

Simulation in VTS

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요약 : 자율적인 행위자들로서 서로 영향을 끼치며 상호작용하는 선박들을 관제하는 VTSO는 불확실성으로 인한 위험을 극복하기 위해서는 적극적으로 상황을 파악하여 최선의 의사결정을 하여야 한다. VTSO는 항상 미래의 상황을 예측하면서 업무를 수행하여야 하는데 이때 VTSO에게 요구되는 것이 바로 시뮬레이션 능력이다. 시뮬레이션은 삽화기억의 구성적 성격을 활용하는 것으로서 삽화기억의 메커니즘은 미래 계획에도 그대로 활용된다. 본고에서는 반사실적 사고가 시뮬레이션에 어떻게 작동되는가를 살펴보고, VTS 상황에 이를 적용하여 보았다. 특히 반사실적 사고와 시뮬레이션을 통해서 VTSO가 업무역량을 향상시키기 위해서 어떻게 학습하여야 하는가를 고찰하였다.

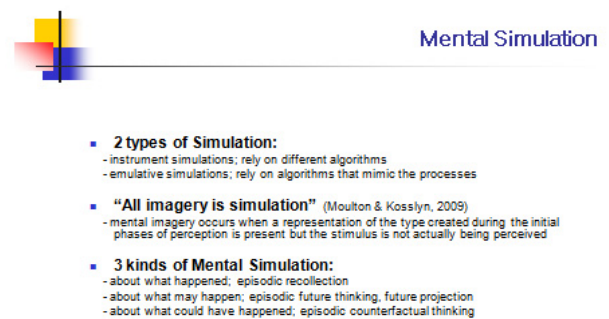
핵심용어 : VTS, Simulation, Counterfactual Thinking, Mirror Neurons, Cognition, Constructive Episodic Simulation Hypothesis, Recognition-Primed Decision Making, Scene Construction, Self-Projection, Default Mode Network, Narratives, Self-focused Counterfactual Thought, Internal Simulation of Conversation



SIMULATION in VTS

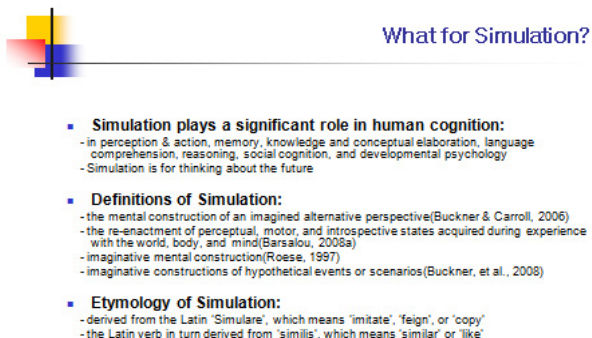
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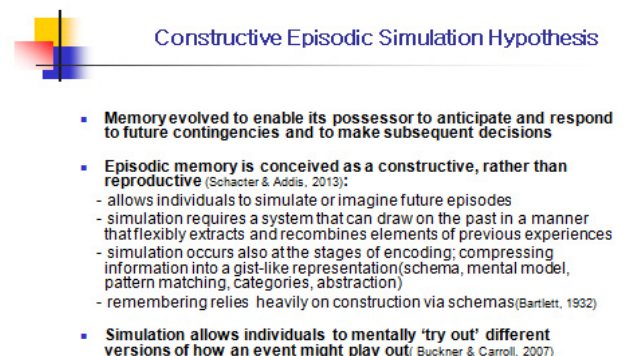
Mental Simulation

- 2 types of Simulation:
 - instrument simulations; rely on different algorithms
 - emulative simulations; rely on algorithms that mimic the processes
- "All imagery is simulation" (Moulton & Kosslyn, 2009)
 - mental imagery occurs when a representation of the type created during the initial phases of perception is present but the stimulus is not actually being perceived
- 3 kinds of Mental Simulation:
 - about what happened; episodic recollection
 - about what may happen; episodic future thinking, future projection
 - about what could have happened; episodic counterfactual thinking



What for Simulation?

- Simulation plays a significant role in human cognition:
 - in perception & action, memory, knowledge and conceptual elaboration, language comprehension, reasoning, social cognition, and developmental psychology
 - Simulation is for thinking about the future
- Definitions of Simulation:
 - the mental construction of an imagined alternative perspective(Buckner & Carroll, 2006)
 - the re-enactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind(Barsalou, 2008a)
 - imaginative mental construction(Roesa, 1997)
 - imaginative constructions of hypothetical events or scenarios(Buckner, et al., 2008)
- Etymology of Simulation:
 - derived from the Latin 'Simulare', which means 'imitate', 'feign', or 'copy'
 - the Latin verb in turn derived from 'similis', which means 'similar' or 'like'

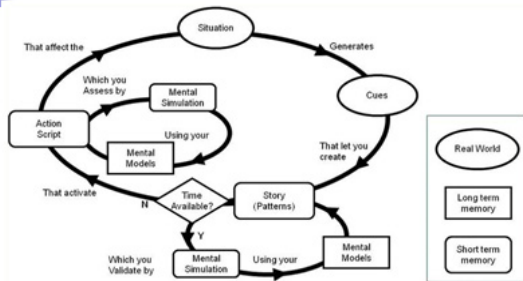


Constructive Episodic Simulation Hypothesis

- Memory evolved to enable its possessor to anticipate and respond to future contingencies and to make subsequent decisions
- Episodic memory is conceived as a constructive, rather than reproductive (Schacter & Addis, 2013):
 - allows individuals to simulate or imagine future episodes
 - simulation requires a system that can draw on the past in a manner that flexibly extracts and recombines elements of previous experiences
 - simulation occurs also at the stages of encoding; compressing information into a gist-like representation(schema, mental model, pattern matching, categories, abstraction)
 - remembering relies heavily on construction via schemas(Bartlett, 1932)
- Simulation allows individuals to mentally 'try out' different versions of how an event might play out(Buckner & Carroll, 2007)

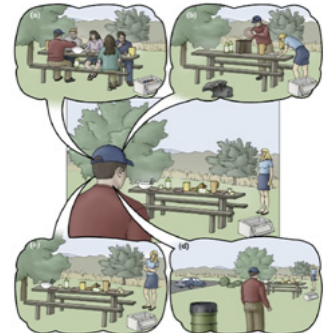
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Recognition-primed Decision Making Model



Forms of Self-Projection

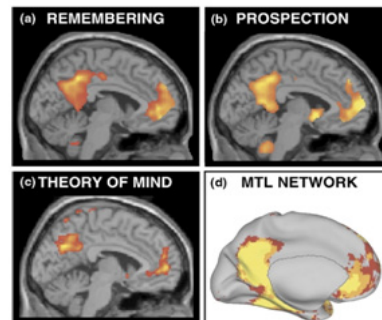
- (a) remembering:
- simulating past
- (b) prospection:
- simulating a possible future event
- (c) theory of mind:
- conceiving another person's perspective
- (d) navigation:
- mapping the environment



Counterfactual Thinking

- Counterfactual thoughts are mental representations of alternatives to past events, actions, or states
- Undoing the past and considering alternatives ('what if-') is required for counterfactual thinking
- Counterfactual thinking demands a more abstract construal level than factual thinking condition (Kray, et al., 2010)
- Counterfactual thinking creates meaning from 'what might have been' to 'what must have been'
- mentally constructing counterfactual worlds actually increases the perception that life's actual path was meant to be
- by reflecting on how knowledge, relationships, and events form one's past are interrelated, personal meaning emerges (Leontiev, 2005)
- Upward counterfactuals: elicits feelings of regret & disappointment
- Downward counterfactuals: elicits feelings of relief & satisfaction

Brain Activation during 3 Forms of Self-Projection



Core Brain Network

- Memory is not to reproduce past experiences, but rather to recombine them in order to entertain episodic hypothetical thoughts
- There is a shared brain network that supports diverse forms of self-projection (mentally project ourselves from the immediate environment onto the alternative situations):
 - thinking about the future (prospection), remembering the past (autographical memory), conceiving the viewpoint of others (theory of mind), navigation (requires imaging one's current position, the desired endpoint, and possible routes using both egocentric and allocentric perspectives)
 - hippocampus, posterior cingulate, retrosplenial cortex, inferior parietal lobe, medial prefrontal cortex, lateral temporal cortex
- Scene Construction (Hassabis & Maguire, 2007):
 - the process of mentally generating and maintaining a complex and coherent scene or event
 - mental simulation often unfolds in one's mind as an imagined scene with rich visual and spatial content

Default Mode Network (DMN)

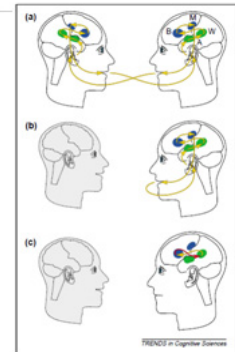
- Default modes of cognition are characterized by a shift from perceiving the external world to internal modes of cognition that simulate worlds that are separate from the one being directly experienced (Reichle, et al., 2001)
- DMN is associated with intrinsic processes like mind wandering and self projection
- DMN is remarkably similar to the core brain network
- DMN is the core brain system associated with spontaneous cognition
- People have a strong tendency to engage the DMN during moments when they are not otherwise occupied by external tasks

Wandering Mind & Default Network

- If people are left to think for themselves undisturbed, without focusing on the immediate environment, their minds wander
- Brain imaging studies show that mind-wandering activates a widespread network in the brain (default mode network)
- Brain imaging reveals that remembering the past and imagining the future activate a common core network, which indeed overlaps considerably with the default network
- Language circuit (enabling the communication of events that are not present in the here-and-now) is also contained within the default network (Corballis, 2013)
- The fundamental function of the default network is to facilitate flexible self-relevant mental explorations- simulations- that provide a means to anticipate and evaluate upcoming events before they happen
- People typically focus on the future and engage in extensive autobiographical planning during mind-wandering episodes (Baird, et al., 2011)

Internal Simulation of Conversation

- (a) usual conversation
- (b) listen & respond to one's own talk
- (c) inner conversation/verbal thinking
 - Thinking is restrained speaking or acting (Alexander, 1966)
 - Thinking (conscious thought) is simulation



Metaphor and Simulation

- Metaphor is not only a figure of speech, but also the way in which the conceptual system organizes abstract concepts in terms of concrete experiences
- In cognitive linguistics, mental simulation has been proposed as a comprehension mechanism for figurative language and conceptual metaphors
- People understand metaphors by creating an imaginative simulation of their bodies in action that mimics the event alluded to by the metaphor (Gibbs & Matlock, 2007)
- The listener assumes a perspective in the scene and unconsciously simulates it.
 - "The road runs through the valley."
 - "Your relationship was moving along in the right direction."
 - "chewing on an idea" / "breaking off the relationship" / "coughing up a secret"

Conscious Thought as Simulation (Hesslow, 2002)

- Behaviors can be simulated by activating motor structures with suppressing its execution
- Perception can be simulated by internal activation of sensory cortex
- The anticipation mechanism will ensure that most actions are accompanied by probable perceptual consequences, so that during normal behavior, we will always, 'in our thoughts', be a few steps ahead of the actual events
- Simulation makes possible the experience of an inner world (consciousness)

Simulation in VTS

- VTSO cannot learn solely by trial-and-error due to the catastrophic costs of severe accidents
- Performance-promoting learning may draw on imagination(counterfactual thinking) rather than experience per se
- Individuals are more likely to learn when they have responded to an event with **upward-directed, self-focused counterfactual thoughts**:
 - the lesson is constructed by substituting a controllable future action and future outcome
- Episodic memory enables past information to be used flexibly in simulating alternative future scenarios
- When we simulate an upcoming future scenario, we need to encode and store that simulation for later use in order to maximize its adaptive effect on future behavior (Ingvar, 1985)

Narratives & Life Stories

- People provide their lives with unity and purpose by constructing internalized and evolving narratives of the self (McAdams, 2011)
- **Identity itself takes the form of a story**: the core of a person's identity derives from the capacity to keep a particular narrative going (Giddens, 1991)
- Parents encourages children to talk about their personal experiences, and to share personal events
- Through midlife, we become more concerned with the 'endings' of our life stories
- Autographical memory helps to locate and define the self within an ongoing life story
- The core brain network could also play a role in narrative processing:
 - brain areas associated with story-processing are similar to those involved in autobiographical memory and theory of mind (Mar, 2004)
 - narratives offer models or simulations of the social world via abstraction and compression (Mar, 2004)