

Spatial perception and hemispheric lateralization – a factor analysis approach

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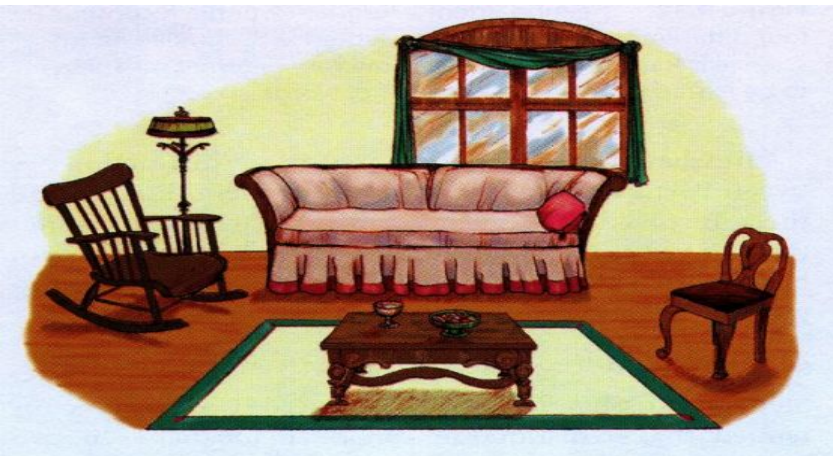
Evanston, 15 June 2008



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Spatial relations

- Spatial relations within and between objects (Kosslyn, 1987)
 - Categorical vs. Coordinate

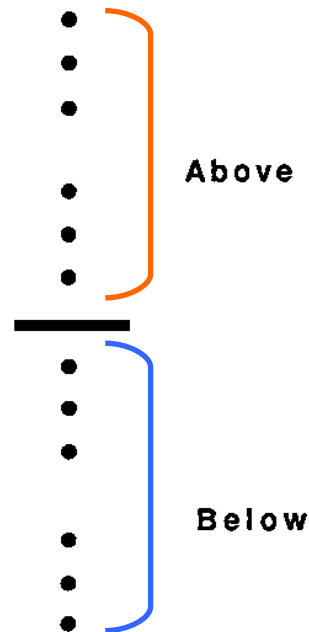


- Hemispheric lateralization
 - Categorical – left hemisphere (LH)
 - Coordinate – right hemisphere (RH)

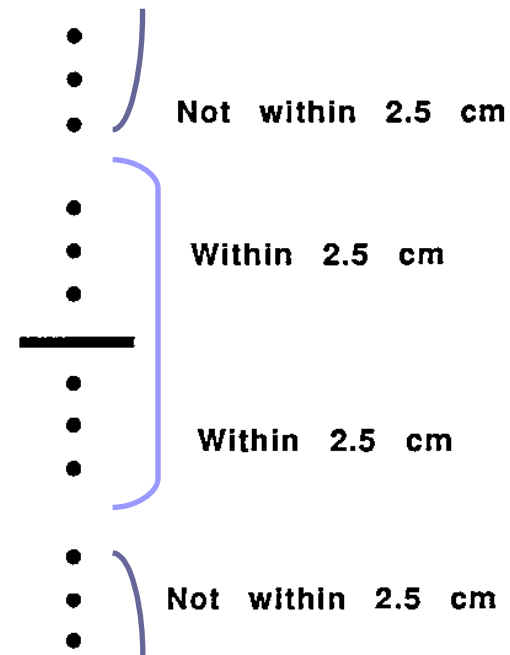
Dot-bar task

■ Visual half-field task

Categorical



Coordinate



Dot-bar results

■ Findings

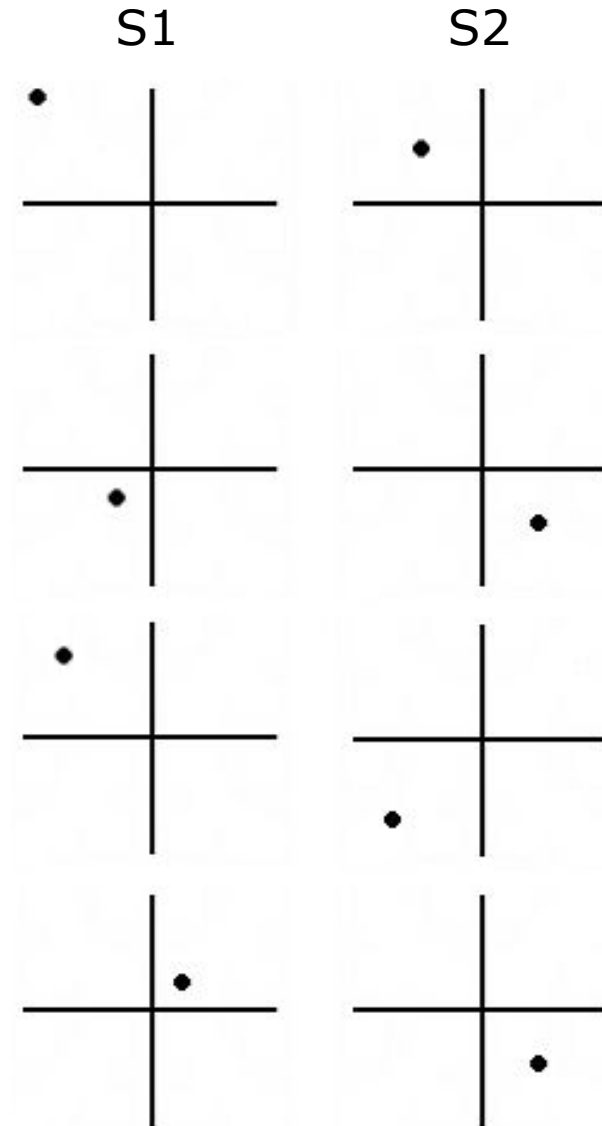
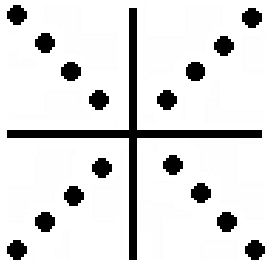
- Coordinate RH advantage is often found
- Categorical LH advantage is less often found
- Coordinate mostly more difficult than categorical
- Results depend on specific stimulus features
- Perceptual vs. working memory tasks

Experiment 1

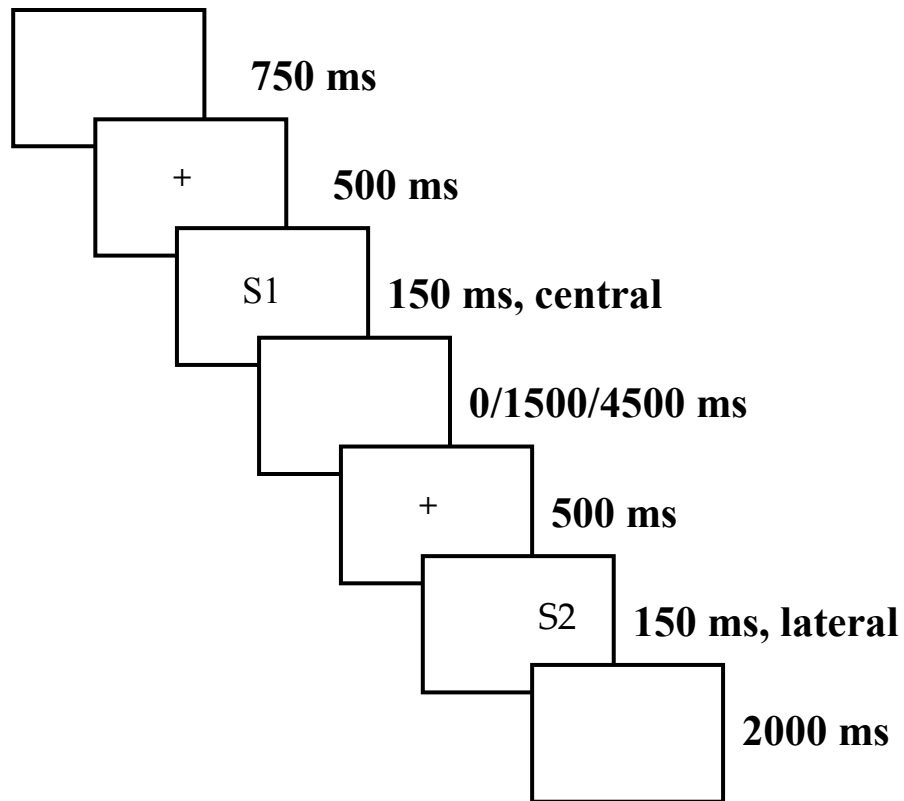
- Interval length variation is suggested to be of importance:
 - Categorical bias – stronger over time
 - Postma et al. (2006)
dot – circle task, 500 ms/2000 ms/5000 ms
 - Coordinate – immediate decay
 - Huttenlocher et al. (1991), Werner & Diedrichsen, (2002)
- Congruency with functional properties
(Kosslyn, 1987)

Stimuli

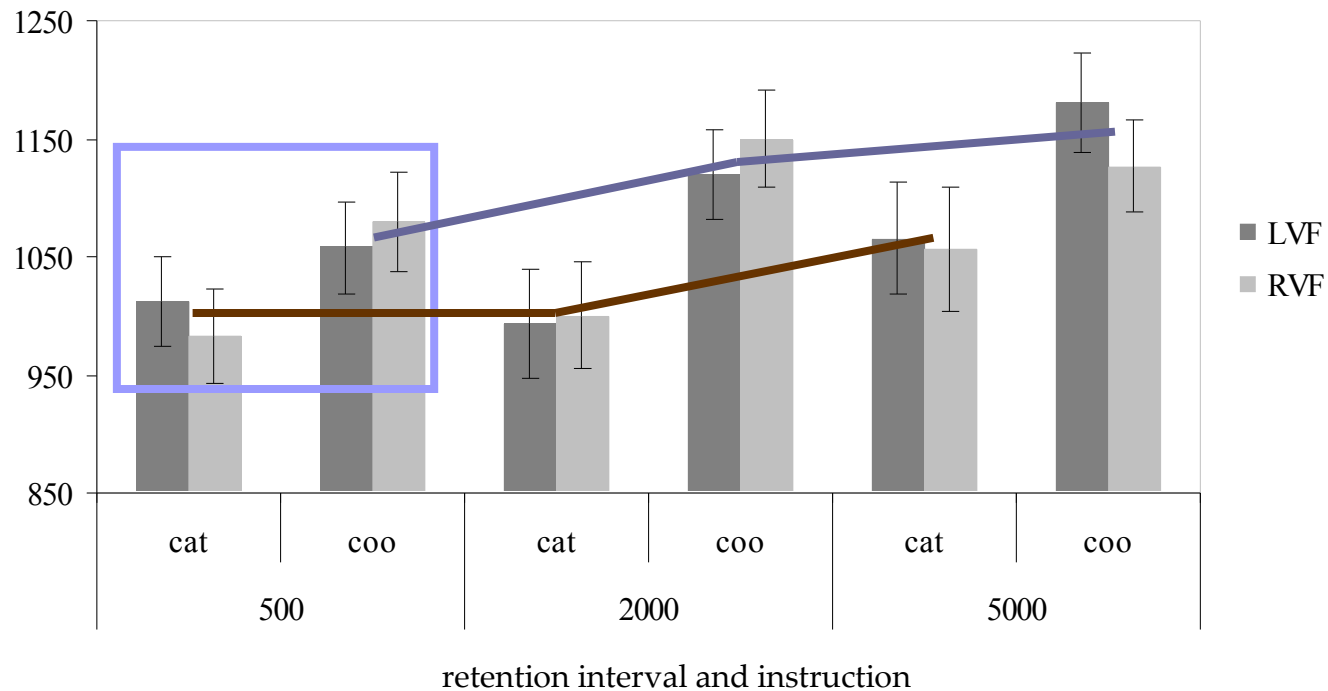
- 4 categories
- 4 coordinates



Trialsequence



- Visual field * retention interval
- Instruction * visual field * retention interval
 - At 500 ms: instruction * visual field
- Within instruction: main effect retention interval
 - Cat. 500 ms/2000 ms < 5000 ms
 - Coo. 500 ms < 2000 ms / 5000 ms



Discussion

- Visual field * instruction effect found in 500 ms
 - Main effect in categorical instruction
- Decay over time
 - Coordinate: quick decay
 - Categorical: decay later in time
- How does this outcome relate to the dot-bar paradigm?

Experiment 2: Task battery

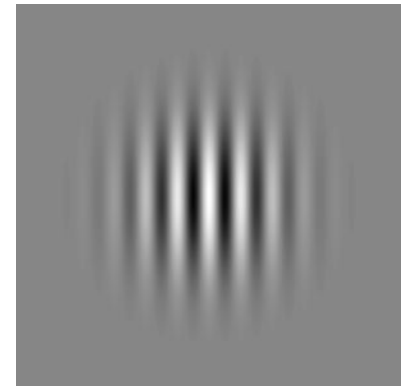
- Hemispheric lateralization found in many tasks in different domains
 - spatial perception
- Bringing such tasks together is of importance
 - Speculation on (evolutionary) origin of the hemispheric differences and (causal) relations between them
 - Interpretation of individual differences
- For spatial tasks this has not been done thoroughly

Three spatial perception tasks

- Spatial frequency identification

High frequency → LH

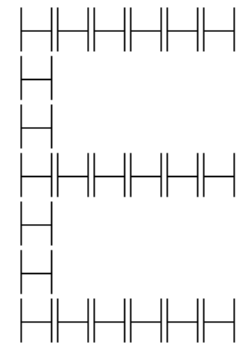
low frequency → RH (e.g. Sergent, 1983)



- Local – global processing

Local features → LH

Global features → RH (e.g. Van Kleeck, 1989)



■ Dot-bar task

Categorical → LH

Coordinate → RH (Hellige & Michimata, 1989)

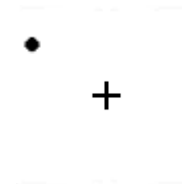


■ Additional task: a version of cross-dot design

Interval of 500 ms

Adapted stimuli

Match-to-sample working memory



Enables comparison between two cat – coo tasks

Combining the tasks

- Theory: Double filtering of frequency model (Ivry & Robertson, 1997)
- Practice: Experiments based on combining features of two of these three paradigms
 - Cat-coo blurred with different frequencies (Okubo & Michimata, 2002, 2004)
 - Local – global with different frequencies (e.g. Badcock, 1990)

Method

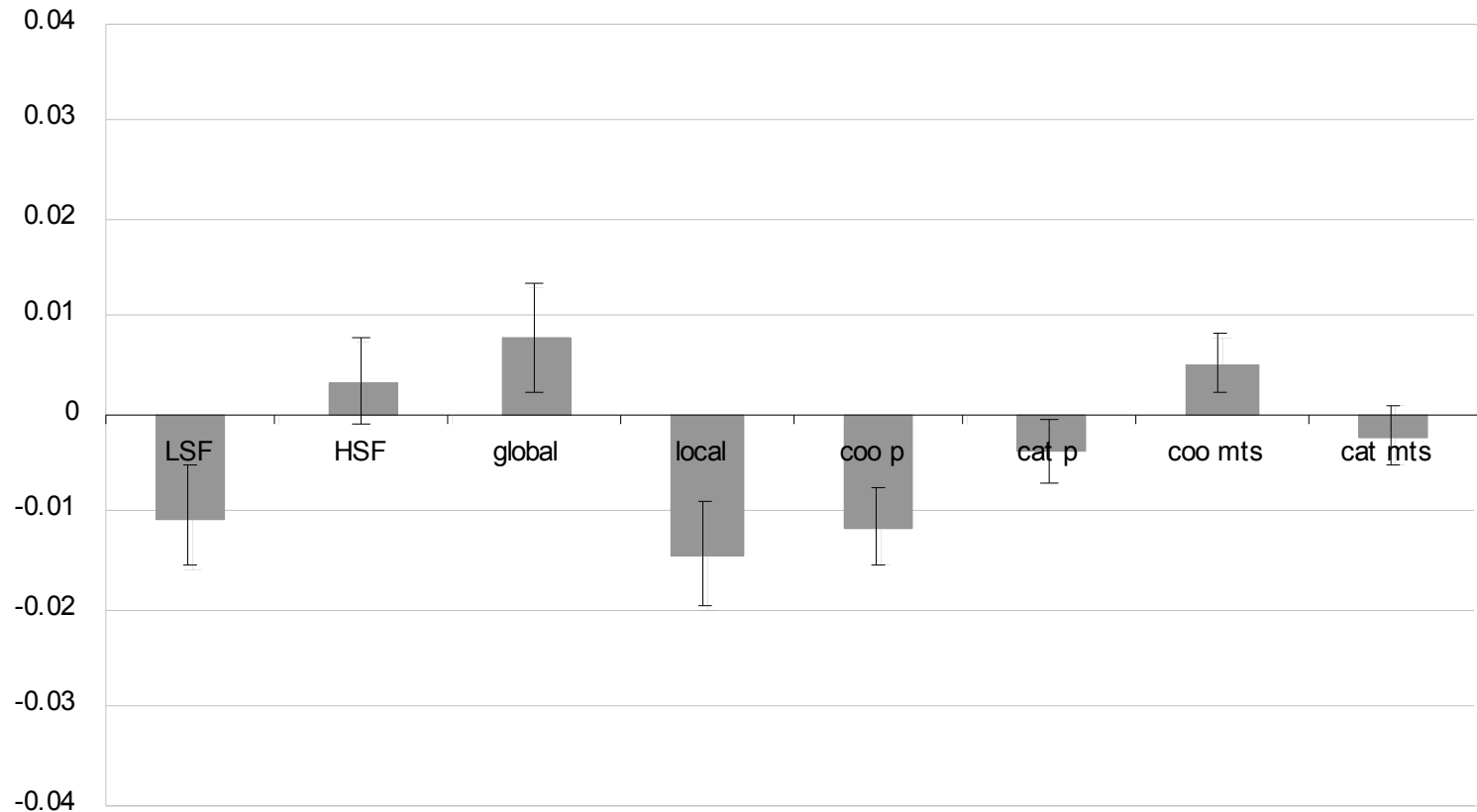
- 47 subjects (20 male)
- 4 tasks
 - 3 perceptual (frequency, local-global, cat-coo)
150 ms stimulus presentation (3° from centre)
 - 1 match-to-sample working memory (cat-coo)
150 ms stimulus 1 central, and 150 ms stimulus 2
lateral (3° from centre)
- RT was used for analysis

Lateralization index in performance

- $(RVF-LVF)/(RVF+LVF)$

- Value between -1 (LVF-RH largest) and 1 (RVF-LH largest)

- RT:



Factor analysis

- 3 factors, 80.24% of the variance explained:

Factor	Subtasks	Factor loading
1	Categorical mts LVF	+0.77
	Categorical mts RVF	+0.73
	Coordinate mts LVF	+0.84
	Coordinate mts RVF	+0.89
	Local LVF	+1.00
	Local RVF	+0.98
2	High spatial frequency LVF	-0.98
	High spatial frequency RVF	-0.99
	Low spatial frequency LVF	-1.03
	Low spatial frequency RVF	-1.14
	Global LVF	-0.52
	Global RVF	-0.55
3	Categorical p LVF	-0.81
	Categorical p RVF	-0.79
	Coordinate p LVF	-1.04
	Coordinate p RVF	-1.05


Factor analysis 2

- Only tasks showing hypothesized lateralization effect:

Factor	Subtasks	Factor loading
1	Categorical mts LVF	+0.87
	Categorical mts RVF	+0.86
	Coordinate mts LVF	+0.82
	Coordinate mts RVF	+0.82
	Local LVF	+0.81
	Local RVF	+0.82
	Global LVF	+0.83
	Global RVF	+0.78

Discussion

- For all tasks 3 factors were found
 - Related to task complexity or level of processing
 - Categorical-coordinate perception is separate
- Comparing the two cat – coo tasks
 - the new cross-dot task reflects the hypothesized lateralization effect, the dot-bar task clearly does not
 - Careful consideration when using such cat-coo tasks in further experiments, a working memory design appears to be more appropriate than a perceptual design

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- Categorical-coordinate WM and local-global load on a single factor
 - Stronger relationship between the two than with spatial frequency has been proposed before (Vauclair et al., 2006)
 - this suggests a link between the two, unaffected by frequency



Discussion points

- Current theoretical claims seem insufficient to explain these results
- Other factors might underly these patterns
 - Suggestions?



Thank you for your attention.

Questions?