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# **Information Overload and Adaptive Minds**

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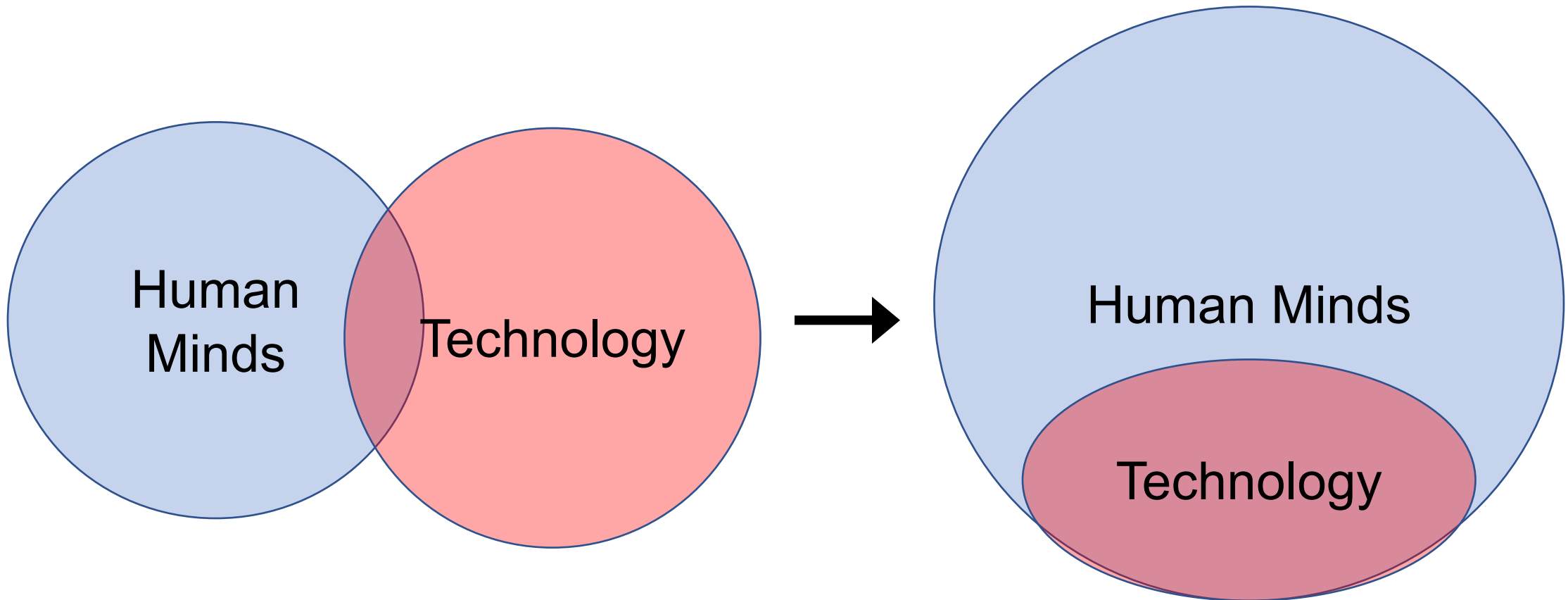
# Weekly Topics

How do the rapid changes in technologies and information environments affect our minds and behavior?

- Week 1. The Extended Minds and Distributed Cognition
- Week 2. Information Proliferation and Misinformation
- Week 3. Information Foraging
- Week 4. Learning in the Wild

# Weekly Topics

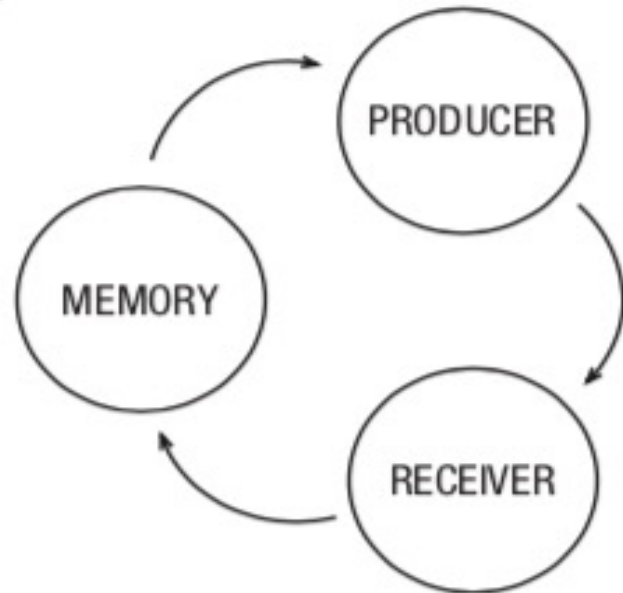
- Week 1. The Extended Minds and Distributed Cognition



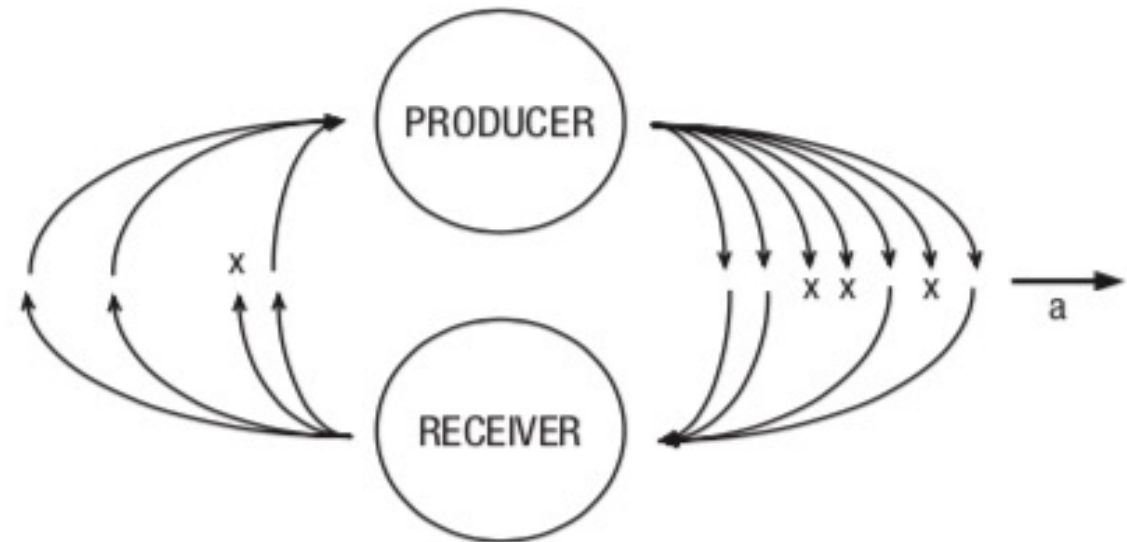
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- Week 1. The Extended Minds and Distributed Cognition
- Week 2. Information Proliferation and Misinformation

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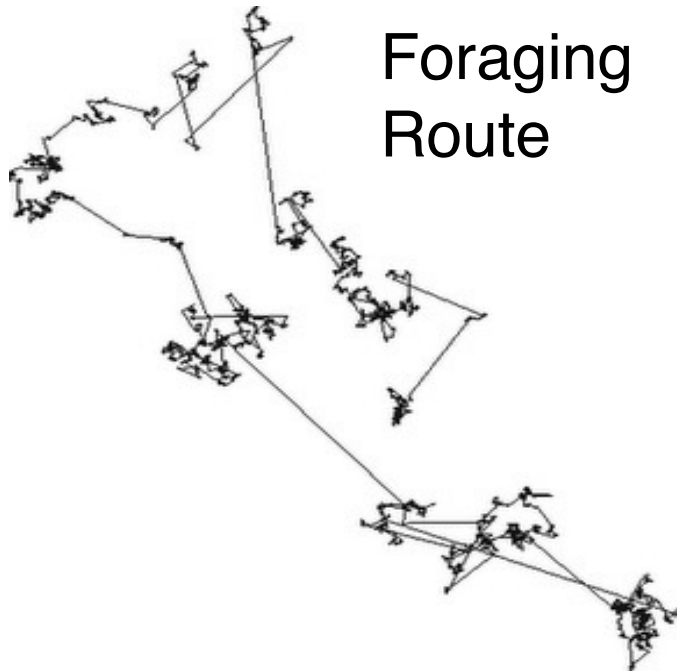


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# Weekly Topics

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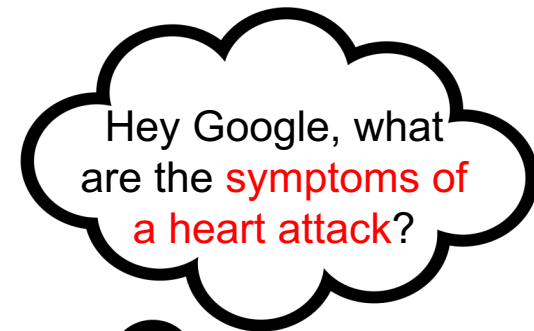
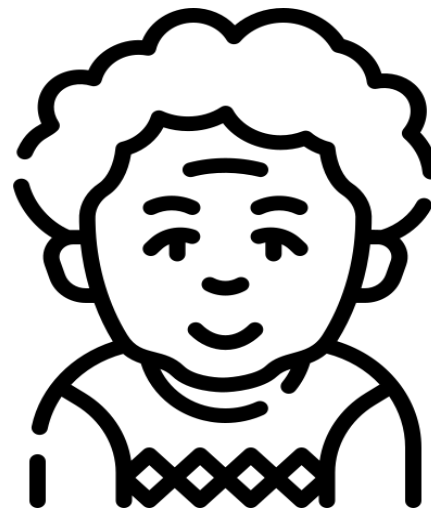


The collage displays various content from the MedlinePlus website, including:

- The homepage with the MedlinePlus logo and search bar.
- A 'High Blood Pressure' article with a detailed description and a list of related topics.
- A 'Heart Diseases' article with an illustration of a heart and a list of related topics.
- A 'Medical Encyclopedia' section with a list of topics.

# Weekly Topics

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# Self-Introduction

- Your name, how would you like to be addressed?
- One thing about yourself that you would like to share with the class
- What do you expect to learn from this course?
- Name one of the mostly used technologies in your everyday life.

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**The Adaptive Cognition and Interaction Design (ACTION) Lab**

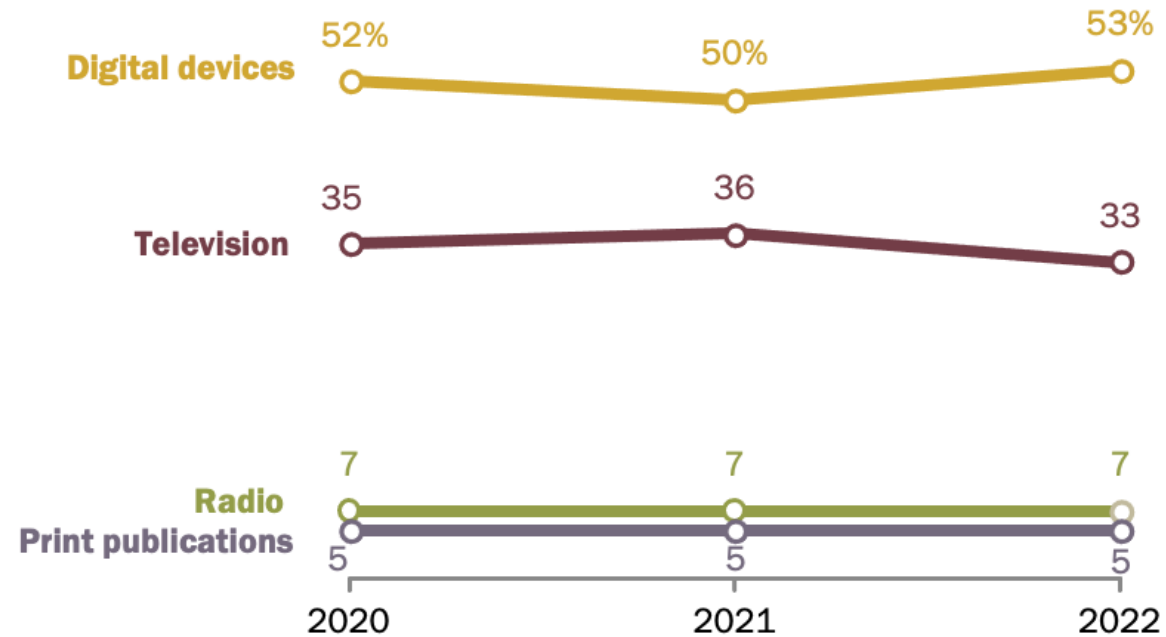
**<https://jessiechinlab.ischool.illinois.edu/>**

# Digital devices become the main source of news

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## News platform preferences

*% of U.S. adults who prefer \_\_\_\_ for getting news*



Source: Survey of U.S. adults conducted July 18-Aug. 21, 2022.

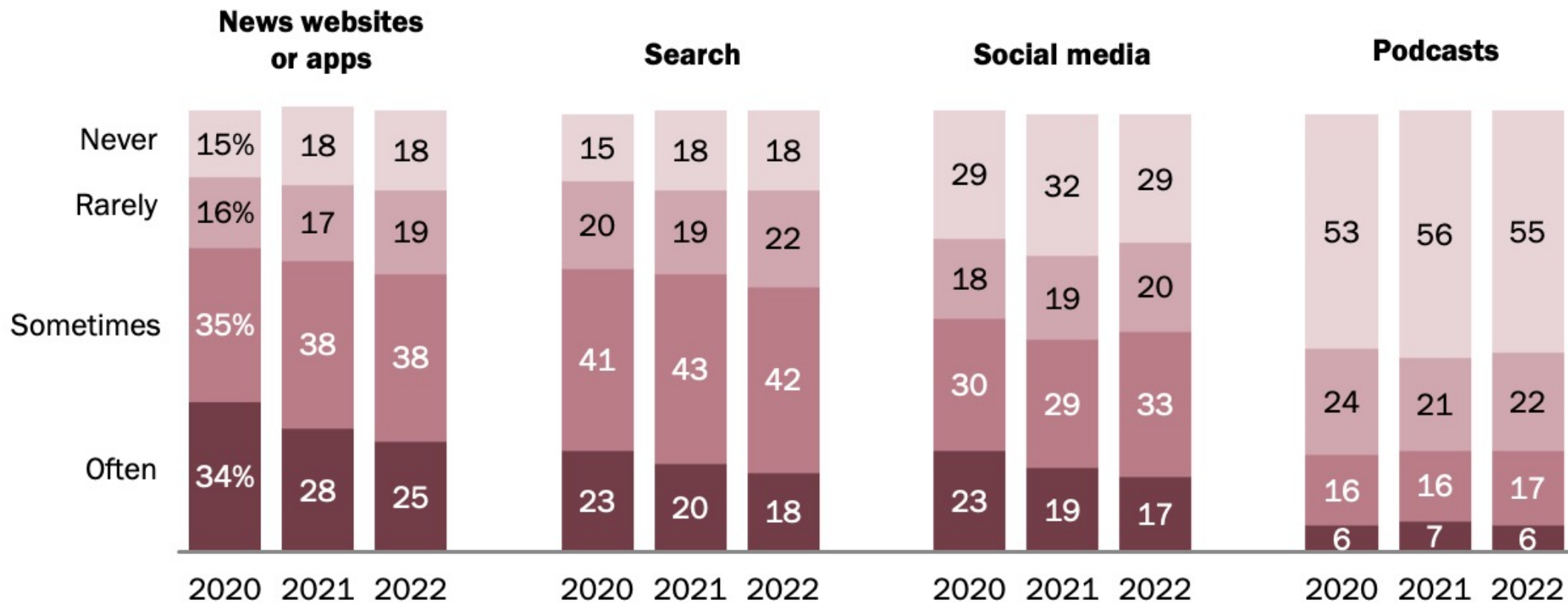
PEW RESEARCH CENTER

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# News consumption across digital platforms

% of U.S. adults who \_\_\_\_ get news from ...

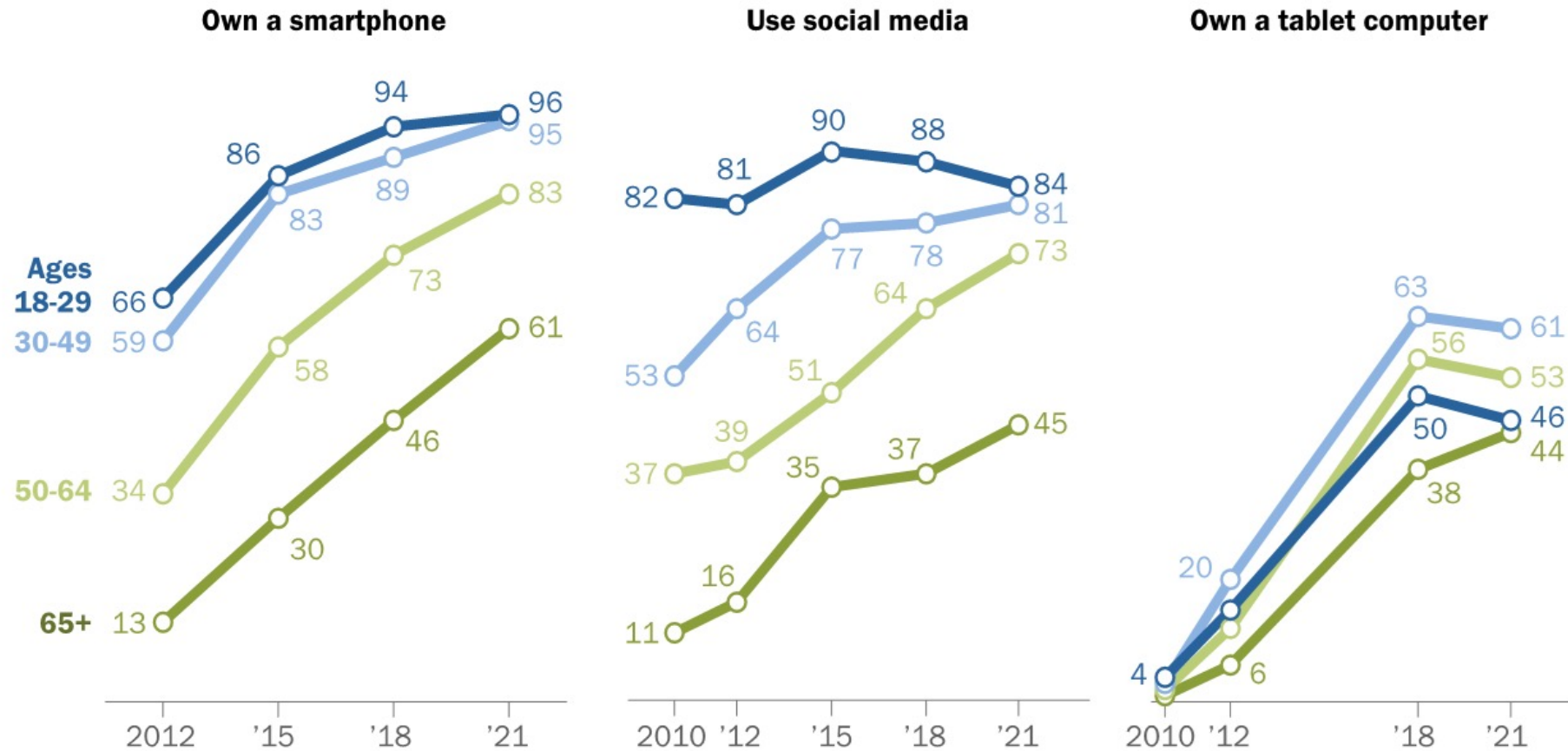


Note: Figures may not add up to 100% due to rounding.  
Source: Survey of U.S. adults conducted July 18-31, 2022.

# Growing trends of smartphone ownership

## Smartphone ownership and social media use among older adults continue to grow

*% of U.S. adults who say they ...*



Note: Respondents who did not give an answer are not shown.

Source: Survey of U.S. adults conducted Jan. 25-Feb. 8, 2021.

# **Interacting with technologies**

# Our cognitive activities are affected by technologies everyday

- How we take notes
- How we retrieve a phone number
- How we go to a new place
- How we find a restaurant in a newly visited area
- How we decide which doctor to go to
- How we cook a new dish
- How we create reminders
- ...

# First example: Internet and reading

- Mixed findings on the impacts

- Length of texts
- Concentration
- Literacy skills

Vs

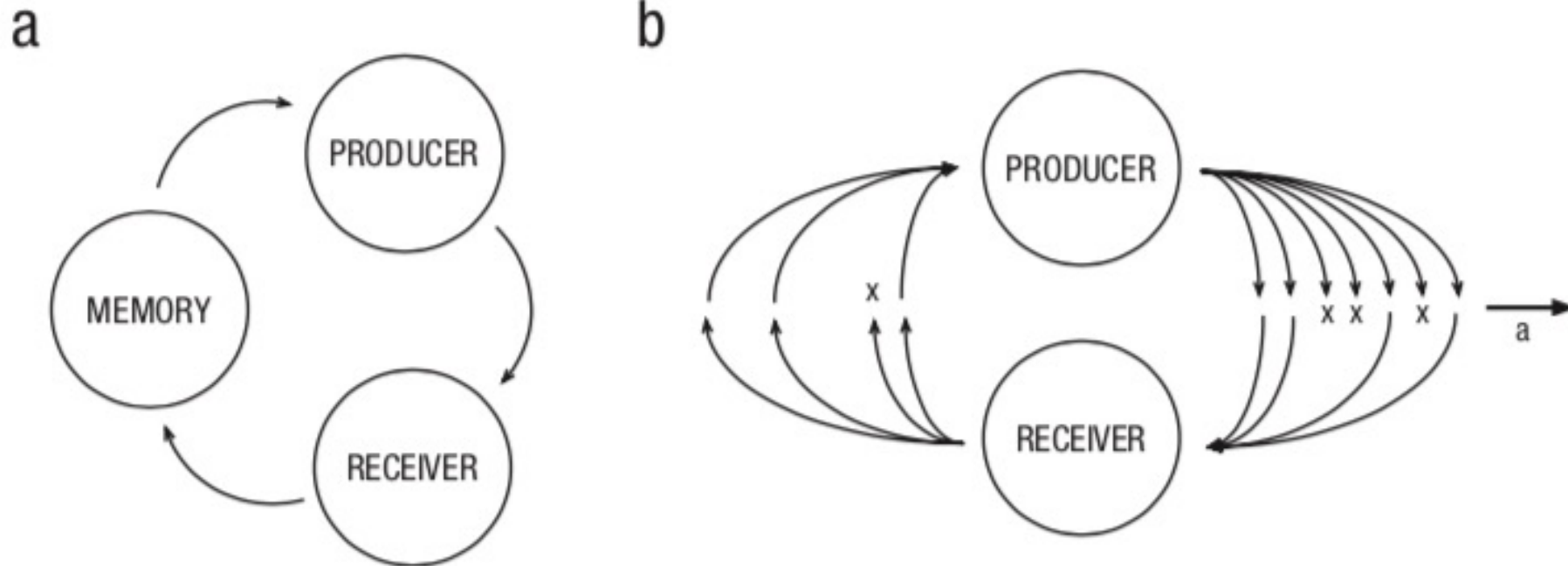
- Speed of reading
- Increasing amounts of reading
- Improved multitasking/skimming

- Different reading practice

Hooper & Herath (2014) BLED 2014 proceeding; Lopez-Escribano, Montesino & Garcia-Ortega (2021) International Journal of Environmental Research and Public Health

# The Evolution of Info Ecosystems

- The cognitive lifecycle of information is accelerated: Produce-> Receive-> Memory



# Herbert Simon's Bounded Rationality



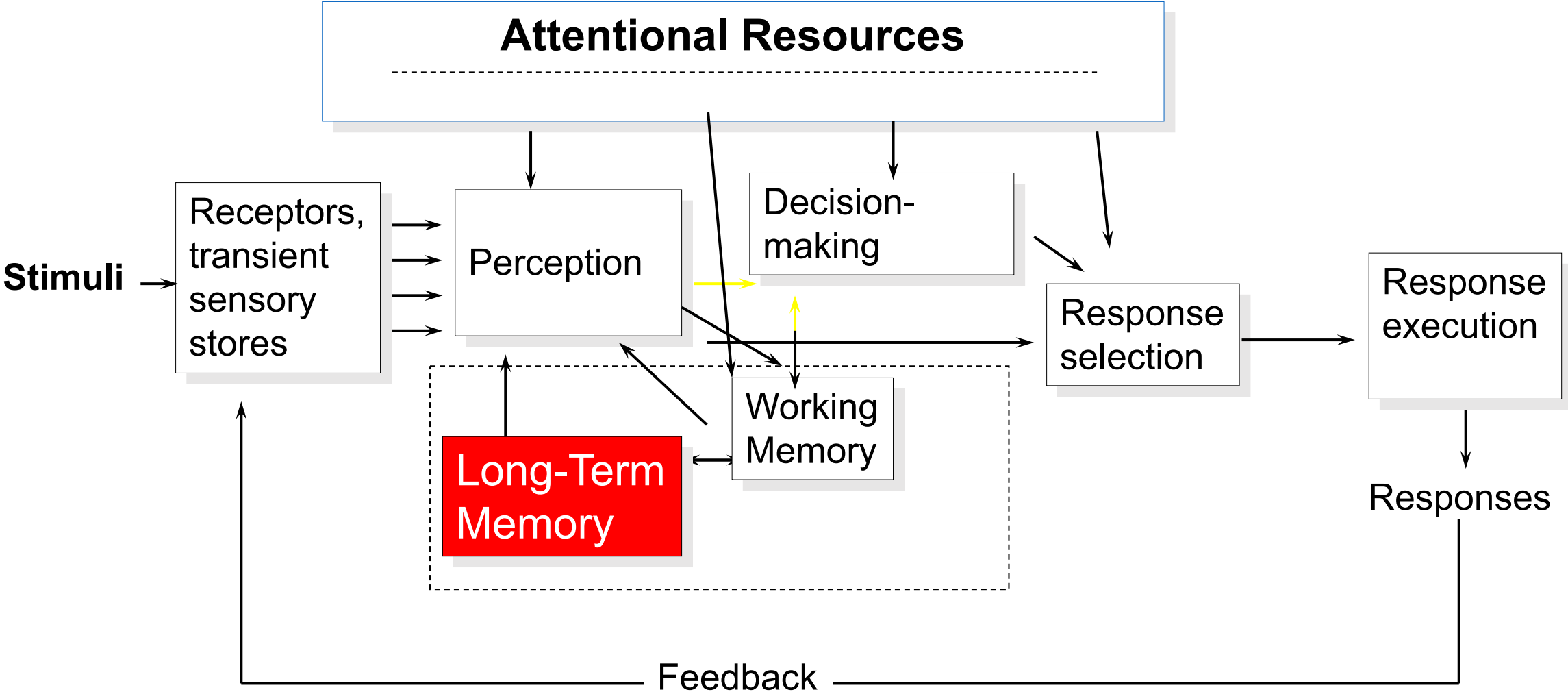
# Cognition in the Wild

- Edwin Hutchins (Cog Sci, UC San Diego)
  - Human cognition in contexts
  - Example: How a pilot work with autopilot systems in a cockpit (Don Norman)
- 
- Hutchins, E. (1995) [How a cockpit remembers its speeds](#). *Cognitive Science*. **19**, 265-288.
  - Hutchins, E & Klausen, T. (1996) [Distributed cognition in an airline cockpit](#). In Y. Engeström and D. Middleton (Eds.) *Cognition and communication at work*. New York: Cambridge University Press. pp. 15-34.



# Long-Term Memory

# A Conceptual Model of Human Minds



# Memory (Long-Term Memory)

- Memory is our internal “representation” of the world
- Long-term memory = Knowledge (representation)

# Memory System (Long Term Memory)

- **Declarative knowledge:** knowledge of facts (“knowing that”).
- **Procedural knowledge:** knowledge of how to do something (“knowing how”).

# Memory System (Long Term Memory)

- **Declarative knowledge:** knowledge of facts (“knowing that”).
  - Episodic memory of particular events or episodes
    - Actor, location, time
  - Semantic memory of facts about the world
    - Language
    - Categorical memory (e.g., animals)
    - Events (schemas)
    - Mental Models
- **Procedural knowledge:** knowledge of how to do something (“knowing how”).

# Processes related to the declarative memory

- Encoding
  - Semantic memory: Reading/Comprehension
    - Surface level (word based): orthography recognition, lexical access (link words to concepts)
    - Textbase (discourse): concept binding through processing “idea units:
    - Situation model: build a coherent story of the current situation

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- Retrieval
  - Recall: ability to produce information from memory
  - Recognition: ability to match information provided to information stored in memory

# Difficulties in memory retrieval

- Retrieval is influenced by encoding (e.g., repeated exposure → fluency → easier to be activated)
- Retrieval may be disrupted by
  - Proactive interference from material learned earlier
  - Retroactive interference from material learned later
  - Absence of retrieval cues (reminders)
  - External reminders → Extended cognition
  - External knowledge → Search Engine



# Distributed Cognition

# Distributed Cognition

- Cognitive processes may be distributed across the members of a social group.
- Cognitive processes may involve coordination between internal and external (material or environmental) structure.
- Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events.

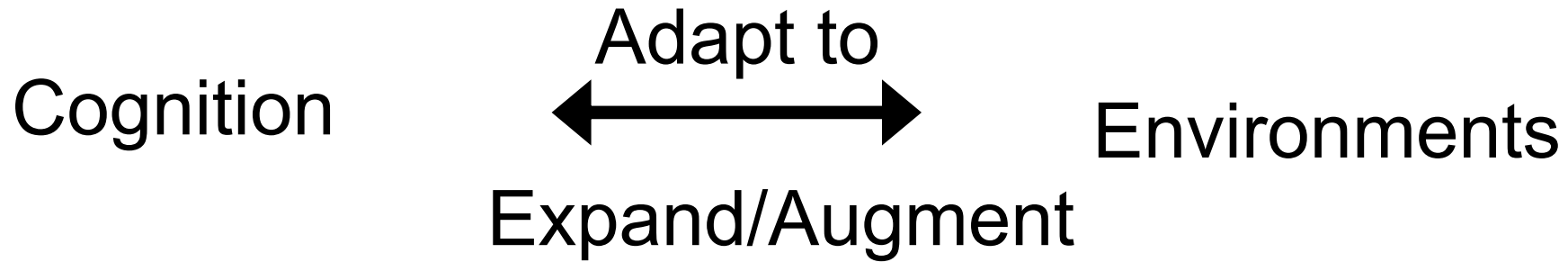
# Group Mind

- Transactive Memory: Other people can be locations of external storage for the individuals.
  - This allows both people to depend on communication with each other for the enhancement of their personal memory stores.
- Wegner, D. M. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behavior* (pp. 185–205). New York, NY: Springer-Verlag.

# Extending Cognition

- *“Humans have tried to offload memory tasks for as long as we have recorded history; in fact, such offloading is why we have the records of history.”* (Nestojko, Finley & Rodieger, 2013: Psych Inquiry)

# Situated Cognition



- We adapt our cognitive practices to the current environments, and we alter the environments to “expand” our ability

# From adapting to coupling

- Technology not only enables “offloading” task demands from our cognitive resources
  - Information storage
  - Navigation
  - Internet search (info retrieval)
- Technology can also team up with the human minds
  - (Permanent) info storage
  - Learning
  - Decision-Making
  - Automation

# Active Externalism

- The human organism is linked with an external entity in a two-way interaction, creating a *coupled system* that can be seen as **a cognitive system** in its own right
- Actively being influenced and actively extracting
- Changes in external features may directly influence internal processing (and vice versa, thru epistemic actions)

# Active Externalism

- Epistemic action vs practical action
- Epistemic action: actions help you interact with the environment, (change the external environment to fit in your internal states) and help you achieve the goal.
- E.g., try to cross the street (goals), look around to avoid cars (epistemic action), walking (practical actions).



# Active Externalism

- E.g., adding pennies, quarters, dimes up (goals)
- put the same kinds of coins together (epistemic action),  
summing up/multiplication/operations (practical actions)

# Forming Coupling System

- General tendency for human to rely on external supports
- However, it's influenced by the time costs of the external supports
- **Embodied cognition:** human minds and body co-evolves with the environments (e.g., using figures to help count not only brain)

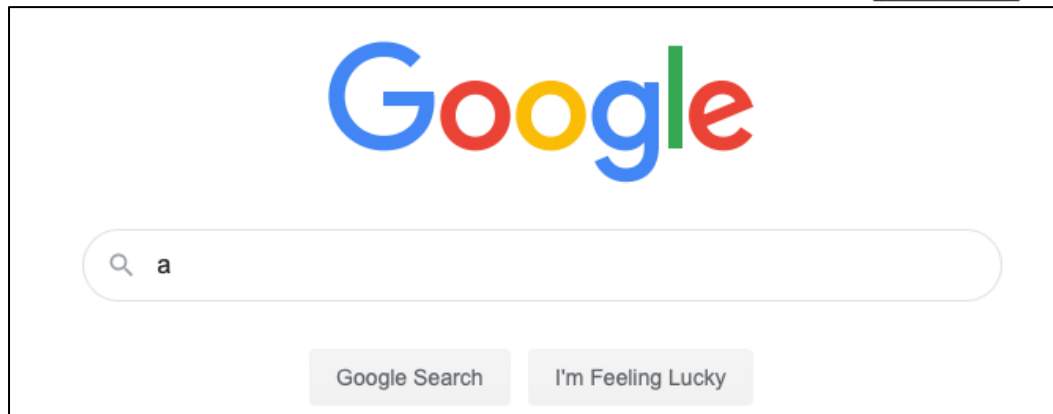
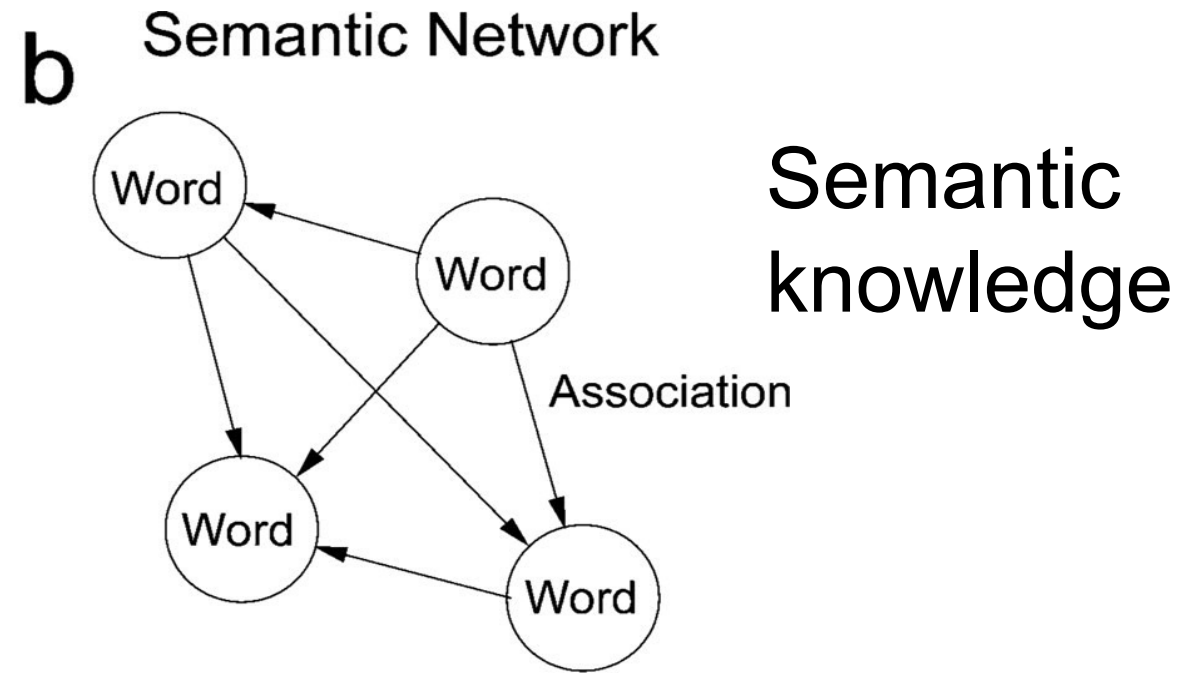
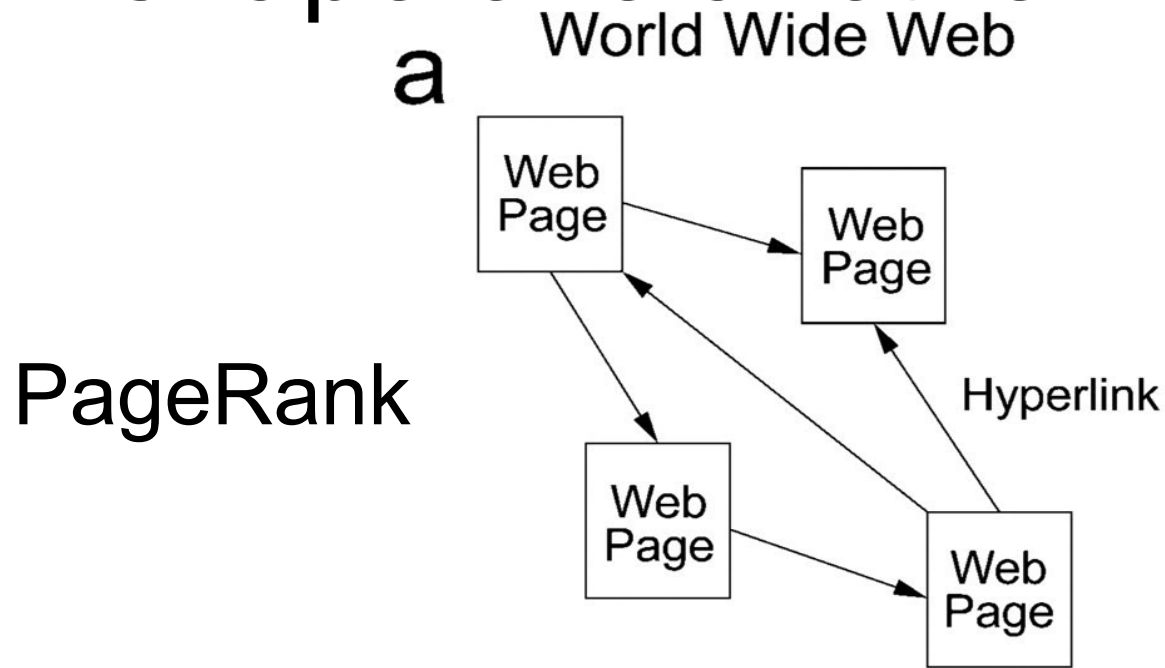
# Coupling System

- Natural environment: quite reliable (e.g., attentional blindness)
- We are not perfectly registered to (coupled with) the external environment
- something needs deliberately registered to our brain (paying attention)
- On a second thought, we take advantages of the stable environment.
- However, the artificial worlds we created (technologies) are not reliable.
- **If the reliability of the technologies just decreased a little bit (1%), the coupled behavior will change (drop) drastically.**

# Co-Evolution

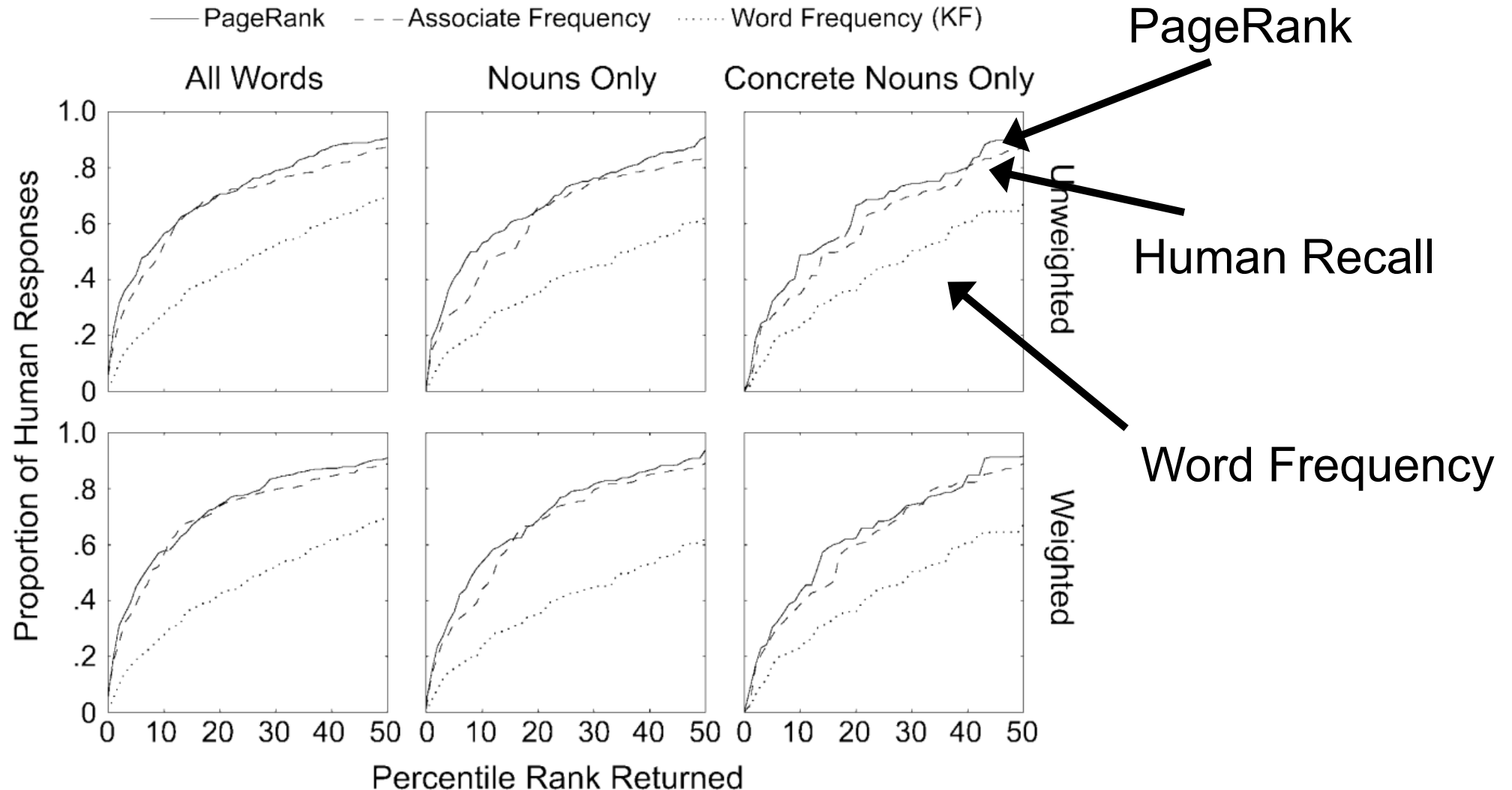
- We increasingly think with computers
- Computers are connected to ever-expanding information resources with previously unimaginable computational power
- Personal information space
- How do we build new representation

# Human knowledge and world knowledge shape one another



Please recall any words that you can think of that starts with "a"?

# Co-Evolution Systems: Minds and WWW



Griffiths, T. L., Steyvers, M., & Firl, A. (2007). Google and the mind: Predicting fluency with PageRank. *Psychological Science*, 18(12), 1069-1076.

# Human memory and digital memory shape one another: Internet Search

- Long-term effects of having info on our fingertips (Google Search)
- Internet, as a transactive memory system
- When people expect to have future access to information
  - Lower rates of recall the actual information
  - Higher recall for where to access it

Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. *science*, 333(6043), 776-778.

# Take Home Messages

- Situated Cognition: Adapts to environment
- Extended Minds
- Embodied cognition
- Coupling system (reliability)
- Effects on human-digital cognition