

Cognitive Cubes: a TUI for Cognitive Assessment

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What's coming

Interface: *ActiveCube*

Application: *cognitive assessment*

System: *Cognitive Cubes*

ActiveCube: a 3D interface

Intuitive 3D modeling

Real-time interaction

Bi-directional interface



ActiveCube: 3D modeling

Intuitive 3D modeling

In construction of 3D shape

In understanding of 3D shape

Real-time interaction

Bi-directional interface



ActiveCube: real-time

Intuitive 3D modeling

Real-time interaction

Interactive capture of 3D shape

Physical & virtual object consistency

Bi-directional interface



ActiveCube: bi-directional

Intuitive 3D modeling

Real-time interaction

Bi-directional interface

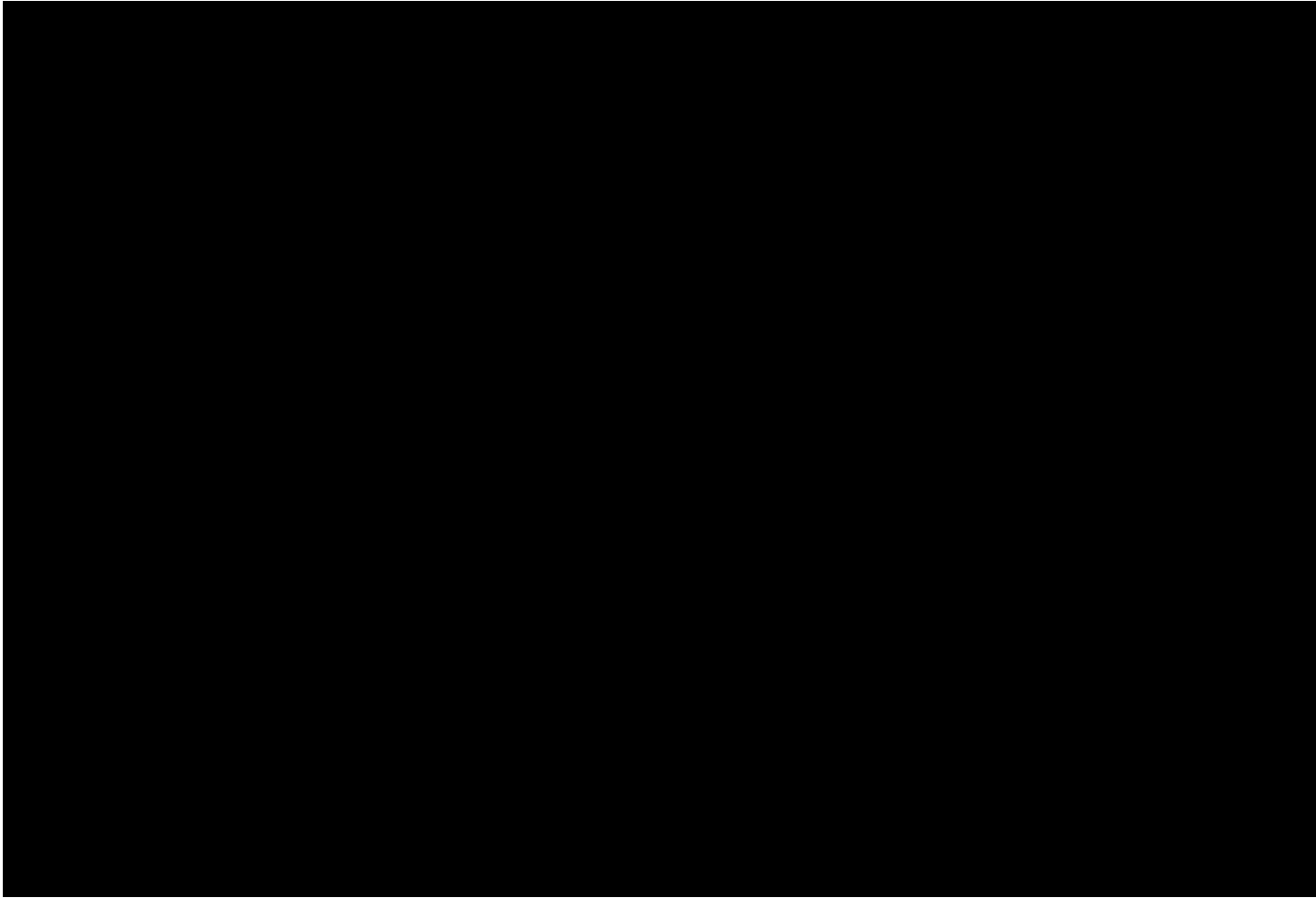
Other I/O functions in cubes

Can arrange functions spatially

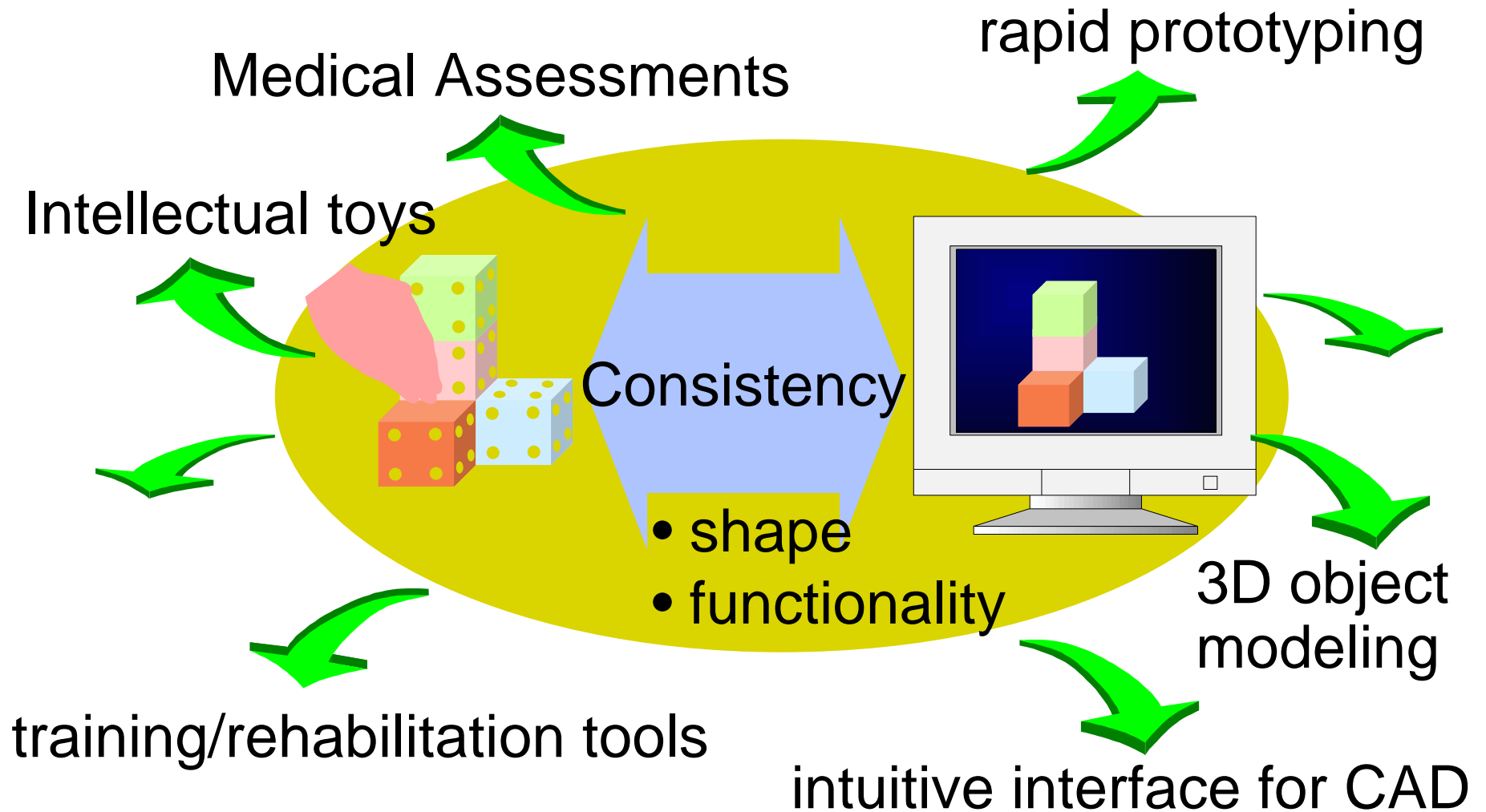
Clear causality between I/O



ActiveCube: video



ActiveCube: other apps



Assessment: why do it?

Diagnosis

Of disease and injury

Monitoring

Of recovery and decline

Research

About brain function

Assessment: spatial tests

Constructional

Integrating of perception & action

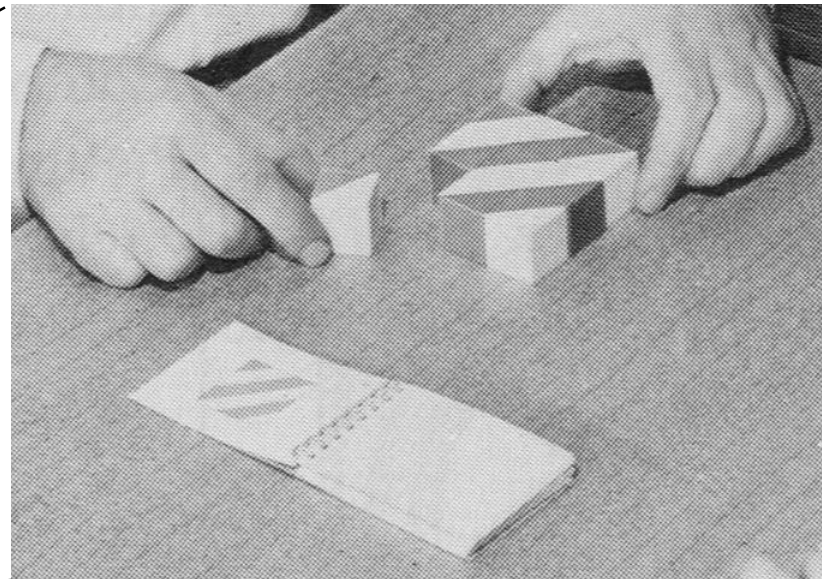
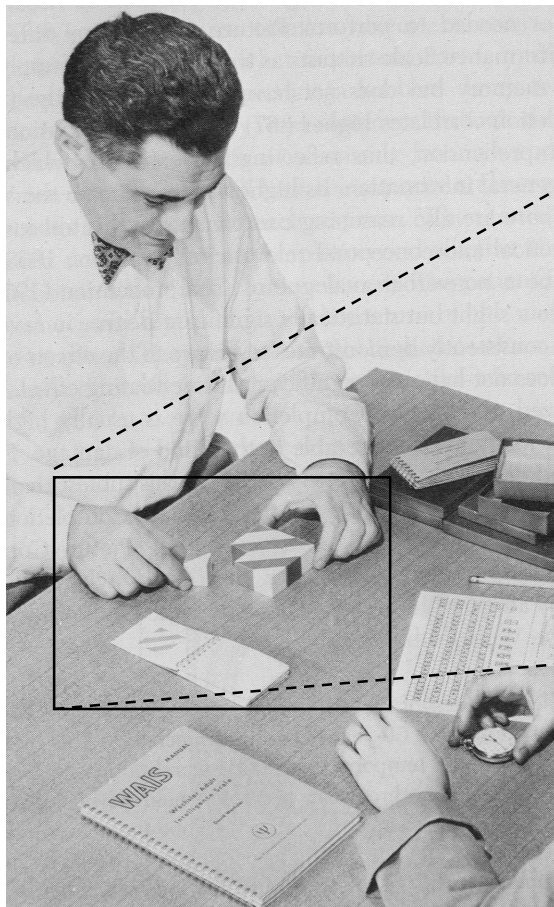
Relevant

Strongly related to everyday tasks

International

Little dependence on language & culture

Assessment: typical test



Assessment: why automate?

Reliability

Consistent testing & scoring

Sensitivity

3D complexity & high res measures

Reduced cost

Less training & adaptive testing

Cognitive Cubes: task

Match this...



...with this.



3 task types: *follow, match & reshape*

Cognitive Cubes: 4 measures

Time to completion

Similarity at completion

intersecting cubes - # extra cubes

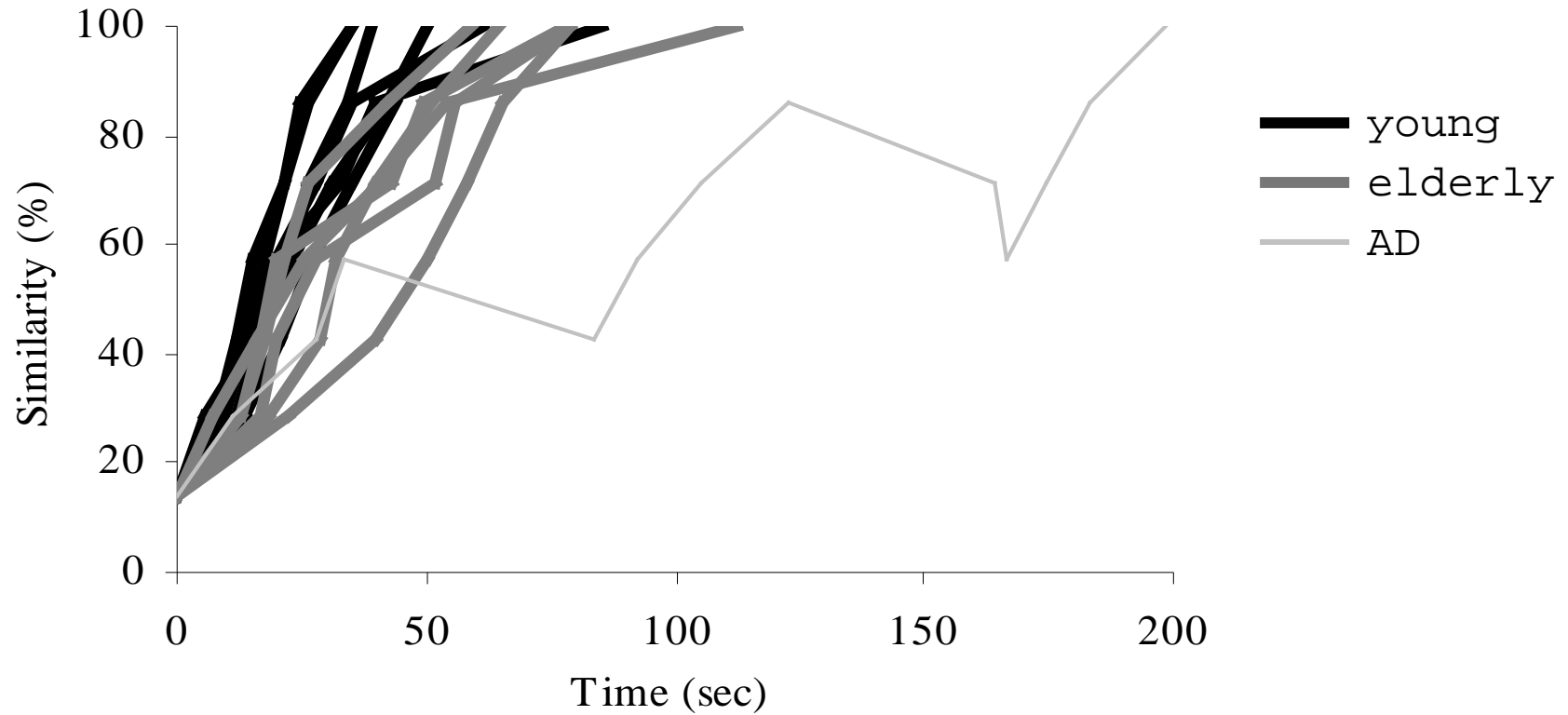
Derivative of similarity

Change in similarity over time

Zero crossings of similarity

times similarity worsened

Cognitive Cubes: similarity



Cognitive Cubes: evaluations

Cognitive sensitivity evaluation

To known cognitive factors

Test comparison evaluation

To standard mental rotation assessment

Cognitive Cubes: test variables

Age

Seven < 37 yrs, seven > 55 yrs, (2 AD)

Task type

8 follow, 15 match, 10 reshape

Shape type

9 two dimensional, 24 three dimensional

Cognitive Cubes: sensitivity

Age: significant by time & derivative

Task type: by all measures

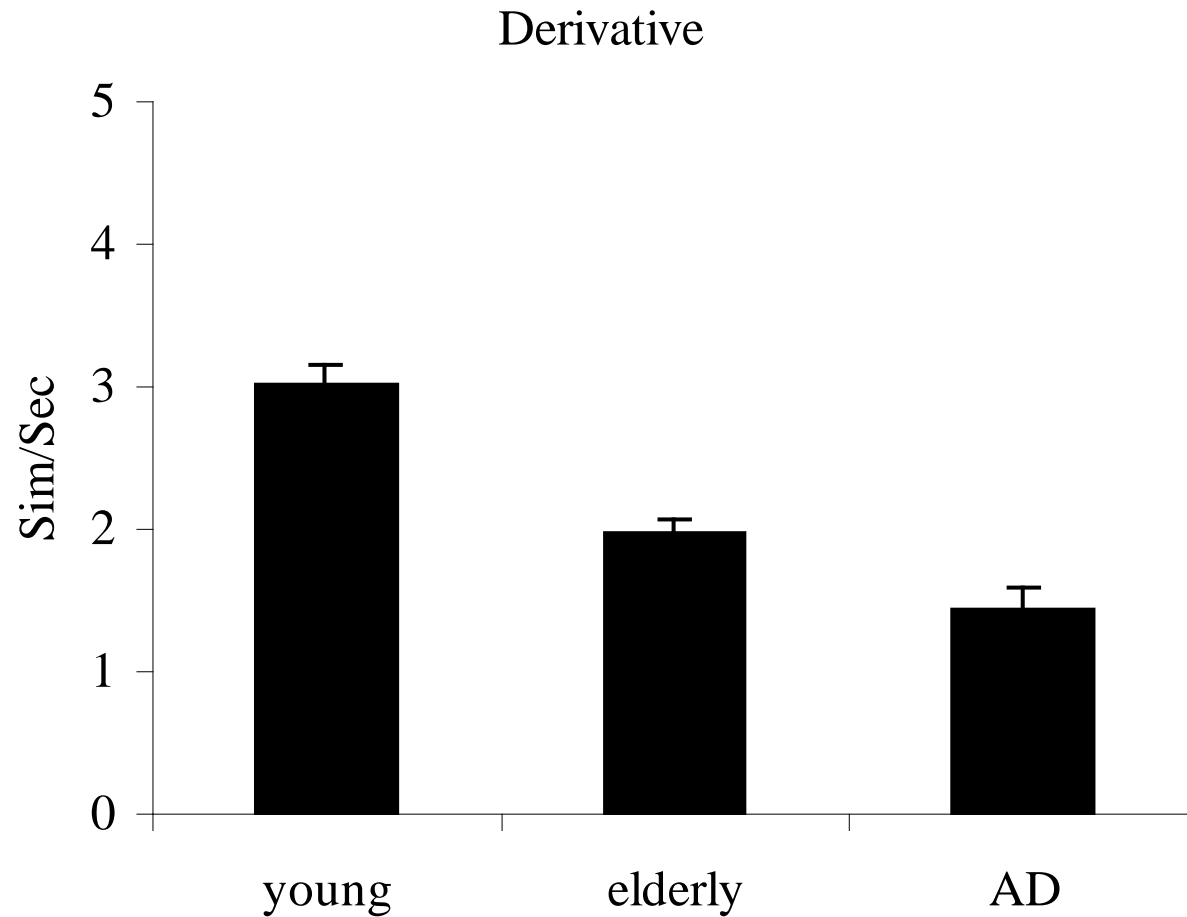
Shape type: by all measures

Task x shape: by all measures

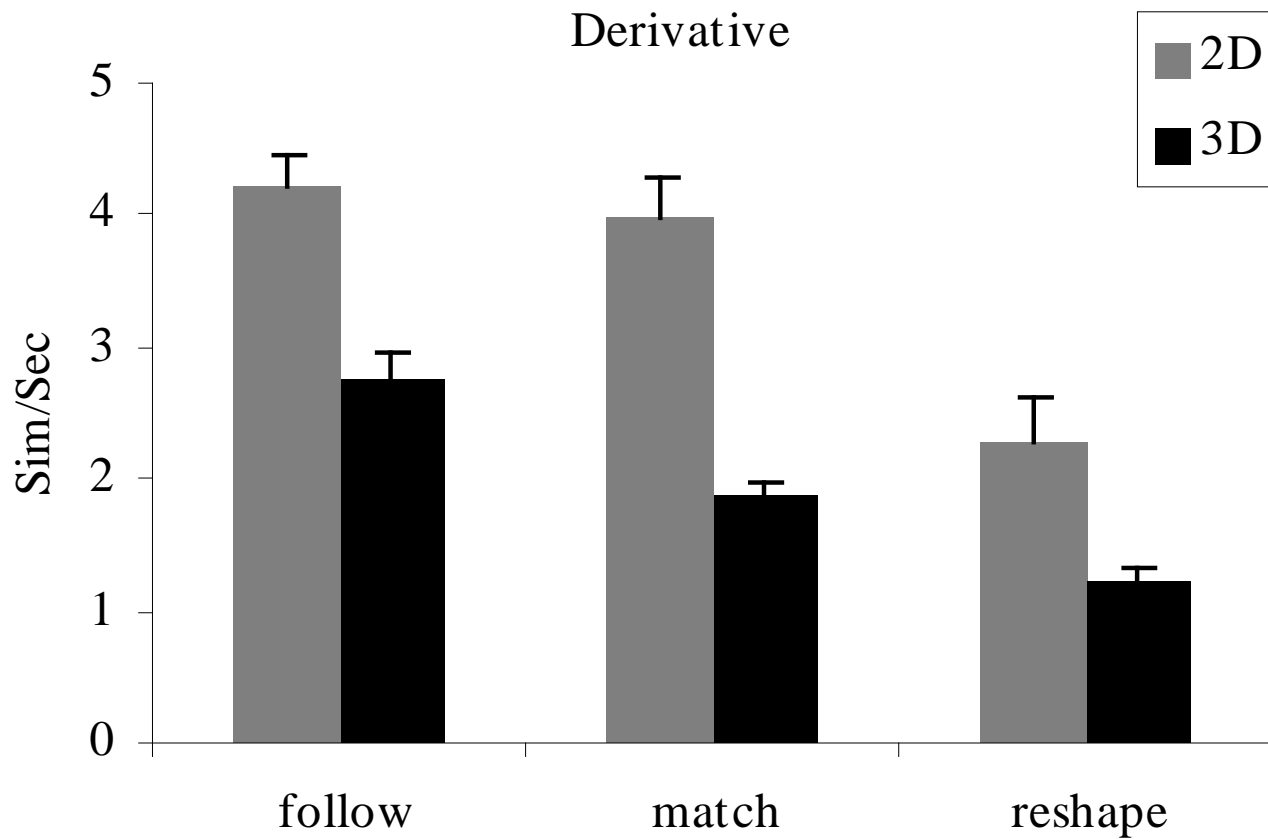
2D: reshape > match = follow

3D: reshape > match > follow

Cognitive Cubes: sensitivity



Cognitive Cubes: sensitivity



Cognitive Cubes: comparison

Measures	All	Shape		follow	Task	
		2d	3d		match	reshape
Time	Stat Insig Corr > .2	Marg Sig Correlation	Stat Insig Corr > .2	Marg Sig Correlation (p<.05)	Stat Insig Corr > .2	
Similarity	Correlation < .2	Stat Insig Corr > .2	Correlation < .2	Correlation < .2		
Crossings	Stat Insig Corr > .2	Correlation < .2	Stat Insig Corr > .2	Correlation < .2	Stat Insig Corr > .2	Correlation < .2
Derivative	Marg Sig Correlation	Stat Insig Corr > .2	Marg Sig Correlation (p<.05)	Stat Insig Corr > .2	Marg Sig Correlation	Stat Insig Corr > .2

 Marg Sig Correlation

 Stat Insig Corr > .2

 Correlation < .2

Conclusions

Promising results

Sensitivity to factors, some correlations

Readying for prime time

Extensive studies of score distributions

Future research

Difficulty and shape complexity

Decision trees

Questions?