Human memory: cognitive science foundations

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Westworld,
HBO

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Intended Learning Outcomes

- By the end of this video you will be able to:
  - Make a reasoned argument to answer:
    - Why is some information maintained in memory, while other things are forgotten?
  - Describe the various types of memory, and their timescales

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What is memory? (cognitive science)

- Memory is the capacity to
  - *encode*,
  - *store*, and
  - *retrieve*
  - information after it has been initially encountered.

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The processes of human memory

- Encoding
  - sending information into storage (for future use)
- Storage
  - maintaining information over time
- Retrieval
  - recalling previously encoded information from storage (fill in the blanks)

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The purpose of human memory

- "we have been wrong about memory: it is not a system which is oriented towards the past, but one whose role is to send data to the future, so we may later access it." Stanislas Dehaene
- The brain must estimate which information could be useful in the future, and send that to the storage
- Sending information from a temporary memory state to a longer-term store is called *encoding*
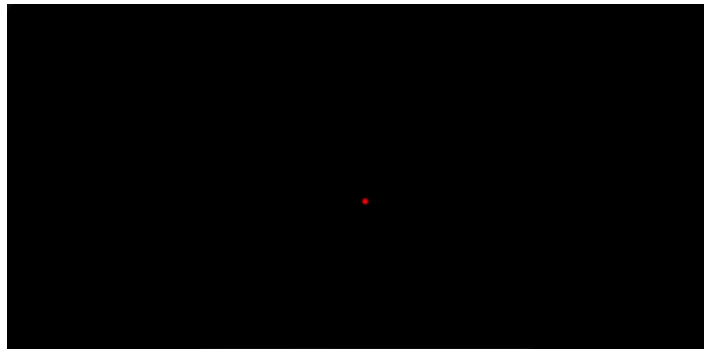
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Sensory memory
– tens to hundreds of milliseconds
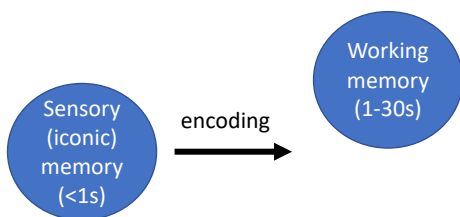
Sensory (iconic) memory (<1s)

Pieter Roelfsema lab
Netherlands Institute of Neuroscience

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Working/short-term memory
– seconds to tens of seconds

Sensory (iconic) memory (<1s) → encoding → **Working memory (1-30s)**

Explicit/conscious

What was the one-time code?

Remember this one-time code
841347

Don't remember this
198322

or this
835768

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Working/short-term memory
– seconds to tens of seconds

Sensory (iconic) memory (<1s) → encoding → Working memory (1-30s) — Explicit/conscious

short-term memory (1-30s) — implicit/unconscious
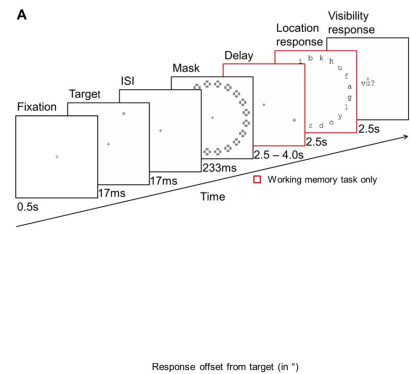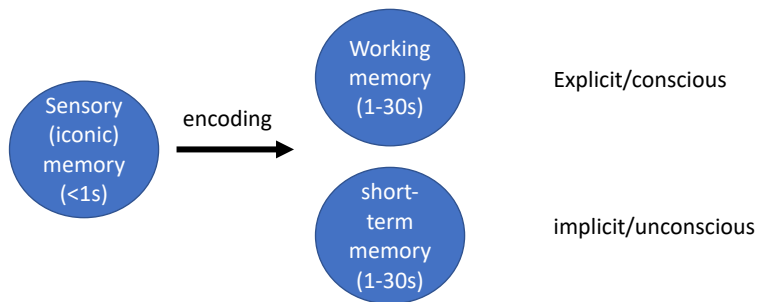
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Long-term memory
– days to decades

Sensory (iconic) memory (<1s) → encoding → Working memory (1-30s)

Explicit/conscious

short-term memory (1-30s)

implicit/unconscious

→ encoding → Long-term memory (up to several decades)
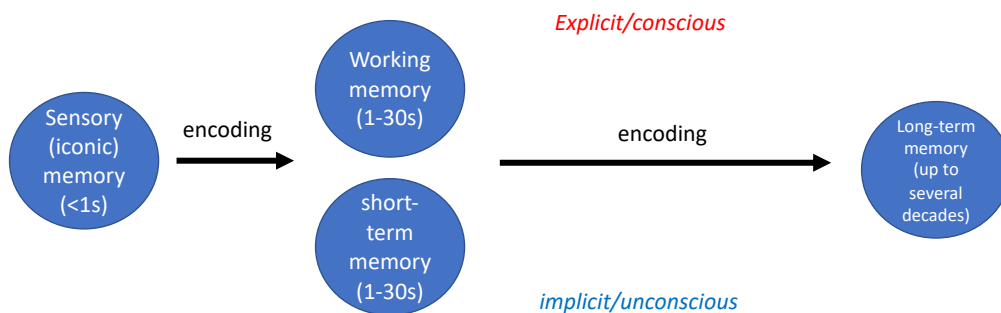
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Quiz

- **Encoding into long-term memory** on Blackboard
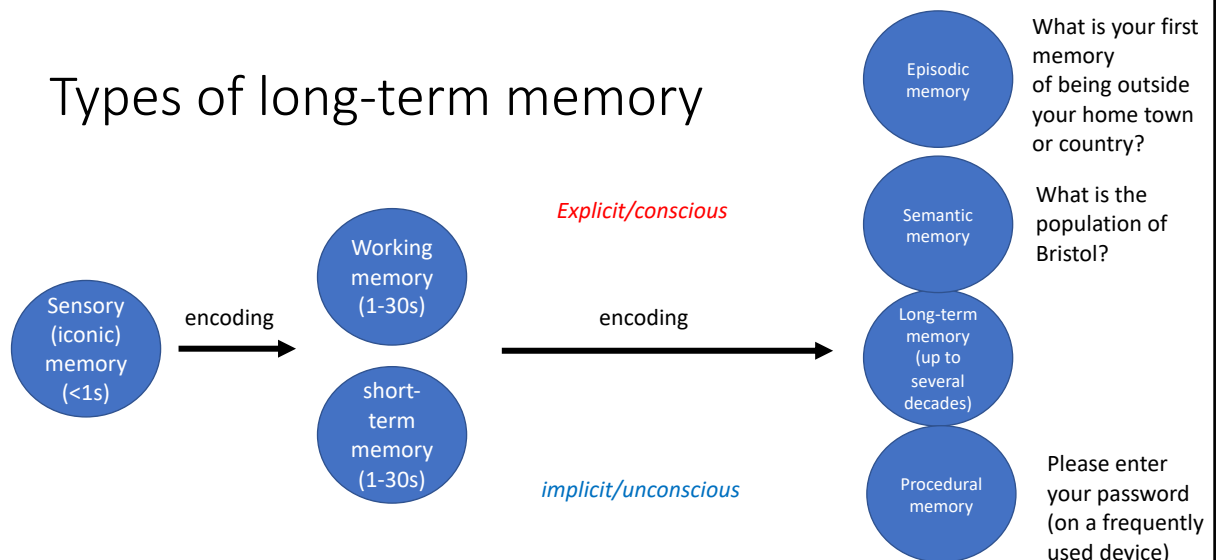- Do you think you are likely to encode the one-time code (presented earlier) in your long-term memory? Please justify your response.

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Types of long-term memory

Episodic memory

What is your first memory of being outside your home town or country?

Explicit/conscious

Semantic memory

What is the population of Bristol?

Sensory (iconic) memory (<1s) → encoding → Working memory (1-30s)

encoding → Long-term memory (up to several decades)

short-term memory (1-30s)

implicit/unconscious

Procedural memory

Please enter your password (on a frequently used device)

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Recap

- Memory can be divided in several ways
  - by timescale
    - sensory, short-term/working, long-term
  - by the involvement of consciousness
    - explicit,implicit
  - by amount of generalization from original experience
    - episodic,semantic
- Memory *may* be thought of as a future-oriented function
  - which information should I make available to the future *(i.e. encode)?*

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Next up: how we learn (cognitive science)

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Still curious? Read more about the topic that interested you the most (optional)

- Sensory, short- and long-term memory
  - Atkinson, Richard C., and Richard M. Shiffrin. "Human memory: A proposed system and its control processes." In *Psychology of learning and motivation*, vol. 2, pp. 89-195. Academic press, 1968.
- Sensory/iconic memory
  - Sperling, George. "The information available in brief visual presentations." *Psychological monographs: General and applied* 74, no. 11 (1960): 1.
  - Teeuwen, Rob RM, Catherine Wacongne, Ulf H. Schnabel, Matthew W. Self, and Pieter R. Roelfsema. "A neuronal basis of iconic memory in macaque primary visual cortex." *Current Biology* 31, no. 24 (2021): 5401-5414.
- Working memory
  - Baddeley, Alan. "Working memory." *Science* 255, no. 5044 (1992): 556-559.
- Unconscious short-term memory
  - Trübutschek, Darinka, Sébastien Marti, Henrik Ueberschär, and Stanislas Dehaene. "Probing the limits of activity-silent non-conscious working memory." *Proceedings of the National Academy of Sciences* 116, no. 28 (2019): 14358-14367
- Episodic memory
  - Tulving, Endel. "Episodic memory: From mind to brain." *Annual review of psychology* 53, no. 1 (2002): 1-25.
- Semantic memory
  - Renoult, Louis, Muireann Irish, Morris Moscovitch, and Michael D. Rugg. "From knowing to remembering: the semantic–episodic distinction." *Trends in cognitive sciences* 23, no. 12 (2019): 1041-1057.
- Procedural memory
  - Cohen, Michael D., and Paul Bacdayan. "Organizational routines are stored as procedural memory: Evidence from a laboratory study." *Organization science* 5, no. 4 (1994): 554-568.
- The sad but incredible case of Clive Wearing, the accomplished musician with severe amnesia
  - https://www.youtube.com/watch?v=Vwigmktix2Y&ab_channel=CasperH.

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