"Bulletproof": Injecting New Life into Slideware

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Abstract

Although PowerPoint has garnered negative attention from some presentation and design experts, it is still a valuable educational tool. New research on student perceptions of PowerPoint suggests that teachers can use slideware like PowerPoint to stimulate student interest and contribute positively to teaching and learning. If slides are designed with the principle of cognitive load theory in mind, students can achieve maximum benefit from the use of presentation software in the classroom. After discussing relevant research, the author provides concrete suggestions on how instructors can "bulletproof" their slide presentations.

Keywords: PowerPoint, cognitive load theory, slideware

In "How PowerPoint Is Killing Education," Marc Isseks laments, "In classrooms across the United States, . . . the lights have gone down, and the curtain has gone up on the bulletization of education" (74). Isseks is not alone in decrying the traditional bullet point design that has now become ubiquitous with the widespread use of PowerPoint in educational and professional contexts (see Figure 1). Indeed, "experts in design say that bullet points are the worst way to learn and impart information" (Gallo, qtd. in Wailgum), and yet the bullet point template continues to haunt the classroom and the boardroom. Other detractors of PowerPoint range from critical to absolutely dismissive. Famously, in *The Cognitive Style of PowerPoint: Pitching out the Corrupts Within* (2003), Edward Tufte rails against the tendency of PowerPoint to oversimplify and to degrade the quality and transmission of ideas, even blaming the use of PowerPoint among NASA engineers for the 2003 Columbia Space Shuttle Disaster. Similarly, in an essay titled "PowerPoint Is Evil," Tufte maintains that "PowerPoint corrupts absolutely."

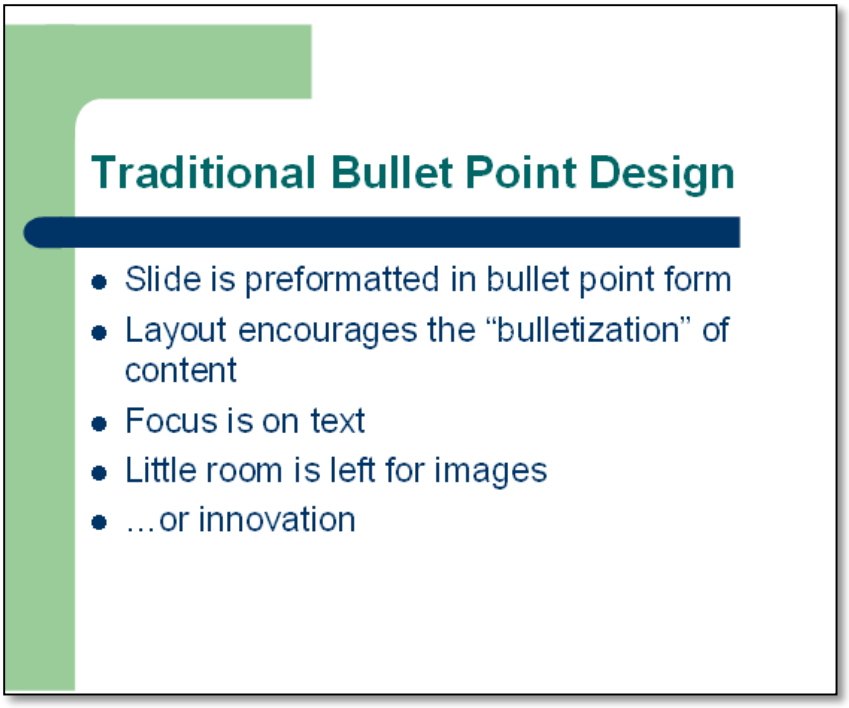

Figure 1. A traditional bullet point template in PowerPoint.

Of Tufte, Tad Simons writes, "No one knows more about effective data design, and no one in the field is more respected," which is why Tufte's denouncement of PowerPoint has garnered so much attention—though not as much as it should among educators. With the advent of Prezi in 2008, and with the increasing host of presentation software programs and mobile applications marketed as alternatives to PowerPoint (e.g. Keynote, Haiku Deck, Pixxa's Perspective, SlideRocket, emaze), it seems more important than ever to use presentation software in a way that best serves the needs of students. The focus of this article, then, is to cull from the existing body of research the best practices for slide design—regardless of which particular program is employed—and to provide concrete strategies that post-secondary educators can employ to make their use of presentation software "bulletproof."

According to Tufte, "the optimal number of bullet points on the optimal number of slides [is] zero in both cases" (*The Cognitive Style of PowerPoint* 23). If slideware like PowerPoint has the potential to "weaken verbal and spatial reasoning" (Tufte 3), and "degrade the quality and credibility of our communication, turning us into bores" (Tufte

24), why use presentation software at all? Certainly, the criticisms levelled against PowerPoint are enough to inspire instructors to look elsewhere in order to meet the needs of their students, but to a significant degree, PowerPoint has become the scapegoat for unskilled and uninformed presenters and presentations. Instead, the discussion needs to be redirected towards helping teachers effectively harness sound principles of slide design rather than condemning the medium of slideware. As Farhad Manjoo puts it in the tagline to his article, "No More Bullet Points, No More Clip Art," "PowerPoint isn't evil if you learn how to use it." After all, presenters and teachers can make the very same errors in presentation design regardless of what communication platform they choose. Evidence suggests that if used adeptly, platforms like PowerPoint and the increasingly popular Prezi can indeed stimulate student interest, provide variety in the classroom, and contribute positively to learning.

Catharina de Wet reports that "in the late 1990s, several studies indicated that college students found PowerPoint-based lectures more interesting than traditional lectures" and that in certain cases, "student scores on tests were even improved" (30). Although studies on the educational value of slideware (with the bulk of the evidence relating to the use of PowerPoint specifically) have not unanimously found positive results upon student success, recent studies have given educators good cause to believe that there is hope for PowerPoint yet. In 2007, researchers from the University of Tennessee at Chattanooga conducted a survey of 1,223 business students and found that "a large percentage of respondents indicated that PowerPoint slides are helpful in understanding the course material" and "deny the negative consequences of this presentation tool" (Ahmadi, Dileepan, and Raiszadeh 7). Building upon this study, Lisa Burke, Mohammad Ahmadi, and Karen James conducted a smaller survey of 230 students in 2009, which found that students perceived PowerPoint as valuable for its "ability to help organize and structure content and to present course-relevant visuals, pictures, and graphs" (248). Jennifer Clark's 2008 paper, "PowerPoint and Pedagogy: Maintaining Student Interest in University Lectures" also confirms that post-secondary students perceive this particular presentation tool as beneficial to their learning.

How, then, can instructors capitalize upon this clearly established student interest in presentation software while also maximizing student success? In order to "bulletproof"

the slides they use in an educational setting, teachers can (and should) avail themselves of new and extant information on cognitive load theory (CLT) and slide design. The benefits of designing instruction with attention to CLT have been repeatedly demonstrated through empirical evidence, dating back to John Sweller's foundational research in the 1980s (Clark, Nguyen, and Sweller 1). Since the inception of CLT, cognitive psychologists have continued to investigate and refine their suggestions as to how the "evidence-based guidelines" of CLT can produce "faster learning, better learning, or both" (Clark, Ngyuen, and Sweller xviii). As Sweller notes in "The Many Faces of Cognitive Load Theory," "instructional design that does not take human cognitive architecture into account is likely to be random in its effectiveness," whereas "instruction formatted according to cognitive load theory principles can result in a 50%+ increase in test scores" (22). With regard to college teaching in particular, Michelle Miller asserts, "Any truly evidence-based approach to college teaching must take into consideration what cognitive research tells us about human memory and related processes" (121). Of particular relevance to the present discussion is the fact that some researchers in the field have specifically turned their attention towards the use of slideware and multimedia in the virtual, on-ground, or blended classroom. In what follows, a brief overview of the fundamental principles of cognitive load theory is presented, followed by further analysis of how the *way* information is communicated with slideware can either enhance or work against students' ability to learn and retain new concepts.

Cognitive load theory proposes that human cognition—and by extension, the human capacity to acquire and retain new information—is governed by certain restrictions imposed by working memory (sometimes conflated with "short-term" memory, although the two are not necessarily synonymous). Richard Mayer and Roxana Moreno even claim that "the learner's capacity for cognitive processing is severely limited" (43), and Sweller explains that "before learners faced with novel material can organize and incorporate it in long-term memory, they must process it using a limited working memory that includes partially independent channels for auditory and visual information" ("Implications of Cognitive Load Theory" 26). Building upon this model of limited working memory, CLT also proposes that there are three kinds of "loads," or demands, placed upon the individual in a learning environment: intrinsic load, which refers to "the intellectual demands or

complexity of the learning material" (Leahy, Chandler, and Sweller 401); extraneous (irrelevant) load, which "imposes mental work that is irrelevant to the learning goal" (Clark, Nguyen, and Sweller 12); and germane (relevant) load, which is "mental work imposed by instructional activities that benefit the instructional goal" (Clark, Nguyen, and Sweller 11). Because extraneous and germane cognitive load are produced from the *way* students learn, they are within the teacher's control, whereas intrinsic load often is not.

The basic principles of cognitive load can help instructors design slides and deliver content in a way that does not put unnecessary stress (extraneous load) upon students' working memory while they are trying to "encode" or learn new information. For example, reading aloud to students the text displayed on a slide (discussed further below), induces extraneous cognitive load because this practice makes the brain work harder and less efficiently than it should have to in order to absorb information. Although in most instances teachers cannot change the inherent difficulty of a concept or skill (intrinsic load) that students must confront, they can aspire to minimize extraneous load in order to "free up working memory" (Clark, Ngyuen, and Sweller 139) as they plan and execute their lectures. When using slideware, instead of using a text-heavy slide as a teleprompter while students inevitably read ahead and simultaneously listen (or not), teachers can use a sparse amount of text—or none at all. Lecture notes or key talking points can be disseminated in a handout for students to later reference, if the instructor desires. During the class time itself, this strategy opens up the possibility of stimulating students' brains in a more effective way with graphics as well as text.

Expert advice holds that "people learn better from words and pictures than from words alone" (Mayer x). Again, in this instance, cognitive science broadly supports the idea that in many cases the best way to impart information is through multimedia learning—that is, instruction that combines graphic and textual representation (pictures, illustrations, charts, graphs, maps, *and* language, whether spoken or written). If used skillfully, slideware can be a crucial component in multimedia instruction that harnesses the "words and pictures" combination. As Mayer and Moreno explain, the brain has two primary means of processing information: "an auditory/verbal channel for processing auditory input and verbal representations and a visual/pictorial channel for processing visual input and pictorial representations" (44). "Although all theorists do not characterize the subsystems

exactly the same way" (Mayer and Moreno 44), it is generally agreed that both channels are of limited capacity and can become overloaded if material is not organized and presented with the dual-channel model in mind. For example, when presenters use and recite from a traditional text-heavy, bulleted slide, the visual cortex is understimulated, while the auditory/verbal channel risks being overloaded. While the visual/pictorial channel may be involved in reading the words on the slide, it still remains only slightly engaged because in the traditional bullet point design, there is little of rich visual interest to the brain. Teachers and students alike have experienced the all-too-common effect of many bulleted slides with few or no images: "Death by PowerPoint."

Even when instructors aim to engage both channels, care must be taken for a variety of reasons. In a 2002 study, Wayne Leahy, Paul Chandler, and John Sweller found that when auditory information was added to a visual (e.g. a diagram) that students were able to understand on its own, "the dual-mode duplication of information is redundant and may hinder learning" (414). Cognitive theorists propose that "extraneous load is reduced and learning is facilitated" if presenters avoid this "redundancy effect" (Sweller, "Implications of Cognitive Load Theory" 27). Therefore, if they can determine when only one means of delivering information to students is sufficient, teachers should *not* duplicate that same information in another form (e.g. reading onscreen text that students can read themselves, explaining a self-evident diagram or visual on a slide). If instructors deem it necessary to use "lengthy segments on screens or slides"—often the key factor in death by PowerPoint—they "should remain silent when presenting textual information to learners" (Clark, Ngyuen, and Sweller 136) in order to avoid extraneous load.

Additionally, when deciding how to present course material with the help of PowerPoint or other slideware, one also needs to consider the inherent difficulty of the material being taught and the competency of the students. When "the learners are novice," the risk for cognitive overloading must be taken into account (Clark, Ngyuen, and Sweller 122). However, research has demonstrated that if principles of cognitive load are disregarded with simple material and/or with expert learners, "working memory capacity may not be exceeded" and that "instructional design may only be critical when dealing with complex material" (Sweller, "Implications of Cognitive Load Theory" 27). In other words, when information is relatively simple, or when students are advanced, teaching with

successful implementation of CLT principles may not be as crucial, as the risk for cognitive overloading is lower. With the vast foundation of research in multimedia learning and cognitive psychology—some of which can be challenging to navigate for those outside the field—educators can take comfort in the fact that not all classrooms produce high-stakes learning environments, in the sense that not all course material is complex and not all learners are novice. Consequently, those interested in implementing CLT principles into their lecture material and slide design might consider first experimenting with the following recommendations in situations like those noted above, where intrinsic cognitive load is low for students.

Recommendations

In general, slides should support or augment what the speaker is saying, not render the speaker superfluous. To avoid the "redundancy effect," instructors should avoid verbally repeating text that appears on a slide or a visual that is self-explanatory. Following this, instructors can engage in polling of students, class discussion, or other forms of assessment as desired (see Figure 2).

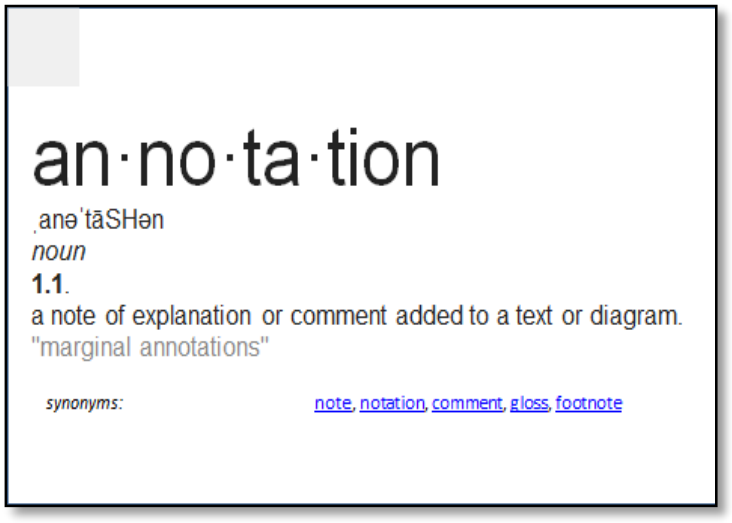

Figure 2. A definition of "annotation" that stands on its own, and can be used as a jumping off point for class activity after students have read the slide.

For a powerful visual message that will tap into students' visual cortex, use meaningful, high quality images. Use slides to project visuals rather than bullet points, and

consider additional material (handouts, soft copy of notes made available on the web) to provide students a detailed record of what was covered in class (see Figure 3).

Figure 3. A visually rich slide used to illustrate the concept of journeys.

When words and graphics are included together on a slide, ensure that each element complements, not replicates, the other (again, avoiding redundancy). Students can be encouraged to make the link themselves, in order to stimulate interest (see Figure 4).

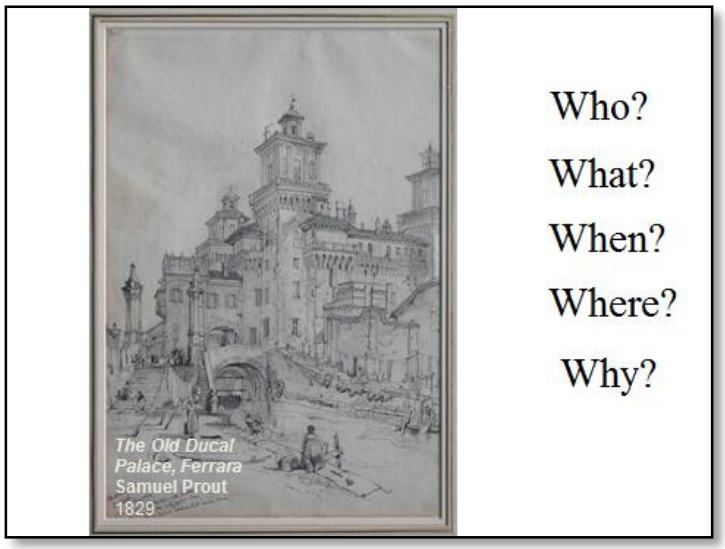

Figure 4. A slide that provides a complementary visual answer to the question "where?" (in this case, with regards to the setting of a poem).

Keeping in mind the principle of "managing cognitive load by reducing the amount of content at one time" (Clark, Nguyen, and Sweller 161), break ideas into easily digested segments over a number of slides (see Figure 5).

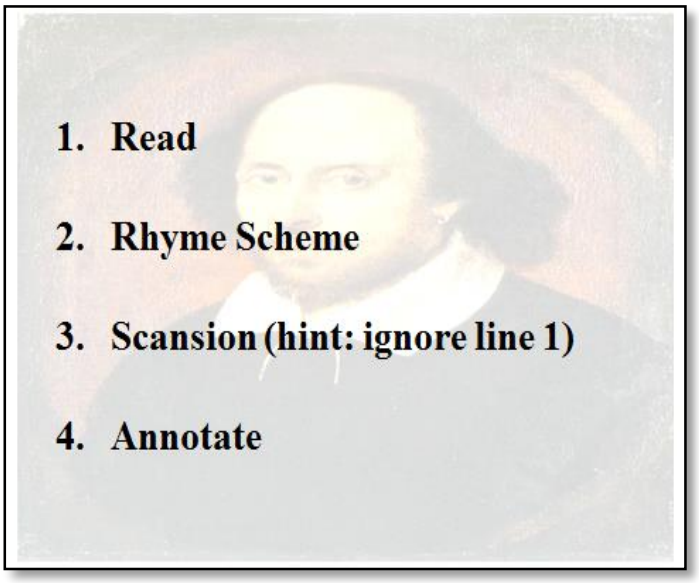

Figure 5. A slide indicating that content in the presentation is divided into smaller, more manageable segments that students encounter one at a time (one idea per slide).

Conclusion

Though much maligned, presentation software like PowerPoint is still of value to students and educators. Instructors can take comfort in the fact that there exists a strong foundation of research in the fields of slide design software and cognitive psychology to support the idea that slideware—if used skillfully and mindfully—can fulfill a crucial role in the classroom. Multimedia learning that employs slideware designed with cognitive load theory in mind can garner and maintain student interest in course material and help students reach the full potential their working memory allows. Moving forward, the present article and the relevant research to date can facilitate further dialogue about how to harness new and existing presentation technology in order to maximize student engagement and success.

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