



Distributed Cognition

CS376 | Stanford University | Apr 30, 2009

The Power of Representation

Donald Norman

On Distinguishing Pragmatic From Epistemic Action

David Kirsh & Paul Maglio

The Power of Representation

The proper representation of a problem makes the solution transparent.

Examples

Roman/Arabic Numerals

MCCXXXIX

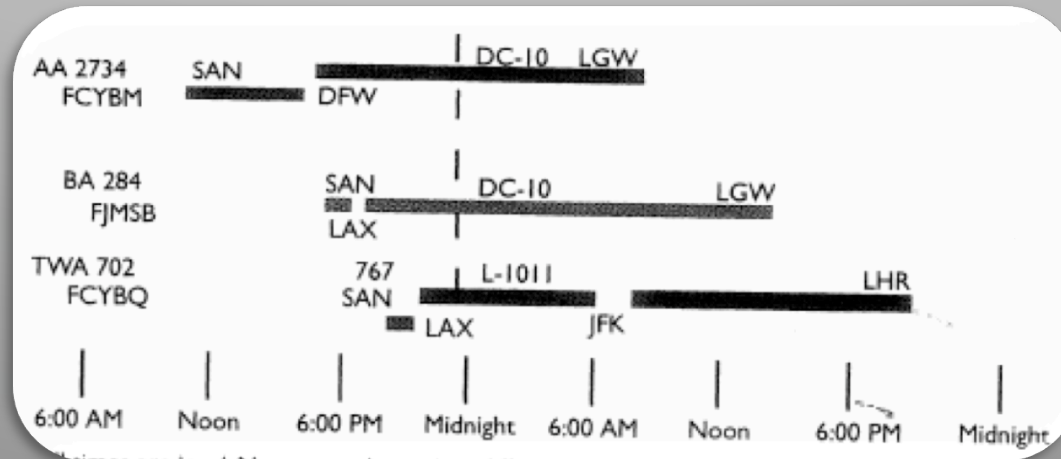
Vs.

1239

Flight Schedules

	1131	SAN	0820+1	LGW	AA	2734	FCYBM	D10	1
		AA	2734	CHG PLANE AT DFW					
X12	1805	SAN	1425+1	LGW	BA	284	FJMSB	D10	1
	2100	SAN	2030+1	LHR	TW	702	FCYBQ	*	2
		TW	702	EQUIPMENT 767 LAX-L10					

Vs.



Medical Prescriptions

Inderal —1 tablet 3 times a day
Lanoxin —1 tablet every a.m.
Carafate —1 tablet before meals and at bedtime
Zantac —1 tablet every 12 hours (twice a day)
Quinaglute —1 tablet 4 times a day
Coumadin —1 tablet a day

Vs.

	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	✓			
Inderal	✓	✓	✓	
Quinaglute	✓	✓	✓	✓
Carafate	✓	✓	✓	✓
Zantac		✓		✓
Coumadin				✓

The Power of Representation

Abstraction:

Representing perceptions, thoughts, experiences in another medium, eliminating irrelevant details

The Power of Representation

What happens to the *left-out details*?

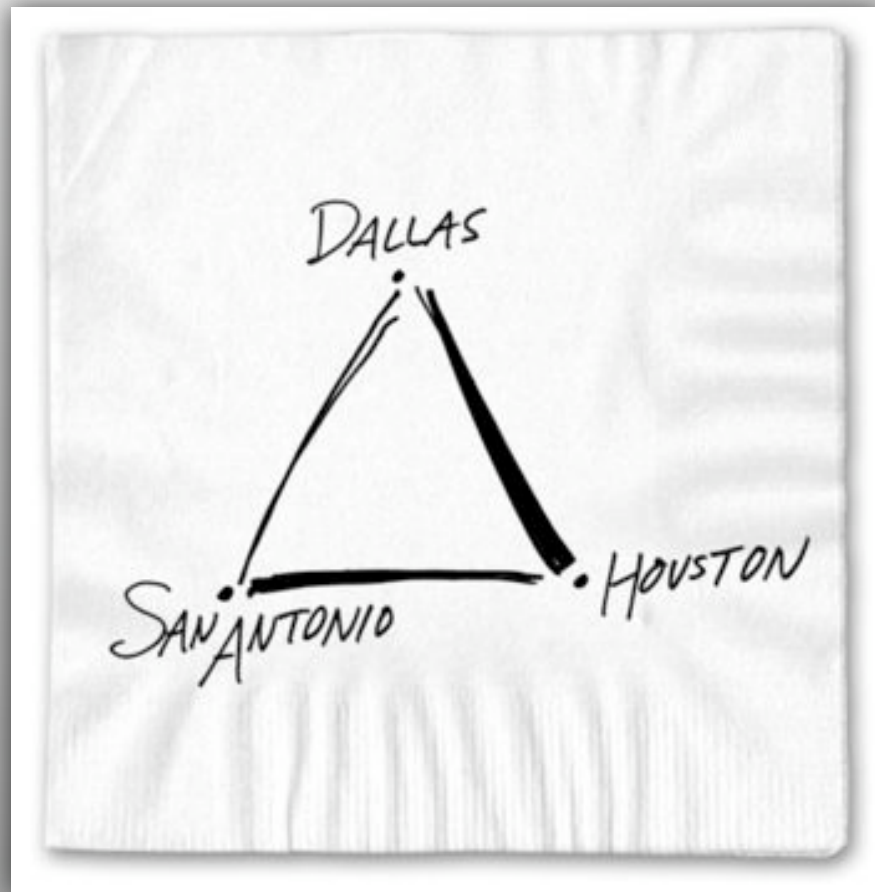
“We value what we can measure (or represent)”

Abstraction Artifacts

- **Reflective**
 - Allow us to ignore the real world and concentrate only upon artificial, representing worlds.
- **Experiential**
 - Provide ways to experience and act upon the world.

The Power of Representation

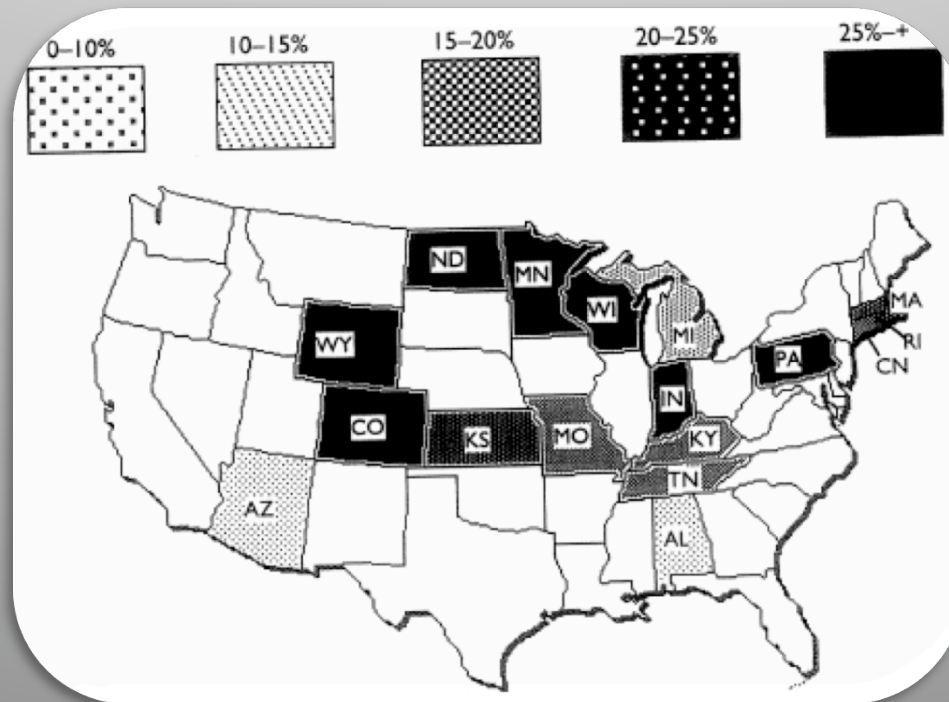
So which is this?



The Power of Representation

Naturalness Principle

Experiential cognition is aided when the properties of the representation match the properties of the thing being represented.



The Power of Representation

Perceptual Principle

Perceptual and spatial representations to be preferred over non-perceptual, non-spatial representations, but only if the mapping between the representation and what it stands for is analogous to the real perceptual and spatial environment.

Tally
Marks



Chinese Tallies

onc

Faculty Support for Student Learning



Academic Support for Students



Focus on the Whole Student



Communication vs. Problem Solving

Utility vs. Ease of Use/Creation

Is *Memory* Abstract?

The Power of Representation

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On Distinguishing Pragmatic From Epistemic Action

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Epistemic vs. Pragmatic Action

- **Pragmatic Action**
 - Actions that advance an agent towards a goal or sub-goal.
- **Epistemic Action**
 - External physical actions that make mental computation easier, faster, or more reliable

Epistemic Action

- Reduces number of mental steps
- Reduces memory required
- Reduces probability of mental error

Examples:

Key in the shoe. String around a finger.

Tetris

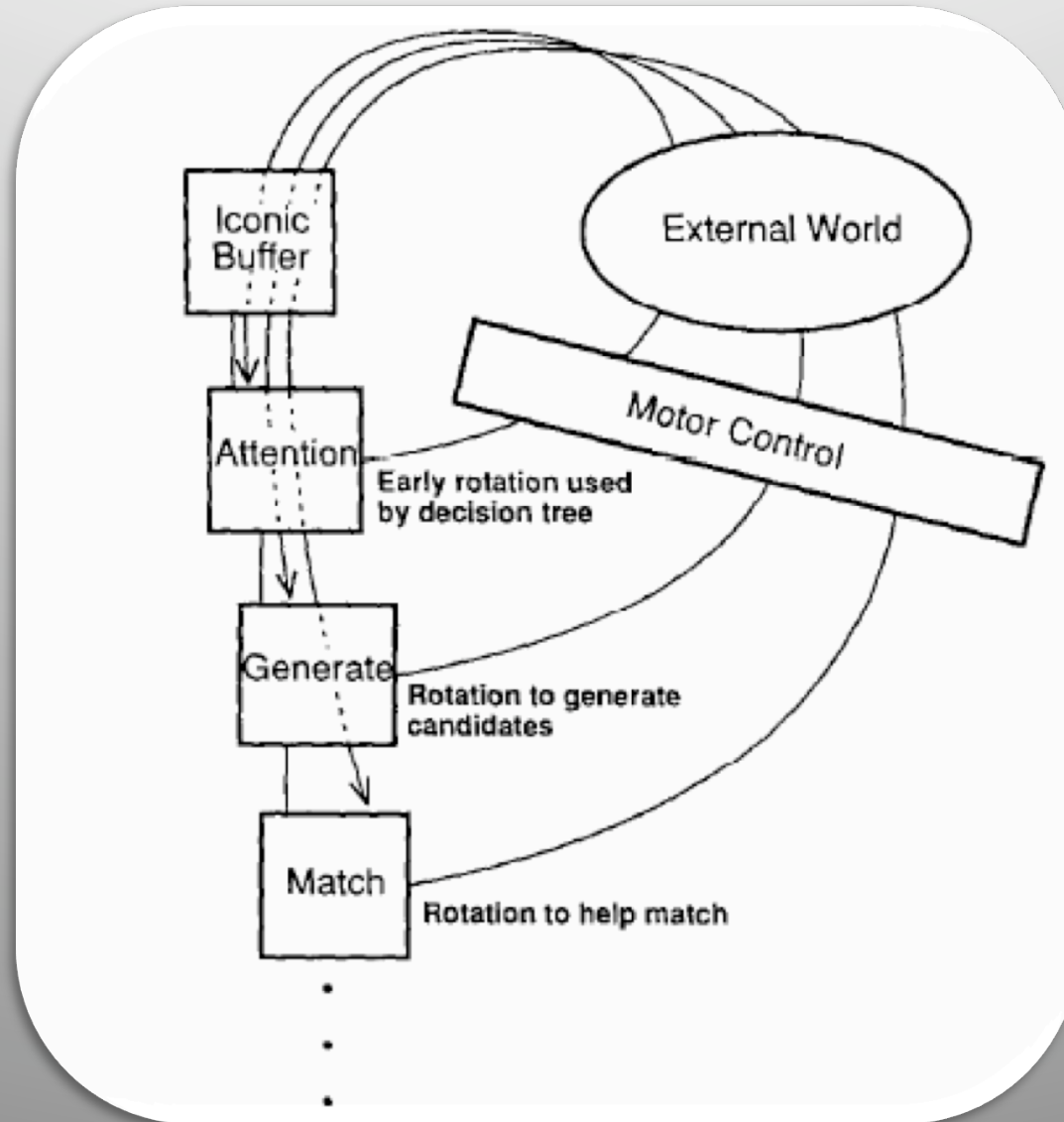


Epistemic Rotations

Uses of rotations

1. Unearth new information very early in the game
2. Save mental rotation effort
3. Facilitate retrieval of zoids from memory
4. Make it easier to identify a zoid's type
5. Simplify the matching process

Tetris



Tetris

To what extent is this *generalizable*?

What are some ways that we do this today?