

Mind and Body

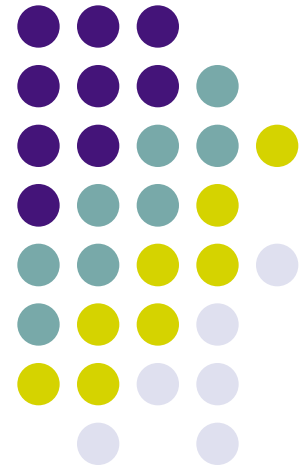
Part II

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Cognitive Science Q400

April 6, 2005



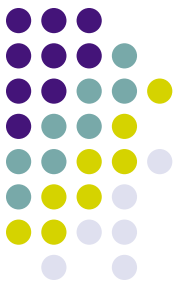
Overview



Q: What is the nature of the representation of verbs?

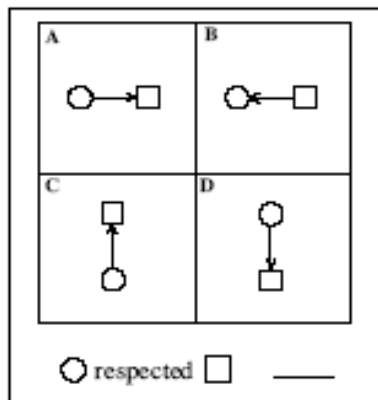
Q: What role does the body play in the formation and activation of these representations?

- Verb meanings and space
- An Experiment
- The eyes and embodiment
- Another Experiment
- Future Studies
- What does it all mean?



Verb Meanings and Space

- Certain verbs have been shown to activate spatial image schemas in real-time.
 - Richardson, Spivey, Barsalou, & McRae, 2003



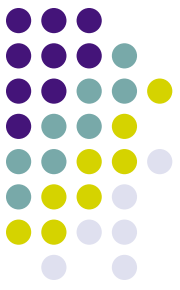
argued with



respected



- **Vertical:** *Respect, Hope, Flee, Bomb, Fly*
- **Horizontal:** *Argue, Give, Push, Point, Impact*

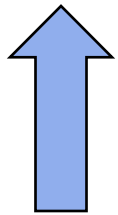
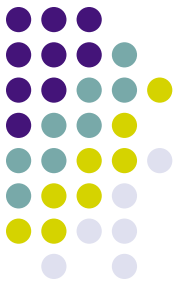


But why is flee vertical?

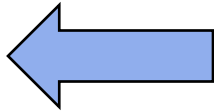
- Some of the findings seem counterintuitive...
 - Word associations?
 - In English you can ‘flee *down* the street.’
 - Analysis of Childe did not support this theory
 - Maybe neither forced choice nor free form tasks get at the right thing...
 - Are dimensions such as directionality and concreteness unidimensional?
 - Are subjects imagining the circles and squares as agents and/or patients?

An Experiment

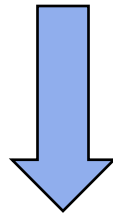
To Jump



40



0



40



0

Unallocated

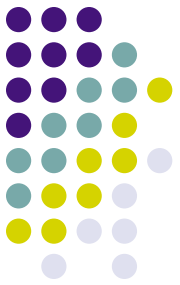
20

Visual

90

Non-Visual

0



An Experiment

- 250 verbs were chosen from Richardson et. al. (2003), MRC, and McArthur and rated
 - N for each verb was about 30
 - Intra-subject reliability was .78
- Benefits of new design
 - Multiple components
 - Degree of directionality
 - Differentiate between all and none

An Experiment

Length: Directionality





Angle: Direction

Width: Spread of directionality

Hue: Visualizability (Red - concrete)

Saturation: Spread of visualizability



Word	N	Icon	Up Avg.	Left Avg.	Down Avg.	Right Avg.	Visualizability
FLUSH	33		0.00	1.97	88.03	1.97	89.09
THINK	32		27.19	1.56	0.78	1.56	16.56
PLEASE	33		26.52	5.15	3.79	2.12	28.33
CLEAN	33		17.73	2.58	12.42	4.09	55.30

An Experiment

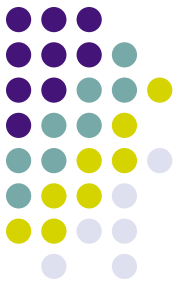


- Language may have evolved from gesture.
 - Liberman & Mattingly, 1985
 - Flöel et. al., 2003
- In fact, verb meanings have gestural and motoric components (Glenberg & Kaschak, 2002).
- We have demonstrated that verbs also have spatial (directional) components, so is it possible that verbs are stored in a form close to the sensorimotor surface?
- If so, can we show this using an inhibition/facilitation paradigm?

The Eyes and Embodiment

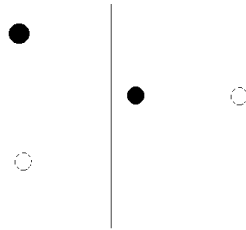


- Natural eye movements are congruent with thought.
 - Laeng and Teodorescu, 2001
 - Spivey and Geng, 2001
- Perhaps it is possible to influence thought by controlling eye movements.
- **Question:** Can memory for verbs be affected by eye scanpaths?

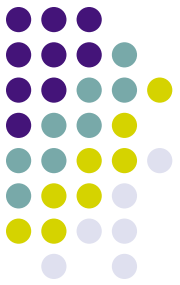


Another Experiment

- Participants are seated in front of a computer monitor.
- On the screen, a black circle flips back and forth horizontally or vertically, and participants are asked to track it.



- At the same time a list of verbs plays.
- Afterwards, participants are handed a list of verbs on paper and asked to circle what they remember hearing.



Another Experiment

- Experiment 1

- Within-Subjects design
- N = 45 sighted undergraduates from Indiana University
- 20 verbs selected from Richardson et. al.

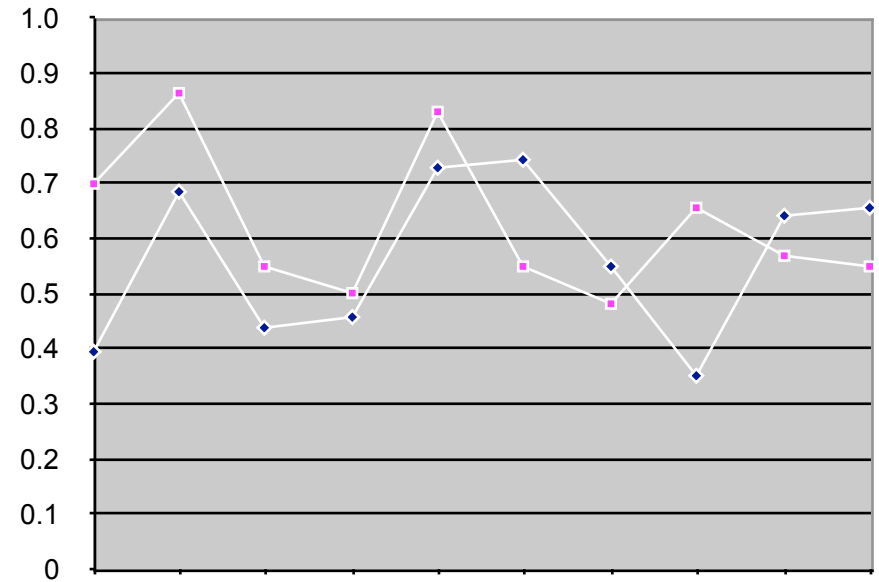
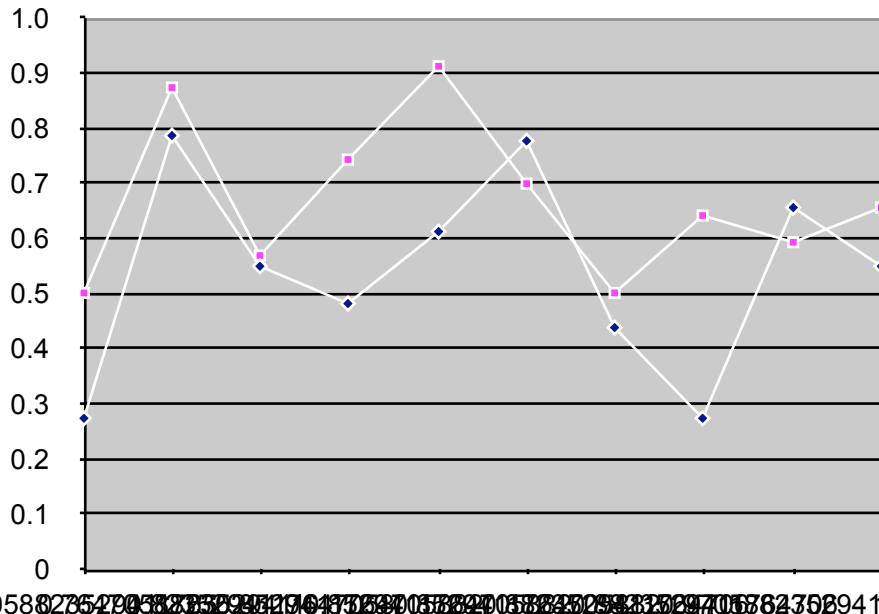
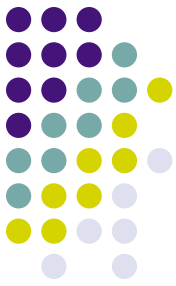
Horizontal Verbs

- **Argue**
- **Rush**
- **Give**
- Warn
- **Want**
- Offend
- Tempt
- Regret
- **Obey**
- **Push**
- **Pull**
- **Hunt**
- **Point**
- **Impact**
- Show

Vertical Verbs

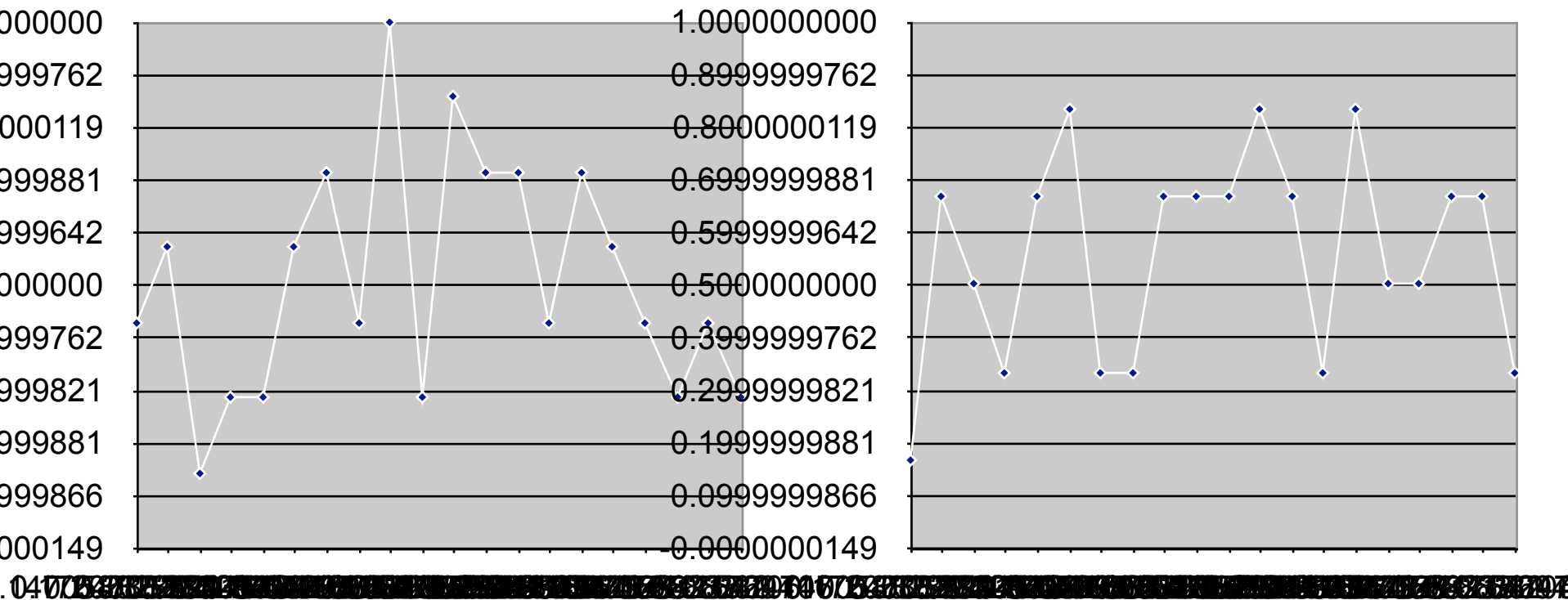
- **Respect**
- **Hope**
- **Succeed**
- Own
- **Increase**
- Rest
- **Smash**
- **Float**
- Flee
- **Fly**
- Walk
- **Lift**
- **Bomb**
- **Sink**
- Perch

Another Experiment – Within-Subjects



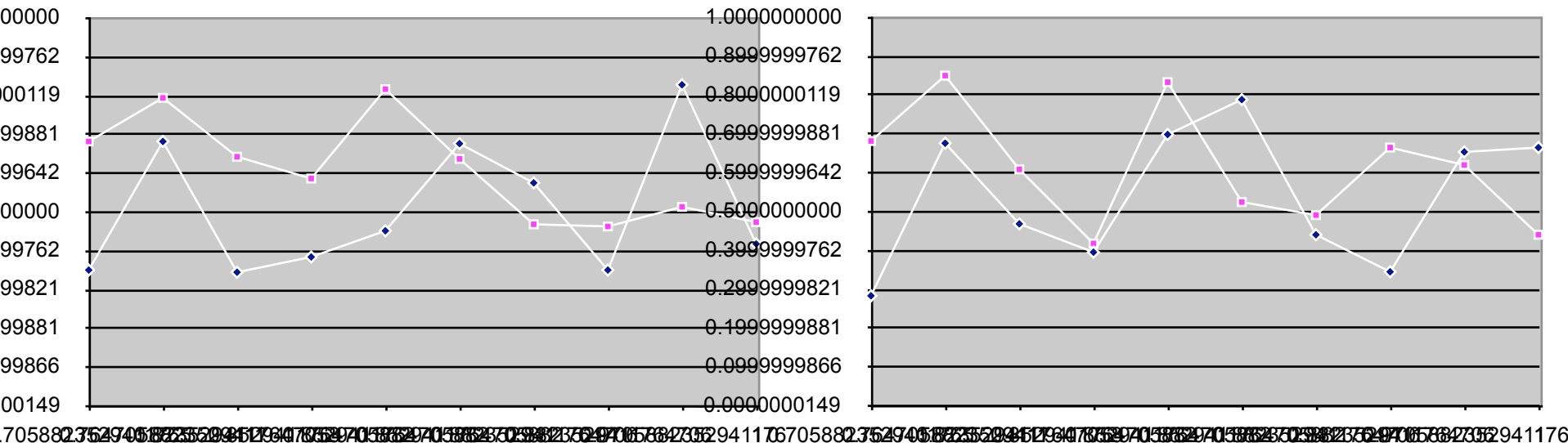
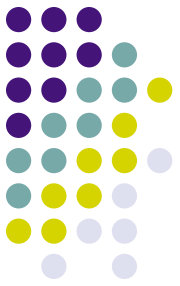
	vertical correlation	horizontal correlation
v<50	0.12	0.35
v>50	-0.45	-0.48

Another Experiment — Between-Subjects



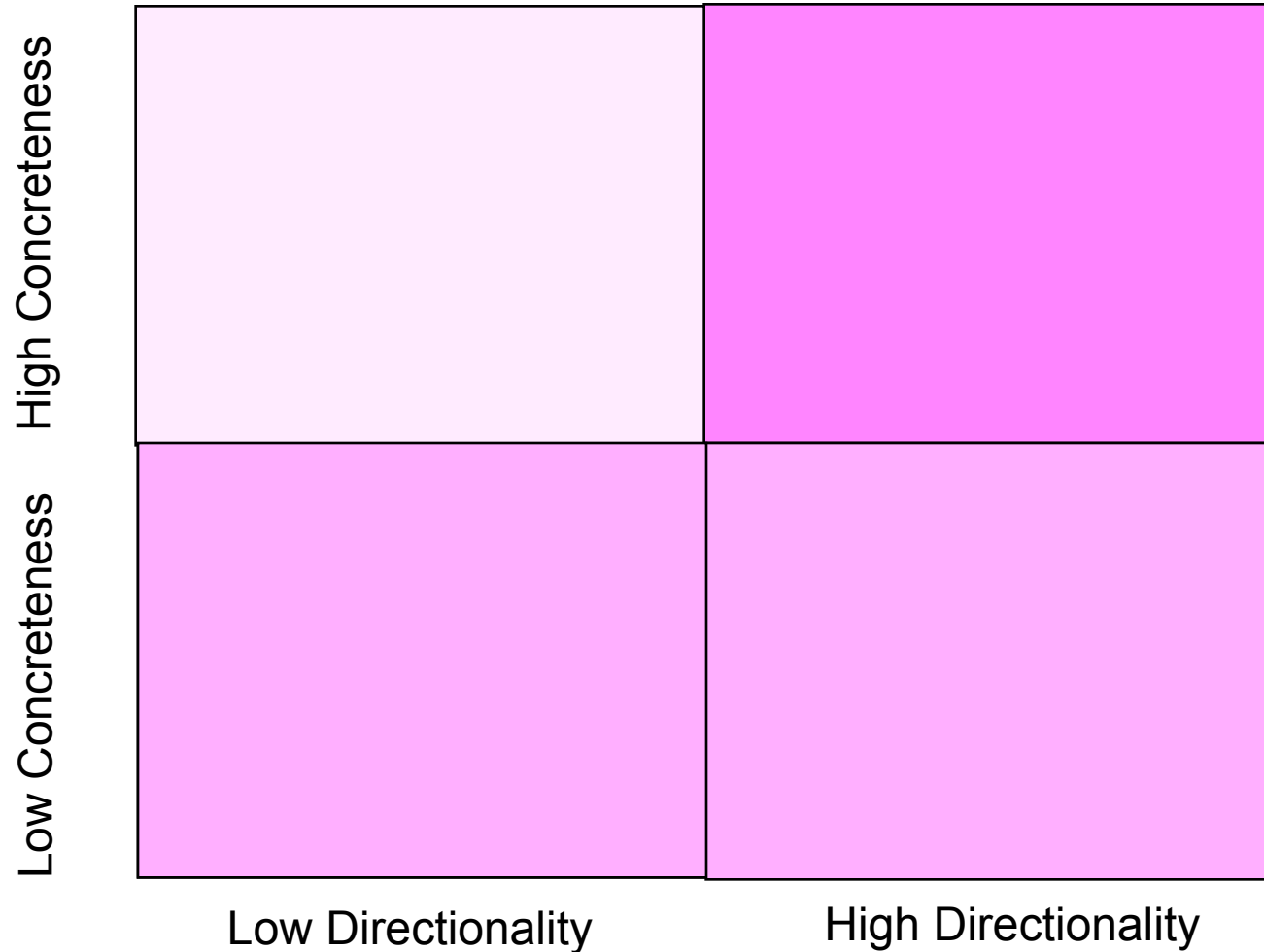
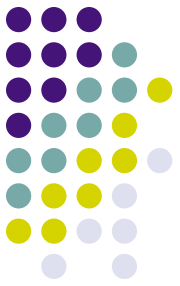
Correlations		
Low vert	0.354189451	0.409728072
High vert	-0.82800743	-0.464650492

Another Experiment - Combined



	vertical correlation	horizontal correlation
v<50	0.32	0.40
v>50	-0.67	-0.50

Another Experiment - BUT

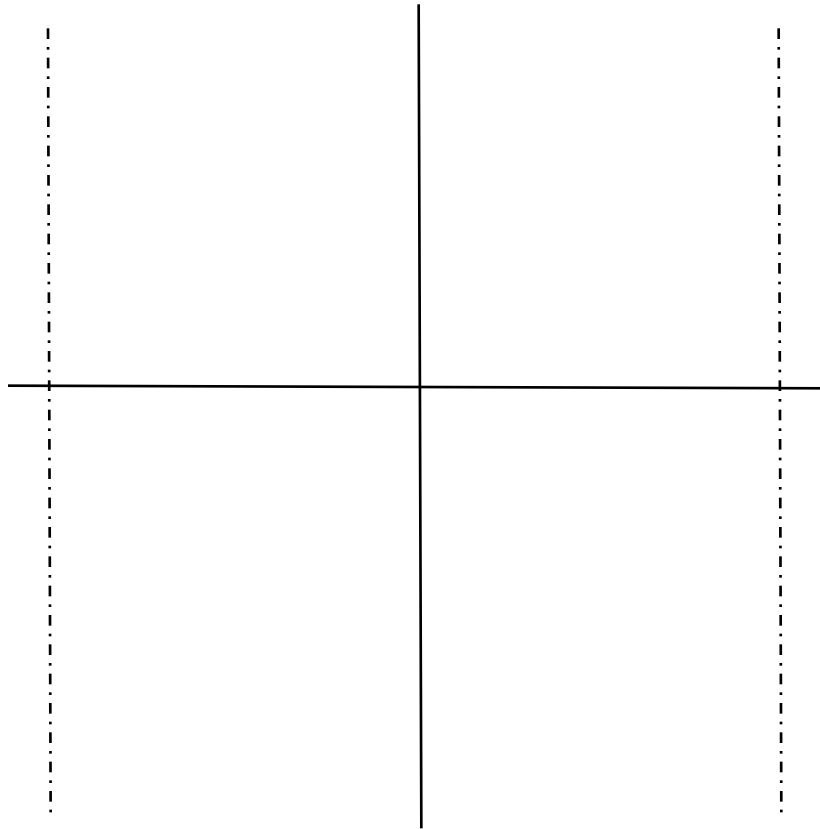


Another Experiment - BUT



High Concreteness

Horizontal



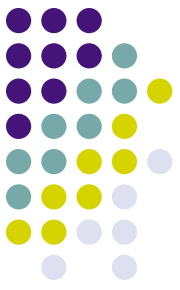
Vertical

Low Concreteness

Future Study



- Experiment 2
 - Same experimental protocol (between subjects)
 - New words:
 - Pity Pump
 - Repeat Exchange
 - Hope Swallow
 - Allow Separate
 - Fail Rise
 - Debate Extend
 - Burden Drop
 - Tell Sway
 - Praise Raise
 - Continue Smooth
 - Cry Increase
 - Share Escape



What does it all mean?

- Verbs have directional components.
- It seems as though eye movements can interfere with the encoding of verbs with certain kinds of components.
 - Write your name using your right hand...
 - At the same time, snap your fingers using your right hand.
- Can we find the same effect with other kinds of motion?
- We still don't know where these spatial orientations come from.
 - Maybe eye movements are naturally congruent with spatial components of certain verbs – especially concrete verbs.
 - Linked to age of acquisition?



References

- Floel, A., Ellger, T., Breitenstein, C., & Knecht, S. (2003). Language perception activates the hand motor cortex: implications for motor theories of speech perception. *European Journal of Neuroscience*, 18, 704-708.
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- Richardson, Daniel C; Spivey, Michael J; Barsalou, Lawrence W; McRae, Ken. (2003) Spatial representations activated during real-time comprehension of verbs. *Cognitive Science*, Vol 27(5), 767-780.