

Week 2: Second Wave HCI (Part 1)
From Cognition to Experiences of Bodies

Chunk 1: External Cognition

A quick look-back

What is external cognition

Properties of external representations

Design implications

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Key insights from last week

First wave HCI theory: Grounded in cognitive psychology:

- **Narrow, precise, and predictive** (e.g. Fitts' Law, GOMS)
- **Broad, general, and prescriptive** (e.g. Gulfs of Es)

Common features of first wave HCI theory:

- All in the brain (hence the “cognitivist” label)
- Atemporal
- Acontextual
- Composable
- Variability = noise

Key insights from last week

Moving beyond *“predict[ing] the performance times of highly skilled users”*

“Providing an analysis of people’s problem-solving activities is beyond [the] capabilities of [things like GOMS]”

- > too low-level*
- > restricted in scope*
- > fail to deal with real world scenarios / experiences*

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Second Wave Approach: Beyond what is in the head..

Knowledge in the *head* and in the *world*

Cognition for HCI should be considered in terms of distribution across:

- People
- Technologies
- Environments

Shifting focus to how tasks and artefacts/representations co-evolve

External cognition

First alternative computational account of cognition which focuses on how people interact with external representations

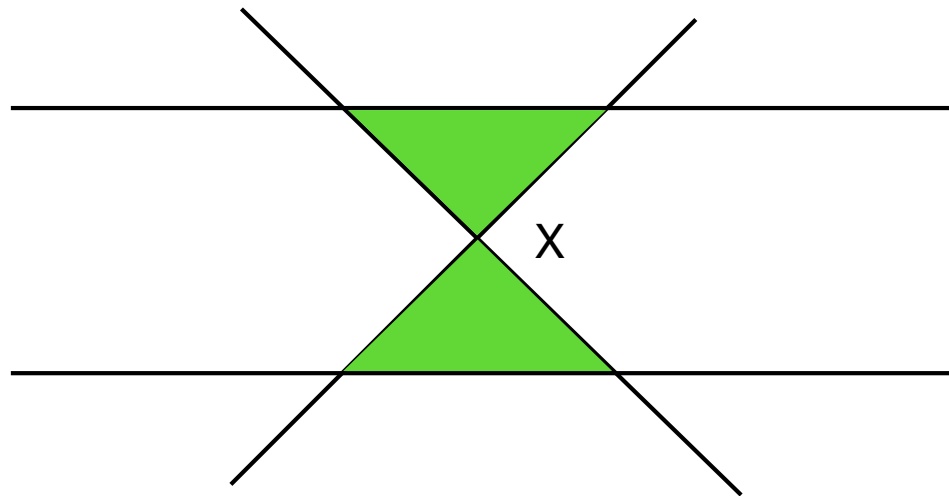
Cognition = interplay between internal and external representations

Example...

Close your eyes, and imagine:

Two parallel lines, they are crossed by two transversal lines, the transversal line intersect with on another at a point X that is at an equal distance from the two parallel lines

Example...



Let's play: the game of fifteen..

- Two players take turns
- Choose a digit from the set $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
- Once a digit is taken it cannot be used again
- First player to collect three digits that sum to 15 wins.

Let's play: the game of fifteen..

Player A

8
4 5

Player B

2
3 ?

Let's play: the game of fifteen..

Player A

8
4 5

Player B

2
3 ?

...We need unaided reflection to keep track of:
opponent numbers
own numbers
sums
remaining number

This is hard!

Let's play: tic tac toe

X	O	X
	X	
O		

...the representation of the game helps:
Makes the next move obvious
We “experience” solution
No need for reflection..

This is Easy!

Let's re-represent the game of 15!

X	0	X
	X	
0		

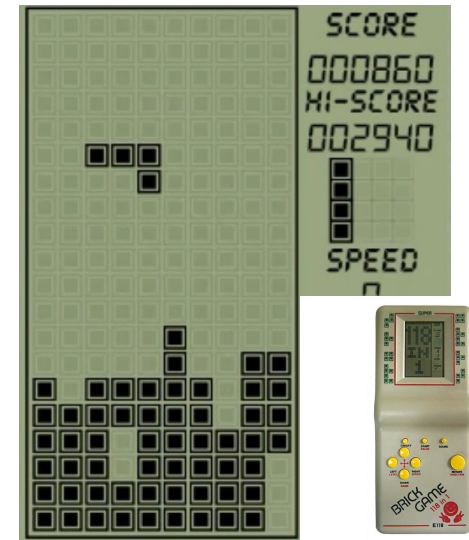
4	3	8
9	5	1
2	7	6

4	3	8
	5	
2		6

The role of interactivity

How do you play Tetris or scrabble?

- Rotate, move left/right?
- Shuffle letters?



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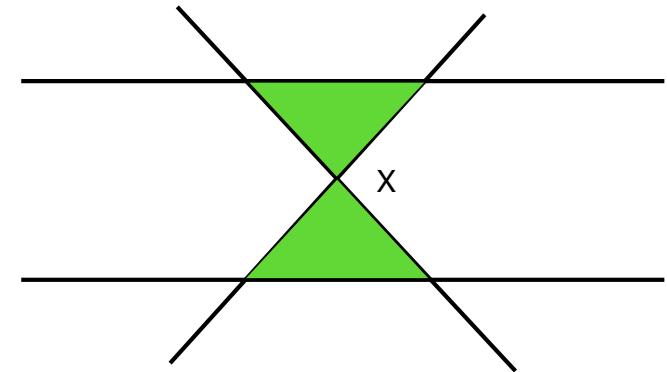
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Properties of external representations

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Properties of external representations

- **Emergent** properties of representation
- Make **inference** and conclusions apparent



Properties of external representations

Re-representation: The choice of representation changes the nature of the task

Requires less reflection

Cognitive processes are externalised, offloaded onto the representation

Constraining: inference rules are embedded in the representation

X	0	X
	X	
0		

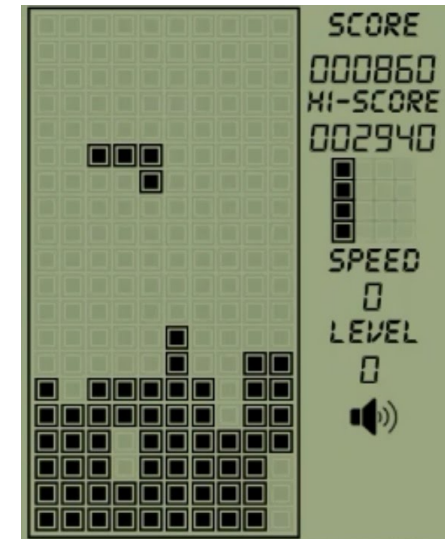
4	3	8
9	5	1
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4	3	8
	5	
2		6

Properties of external cognition

Computation offloading: e.g. inference is experiential rather reflective

Cognitive processes are externalised, offloaded onto the representation



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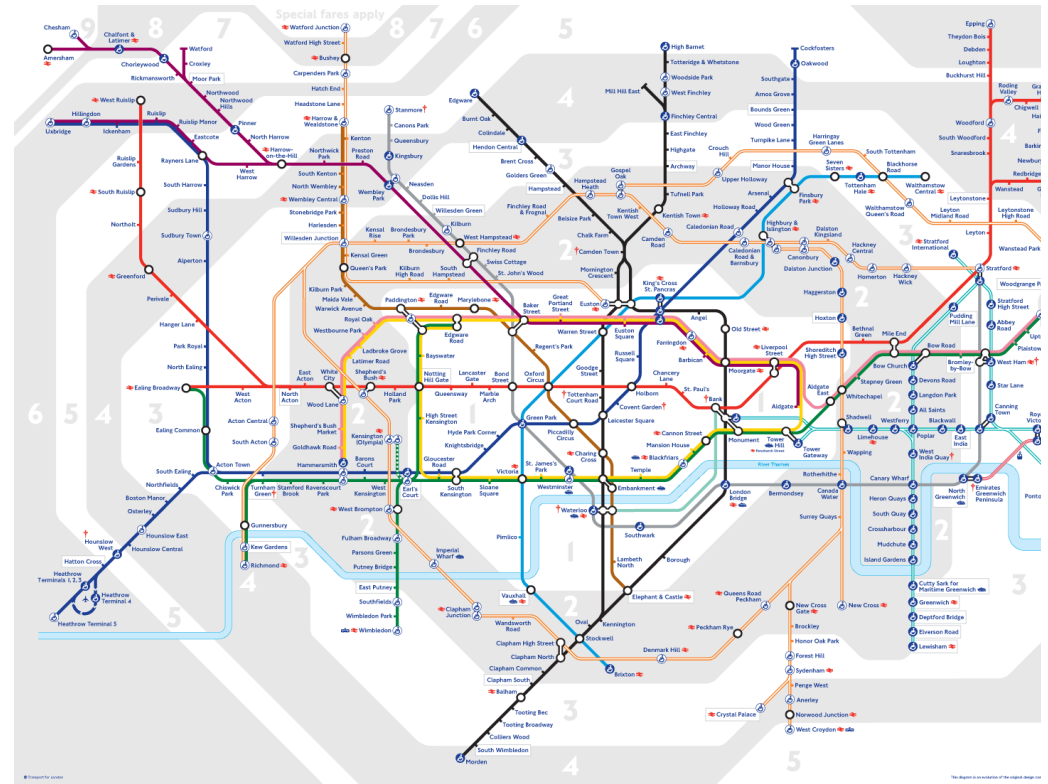
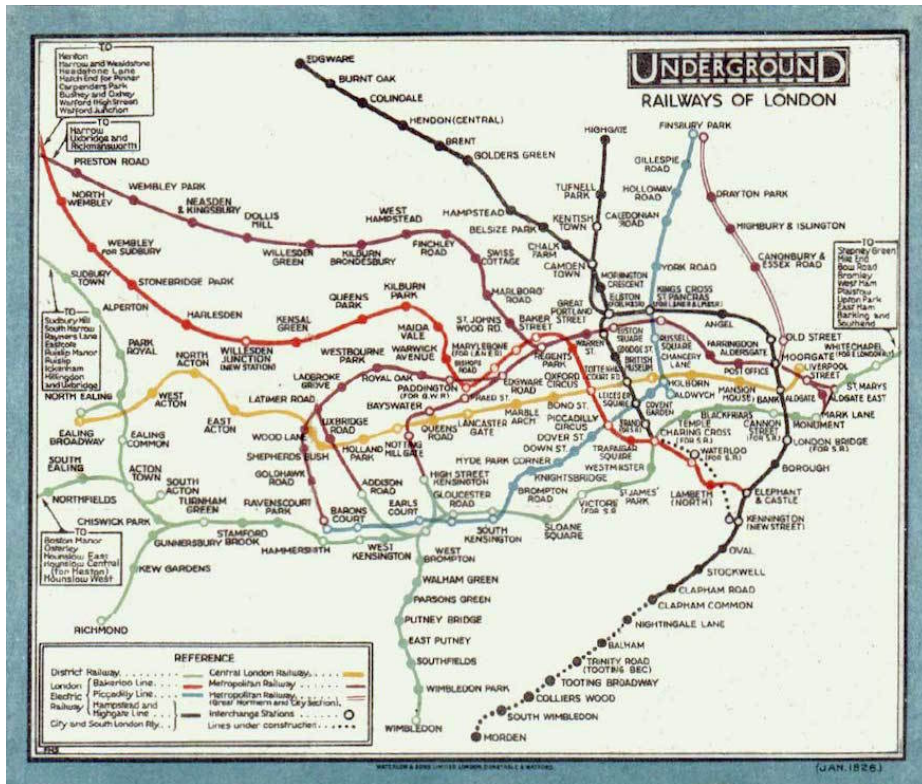
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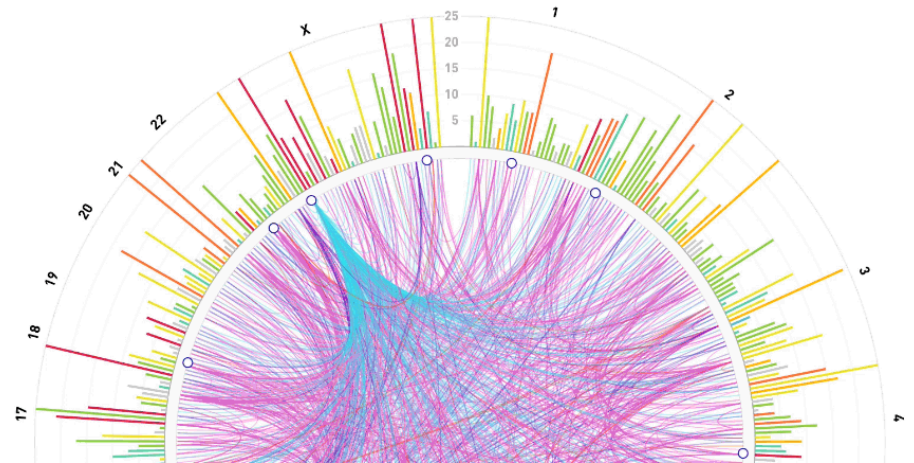
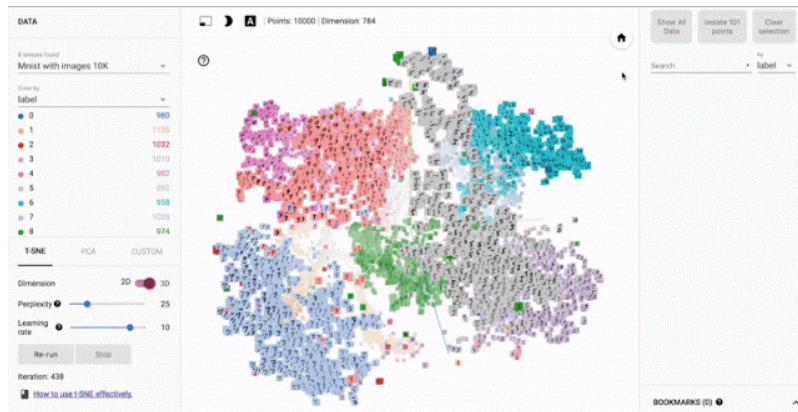
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Re-representation



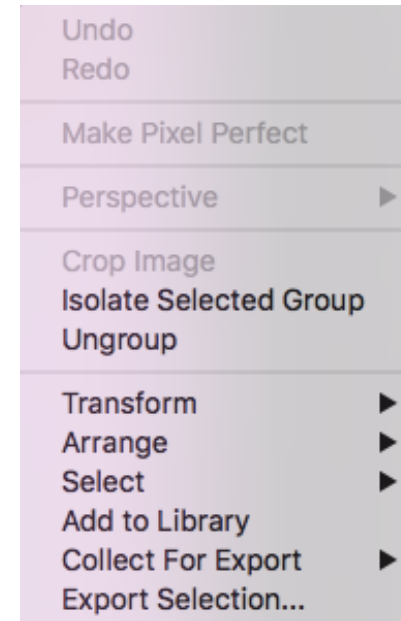
Explicitness and visibility



Explicitness and visibility: Making certain features of the display more salient so they help make certain inferences more apparent and emergent

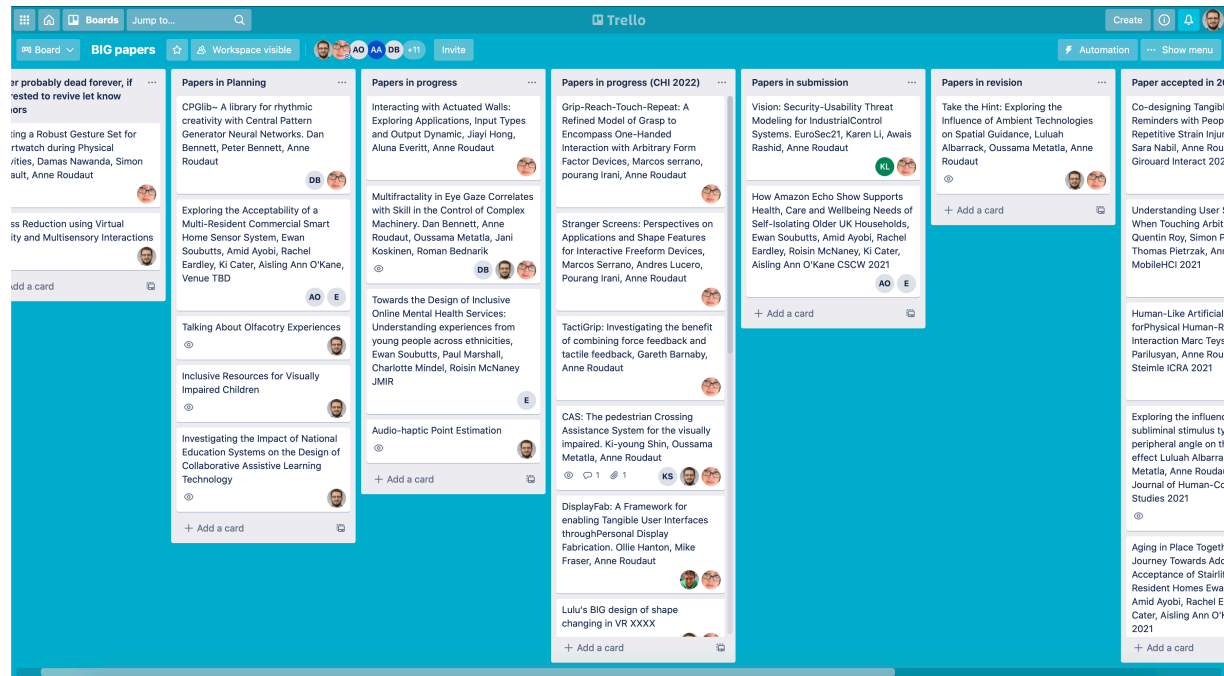
Constraining

- Constraining choice of action
- Properties of the representation match the properties of the task



Cognitive tracing

Cognitive tracing:
the ability to
manipulate
representation to
project structure onto
things, then act on
those projections



In summary...

A shift of view of cognition from internal processes only -> to
interplay between internal and external representations

External Cognition: an alternative account

- Computational offloading

- Re-representation

- Constraining

Design implications

- E.g. Change the nature of task, Cognitive tracing, Make information salient and explicit, constrain possibilities