Applying Cognitive Load Theory (CLT) to Improve Accessibility of Lecture Slides

When creating lecture slides it is crucial that they are accessible for all students. One important concept to assist with this is **cognitive load theory** (Sweller, 1988/1994/2010; Sweller, van Merrienboer, & Paas, 1998). The working memory has a limited amount of space and it is important to maximize this space as much as possible for learning to occur. Cognitive load is housed within working memory. If the cognitive load is too high, overload can occur, and learning will become more difficult.

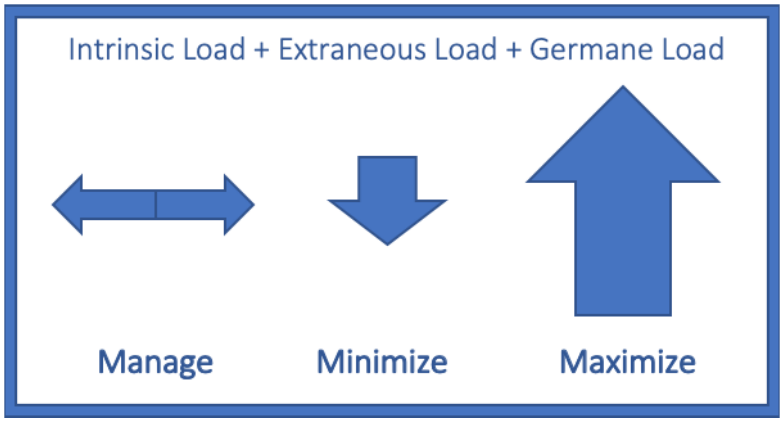
There are three components to cognitive load theory:

Extraneous	is caused by inappropriate instructional designs that ignore working memory limits and fail to focus working resources on schema construction and automation.
Intrinsic	is caused by the natural complexity and structure of the material that must be processed.
Germane	is caused by effortful learning resulting in schema construction and automation.

Another way to think of the three cognitive loads types:

- **Extraneous Load** is the distractions that occur outside of the learning-the environment, the method of learning (typically slides, handouts, and lectures), and other instructional design elements
- **Intrinsic Load** is the complexity of the material that learner is trying to process
- **Germane Load** is the actual learning that occurs

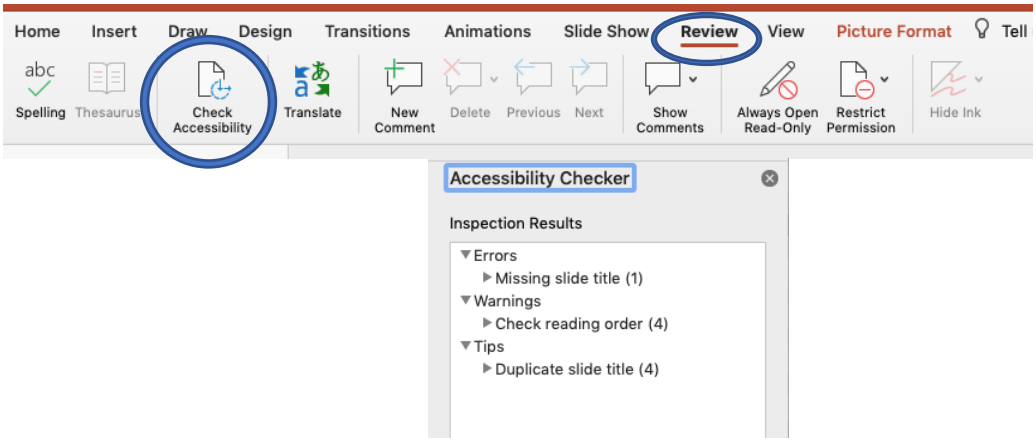
For germane load maximization to occur, it is important to manage intrinsic load and minimize the extraneous load. All of this can be completed with properly designed lecture slides.



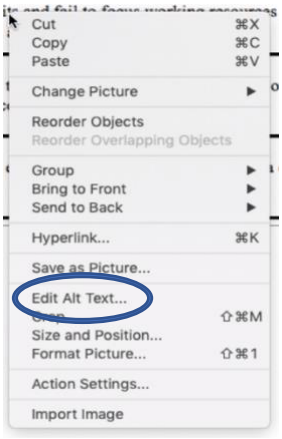
For slides, it is important that the content is easy to understand. This will make sure that the germane load, extraneous load, and intrinsic load are controlled.

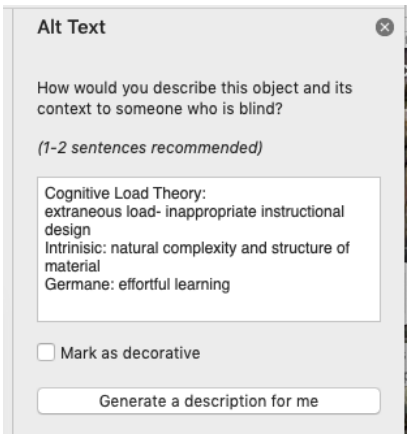
Tips for Making Slides Accessible (Mayer, 2001)

1. **Use fewer words, and more graphs/charts**
   - This technique streamlines the information on the slides and helps the presenter not to read off the slides
   - This also allows for the slides to be updated more quickly in the future as most of what is delivered in a lecture will be spoken
2. **Photos used in slides should reflect the material and not distract**
   - Use of *seductive details* can seem fun, but they distract the learner from the material presented on the slide as well as from listening to the presenter
3. **Limit animation as it can distract from the material**
   - Animation of texts and transitions can overwhelm the learner
4. **Reduce use of extreme fonts, colors and animation**
   - Less is more! Backgrounds without much color, neutral font colors and neutral text are better for fostering learning
5. **Ensure that slides are accessible for students with diagnosed disabilities that may need to utilize alternative software**
   - Microsoft Office has an Accessibility button. Under the *Review* Tab across the top of PowerPoint, click on *Check Accessibility* button and will show a box of alert issues.

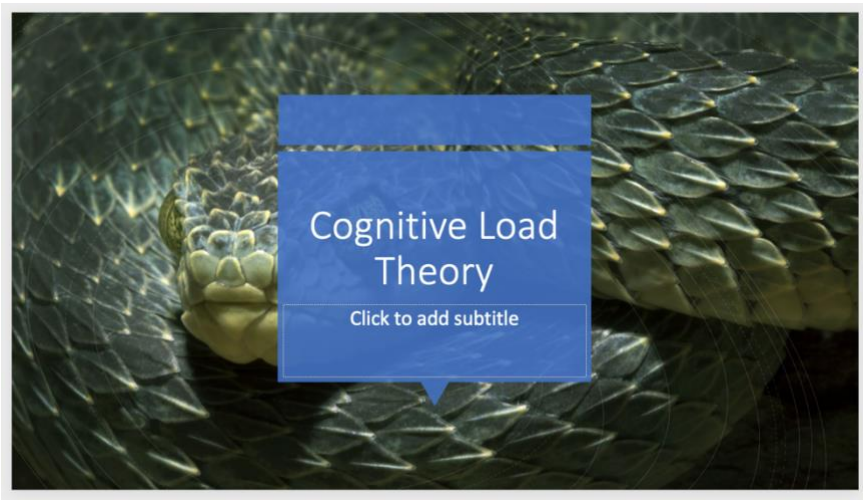


   - To add alternative text for photos, right click and select *Edit Alt Text,* and type in the description or have it generate a description for you

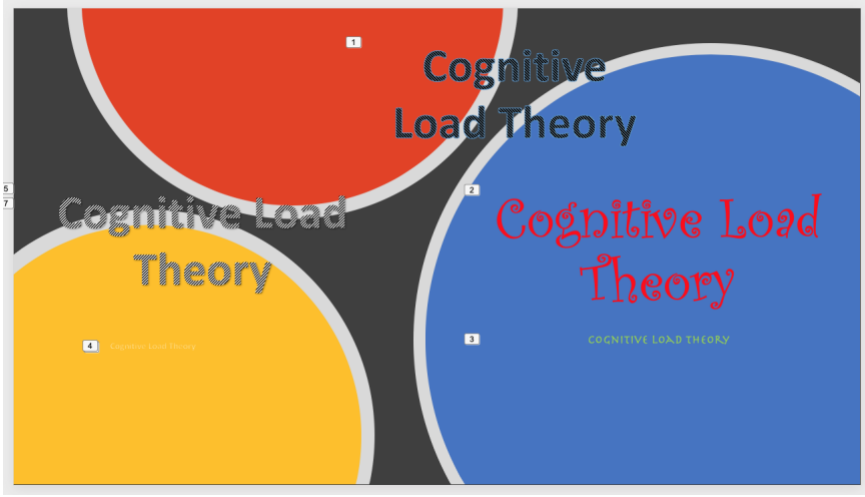




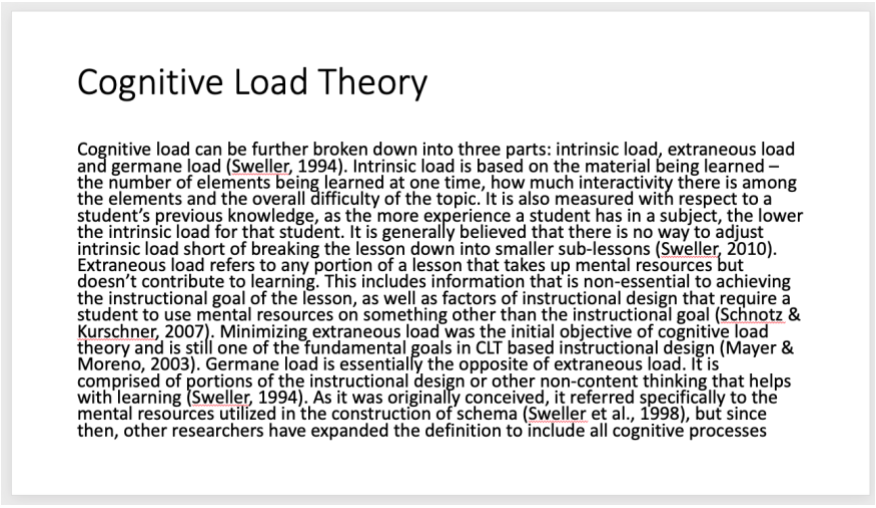
Examples of Poorly Designed PowerPoint Slides



This slide has a random photo of a snake (a seductive detail with no connection to the lesson) and a blue box that also doesn't connect to the lesson and distracts from the title.



This slide has a busy background and fonts that are hard to read because of color, shading and size. It also includes animation, which is distracting.

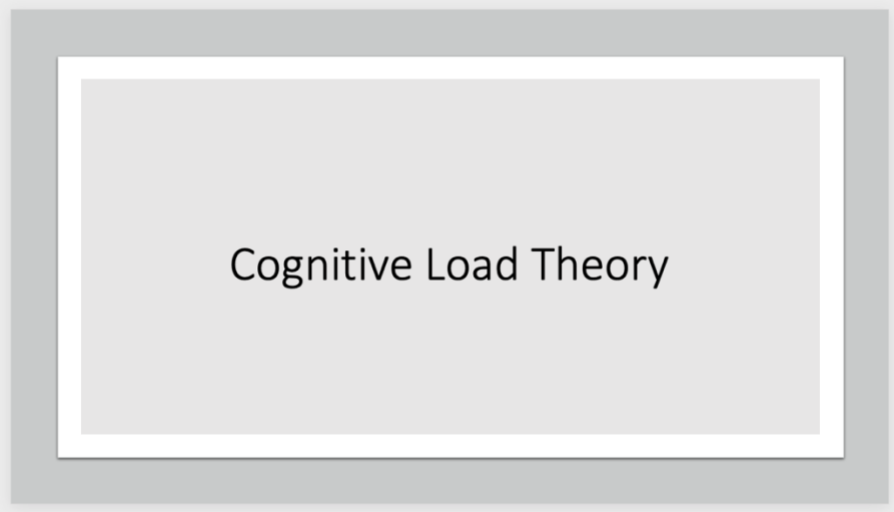


Cognitive Load Theory

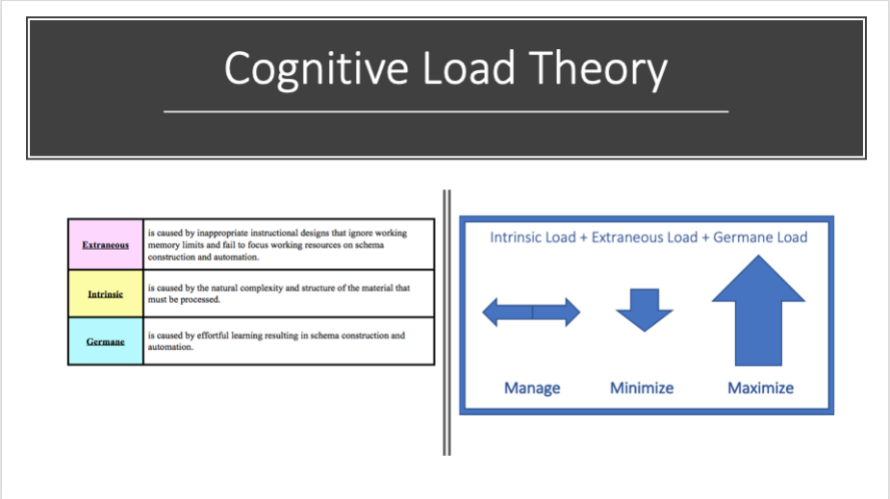
Cognitive load can be further broken down into three parts: intrinsic load, extraneous load and germane load (Sweller, 1994). Intrinsic load is based on the material being learned – the number of elements being learned at one time, how much interactivity there is among the elements and the overall difficulty of the topic. It is also measured with respect to a student's previous knowledge, as the more experience a student has in a subject, the lower the intrinsic load for that student. It is generally believed that there is no way to adjust intrinsic load short of breaking the lesson down into smaller sub-lessons (Sweller, 2010). Extraneous load refers to any portion of a lesson that takes up mental resources but doesn't contribute to learning. This includes information that is non-essential to achieving the instructional goal of the lesson, as well as factors of instructional design that require a student to use mental resources on something other than the instructional goal (Schnotz & Kurschner, 2007). Minimizing extraneous load was the initial objective of cognitive load theory and is still one of the fundamental goals in CLT based instructional design (Mayer & Moreno, 2003). Germane load is essentially the opposite of extraneous load. It is comprised of portions of the instructional design or other non-content thinking that helps with learning (Sweller, 1994). As it was originally conceived, it referred specifically to the mental resources utilized in the construction of schema (Sweller et al., 1998), but since then, other researchers have expanded the definition to include all cognitive processes

This slide has too much text. It is hard for the learner to see it, follow it, and understand it. Also, the chances of reading off the slide are greater for the presenter, which can also overwhelm the learner.

Examples of Well-Constructed PowerPoint Slides



This slide has a clear and easy to read font, it is free from photos and outlandish text.



This slide has all the necessary information above, but is now organized in charts that are easy to follow and understand. The photos have been labeled with alternative text. The lecturer would use this information as a basis for the presentation but also verbally expand for the audience to increase learning.

For more information on effective lecture and multimedia for slide design:
https://support.office.com/en-us/article/make-your-powerpoint-presentations-accessible-to-people-with-disabilities-6f7772b2-2f33-4bd2-8ca7-dae3b2b3ef25

Or contact the Center for Excellence in Teaching at usccet@usc.edu

Mayer, R. (2001). *Multimedia Learning.* Cambridge: Cambridge University Press.
Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*, 257-285.
Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*, 295-312.
Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review, 22*(2), 123-138.
Sweller, J., van Merrienboer, J. J. G. & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*(3), 251-296.