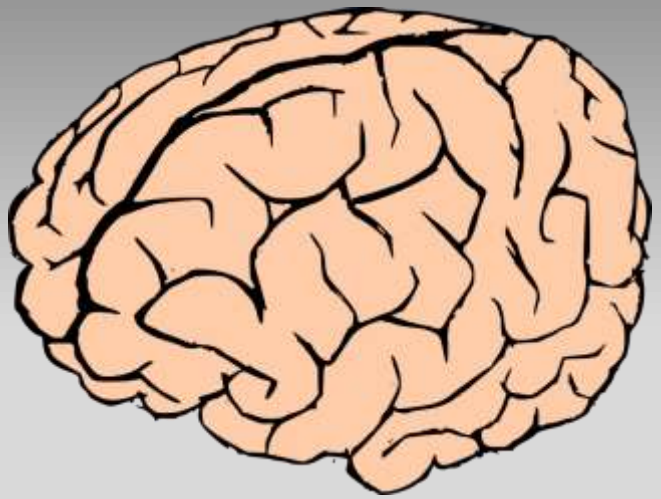
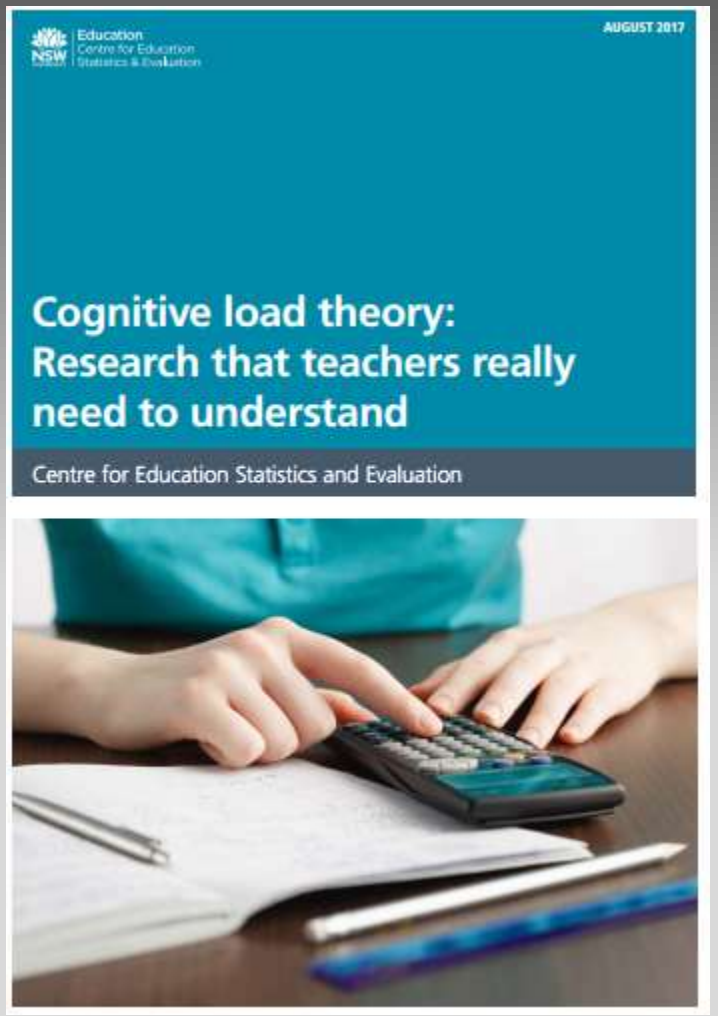
Cognitive Load Theory





Cognitive Load Theory

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Follow

I've come to the conclusion Sweller's Cognitive Load Theory is the single most important thing for teachers to know bit.ly/2kouLOq

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Cognitive Load Theory

Cognitive load theory emerged from the work of educational psychologist John Sweller and colleagues in the 1980s and 1990s (see especially Sweller 1988, 1999). They assert:

> *The implications of working memory limitations on instructional design can hardly be overestimated … Anything beyond the simplest cognitive activities appear to overwhelm working memory. Prima facie, any instructional design that flouts or merely ignores working memory limitations inevitably is deficient.*
>
> (Sweller, van Merrienboer & Paas 1998, pp. 252-253)

Memory

Short-term (working)

Long term (stored)

Schema

Schemas

try to remember the following combination of letters:

y-m-r-e-o-m

6 items

Schemas

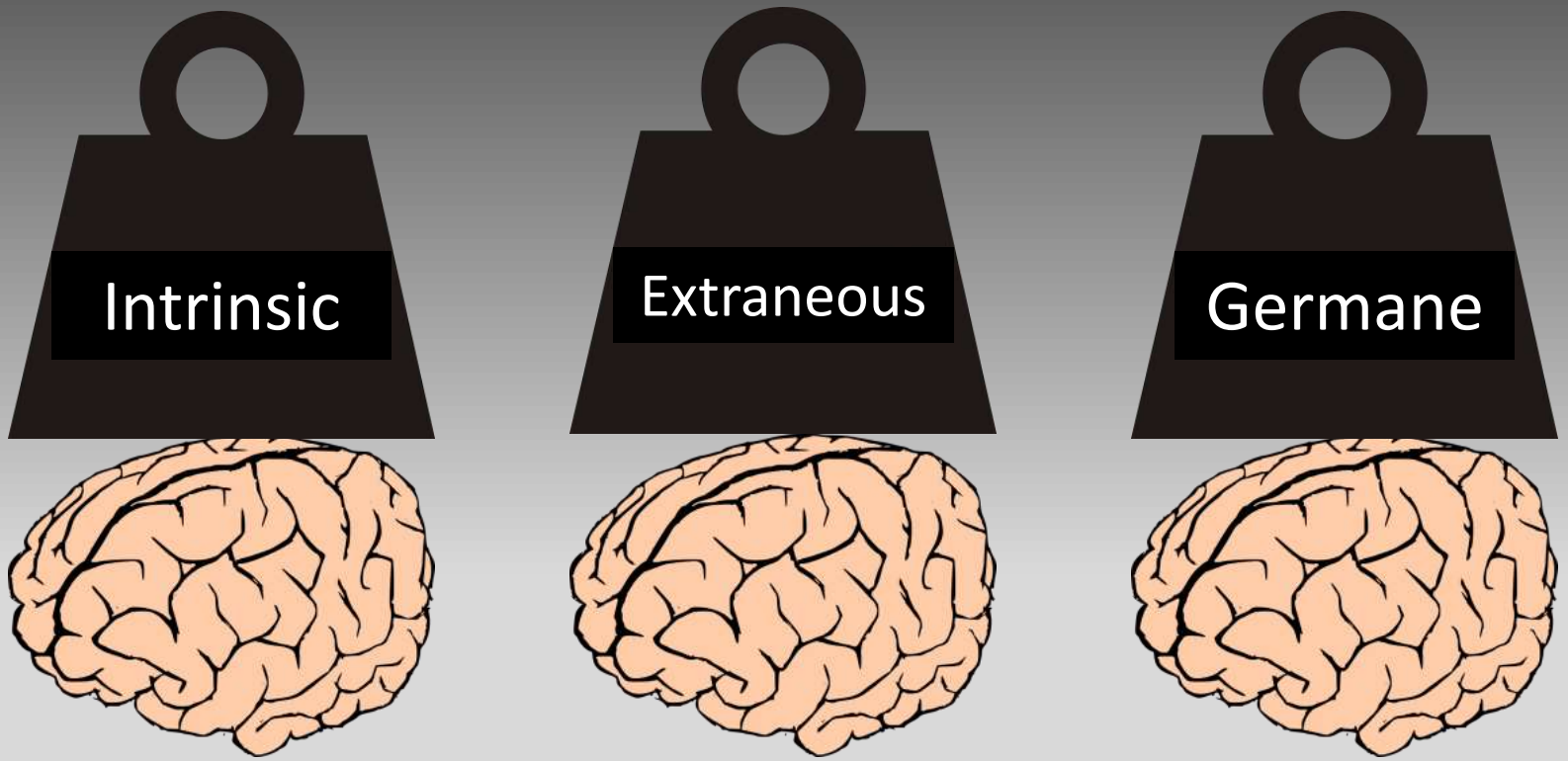
Now try to remember the letters:

m-e-m-o-r-y

1 item

Working memory is freed up

Types

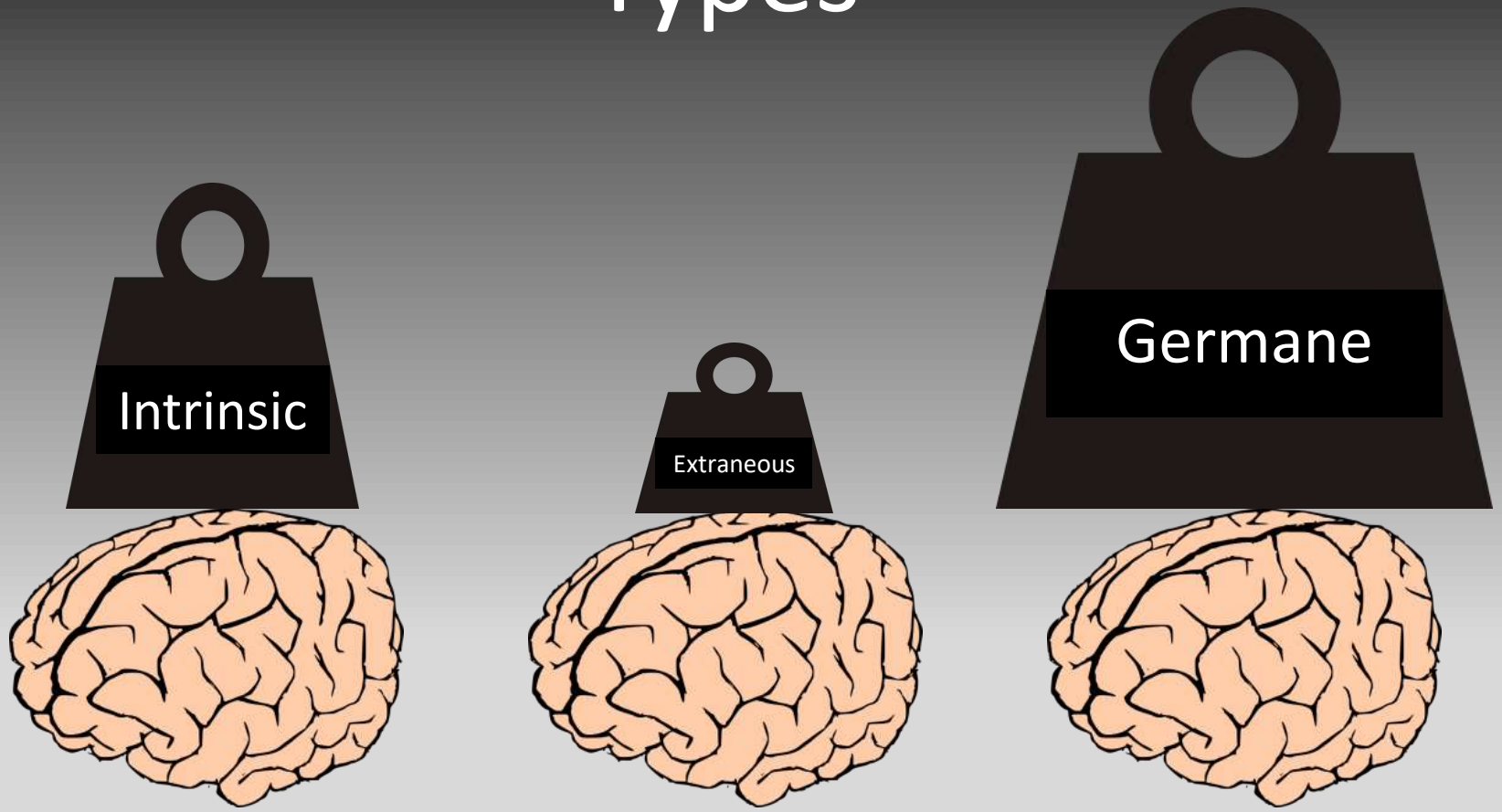


Types

Types of cognitive load

Load type	Source	Effect on learning	Example
Intrinsic load	The inherent complexity of the material and the prior knowledge of the learner	Necessary to learning (but potentially harmful if too high, because it can cause cognitive overload)	Learning how to solve the mathematical equation *a / b = c, solve for a* Learning this equation might have a high intrinsic load for a novice maths student, but would have a low intrinsic load for an expert mathematician
Extraneous load	Poorly designed instruction that does not facilitate schema construction and automation	Harmful because it does not contribute to learning	The student is required to figure out how to solve the equation themselves, with minimal guidance from the teacher This imposes a high cognitive load, but does little to encourage schema construction because the student's attention is focused on *solving* the problem rather than on *learning* the technique
Germane load	Well designed instruction that directly facilitates schema construction and automation	Helpful because it directly contributes to learning	The student is explicitly taught how to solve the problem and given lots of worked examples demonstrating how to do it This imposes a lower cognitive load on the student, enabling them to learn and remember *how* to solve the problem when faced with it again

Types

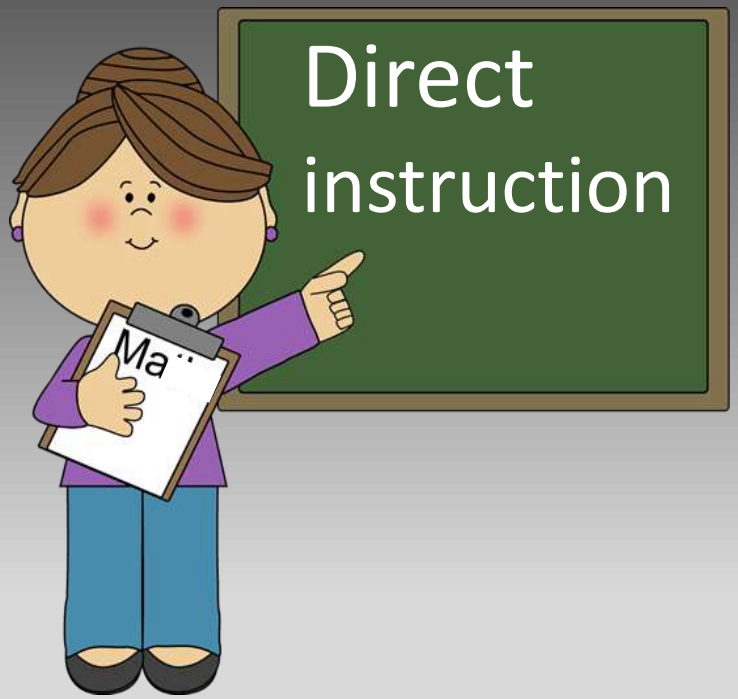


Types

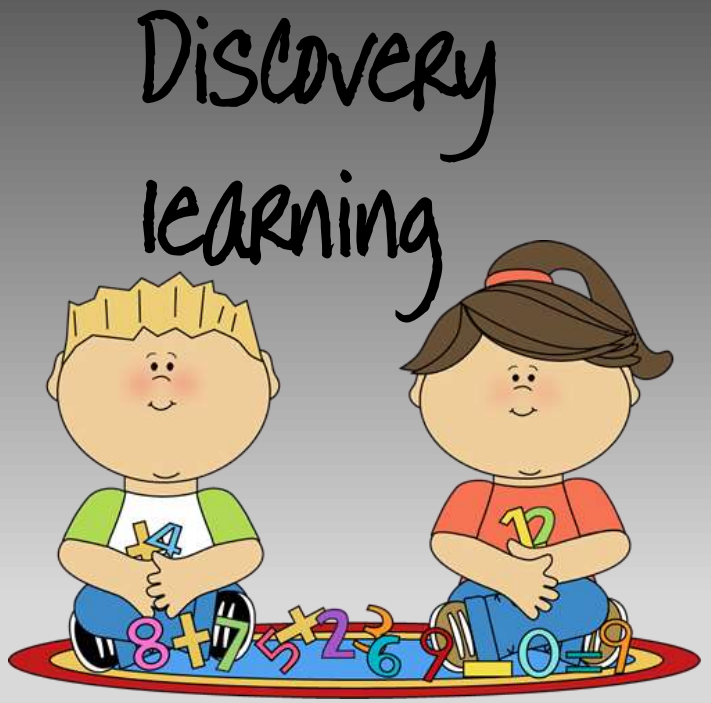
The combination of decreasing extraneous cognitive load and at the same time increasing germane cognitive load involves redirecting attention: Learners' attention must be withdrawn from processes that are not relevant to learning and directed towards processes that are relevant to learning and, in particular, toward the construction and mindful abstraction of schemas.

(Sweller, van Merrienboer & Sweller 1998, p. 264)

Implications for teaching

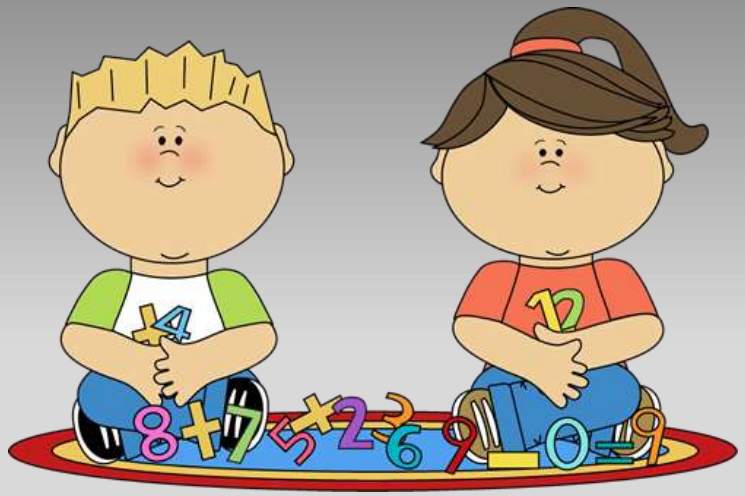


Lower cognitive load
More effective for learning



Higher cognitive load
Less effective for learning

Implications for teaching



Novices

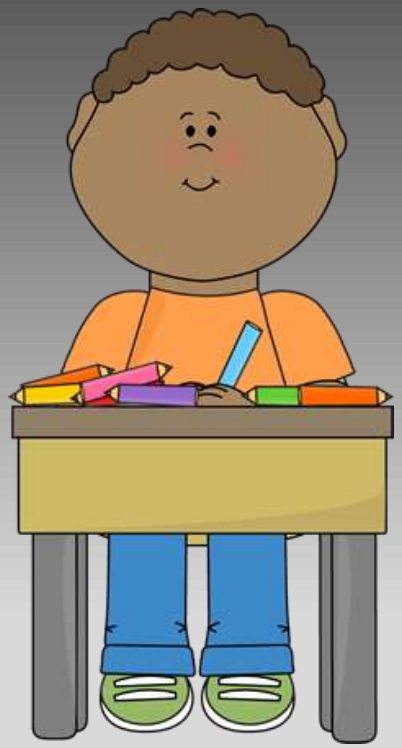
Experts

Implications for teaching

It is important to note that cognitive load theorists do not advocate using *all* aspects of explicit instruction *all* the time. Indeed, they recognise the need for learners to be given the opportunity to work in groups and solve problems independently – but assert this should be used as a means for *practicing* newly learnt content and skills, not to *discover* information themselves (Clark, Kirschner & Sweller 2012, p. 6).

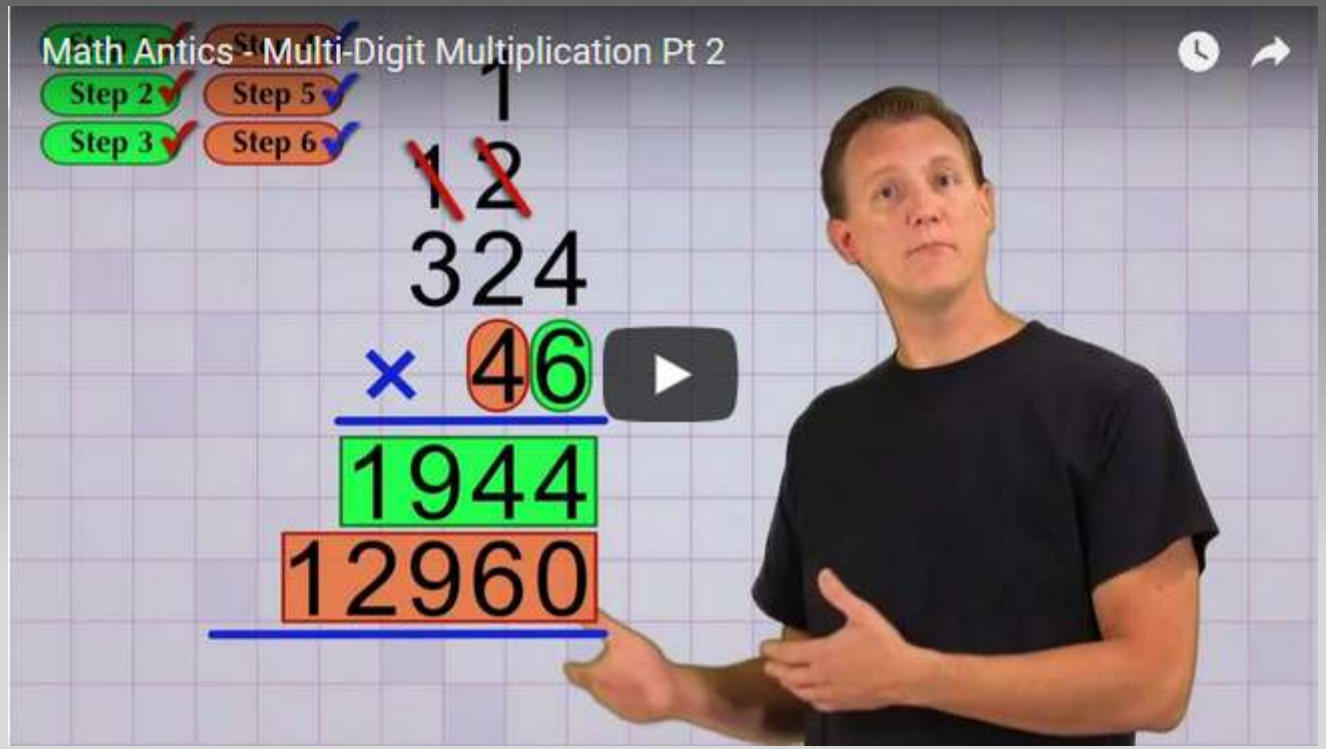
Implications for teaching

Generic skills - Problem solving
Innate - no explicit teaching required



Domain-specific skills
Not innate
Require specific teaching

Worked example

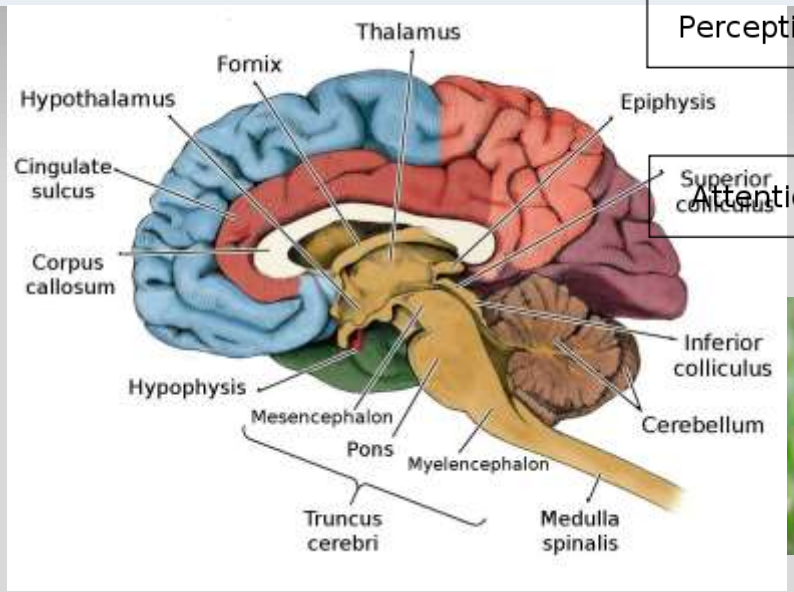


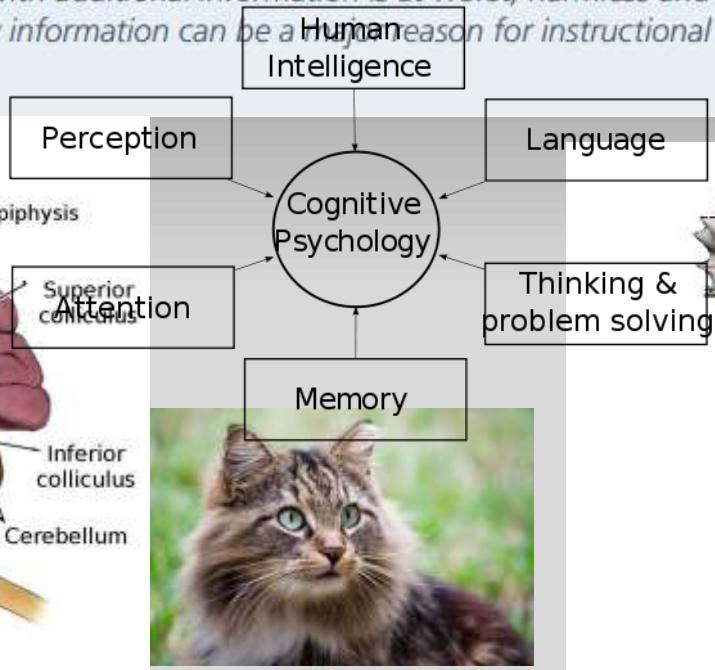
Expertise reversal

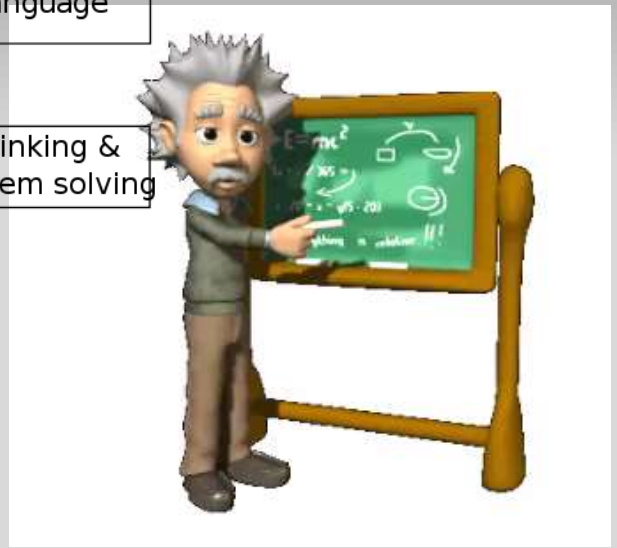
Redundancy

Students do not learn effectively when their limited working memory is directed to unnecessary or redundant information. The 'redundancy effect' occurs when learners are presented with additional information that is not directly relevant to learning, or with the same information in multiple forms. An example is a textbook which includes both text and a diagram that needlessly repeat information, or a PowerPoint presentation in which the presenter reads the text presented on the screen. Requiring learners to process redundant information inhibits learning because it overloads working memory. Cognitive load research shows that best practice is to remove redundant information from learning material (Bobis, Sweller & Cooper 1994; Chandler & Sweller 1991; Mayer et al 1996; Torcasio & Sweller 2010). Sweller argues:

> *Most people assume that providing learners with additional information is at worst, harmless and might be beneficial. Redundancy is anything but harmless. Providing unnecessary information can be a major reason for instructional failure.*
> (Sweller 2016, p. 8)

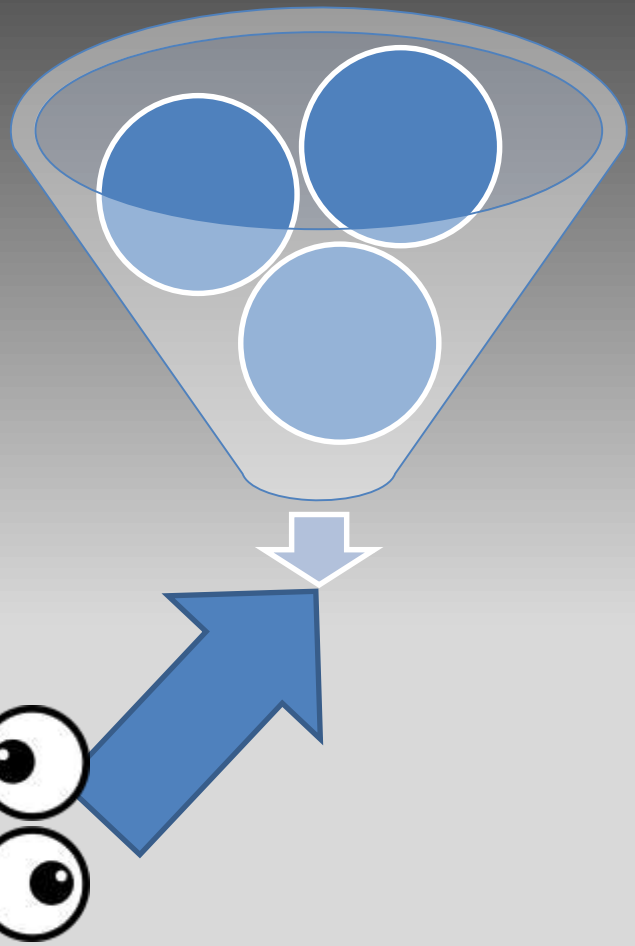






Split attention

The 'split attention effect' occurs when learners are required to process two or more sources of information simultaneously in order to understand the material. This might occur, for example, when a diagram is used to explain a concept, but it cannot be understood without referring to a separate piece of explanatory text



Modality