Relevant Word Identification on PowerPoint Slides: Using Irrelevant Information to Aid the Identification Process

Theresa R. Reilly, Jeremy M. Haynes, Nancy G. McCarley, Joshua L. Williams, Tiffany A. Whetzel, Lindsey Bailey, Joshua L. Sharpe, Justin Phillips
Armstrong State University, Savannah, GA

Learning strategies are designed to reduce cognitive load and help students organize and integrate important information for later recall; however, students must first select the appropriate information to integrate. Thus, careful development of selection strategies to distinguish between relevant and irrelevant information is necessary for successful application. In a prior study, we found that specific feedback as students learned to identify relevant information positively influenced students' abilities to identify relevant words on a set of PowerPoint slides. In this study, we extended those findings to determine how feedback on *irrelevant* word identification would affect the detection of relevant words on a set of PowerPoint slides. We found that provision of feedback on irrelevant word identification yielded a similar pattern of results as when students from the prior study received feedback on relevant word identification. Specifically, we found that specific feedback helped students increase their relevant word identification accuracy, and that accuracy was higher on slides that contained a higher relevant to total word ratio versus slides with a lower relevant to total word ratio, regardless of condition. Helping students learn to identify irrelevant information did not lead to higher relevant word identification performance than students in the previous study who learned to identify relevant information; however, it also did not interfere with the identification process as we had originally predicted. These findings are important for shaping a more complete understanding of the identification process employed by students when implementing various study techniques.

University students acquire knowledge from various sources; however, course curriculum is primarily sourced from textbook readings and classroom lecture content (Brock, Joglekar, & Cohen, 2011; Huxham, 2010; van der Meer, 2012). Students often employ learning

Author info: Correspondence should be sent to: Theresa Reilly, Department of Psychology, Armstrong State University, Savannah, GA , 31419

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strategies such as note taking and highlighting to help process the vast amount of information to which they are exposed on a regular basis.

Many studies suggest that learning tactics are not intuitive to the learner, despite students' beliefs; instead these learning tactics must be carefully and deliberately developed (Leutner, Leopold & Elzen-Rump, 2007; van der Meer, 2012; Wade, Trathen & Schraw, 1990). Leutner et al. (2007) emphasized the importance of teaching students how to regulate these learning strategies to achieve specific goals. Often, several tactics are simultaneously integrated to shape an overall learning strategy (Cioffi, 1986), and these various tactics are suited differently to different students such that no single study strategy is inherently better than another. However, for any given strategy to be effective, it must be employed by the learner with a clear purpose, and it should be relatively adaptable to complement the requirements of the material being studied (Wade et al., 1990).

Note taking is largely regarded as the fundamental learning tactic that facilitates the processing of information from sources such as lecture and readings (Arslan, 2006; Cioffi, 1986; Huxham, 2010; van der Meer, 2012). The benefits of taking quality notes include the convenience of having a written record of important details, as well as allowing students to select and organize information in a way that makes sense to them (Arslan, 2006; Kiewra et al., 1991; Stacy & Cain, 2015). This selection process is likely the key to improving many learning strategies. Haynes, McCarley, and Williams (2015) examined this selection process and found that students tend to exclude relevant information, while including a substantial amount of irrelevant information in their study materials. Both errors in identification can be equally problematic.

Baker and Lombardi (1985) found that including more information in notes, such as main points, details, transitions, and examples, is correlated with higher performance on a subsequent test, as well as overall success in a course. However, they also found that students' notes tend to be inadequate, including less than 50% of the main ideas that had been addressed during a lecture and even fewer important supporting details. Huxham (2010) also found students fail to include all main ideas, with only 16% of note sets containing the key points of a lecture.

These findings might lead one to believe that the solution to poor note taking skills is to simply include more information. However, van der Meer (2012) explains that even when students have access to transcripts of entire lectures it does not help them isolate the important pieces of information for further study. Huxham (2010) found that high word count alone is not sufficient for a good note set, providing further evidence that simply writing down every detail is not an effective note taking strategy. Furthermore, Nist and Hogrebe (1987) maintain that students cannot possibly learn everything they read, so discerning what needs to be learned is a vital first step in classroom success.

The results of Baker and Lombardi's (1985) study suggest that students are aware of the presence of both relevant and irrelevant information and consciously make decisions about inclusion or exclusion when compiling notes. However, students struggle to identify exactly which pieces of information should be included. The most useful note sets are concise but accurate; containing more relevant information and less irrelevant information (Haynes et al., 2015).

In addition to note taking, typographical cuing is another commonly used study tactic (Gier, Herring, Hudnell & Montoya, 2010; Leutner et al., 2007) and includes underlining, highlighting, color, italics, brackets, indentation and numbering (Bell & Limber, 2010).Typographical cuing tactics share similarities with note taking tactics as both assist in the reduction of cognitive load by drawing attention to perceived relevant material, and both serve as a practical, condensed version of lengthy readings or lectures (Bell & Limber, 2010). Much like note taking, typographical cuing is often improperly employed due to a tendency to include irrelevant and exclude relevant information (Baker & Lombardi, 1985). Making this distinction and mentally deleting trivial or redundant information is crucial for complete comprehension, but that task can be difficult for some students, as it is a higher-level process (Kintsch, 1998).

Bell and Limber (2010) found that students with lower reading skills tend to rely more heavily on typographical cuing than high-skill readers and that the low-skill readers also tend to mark an excessive amount of irrelevant information. Additionally, low-skill readers have a strong tendency to study only the information they previously marked as important while disregarding other information. Not surprisingly, Bell and Limber's results showed a correlation between poor highlighting strategy and poor course performance. This finding emphasizes the importance of improving the identification strategy in order to ultimately improve course performance.

Many variables influence a student's ability to effectively discern between relevant and irrelevant information. When processing new information, students must interact with, select, organize, and integrate new information in a useable way, while simultaneously avoiding extraneous details to minimize interference from cognitive overload (Moreno, 2004; Ponce & Mayer, 2014). Processing new information and discerning between relevant and irrelevant information is not a simple task, especially in conjunction with learning tactics such as note taking. Peverly et al. (2007) explained that note taking is a cognitively taxing and complicated process, requiring strong verbal working memory, skillful selection of information from working memory, the ability to transform information, and the manual transcription of chosen information, all while engaging auditory memory to maintain fluency in listening to a lecture.

The current study focused on an intervention that can improve a student's overall accuracy in the identification of relevant and irrelevant material. Previous research shows that interventions can be successful in improving study tactics (Robin, Martello, Foxx, & Archable, 2001; Williams et al., 2016). McCrudden and Schraw (2009) found that providing instructions that focus a reader on specific goals leads to greater recognition of relevant information as well as lower recall and recognition of irrelevant information. If this is an effective intervention, then training students to discern between relevant and irrelevant information could lead to better identification, improved retention, and ultimately better test scores.

Much of the research to date focuses on interventions that draw attention to relevant information; however, it may be beneficial to train students on identifying irrelevant information as well (Williams, et al., 2016). Peshkam, Mensink, Putnam, and Rapp (2011) suggest that students may benefit from irrelevance instruction because it could assist in avoidance of excess details as well as emphasize the potentially harmful impacts of extraneous information.

However, only minimal research has been conducted on the effects of focused training on *irrelevant* information, and two competing hypotheses exist on the subject (Peshkam et al., 2011). The first suggests that drawing attention to irrelevant information will allow the reader to categorize that information as unimportant and thus ignore it during processing. The other hypothesis suggests that drawing attention to irrelevant information may lead the reader to unintentionally focus on it and increase the mental processing of unimportant material.

The goal of this study was to assess various types of feedback during irrelevance training to determine how well students subsequently identify relevant information on a set of PowerPoint slides. By determining the impact of different types of feedback on learning to identify irrelevant information, we can clarify the effect that irrelevance training has on identifying information, in general. We hope that examining information differentiation in this new way will allow us to test existing hypotheses and perhaps raise new questions about how irrelevant information is processed during the selection of relevant and irrelevant information.

Findings from previous work on relevance training found that giving specific feedback improved identification of relevant words on PowerPoint slides. However, on slides that contained more irrelevant than relevant words, students struggled to exclude irrelevant information, indicating that a problem in differentiation may be present when there is more extraneous information present (Williams et al., 2016).

We employed a method adapted from Williams et al. (2016) in which they provided different levels of feedback (specific, general, and none) to help students learn to identify *relevant* information on PowerPoint slides. They examined how training on relevant word identification aided later relevant word identification and selection. However, in the current study we provided training on what constitutes an *irrelevant* word as opposed to a *relevant* word. We sought to assess if learning to identify irrelevant information could consequently allow students to better understand what is relevant.

We hypothesized that participants in this study would not perform as well compared to the corresponding conditions from Williams et al. (2016) due to a mismatch in training (learning to identify irrelevant information during feedback sessions but then identify relevant information during the testing phase). We hypothesized that the groups that received irrelevance training would be better able to pick out irrelevant words on the second training session, but when asked to identify relevant information during the testing session, the task inversion would lead to confusion and interfere with the selection process. However, we expected to see the same pattern of results as demonstrated in Williams et al. (2016) in which participants receiving specific feedback displayed better relevant word identification relative to the general and no feedback conditions.

METHOD

Participants

Eighty-nine (M=21.28 years of age, SD= 6.56) undergraduate college students enrolled in Introduction to Psychology at a mid-size university in the southeastern United States during the Spring of 2015 and Fall of 2016 participated in this study. All participants earned 0.5 hours of research credit toward the fulfillment of a course requirement. The final sample consisted of 25 males and 64 females. Of the 89 participants, 4 identified as Asian, 23 as African American, 5 as Hispanic, 52 as White, and 5 as other. To maintain confidentiality, each participant had a randomly generated identification number. We randomly assigned participants to either a no feedback (NF) condition (n=33), general feedback (GF) condition (n= 29) or specific feedback (SF) condition (n= 27).

Materials

Study materials consisted of a total of six PowerPoint slides: Two feedback slides and four test slides. All slides had a total word count of 47 words which we classified as either relevant or irrelevant (see Scoring section below).One feedback slide was on the topic of European History and the other on Economics, and each of these contained a relevant words to total words ratio of .51. A packet of four test slides, each of which on a topic in Ethology, included two high relevance slides (.70 relevant words to total words ratio) and two low relevance slides (.30 relevant words to total words ratio). We selected slide topics to be typical of college-level coursework and cover information unlikely to have been addressed in the participants' education. Slides were representative of those an instructor would use in a typical classroom lecture. We counterbalanced the presentation order of feedback and test slides across participants so as to prevent order effects. For counterbalancing in the feedback phase, half of the participants completed the European History slide first and then the Economics slide while the other half completed these slides in the reverse order. For the test slides, we counterbalanced the presentation order of high- (H) and low- (L) relevant test slides in the packet across participants (i.e. HHLL, HLHL, HLLH, LLHH, LHLH, LHHL).During the study, each participant had a yellow highlighter to mark their word choices, and in the specific feedback condition, we used a red pen to indicate the correct word choices.

Procedure

Participants in the NF condition served as a control group and received no form of feedback and only engaged in the testing session. Participants in the GF and SF conditions received two practice sessions with subsequent feedback appropriate to their assigned condition. During the first practice session, we provided one of the practice slides to the participant and instructed them to use the highlighter to indicate what they believed to be irrelevant information on the PowerPoint slide. We allowed two minutes for the completion of this task. Following this task, we provided either general or specific feedback. General feedback consisted of informing the participant of the percentage of irrelevant words they correctly identified with no further explanation. Specific feedback consisted of informing the participant of the percentage of irrelevant words they correctly identified and allowing a one-minute review period during which the participant examined their graded slide. We used a red pen to indicate the correct irrelevant words on the slide. During this time, we made no comments and the participant could examine the graded PowerPoint slide. Following this practice session, a second, identical practice session occurred with the remaining practice slide. Again, participants either received general feedback or specific feedback on the second PowerPoint slide. Following the second practice session, we administered a testing session with the test slide packet and instructed participants to complete the packet in order. This time, we instructed participants to use the highlighter to indicate what they believed to be *relevant* information on the slides. We gave participants 10 minutes to complete the testing task. Upon completion, all participants completed a demographic questionnaire and then the researcher debriefed them on the nature of the study.

Scoring

We defined relevant words as "names, content words, and words providing the meaning or context of a content word" (Haynes et al., 2015, p. 178). Irrelevant words consisted of "prepositions, definite and indefinite articles, and redundant words implicit in a content word" (Haynes et al., 2015, p. 178). This definition, constructed by Haynes et al. (2015), was based on prior research which considered important information as anything crucial to the understanding of the material and unimportant information as anything that would not change the meaning or understanding if removed (Brown & Smiley, 1977; Johnson, 1970).

We calculated a relevance index for each participant on the individual practice slides as well as on the high- and low-relevance slides in the test slide packet. We derived the relevance index, which served to capture identification of relevant and irrelevant words in a single measure by dividing the difference in the number of highlighted relevant (R) and irrelevant (IR) words on the slides by the sum of the highlighted words [(#R - #IR)/(#R + #IR)]. Given this calculation, relevance indices fell on a range of -1 to +1 and if the participant identified more relevant words than irrelevant words, their relevance index was positive. If the participant identified more irrelevant than relevant words, their relevance index was negative. Based on this index, and if the intervention was successful, we should expect to see negative scores during the feedback sessions where we asked participants to identify irrelevant information, and positive scores during the testing session where we asked participants to identify relevant information.

RESULTS

Feedback phase

Figure 1 shows the mean relevance indices for the GF and SF conditions during the first feedback session (M = -.10, SEM = .09; M = -.04, SEM = .10, respectively) and the second feedback session (M = -.33, SEM = .08; M = -.67, SEM = .08, respectively). To note, if the feedback worked to help students identify the *irrelevant* information then relevance indices should decrease over time during the feedback phase of the study. A 2 (Feedback Session: 1 v. 2) x 2 (Feedback Condition: GF v. SF) mixed factorial ANOVA with Feedback Session as the within-subjects factor and Feedback Condition as the between-subjects factor revealed a significant main effect of Feedback Session with relevance indices being lower at session two relative to session one, $F(1, 54) = 37.966$, $p < .0001$, $\eta_p^2 = .413$. There was no significant main effect of Feedback Condition, $F(1, 54) = 2.182$, $p = .145$, $\eta_p^2 = .039$. There was a significant interaction between Feedback Session and Feedback Condition, $F(1, 54) = 7.794$, $p = .007$, $\eta_p^2 = .126$. Within the first feedback session, there was no difference in relevance indices between the GF and SF conditions ($p = .662$). Within the second feedback session, those in the SF condition had significantly lower relevance indices than those in the GF condition ($p = .003$). Within the GF and SF conditions, participants showed a significant decline in relevance indices over the feedback sessions ($p = .019$, $p < .0001$, respectively).

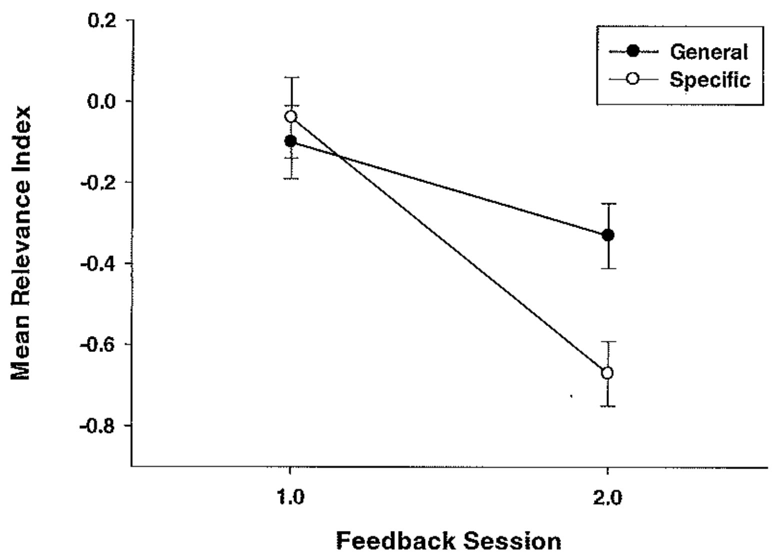

FIGURE 1 Mean Relevance Index (± 1 *SEM*) for General & Specific Feedback Groups During Feedback Sessions

Test phase

Figure 2 shows the mean relevance indices for the NF, GF, and SF conditions on high-relevance test slides ($M = .54$, $SEM = .03$, $M = .55$, $SEM = .04$, $M = .76$, $SEM = .06$, respectively) and low-relevance test slides ($M = -.05$, $SEM = .05$, $M = -.17$, $SEM = .05$, $M = .17$, $SEM = .08$, respectively). A 2 (Slide: High v. Low) x 3 (Feedback Condition: NF v. GF v. SF) mixed ANOVA with Slide as the within-subjects factor and

Feedback Condition as the between-subjects factor revealed a main effect of slide with higher relevance indices on high-relevance slides than low-relevance slides, $F(1, 86) = 1067.177$, $p < .0001$, $\eta_p^2 = .925$.There was a main effect of Feedback Condition, $F(2, 86) = 8.028$, $p = .001$, $\eta_p^2 = .157$. Scheffé post hoc comparisons showed that those in the NF and GF

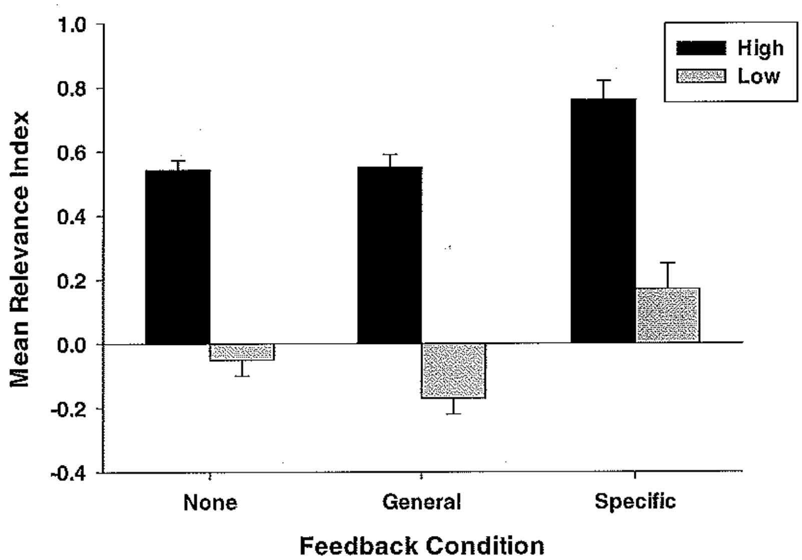

FIGURE 2 Mean Relevance Index (1 *SEM*) on High- and low-relevant Test Slides for the Three Feedback Groups

conditions did not differ ($p = .694$), and those in the SF condition had significantly higher relevance indices relative to those in the NF ($p = .011$) and GF ($p = .001$) conditions. Also, there was a significant interaction between Slide and Feedback Condition, $F(2, 86) = 4.562$, $p = .013$, $\eta_p^2 = .096$. Pairwise comparisons with a Bonferroni adjustment revealed that within each feedback condition, participants had higher relevance indices on high-relevant slides than on low-relevant slides (p's $< .0001$). Within the high-relevant slides, NF and GF did not differ ($p = 1.000$), and SF had significantly higher relevance indices than those in the NF ($p = .002$) and GF ($p = .003$) conditions. Within the low-relevance slides, NF and GF did not differ ($p = .466$), and SF had significantly higher relevance indices than those in the NF ($p = .039$) and GF ($p = .001$) conditions.

DISCUSSION

Because cognitive processing occurs within a limited capacity (Moher & Egeth, 2012), studies geared toward maximizing the efficiency of working memory are of great value. Notes derived from oral-visual lectures need to be accurate to be useful, yet concise enough to be processed within the limited capacity of working memory. In prior work we found that specific feedback can improve the ability to recognize what is and is not important on PowerPoint slides which may reduce cognitive load during lectures, thereby allowing for more resources to be dedicated to other cognitive processes during the lecture. However, the problem remained that when there was more irrelevant information relative to relevant information on a slide, students had more difficulty discerning the relevant from irrelevant information (Williams, et al., 2016). We examined whether helping students to better recognize *irrelevant* information on PowerPoint slides would aid *relevant* information identification to gain a better understanding of how this selection process works.

We found that helping students learn to identify *irrelevant* information on PowerPoint slides during practice sessions yielded a similar pattern of results as that of Williams et al. (2016), in which they helped students identify *relevant* information during practice sessions. Specifically, students who received specific feedback improved irrelevant word identification accuracy on their second practice session relative to the first, and they performed better during the second practice session relative to the GF group. The testing phase showed that students, overall, are more skilled at picking out relevant words when there are more relevant words available, and they decrease in accuracy as more irrelevant information becomes available. On high- and low-relevance slides, SF outperformed NF and GF, which, again, resembles the pattern from Williams et al. (2016).

Because we only looked at relevant word identification accuracy and excluded any measure of knowledge retention, we are limited in explaining why students continue to highlight irrelevant words when they are presented at a higher ratio, even though they accurately differentiate when relevant information is presented at a higher ratio. It may be the case that students struggle to meet performance goals on a task that conflicts with their personalized learning goals in mind. In other words, the task of typographical cuing is personally cultivated by the individual to meet their own specific learning needs, and introducing a performance-based requirement with outside appraisal may drive them to over perform, or in this case, excessively highlight.

Helping students to identify *irrelevant* information on PowerPoint slides did not improve scores more than when Williams et al. (2016)

trained students to identify *relevant* information. For instance, the mean relevance indices for high- and low-relevant test slides, respectively, in Williams et al. (2016) were for NF (M = .54, M = -.05), GF (M .58, M = -.12), and SF (M = .74, M = .17). In the current study, they are for NF (M=.54, M=-.05), GF (M=.55, M=-.17) and SF (M=.76, M=.17). This suggests that helping students identify irrelevant information during the feedback phase did not interfere with subsequent identification of relevant information and thus, training on irrelevant information may be equally effective as training on relevant information in this particular type of scenario.

One possible explanation for this may be found in a linguistic study by Johnson (1970). Johnson developed a unique objective method for reducing a piece of literature to individual linguistic units and assigning a rating of importance to each unit. Results confirmed that (a) Learners recognize the varying levels of importance of linguistic units, (b) Learners do not spend more or less time on a unit depending on the perceived importance, and (c) There is consistency in importance ratings of units, regardless of the nature of following units.

These findings suggest that judgments of importance are based on relationships between units being judged. The research points toward a learner's tendency to perform both inclusion and exclusion tasks simultaneously without preexisting knowledge of the information being presented. For this reason, we cannot simply design interventions to promote recognizing importance without learning more about how we also recognize unimportance. Furthermore, the hierarchal order that participants assigned to selected units accurately predicted recall of those units, so understanding how individuals mentally assign these ratings could help us better understand how to improve learning techniques.

There are several limitations to this study, including the participants that were used. The participants were all students at the same university drawn from the Introductory Psychology participant pool, limiting generalizability. Furthermore, it is likely that students may be more skilled at performing selection tasks in general when provided with specific feedback, regardless of the intuitive nature of the task, when compared to the general population.

An additional limitation arises in the use of PowerPoint slides, as this is not reflective of all educational settings. However, Buchko, Buchko, and Meyer (2012) noted its widespread use and Holstead (2015) found that 97% of her sample reported that their professors use PowerPoint technology. This increased use of digital materials in the classroom may lead to a growing trend toward typographical cuing in place of note taking. Students may begin to view note taking as unnecessary, since the external storage function of notes is already satisfied in many cases by online materials (Stacy & Cain, 2015). If this is the case, it will become increasingly important for students to discern what is most important on a set of materials provided by the instructor, such as PowerPoint slides. As digital and collaborative resources begin to change classroom structure and learning behavior, it is wise to reevaluate information selection strategies to assess interventions that fit with the current reality of the learning environment (Huxham, 2010; Stacy & Cain, 2015; van der Meer, 2012).

Austin, Lee, and Carr (2004) suggested the benefits of creating accurate and complete note sets would be to facilitate remembering information and increasing exam scores, as well as increasing the ability to apply information in a useful way. Future studies should include measures to evaluate whether these benefits are improving with each intervention. In other words, studies like that of Williams et al. (2016), Williams, McCarley, Sharpe, and Johnson (2017), as well as the current study, should be situated into real-world classroom environments where there is an information retention component to permit assessment of training effectiveness. For instance, specific to this current study, one open question is whether or not irrelevant training would negatively impact recall of information once an information retention component is figured into the scenario. Placing these feedback models into such a real-world college-level classroom is one of the crucial next steps in our line of research.

While this study is geared toward assisting the learner in a classroom setting, an additional line of future research might include an examination of the classroom teacher. More specifically, we would like to examine the construction of PowerPoint slides to determine if there is an ideal format, relevant to irrelevant word ratio, or level of emphasis that is most facilitative for effective note-taking.

We endeavored to contribute to an under-researched aspect of information differentiation during the selection process. There is relatively little support for any one hypothesis, which prevents us from making confident statements about the concept, but it is likely that differentiation between types of information arises as a result of multiple processes working together in a dynamic system. The relevance score achieved in this study reflects only one aspect of the process, so we aim for future research to create a more comprehensive understanding of how irrelevance training influences an overall *pattern* of discrimination. Students may eventually learn how to select what is important, given the correct training, but until we understand how this pattern of integration and distinction works to drive comprehension, we sacrifice the ability to design maximally effective interventions.

REFERENCES

Arslan, M. (2006). The influence of teaching note-taking and information mapping on learning and recalling in science. *The Turkish Online Journal of Educational Technology, 5*(2), 8.

Austin, J. L., Lee, M., & Carr, J. P. (2004). The effects of guided notes on undergraduate students' recording of lecture content. *Journal of Instructional Psychology, 31*(4), 314-320.

Baker, L., & Lombardi, B. R. (1985). Students' lecture notes and their relation to test performance. *Teaching of Psychology, 12*(1), 28-32.doi:10.1207/s15328023top1201_9

Bell, K. E., & Limber, J. E. (2010). Reading skill, textbook marking, and course performance. *Literacy Research and Instruction, 49*(1), 56-67. doi:10.1080/19388070802695879

Brock, S., Joglekar, Y., & Cohen, E. (2011). Empowering PowerPoint: Slides and teaching effectiveness. *Interdisciplinary Journal of Information, Knowledge & Management, 6,* 85-94

Cioffi, G. (1986). Relationships among comprehension strategies reported by college students. *Reading Research and Instruction, 25*(3), 220-232. doi:10.1080/19388078609557880

Gier, V. S., Herring, D., Hudnell, J., Montoya, J., & Kreiner, D. S. (2010). Active reading procedures for moderating the effects of poor highlighting. *Reading Psychology, 31*(1), 69-81.doi:10.1080/02702710903397082

Haynes, J. M., McCarley, N. G., & Williams, J. L. (2015). An analysis of notes taken during and after a lecture presentation. *North American Journal of Psychology, 17*(1), 175-186.

Holstead, J. (2015). The impact of slide-construction in PowerPoint: Student performance and preferences in an upper-level human development course. *Scholarship of Teaching and Learning in Psychology, 1*(4), 337-348. doi:10.1037/stl0000046

Huxham, M. (2010). The medium makes the message: Effects of cues on students' lecture notes. *Active Learning in Higher Education, 11*(3), 179-188. doi:10.1177/1469787410379681

Johnson, R. E. (1970). Recall of prose as a function of the structural importance of the linguistic units. *Journal of Verbal Learning & Verbal Behavior, 9*(1), 12-20. doi:10.1016/S0022-5371(70)80003-2

Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Note-taking functions and techniques. *Journal of Educational Psychology, 83*(2), 240-245. doi:10.1037/0022-0663.83.2.240

Kintsch, W. (1998). The representation of knowledge in minds and machines. *International Journal of Psychology, 33*(6), 411-420. doi:10.1080/002075998400169

Landrum, R. E. (2010). Faculty and student perceptions of providing instructor lecture notes to students: Match or mismatch? *Journal of Instructional Psychology, 37*(3), 216-221.

Leutner, D., Leopold, C., & Den Elzen-Rump, V. (2007). Self-regulated learning with a text-highlighting strategy: A training experiment. *ZeitschriftFürPsychologie/Journal of Psychology, 215*(3), 174-182. doi:10.1027/0044-3409.215.3.174

McCrudden, M. T., & Schraw, G. (2009). The effects of relevance instructions and verbal ability on text processing. *Journal of Experimental Education*, *78*(1), 96-117. doi:10.1080/00220970903224529

Moher, J., & Egeth, H. E. (2012). The ignoring paradox: Cueing distractor features leads first to selection, then to inhibition of to-be-ignored items. *Attention, Perception, & Psychophysics*, *74*(8), 1590-1605. doi:10.3758/s13414-012-0358-0

Moreno, R. (2004). Decreasing cognitive load for novice students: Effects of explanatory versus corrective feedback in discovery-based multimedia. *Instructional Science*, *32*(1-2), 99-113. doi:10.1023/B:TRUC.0000021811.66966.1d

Nist, S. L., & Hogrebe, M. C. (1987). The role of underlining and annotating in remembering textual information. *Reading Research and Instruction*, *27*(1), 12-25. doi:10.1080/19388078709557922

Peshkam, A., Mensink, M. C., Putnam, A. L., & Rapp, D. N. (2011). Warning readers to avoid irrelevant information: When being vague might be valuable. *Contemporary Educational Psychology*, *36*(3), 219-231. doi:10.1016/j.cedpsych.2010.10.006

Peverly, S. T., Ramaswamy, V., Brown, C., Sumowski, J., Alidoost, M., & Garner, J. (2007). What predicts skill in lecture note taking? *Journal of Educational Psychology*, *99*(1), 167-180. doi:10.1037/0022-0663.99.1.167

Ponce, H. R., & Mayer, R. E. (2014). Qualitatively different cognitive processing during online reading primed by different study activities. *Computers in Human Behavior, 30,* 121-130.

Robin, A. L., Martello, J., Foxx, R. M., & Archable, C. (1977). Teaching note-taking skills to underachieving college students. *The Journal of Educational Research*, *71*(2), 81-85. doi:10.1080/00220671.1977.10885042

Stacy, E. M., & Cain, J. (2015). Note-taking and handouts in the digital age. *American Journal of Pharmaceutical Education, 79*(7), 107.

van der Meer, J. (2012). Students' note-taking challenges in the twenty-first century: Considerations for teachers and academic staff developers. *Teaching in Higher Education*, *17*(1), 13-23. doi:10.1080/13562517.2011.590974

Wade, S. E., Trathen, W., & Schraw, G. (1990). An analysis of spontaneous study strategies. *Reading Research Quarterly*, *25*(2), 147-166.doi:10.2307/747599

Williams, J. L., McCarley, N. G., Haynes, J. M., Williams, E. H., Whetzel, T., Reilly, T., Giddens, M. & Bailey, L. (2016). The use of feedback to help college students identify relevant information on PowerPoint slides. *North American Journal of Psychology*, *18*(2), 239-256.

Williams, J. L., McCarley, N. G., Sharpe, J. L., & Johnson, C. E. (2017). The ability to discern relevant from irrelevant on PowerPoint slides: A key ingredient to the efficacy of performance feedback. *North American Journal of Psychology, 19*(1), 219-236.