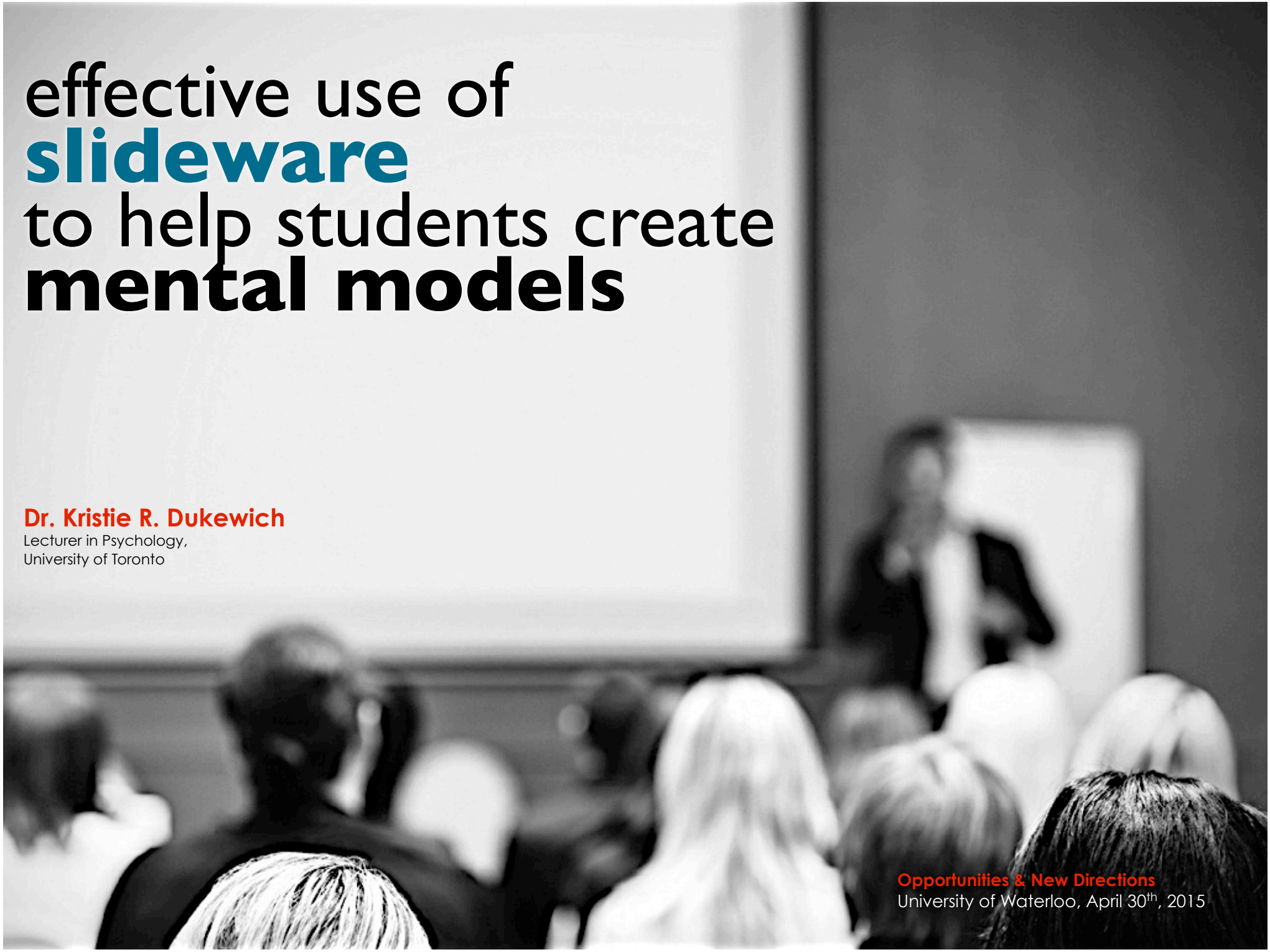
# effective use of **slideware** to help students create **mental models**

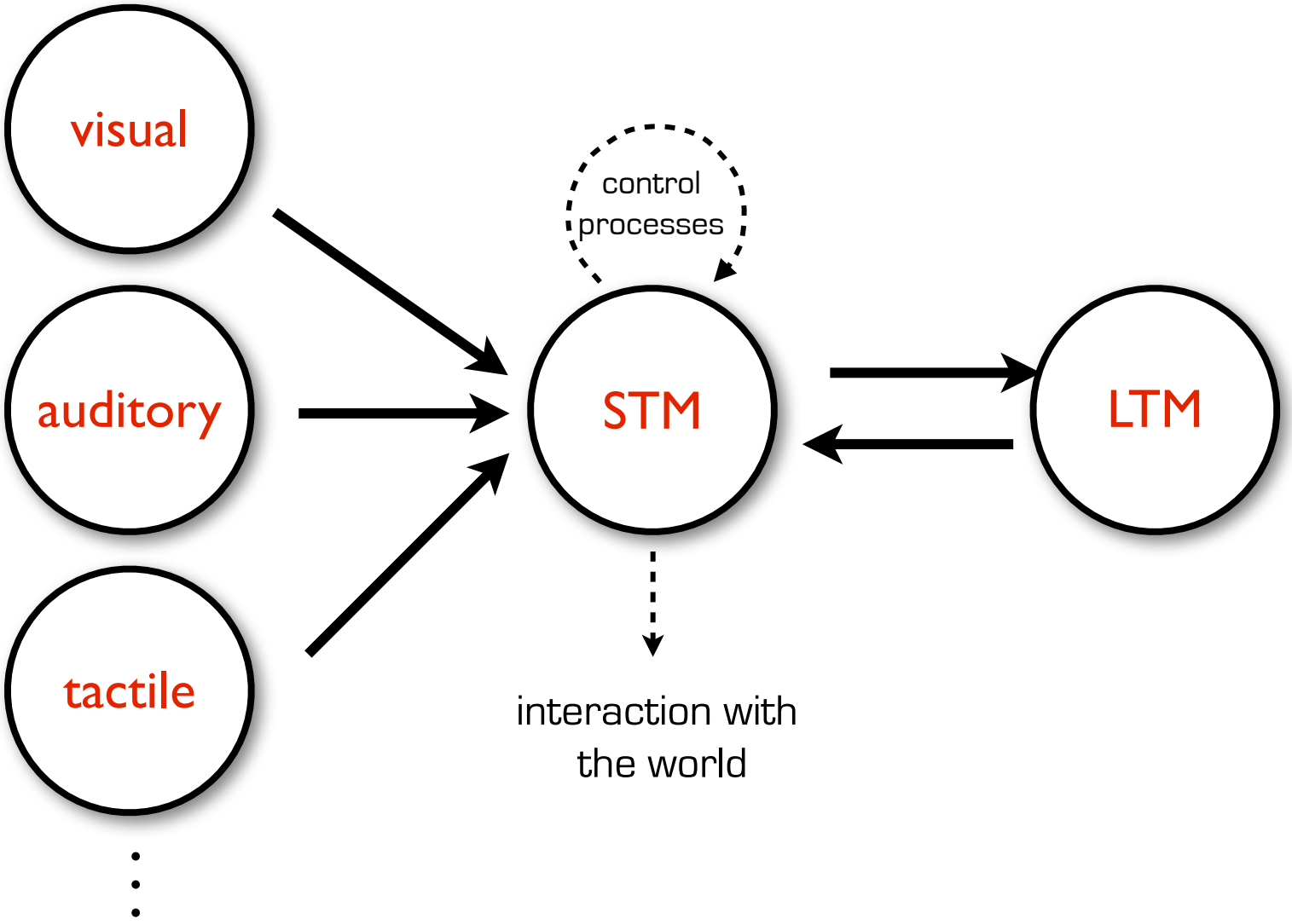


**Dr. Kristie R. Dukewich**
Lecturer in Psychology,
University of Toronto

**Opportunities & New Directions**
University of Waterloo, April 30th, 2015

# By the end of this workshop, you should be able to:

- **explain** the relationship between working memory, long-term memory & slides that are effective for learning
- summarize Sweller's **Cognitive Load Theory** as it relates to slide design
- apply Mayer's principles from his applied **Cognitive Theory of Multimedia Learning**
- **recognize** the effective use of different forms of graphical representations
- go back to your slides and implement at least a few of these tips to **help your students** learn more effectively




Attkinson & Shiffrin (1968)

can you reproduce the **symbol**
I showed a minute ago?

**Schemas** are **mental models** of the world.

cognitive theory of
multimedia learning

cognitive load theory

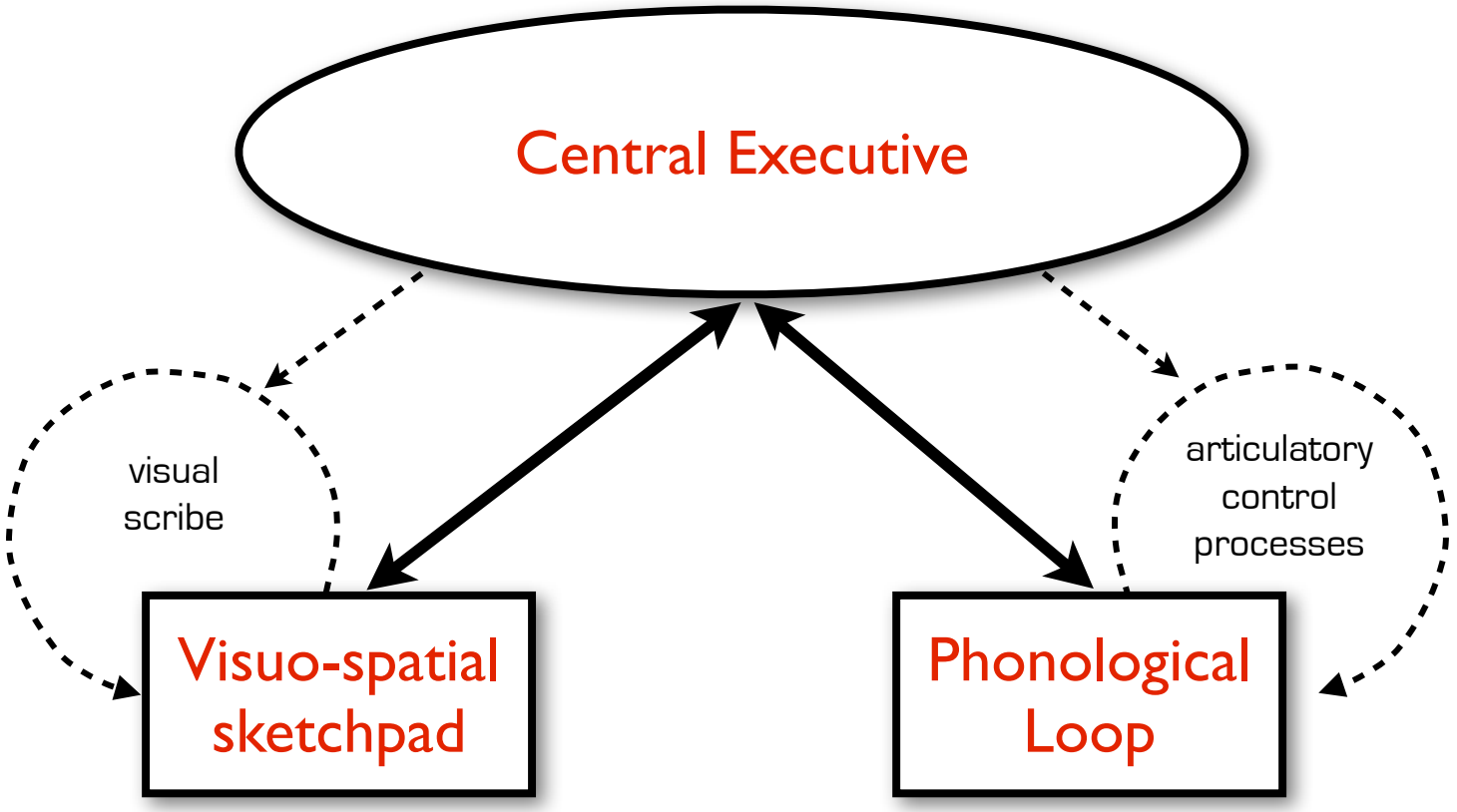
cognitive architecture

cognitive theory of
multimedia learning

cognitive load theory

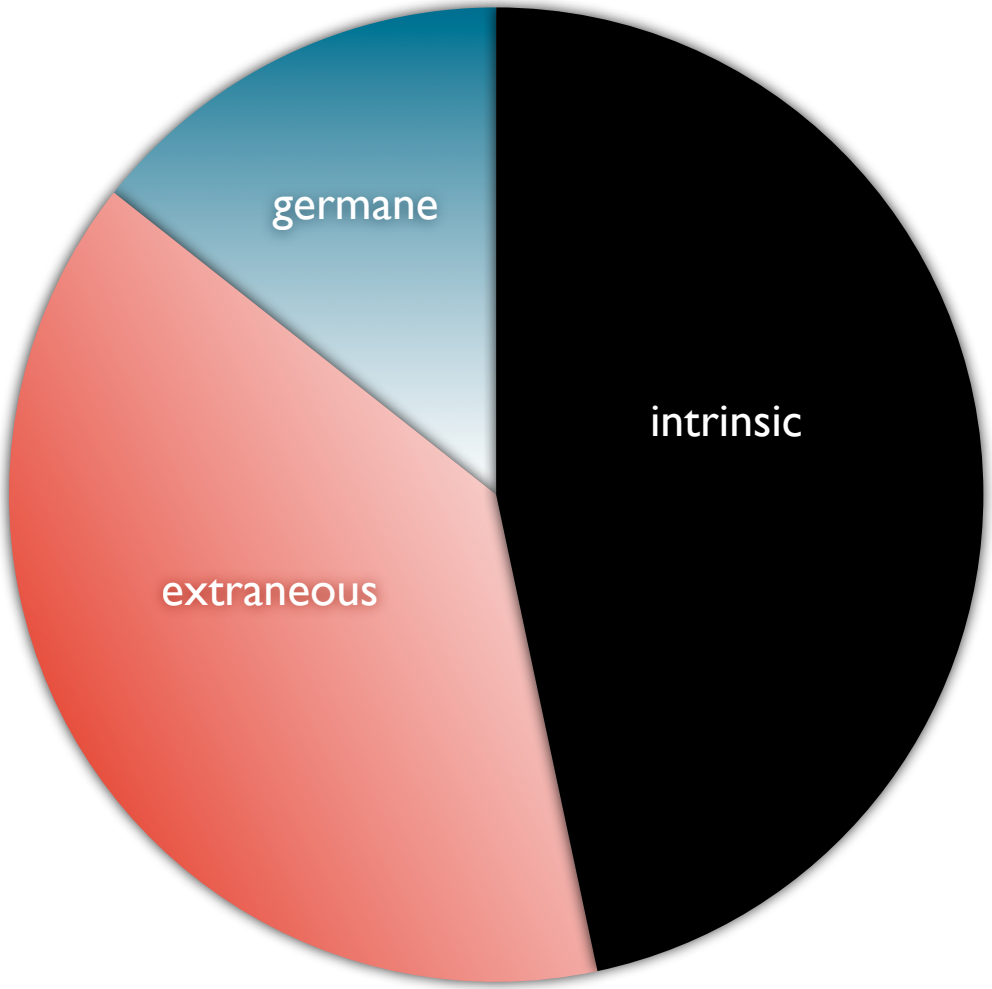
cognitive architecture

# working memory




Baddeley & Hitch (1974)

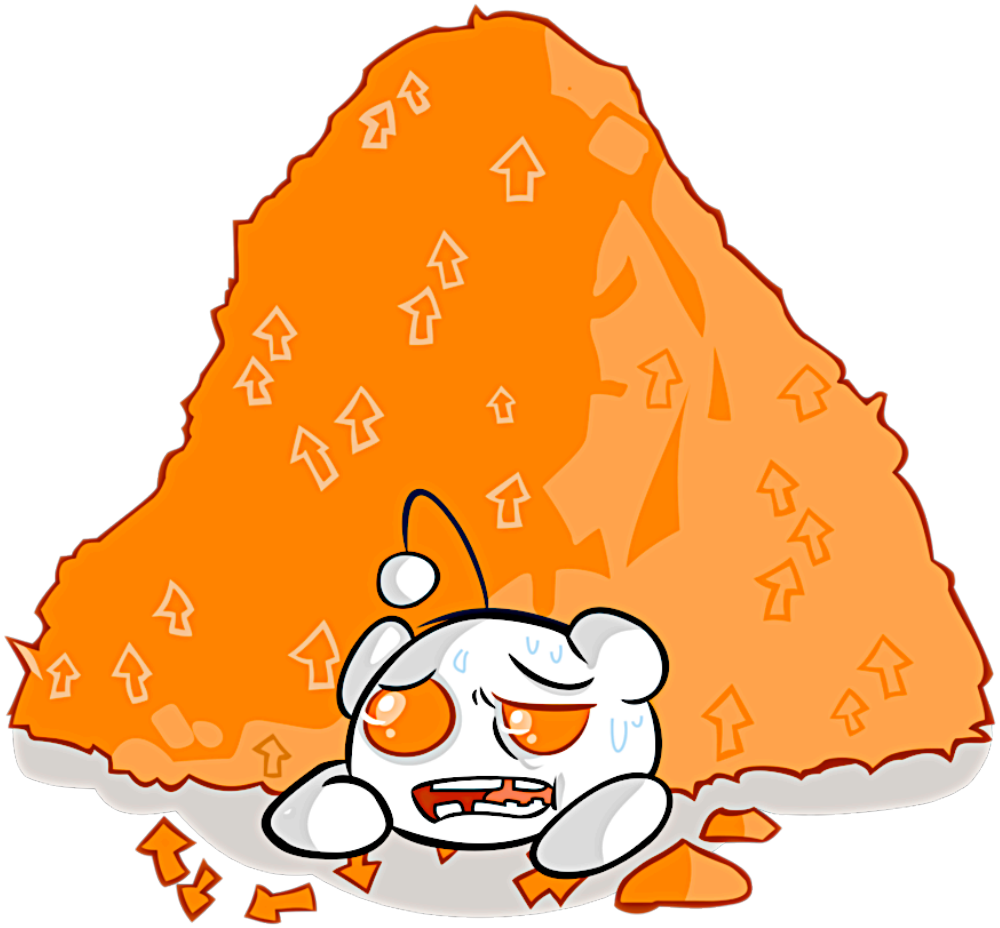
# cognitive load theory




Reducing **extraneous** cognitive load provide more capacity for **germane** cognitive load.

Sweller, Merrienboer & Paas (1998); Paas, van Gog & Sweller (2010)

# cognitive theory of multimedia learning



CTML is an applied approach aimed at **reducing extraneous** load.

Mayer (2001)

# multimedia principle

People learn more **effectively** with a combination of **words & pictures** than from either one alone.

Mayer & Moreno (2003)

**Images** can be processed using both the **verbal** and **visual** channel.

images

visual

verbal

*dog*

auditory

modality principle

Mayer & Moreno (2003)

The **redundancy principle** refers to the fact that when text on screen is the same as the information being conveyed verbally information is encoded less effectively. People are busy reading the text instead of listening to the information that a person is trying to convey overwhelming both the visual and verbal channels, but people can't stop themselves from reading. Stop reading this. Seriously, stop reading this and pay attention to what I am saying. Fine, if you've gotten this far, please pat your head.

Mayer & Moreno (2003)

# performance: comprehension

recognition by components

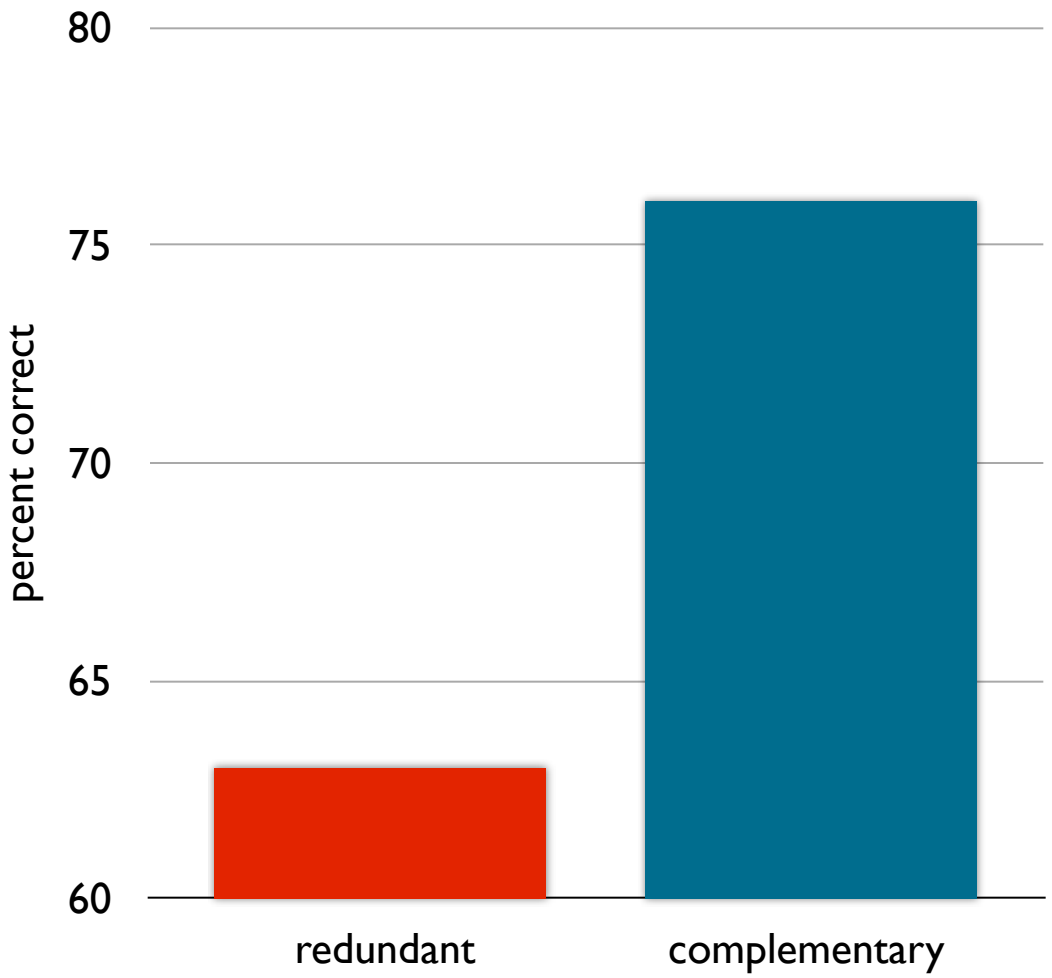
- 3D featural components are called geons
- basic units of objects
- 36 unique geons with viewpoint invariance
- objects are combinations of geons
- component geons compared to existing geon-configurations in memory
- match = object recognition

*redundant*

recognition by components

Every object can be reduced to a **combination** of a subset of **36 geons**.

*complementary*




Fenesi & Kim (2014)

# how do you use bullet points?

People remember **grammatical** sentences better than **lists of words**.

Dukewich & Nicolas (in progress)

# let's translate

## blatant plagiarism

- copying a classmate's paper or copying one from the internet
- having someone write your paper for you
- buying a paper
- using a paper that you wrote for another class without the approval of your current instructor

1:30

# let's translate

## Blatant plagiarism

- *copying a classmate's paper or copying one from the internet*
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**Copying** from a classmate or the internet is plagiarism.

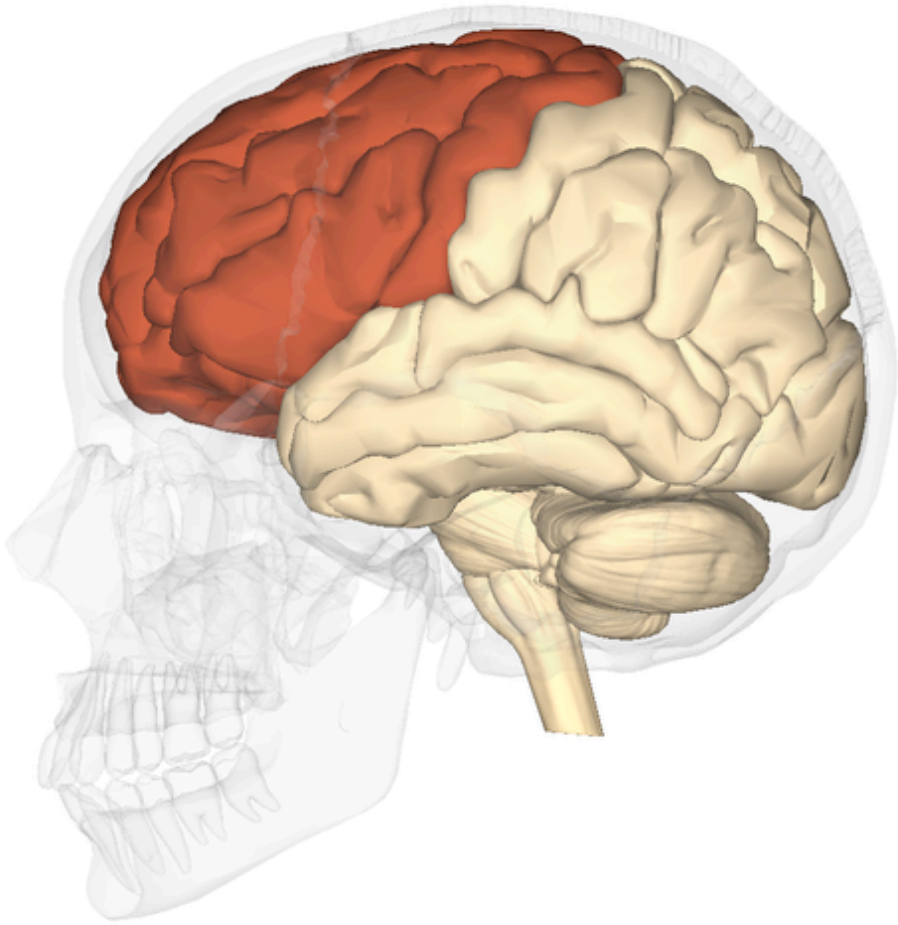
Buying a paper or having **someone else** write it for you is plagiarism.

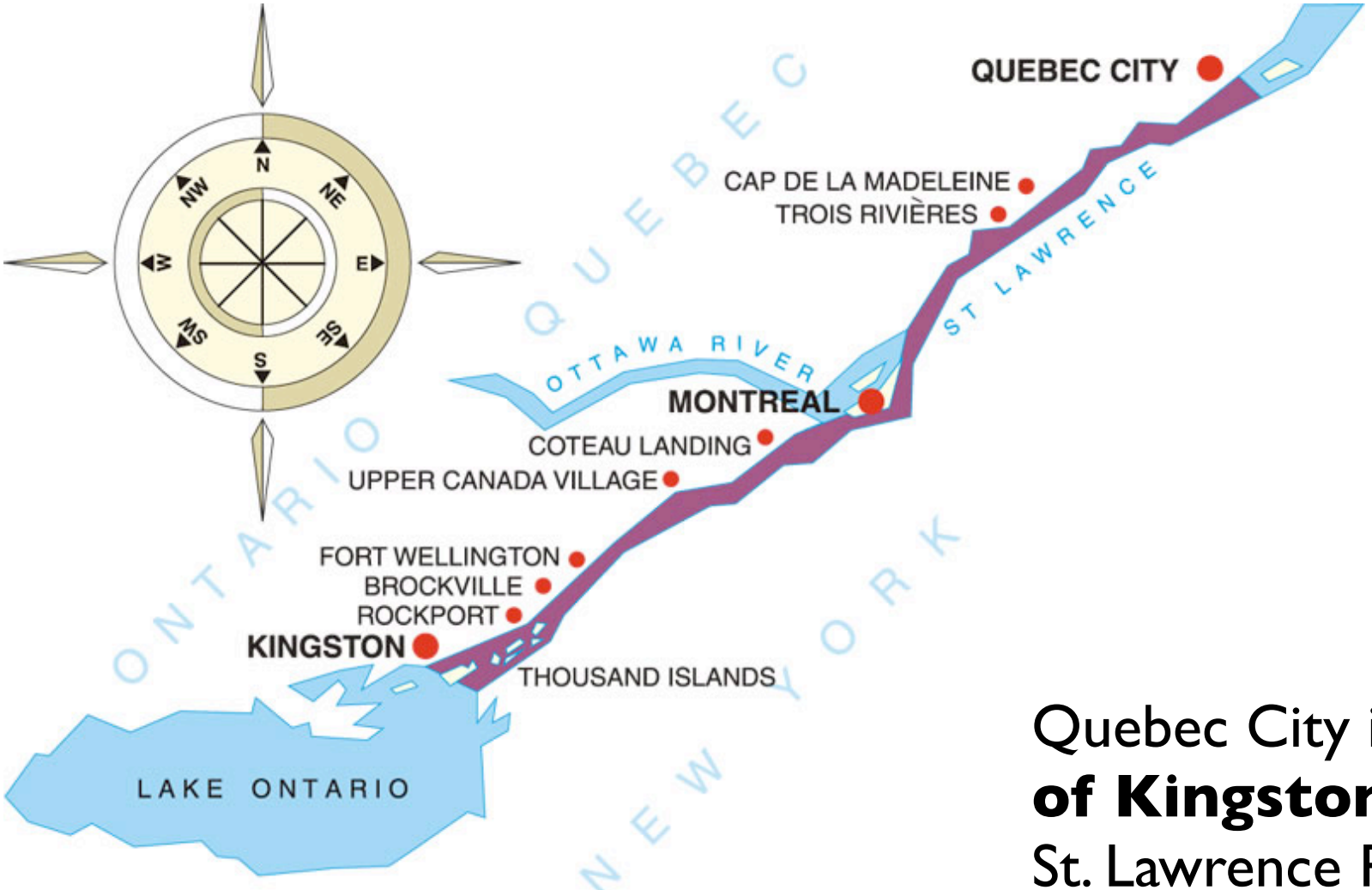
Recycling a paper **without permissio**n is plagiarism.

decorative graphics*

… can be **distracting**.

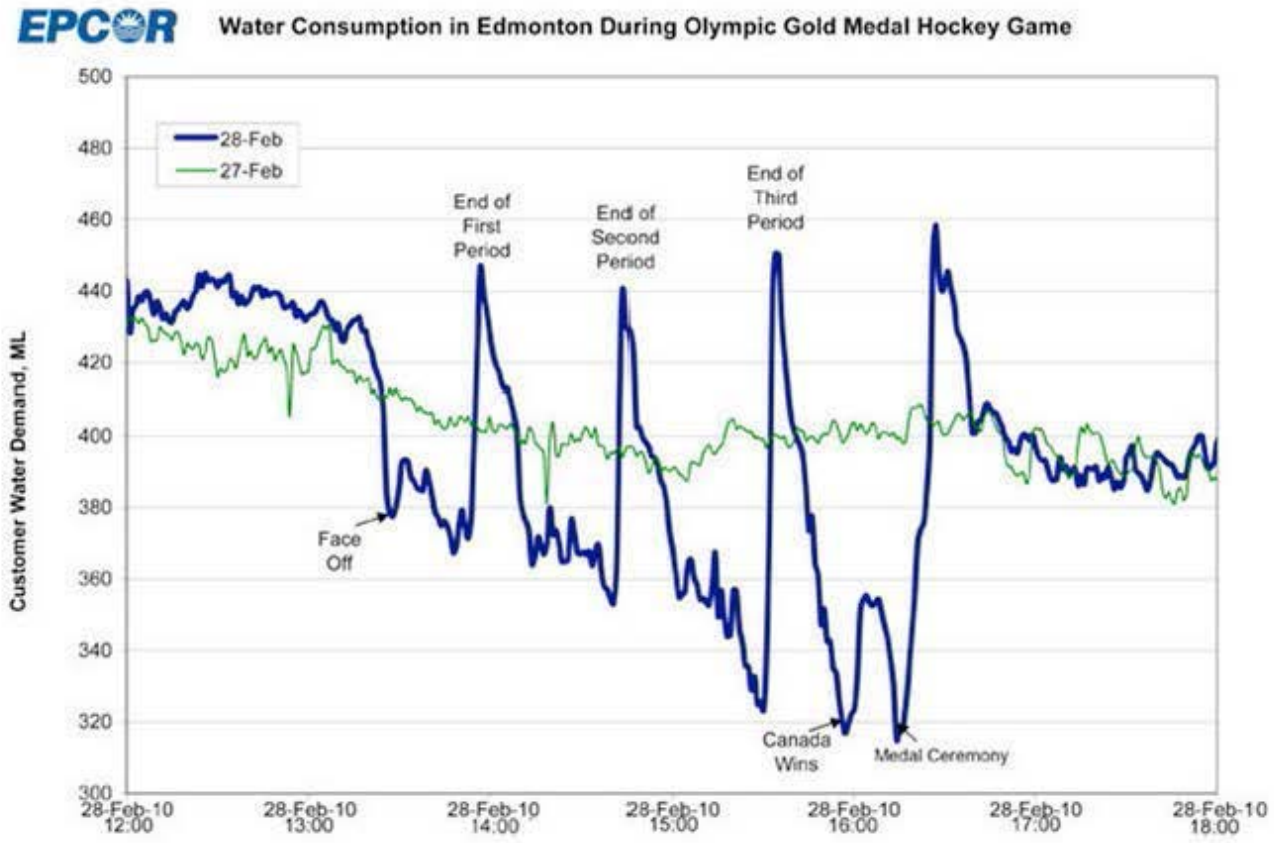
The **frontal lobe** is involved in **higher-order** cognitive processes.






Quebec City is **north of Kingston** on the St. Lawrence River.

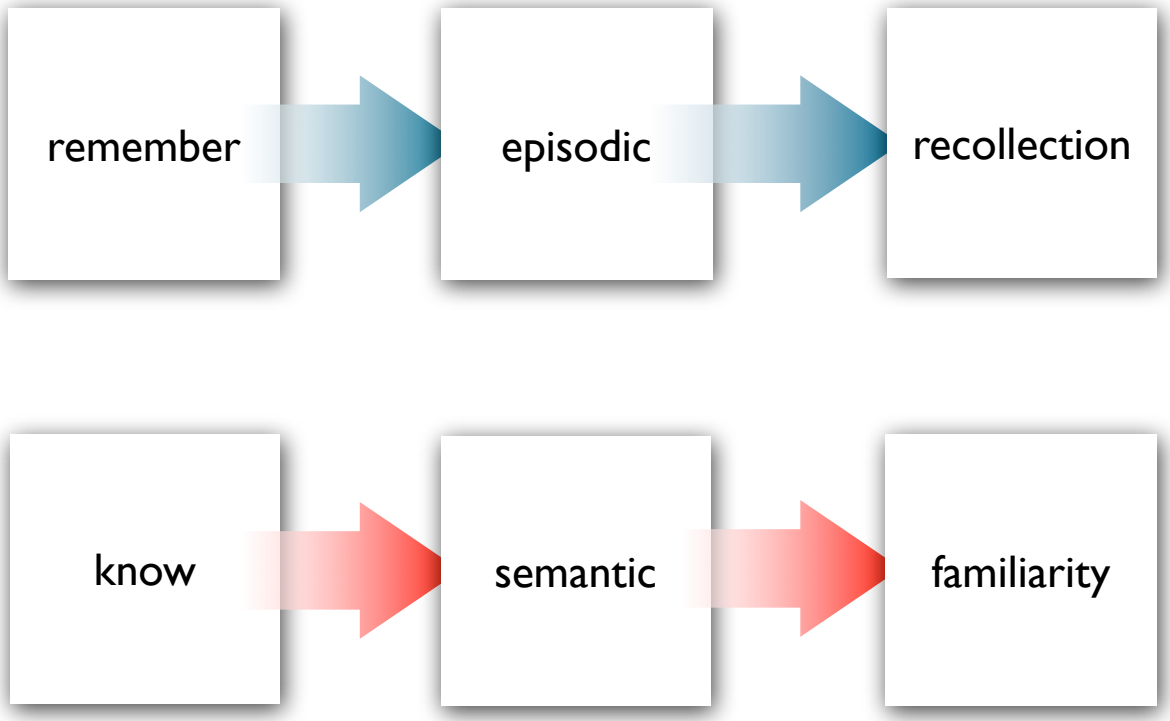
# relational graphics



# remember/know procedure

- remembering
  - associated with episodic memory
  - experience of recollection
- knowing
  - associated with semantic memory
  - experience of familiarity

# remember/know procedure

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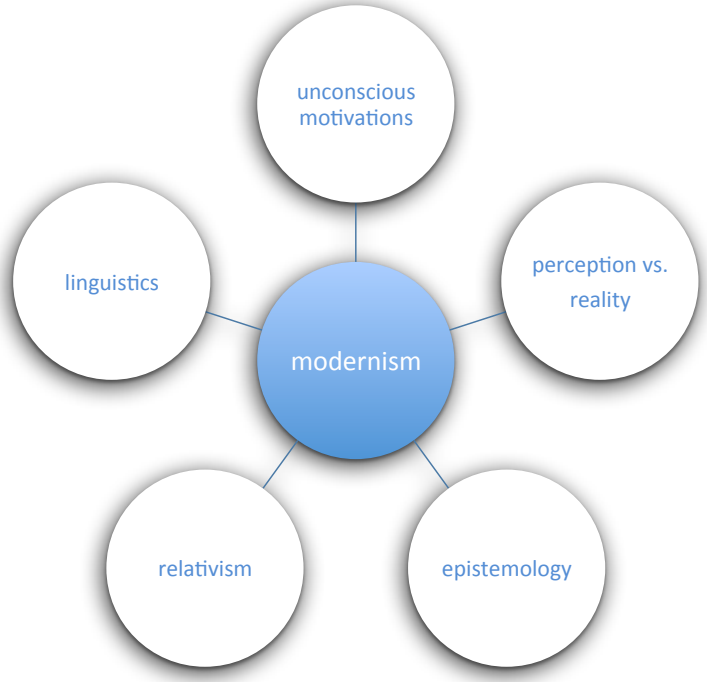
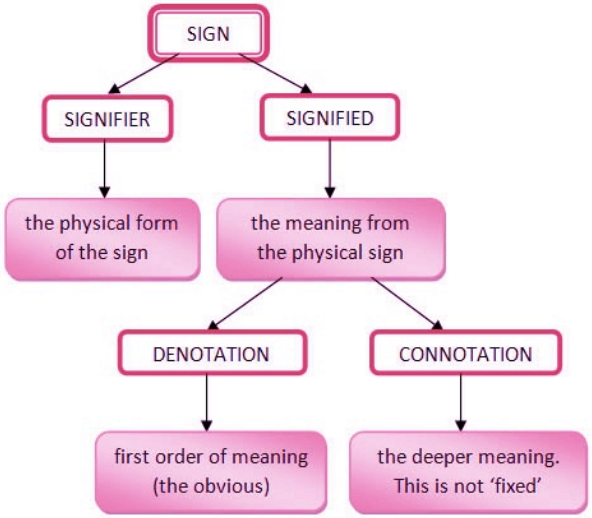
organizational graphics

# organizational graphics



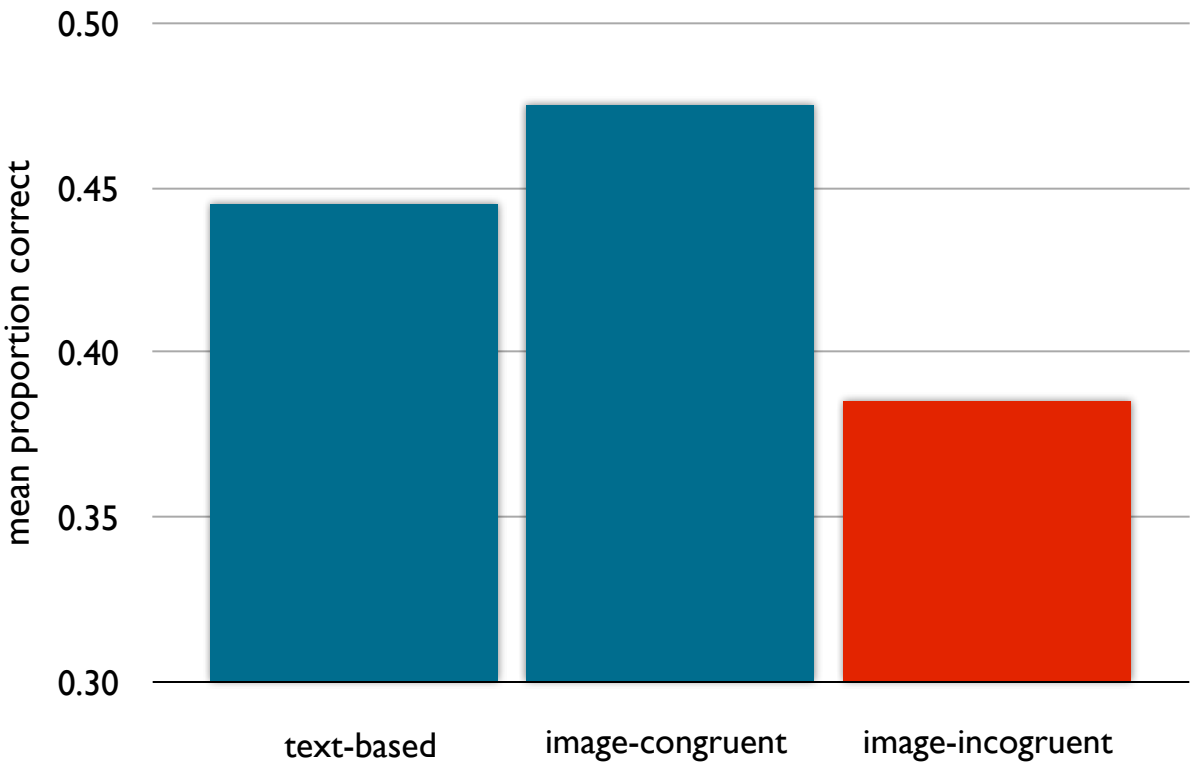


# coherence principle

Remove extraneous material,
in **all forms**.

Mayer & Moreno (2003)

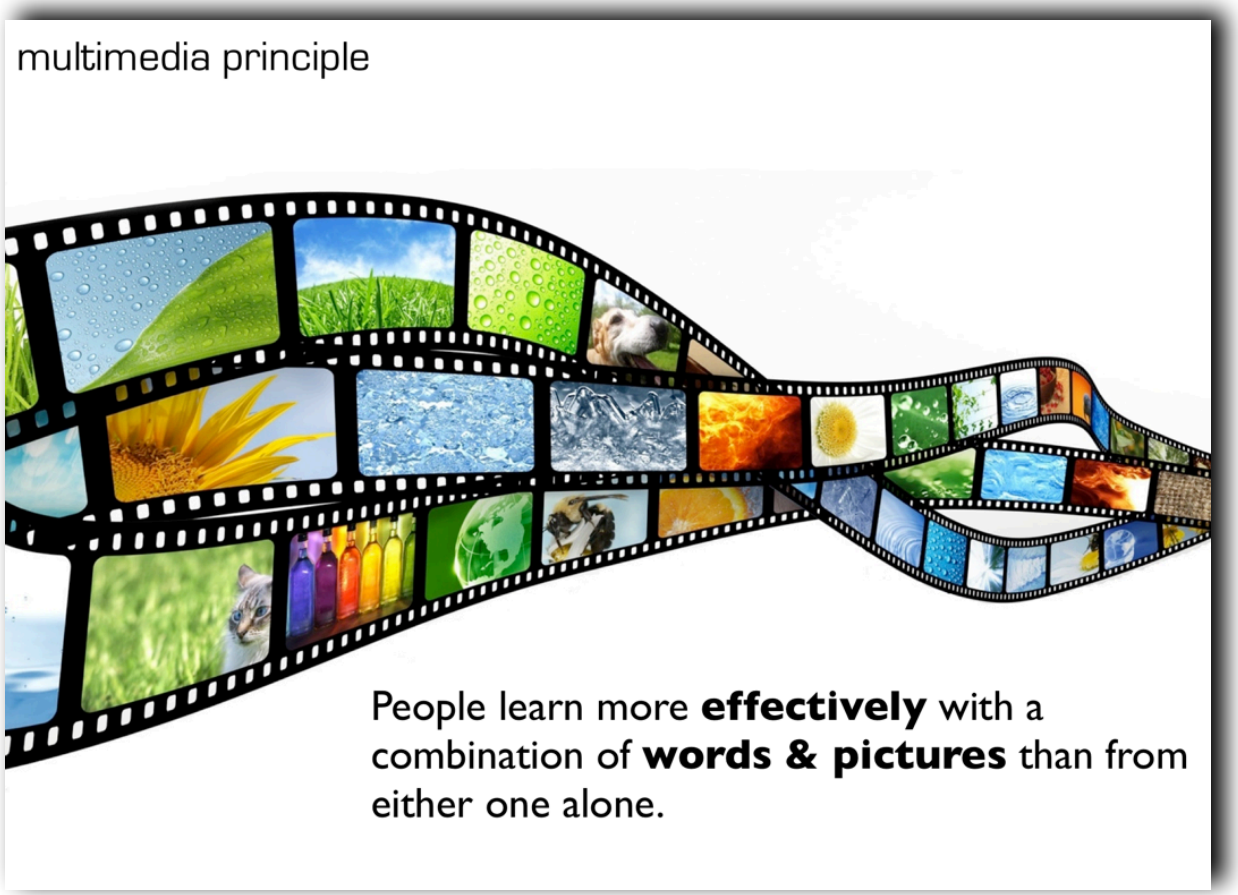
# coherence principle




Images that are "**decorative**" can be helpful for learning as long as they're **related**.

Tangen, Constable, et al (2011)

# coherence principle

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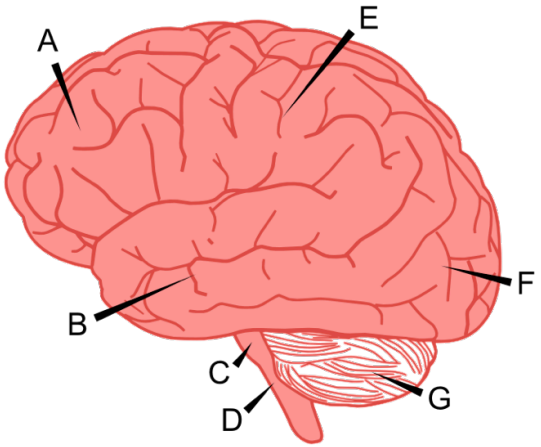
# contiguity principle



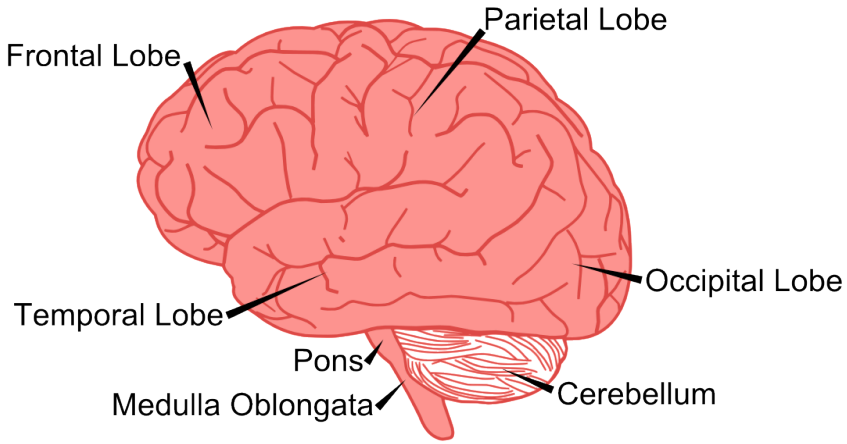

A - Frontal Lobe
B - Temporal Lobe
C - Pons
D - Medulla Oblongata

E - Parietal Lobe
F - Occipital Lobe
G - Cerebellum

Words & corresponding text should be **spatially** & **temporally** aligned.

Mayer & Moreno (2003)

# contiguity principle

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Mayer & Moreno (2003)

# how would you improve this?

1:30

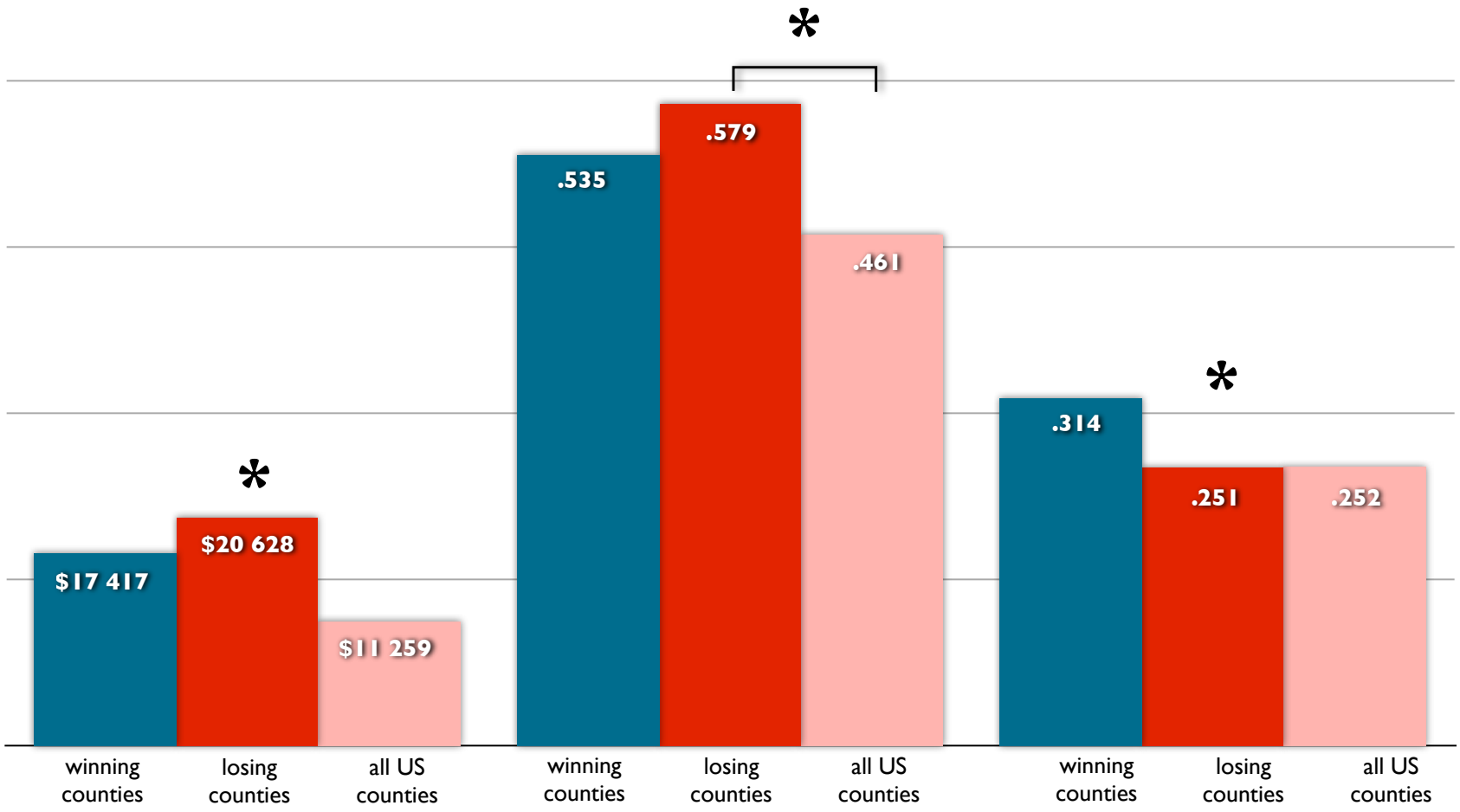
## Greenstone, Hornbeck and Moretti (2010)

TABLE 3
COUNTY AND PLANT CHARACTERISTICS BY WINNER STATUS, 1 YEAR PRIOR TO A MILLION DOLLAR PLANT OPENING

| | All Plants | | | | | Within Same Industry (Two-Digit SIC) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Winning Counties (1) | Losing Counties (2) | All U.S. Counties (3) | t-Statistic (Col. 1 − Col. 2) (4) | t-Statistic (Col. 1 − Col. 3) (5) | Winning Counties (6) | Losing Counties (7) | All U.S. Counties (8) | t-Statistic (Col. 6 − Col. 7) (9) | t-Statistic (Col. 6 − Col. 8) (10) |
| **A. County Characteristics** | | | | | | | | | | |
| No. of counties | 47 | 73 | | | | 16 | 19 | | | |
| Total per capita earnings ($) | 17,418 | 20,628 | 11,259 | **−2.05** | **5.79** | 20,230 | 20,528 | 11,378 | −.11 | **4.62** |
| % change, over last 6 years | .074 | .096 | .037 | −.81 | 1.67 | .076 | .089 | .057 | −.28 | .57 |
| Population | 322,745 | 447,876 | 82,381 | −1.61 | **4.33** | 357,955 | 504,342 | 83,430 | −1.17 | **3.26** |
| % change, over last 6 years | .102 | .051 | .036 | **2.06** | **3.22** | .070 | .032 | .031 | 1.18 | 1.63 |
| Employment-population ratio | .535 | .579 | .461 | −1.41 | **3.49** | .602 | .569 | .467 | .64 | **3.63** |
| Change, over last 6 years | .041 | .047 | .023 | −.68 | **2.54** | .045 | .038 | .028 | .39 | 1.57 |
| Manufacturing labor share | .314 | .251 | .252 | **2.35** | **3.12** | .296 | .227 | .251 | 1.60 | 1.17 |
| Change, over last 6 years | −.014 | −.031 | −.008 | 1.52 | −.64 | −.030 | −.040 | −.007 | .87 | **−3.17** |
| **B. Plant Characteristics** | | | | | | | | | | |
| No. of sample plants | 18.8 | 25.6 | 7.98 | −1.35 | **3.02** | 2.75 | 3.92 | 2.38 | −1.14 | .70 |
| Output ($1,000s) | 190,039 | 181,454 | 123,187 | .25 | **2.14** | 217,950 | 178,958 | 132,571 | .41 | 1.25 |
| % change, over last 6 years | .082 | .082 | .118 | .01 | −.97 | −.061 | .177 | .182 | −1.23 | **−3.38** |
| Hours of labor (1,000s) | 1,508 | 1,168 | 877 | 1.52 | **2.43** | 1,738 | 1,198 | 1,050 | .92 | 1.33 |
| % change, over last 6 years | .122 | .081 | .115 | .81 | .14 | .160 | .023 | .144 | .85 | .13 |

NOTE.—For each case to be weighted equally, counties are weighted by the inverse of their number per case. Similarly, plants are weighted by the inverse of their number per county multiplied by the inverse of the number of counties per case. The sample includes all plants reporting data in the ASM for each year between the MDP opening and 8 years prior. Excluded are all plants owned by the firm opening an MDP. Also excluded are all plants from two uncommon two-digit SIC values so that subsequently estimated clustered variance matrices would always be positive definite. The sample of all U.S. counties excludes winning counties and counties with no manufacturing plant reporting data in the ASM for 9 consecutive years. These other U.S. counties are given equal weight within years and are weighted across years to represent the years of MDP openings. Reported t-statistics are calculated from standard errors clustered at the county level. t-statistics greater than 2 are reported in bold. All monetary amounts are in 2006 U.S. dollars.

# 1 year prior to the opening of a million dollar plant




Greenstone, Hornbeck & Moretti (2010)

**Signalling** is a way to point at things you want people to **pay attention** to.

Mayer & Moreno (2003)

# signalling

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| % change, over last 6 years | .078 | .086 | .087 | −.81 | 1.07 | .076 | .089 | .057 | −.28 | .57 |
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| Change, over last 6 years | .041 | .057 | .023 | −.88 | 2.34 | .045 | .008 | .028 | .58 | 1.67 |
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| Change, over last 6 years | −.019 | −.031 | −.008 | 1.52 | −.64 | −.030 | −.040 | −.007 | .67 | −3.17 |

pay attention to this

*now this*

**look over here!**

builds can also serve as **reminders** of what you want to say

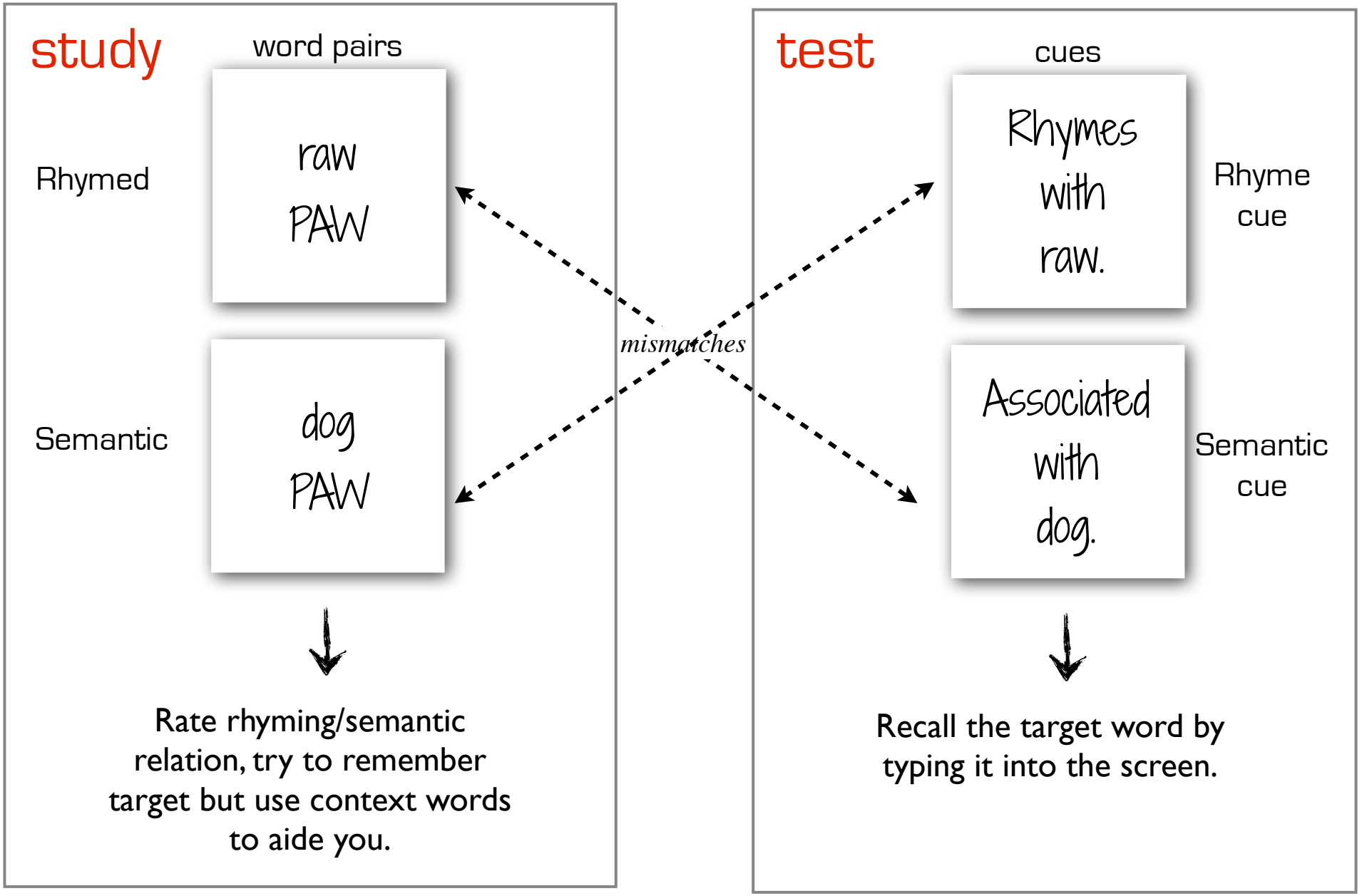
Dukewich & Zych (in progress)

# Thomson, Smilek & Besner (2012) - Expt 1

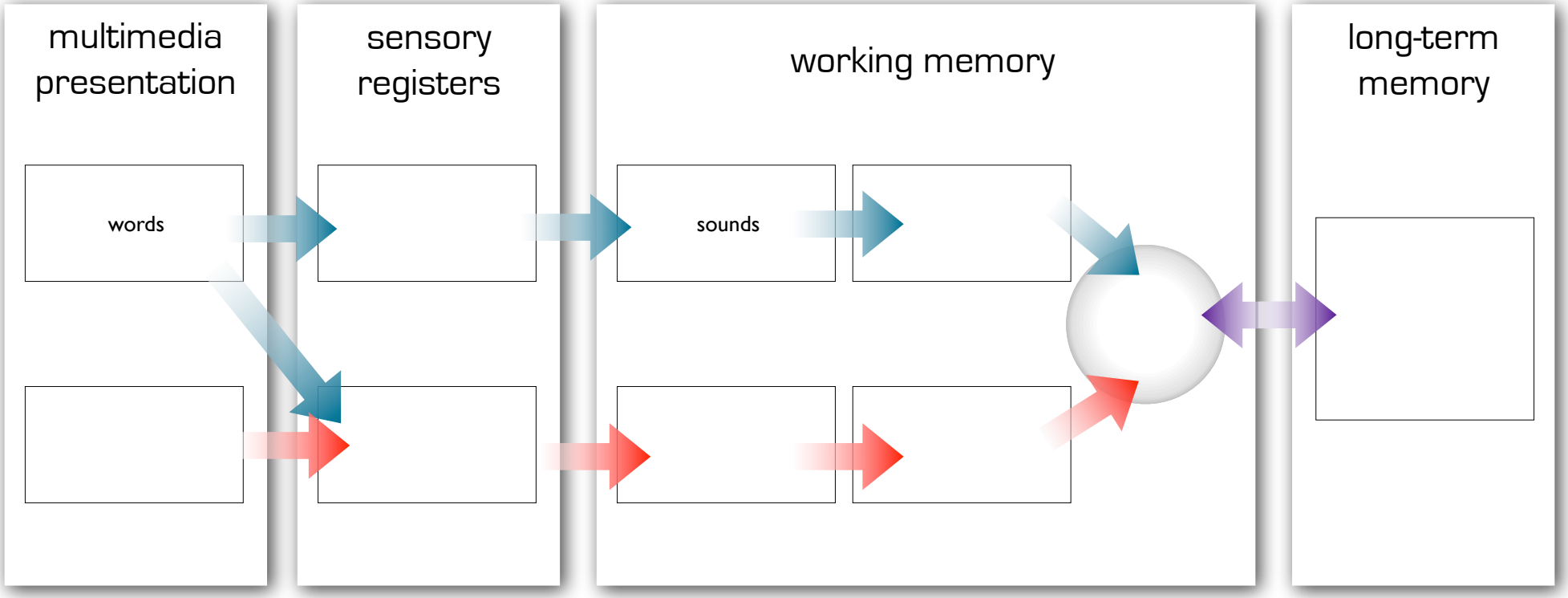
- **study phase:**
  - participants presented with word pairs
  - capitalized = recall target
  - two conditions:
    - rhymed ex. *raw-PAW*
    - semantic ex. *dog-PAW*
  - rate rhyming/semantic relation strength
  - "*try to remember target, use context word*"
- **test phase:**
  - participants give cue, asked to recall target
  - two conditions:
    - rhyme cue: "*rhymes with raw*"
    - semantic cue: "*associated with dog*"
  - recall target word

- **study x test fully crossed to produce match/mismatch**
  - ex. match: study (rhyme) + test (rhyme)
  - ex. mismatch: study (rhyme) + test (semantic)

# signalling: builds/animations



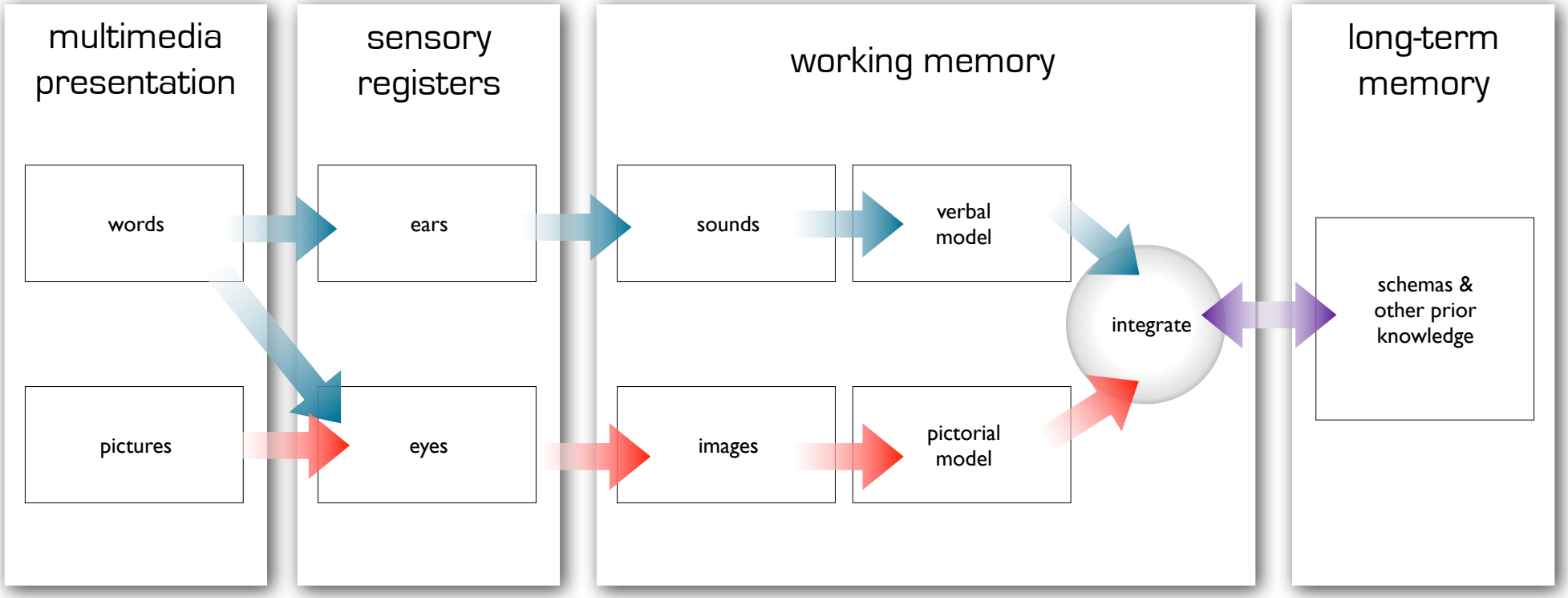
# try to fill this in





Mayer & Moreno (2003)

# summary




Mayer & Moreno (2003)

# It's the end of this workshop! You should be able to:

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- **recognize** the effective use of different forms of graphical representations
- go back to your slides and implement at least a few of these tips to **help your students** learn more effectively

# a moment to reflect

- What is one **insight** you gained from the session?
- What one idea could you **apply** to your teaching?


Email us if you'd like a PDF of my slides

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