Distributed Cognition
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

<table>
<thead>
<tr>
<th>Flight</th>
<th>Origin</th>
<th>Dest</th>
<th>Time (H:M:S)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>113I</td>
<td>SAN</td>
<td>LGW</td>
<td>0820+1</td>
<td>AA 2734 CHG PLANE AT DFW</td>
</tr>
<tr>
<td>1805</td>
<td>SAN</td>
<td>LGW</td>
<td>1425+1</td>
<td>BA 284</td>
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<td>2100</td>
<td>SAN</td>
<td>LHR</td>
<td>2030+1</td>
<td>TW 702</td>
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**Equipment:** 767 LAX-L10

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Vs.

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# Flight Schedules

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**Hours:**
- 6:00 AM
- Noon
- 6:00 PM
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.
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.
Communication vs. Problem Solving
Utility vs. Ease of Use/Creation
Is Memory Abstract?
The Power of Representation
Donald Norman

On Distinguishing Pragmatic From Epistemic Action
David Kirsh & Paul Maglio
Epistemic vs. Pragmatic Action

- Pragmatic Action
  - Actions that advance and 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

Diagram:
- Iconic Buffer
- Attention: Early rotation used by decision tree
- Generate: Rotation to generate candidates
- Match: Rotation to help match
- External World
- Motor Control
Tetris

To what extent is this generalizable?
What are some ways that we do this today?