicate the findings from Experiment 1 with all students together in addition to simply adapting the feedback model for group use. Indeed, we found that in the real-world classroom, students in the NF and SF conditions displayed similar results as students who engaged individually in Experiment 1.

In these experiments we demonstrated that simple, but specific, feedback can aid students in identifying a greater number of relevant words over the short term. Based on prior research the ability to discern relevant from irrelevant information is an important first step in encoding information and storing it over the long term. Therefore, if students are better able to identify the relevant information presented and get more of that relevant information into their notes for later review then it is likely that their performance on later quizzes and exams will be higher (Brown & Smiley, 1977; Einstein et al., 1985; Haynes et al., 2015; Johnson, 1970; Leutner, et al., 2007).

One limitation of the current experiments is the short term nature of the task and assessment. In other words, it remains to be seen whether this simple feedback has positive, long term consequences for student note taking in the class. As our focus here was mainly to discover an effective, yet efficient, way to aid relevant word identification, we did not track students longitudinally over the course and examine how they took notes from the lectures accompanied by PowerPoint. Thus, we do not know if the simple improvement in identification of relevant words translated to more of those words appearing in the notes students took in the course. Future studies need to be conducted to examine the short and long term impact that the initial feedback has on the quality of students' notes and subsequently how that impacts students' performance on retention quizzes and exams.

A second limitation of our experiments may be that participants engaged the task in what might be considered a semi-realistic context. Specifically, we asked students to identify relevant information on PowerPoint slides in the absence of a concurrent oral lecture. Also, we prompted students to identify relevant information related to topics that in all likelihood were unfamiliar to them and they had to do this without the context of a real lecture to drive the identification process. One could argue that this lack of context hinders our ability to make any connection between our feedback model and subsequent note taking. First, however, it is important to remember that the current study focused on modifying behavior during initial relevant word identification and not the actual note taking process. Based on prior research, the initial ability to identify relevant information is important to effective note taking (Brown & Smiley, 1977; Johnson, 1970; Leutner, Leopold, & den Elzen-Rump, 2007). Thus, as an early part of our overall line of research, we aimed to examine a way to enhance students' initial ability to identify relevant information. As previously stated, our next steps will be to place our feedback model in more realistic contexts to examine transfer of training. Second, it could be argued that for students to identify relevant information they may need a context to drive the identification process. While we agree that a real class context may provide students with a framework for identifying relevant information on PowerPoint slides, in the current study we assumed the worst case scenario. Specifically, we assumed the situation where students attend lecture without reading the textbook ahead of time and view a PowerPoint slide that contains novel content. In reality this context may not be all that uncommon in college-level courses (Lei, Bartlett, Gorney, & Herschbach, 2010). Ultimately, we are designing experiments in which we take our feedback model into more realistic note taking contexts so as to examine the impact of the feedback model.

A third limitation of these experiments deals with the possibility that feedback may not be necessary at all to help students discern relevant from irrelevant information presented during a lecture. As students are presented with the oral and visual parts of a lecture concurrently, we know that their cognitive system is taxed, especially their working memory (Bui & Myerson, 2014; Bui et al., 2013; Peverly et al., 2007). For instance, students listen to the lecturer, scan the PowerPoint slide, and apply their personal working definition of relevant and irrelevant information so as to translate that information into their own words and transcribe it into their notes. In this context, it is important to recall that most students never receive any formal training in note taking (van Meter et al., 1994). More basically, it is possible that students never receive any sort of definitional distinction between relevant and irrelevant information as it applies to the lecture environment. Thus, it is possible that simply providing students with a clear definition of relevant and irrelevant information, independent of any feedback task, at the beginning of a class may be enough to improve the effectiveness of their note taking. Or, it may be that adding a definition to our specific feedback model may serve to further improve students' identification of relevant words. For instance, despite students in the SF condition being the only ones to identify more relevant information on low-relevant slides, they still exhibited a lower relevance index value on those slides compared to the high-relevant slides. This suggests that they still had a difficult time ignoring the irrelevant information present on the low-relevant slides. We are currently examining these possibilities in our laboratory by examining the impact of providing such definitions with and without feedback.

The traditional lecture method, now commonly accompanied by PowerPoint slides, continues to dominate the majority of contemporary higher education. This paired with students' beliefs in the positive benefits of, and reliance on, note taking warrants more investigations into note taking strategies. Building on previous work that dealt with the functions of note taking, new research must be geared toward how students can learn to effectively use note taking in order to maximize those functions. Here we initiated a line of research that aims to assess ecologically valid strategies for helping college-level students get acclimated to the typical lecture environment, gain the appropriate tools to retain information, and subsequently enhance their academic success.

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