**Introduction**

PowerPoint is widely used as a lecture aid in classrooms. In several well-controlled laboratory studies, we have evaluated variables that may help or hinder learning from PowerPoint presentations used in academic classrooms and tested whether Mayer’s principles of multimedia learning explain the effects of these variables. Mayer’s work, participants are typically assessed first for retention of material from a presentation, and then for transfer of that material to new situations. Pilot work in which we varied test order suggested that it would influence scores on measures of retention and comprehension. In the current study, we explored the effects of test order on student performance. Research on test item order has provided conflicting results and has not evaluated effects of test orders such as those used by Mayer.

To test this, students viewed a video-recorded lecture on neuron communication, either accompanied by a PowerPoint presentation, or not. Students were randomly assigned to each possible test order and completed retention and transfer tests immediately after the lecture. Pilot results suggested that PowerPoint did not affect student scores on either measure, which is consistent with our previous work; however, test order did affect performance. We sought to strengthen this result with a larger sample of participants.

**Hypotheses**

We expect that when students complete the retention test first, their scores on the transfer test will be higher than when they complete the transfer test first because prior recall of retention material will improve their ability to transfer that information. However, when they complete the transfer test first, they will score lower on the retention test than when they take the retention test first.

**Method**

Participants
- 141 students from 2 midsize Midwestern universities recruited through their Departments of Psychology
- 21.3% of sample were freshmen, 5% were sophomores, 15.6% were juniors, 56% were seniors; 2.1% did not report their class
- 82.4% of participants were male and 37.6% were female

Materials
- Informed consent form
- Students’ laptop computers or University desk-top computers using Qualtrics and headphones or a paper based survey
- 2 video-recorded lectures on neuron communication, either with or without a PowerPoint presentation accompanies
- 26-item multiple choice retention test
- 24-item true/false transfer test
- Debriefing form

Procedure
- Students read and signed an informed consent form
- Surveys were conducted on laptop and desktop computers using Qualtrics or in a paper based format
- Participants were randomly assigned to one of 4 conditions
- Participants viewed a previously recorded lecture about neuron communication
- Variations in the independent variables were completely crossed
- After the lecture participants completed either a retention test and transfer test or a transfer test and then a retention test
- When finished, participants received a debriefing form

**Results**

A 2 x 2 ANOVA for retention scores yielded no effects for test item order for either video only or PowerPoint and video conditions (Figure 1). For video only, retention-transfer test order condition, mean retention score was 16.97 (SE = .92). In the video only, transfer-retention test order condition, mean retention was 16.36 (SE = .92). For the video + PowerPoint, retention-transfer order condition, the mean retention score was 16.45 (SE = .87). In video + PowerPoint, with transfer-retention order condition, mean retention was 15.69 (SE = 1.03). Mean transfer overall was 16.37 (SD = 5.48).

The same ANOVA design for transfer scores yielded no effects of test order for either video only or PowerPoint and video condition (Figure 2). The mean score for video only, with retention-transfer was 15.42 (SE = 5.4); the mean score for video only, with transfer-retention order was 14.22 (SE = 5.4). In the video + PowerPoint, retention-transfer condition the mean transfer score was 15.20 (SE = .52). In the video + PowerPoint, transfer-retention condition, the mean transfer score was 15.45 (SE = .61). Mean transfer score overall was 15.07 (SD = 3.27). Finally, the correlation (r) between retention and transfer scores was .60, p < .001.

**Discussion & Conclusions**

We originally believed that completion of the retention test would help students to remember what they learned to facilitate transfer and that asking students to apply what they had learned first would interfere with remembering the facts. Therefore, they should have performed better when they took the retention test before the transfer test. However, we found no significant main effects or interactions to confirm our hypotheses. The patterns of means however, remain intriguing. Also interesting was the strong correlation between retention and transfer scores. The relationship between these measures is likely more complicated than we imagined.

One limitation of our study that may have negatively affected our results is the large percentage of seniors that completed it. Older students may be more experienced test takers, and therefore test item order may not interfere as greatly with their learning. Other potential problems include measurement concerns (test reliability), the validity of our transfer measures, and previous understanding of the lecture material. Eliminating limitations of this study in future research may yield more conclusive results indicating that practical implications exist for instructors who want to assess both their students’ retention and transfer of course material, and contrast with transfer-appropriate processing interpretations of test order effects.

**References**


**Acknowledgements**

This project was supported by the University of Wisconsin-Eau Claire and the University of Wisconsin-Stout.