



Cognition & Representation

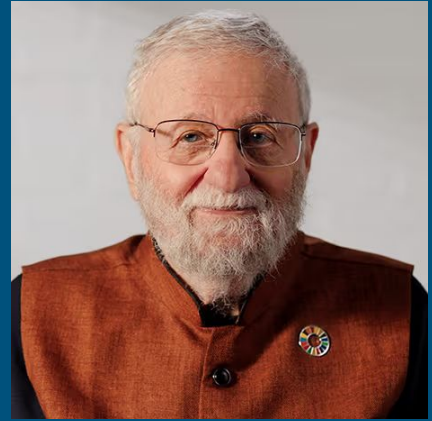


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Don Norman, “Things That Make Us Smart” Ch. 3

Background



Don Norman:

- Researcher, Professor, Author
- Well-known for contributions to design, usability engineering, cognitive science
 - Big advocate for user-centered/human-centered design

“Things That Make Us Smart”:

- Explores the relationship between the human mind and technology
- Different representations shape the way we think

About the Reading

Core Argument:

It is “things” (i.e. the artifacts and ways in which we represent information), that “make us smart” (i.e. influence and enhance how we think, solve problems, and communicate).

Representations are cultural inventions, conventions that humans created

Representation: The form or way in which we present information.

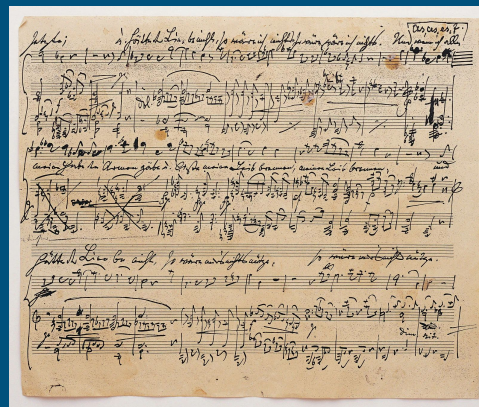
Cognitive Artifact: A tool or external aid that enhances (or hinders) our cognitive abilities.

Experiential vs Reflective

Warm-Up Exercise

- What is an example of a powerful representation/cognitive artifact you've interacted with and what made it effective?
- What's an example of a poor or ineffective representation/cognitive artifact?

ROMAN NUMERALS							
I	II	III	IV	V	VI	VII	VIII
1	2	3	4	5	6	7	8
IX	X	L	C	D	M		
9	10	50	100	500	1,000		



Discussion Question

Do you agree with Norman that representations shape *what we can think*, not just *how easily we think*? Why or why not?

Are there limits to what representations can do—things they can't help us think about effectively?

Broader Implications

“Solutions, to be effective, must include and support the needs of all the people involved with the prescription: the patient, the physician and the physician’s aides, and the pharmacist. This issue can truly be a matter of life and death.”

- What are ways we can create shared mental representations that support and work across groups of individuals?
- In HCI or computer science, what domains most need more intentional design of representations to create meaningful, safe, or equitable solutions?

Humans vs Computers

- Humans and computers represent and process information in very different ways (e.g. 0s and 1s vs. language, logic vs. emotion). What are the implications of these differences for designing systems and tools that support human thought and feeling?
- In HCI, we often act as “translators” between human mental models and computer representations. Where do you see this translation working well, and where does it break down?



Understanding computers and cognition

→ one of the most thought-provoking works on hci and the philosophy of design

Winograd & flores



Computers & Representation

Programming is a symbolic representation, just like language

Programming is about the formal manipulation of symbols

“The problem is representation is in the mind of the beholder”



a16z
@a16z



.@drfeifei on why LLMs will struggle to solve spatial intelligence:

"Language is fundamentally a purely generated signal."

"You don't go out in nature and there's words written in the sky for you."

"There is a 3D world out there that follows laws of physics... to fundamentally back that information out and be able to represent it and be able to generate it is just fundamentally quite a different problem."

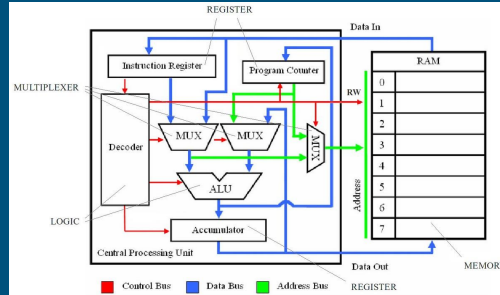


Chap 7 - computing as representation

Main argument: programming and computer systems are fundamentally about “representation – formalizing certain aspects of the world into symbolic structures that a machine can manipulate



Physical machine



Logical & abstract machine

```
print(round(pi))
print(math.ceil(pi))
print(math.floor(pi))
print(abs(pi))
print(pow(pi,2))
print(math.sqrt(pi))
print(max(x,y,z))
print(min(x,y,z))
```

High level language <->
representation scheme

Relation to earlier chapters - 1

Chapter 1 - 6

- Laying the groundwork

“The book dismantles the dominant computational/cognitive model and replaces it with a more heideggerian, biological, and social view of cognition”

Relation to earlier chapters - 2

From heidegger:

From maturana:

From the discussion of language:

Chapter 7

“Computers are powerful only insofar as we formalize the world into representations they can process. But this means they inevitably miss the fluid, contextual, embodied nature of human understanding. ”

Do you agree or disagree with this statement? What are your general thoughts on this?

Looking forward

Limitations of breakdowns, “resource use” (different levels of abstraction), accidental representation

Implicit argument: when a breakdown occurs and the object goes from ready-at-hand to present-to-hand, users will think more deeply about mismatched representations and this may actually result in new insights that the designer of the representations did not originally intend

Do you have an example of a breakdown in your life?

What did it teach you?

Can you design for scenarios like this? If so, how?

Cross-text Discussion Question

Why is it important to consider human context and cognition in the design of technologies?

What are your thoughts on designing systems that “respect human context”

Any interesting trend you observe that’s going on right now that fit into “human-centeredness” / or like any critique on any current trend

Summary of the Reading

History, Societal

- Physical representations and tools empower people to better demonstrate and articulate their own perspectives
- Writing systems, mathematical notation, and data visualizations are not natural—they're conventions humans created. Cultural Inventions
- OAG example: Humans possess a powerful capacity for reflection but takes more deliberate and focused mental effort. Except we shouldn't need this reflection
- "Bad representations turn problems into reflective challenges. Good representations can often transform the same problems into easy experiential tasks. The answer so difficult to find in one mode can jump right out in the other."
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- Difference in the way humans vs computers approach/compute a problem: tictactoe example
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