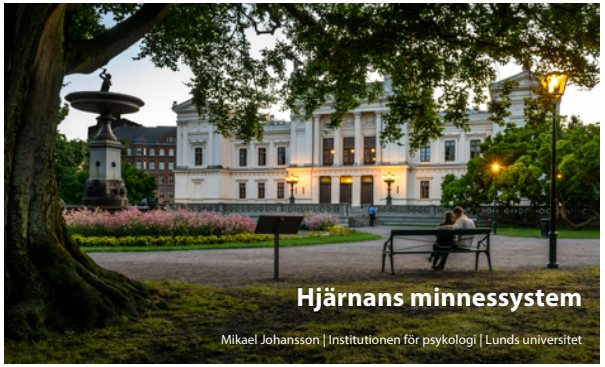
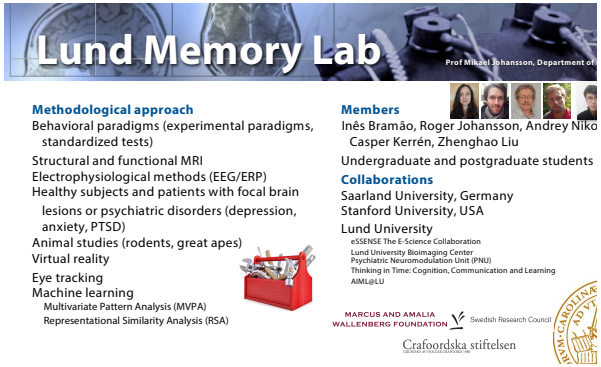
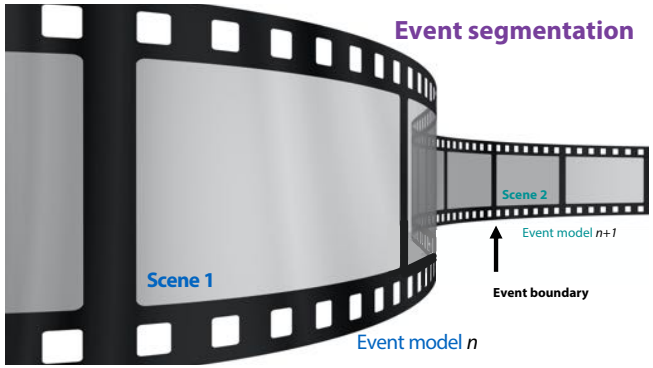
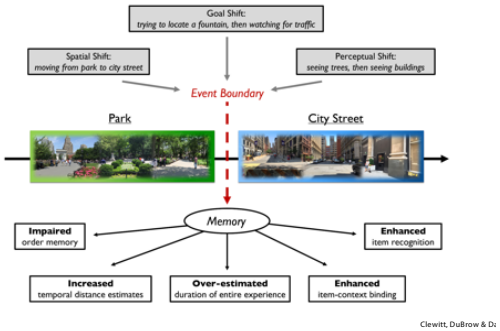




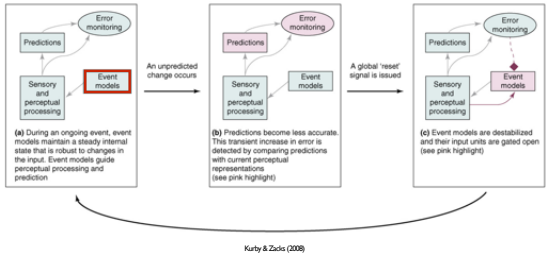
Minne och verklighet

Konstruktion och rekonstruktion

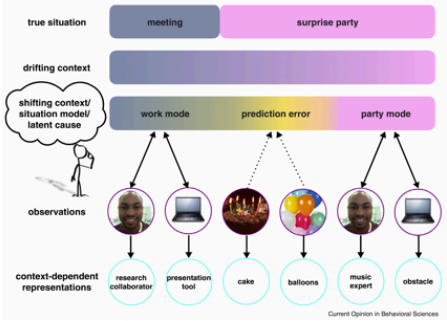




Event Segmentation Theory



Kurby & Zacks (2008)



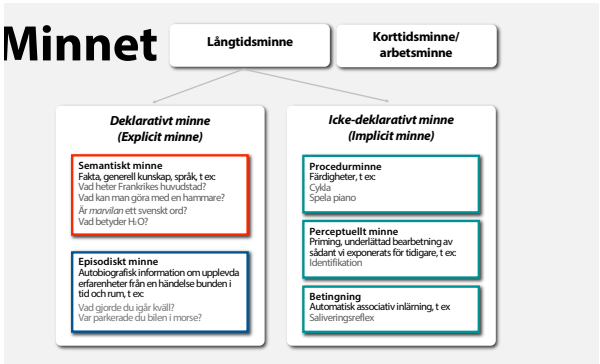
DuBrow et al. (2017)

Basic memory components

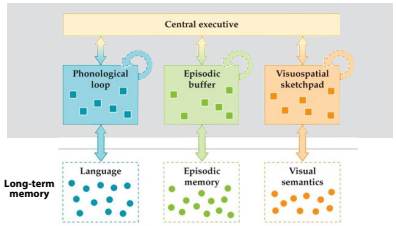
Inkodning → **Lagring** → **Framplockning**

Atkinson & Shiffrin (1968)

Minnet

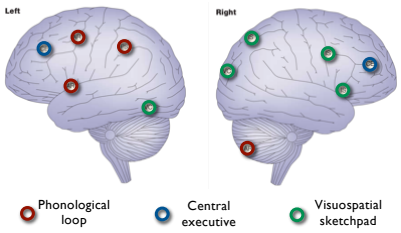


Working Memory

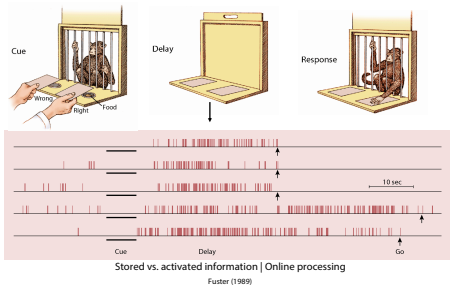


Baddeley & Hitch (1974), Baddeley (2000,2003)

Neuroimaging results



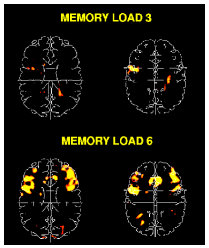
PFC: Delay-selective activity



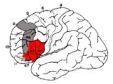
Stored vs. activated information | Online processing

Fuster (1989)

Working memory – Sternberg task



Low memory-demand activity
Ventrolateral Prefrontal Cortex

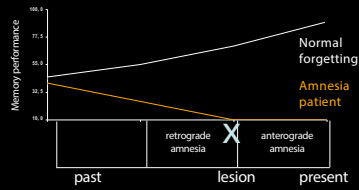


High memory-demand also activates
Dorsolateral Prefrontal Cortex

Rypmaet al. (1999)

Memory and the Brain - Amnesia

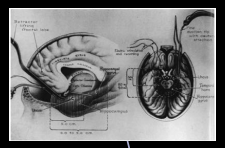
Deficits in memory as a function of brain injury or deterioration, disease, or psychological trauma



Henry Molaison (H.M.)

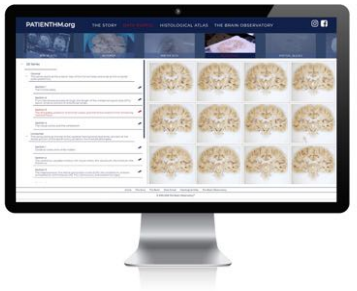
Milner & Scoville (1957)

Medial Temporal Lobe (MTL)

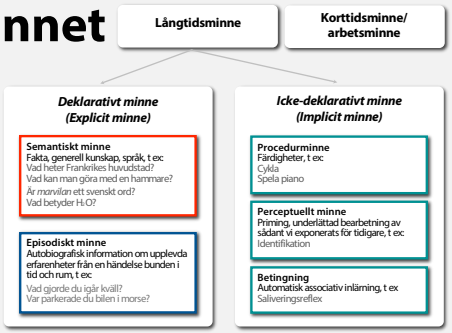


- Anterior Hippocampus
- Amygdala
- Perirhinal/entorhinal cortex

Project H.M. 2009

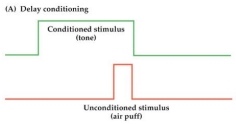


Minnet



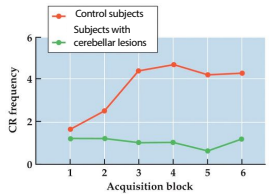
Nondeclarative memory

Conditioning



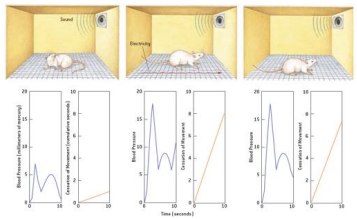
Nondeclarative memory

Eyeblink conditioning

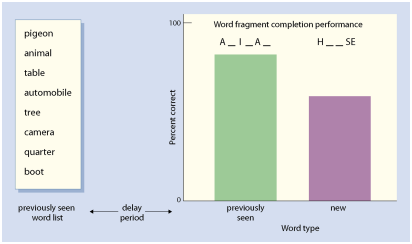


Nondeclarative memory

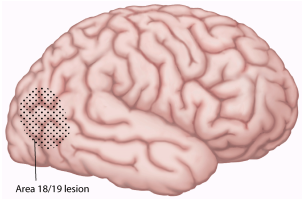
Fear conditioning



Perceptual priming

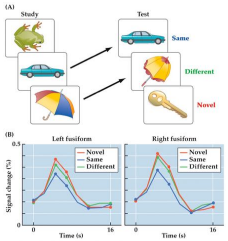


Perceptual representation system



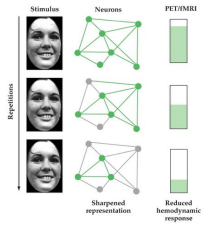
Patient M.S.
Normal declarative/explicit memory
No perceptual priming!

Repetition suppression



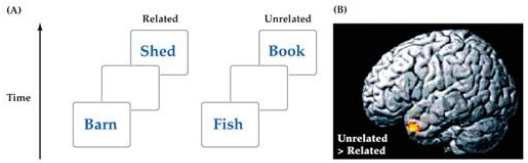
Koutstaal et al. (2001)

Sharpening theory



e.g. Henson & Rugg (2003); O'Reilley & Norman (2001)

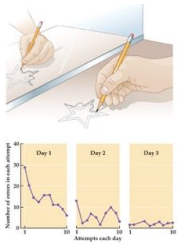
Semantic priming



Rossell et al. (2003)

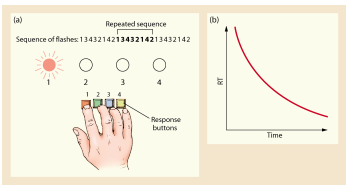
Nondeclarative memory

Procedural memory
Mirror drawing task

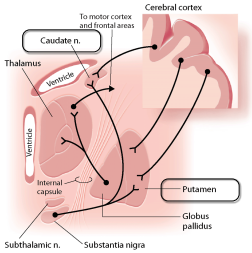


Nondeclarative memory

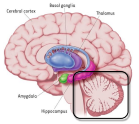
Procedural memory
Sequence learning



Nondeclarative memory

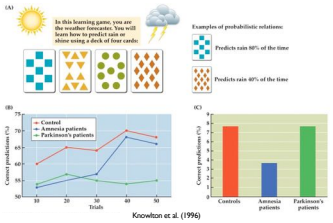


Procedural memory
Basal ganglia
Cortical-subcortical loop
Motor control functions



Nondeclarative memory

Cognitive skill learning



Knowlton et al. (1996)

Minnet

Långtidsminne

Korttidsminne/ arbetsminne

Deklarativt minne (Explicit minne)

Semantiskt minne
Fakta, generell kunskap, språk, t ex:
Vad heter Frankrikes huvudstad?
Vad kan man göra med en hammare?
Är manvilan ett svenskt ord?
Vad betyder H_2O?

Episodiskt minne
Autobiografisk information om upplevda erfarenheter från en händelse bunden i tid och rum, t ex:
Vad gjorde du igår kväll?
Var parkerade du bilen i morse?

Icke-deklarativt minne (Implicit minne)

Procedurminne
Färdigheter, t ex:
Cykla
Spela piano

Perceptuellt minne
Priming, underlättad bearbetning av sådant vi exponerats för tidigare, t ex:
Identifikation

Betingning
Automatisk associativ inlärning, t ex
Salliveringsreflex

Episodic *vs* semantic memory

Characteristics of episodic memory

"Its dependence on a special kind of awareness that all healthy adults can identify. It is the type of awareness experienced when one thinks back to a specific moment in one's personal past and consciously recollects some prior episode or state as it was previously experienced." (Wheeler, Stuss, & Tulving, 1997, p. 333).

Autonoetic awareness
First person perspective
Mental time travel - "What, where, when"

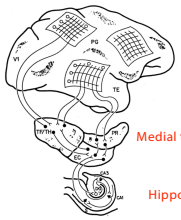
?

Semantic memory

Noetic awareness; acontextual

Cortical reinstatement theory

Cortical modules
Visual
Auditory
Somatosensory
Visuospatial
Emotional
Polymodal

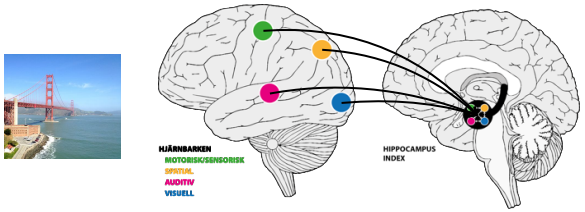


Medial temporal lobe (MTL)

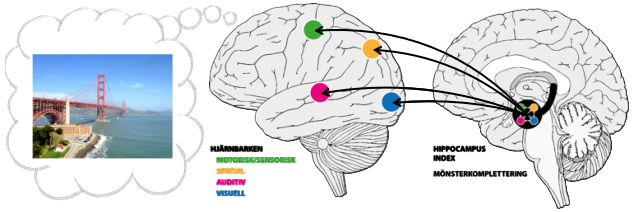
Hippocampus

Squire & Zola-Morgan (1991)

‹odning av en händelse



Framplockning av en händelse



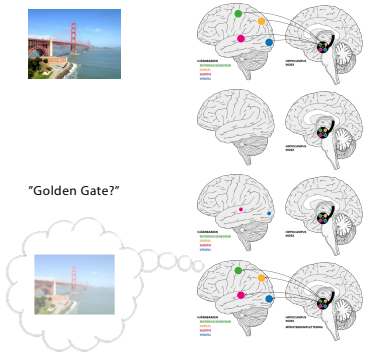
Inkodning

Aktivering

Framplockning

Ledtråd
Reaktivering

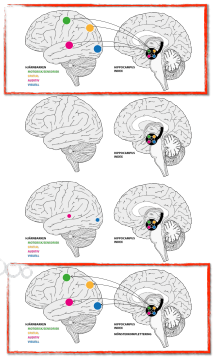
"Golden Gate?"



Danker & Anderson (2010); Rissman & Wagner (2012); Rugg, Johnson, Park, & Uncapher (2008); Xue (2018)

kodning

ktivering



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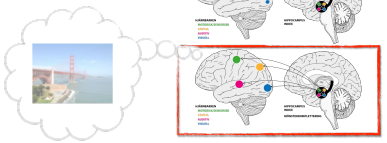
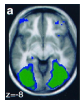
eaktivering

"Golden Gate?"



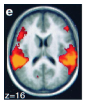
Inkodning

hund



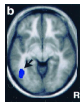
"Vov"

hund



Framplockning

"hund?"



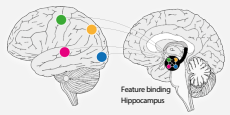
"hund?"

Wheeler et al., (2000). PNAS

Decoding mental states

Multivariate pattern analysis (MVPA)

Perception



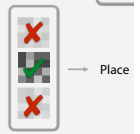
Feature binding
Hippocampus

Face

Place

Object

Classifier training and cross-validation on independent data



Place

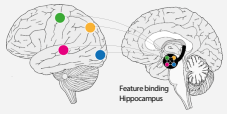
Lund

oding memory reactivation

ltivariate pattern analysis (MVPA)

Classifier training and cross-validation on independent data

oding



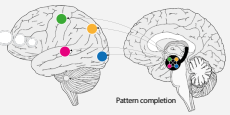
Feature binding
Hippocampus

Face

Place

Object

ieval

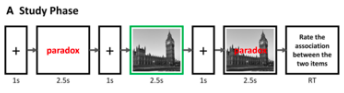


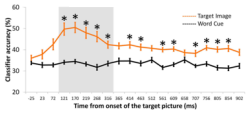
Pattern completion

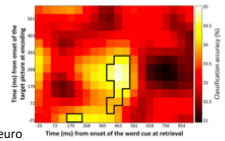
Place

Lund Memory Lab

Decoding memory retrieval



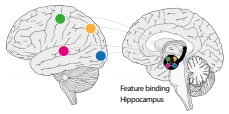




Bramão & Johansson (2018) eNeuro

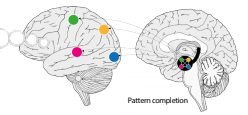
Mental Time Travel

Inkodning



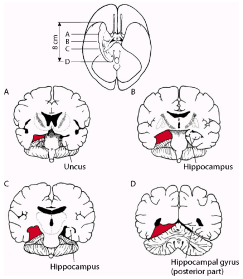
Feature binding
Hippocampus

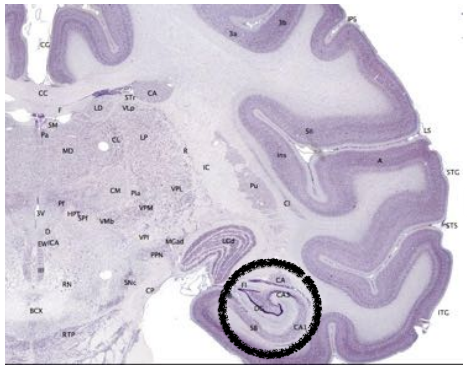
Framplockning



Pattern completion

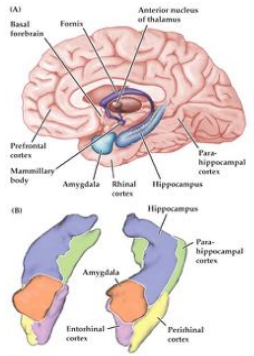
H.M.





Hippocampus
Feature binding
Pattern separation
Pattern completion

?



coding

tivation

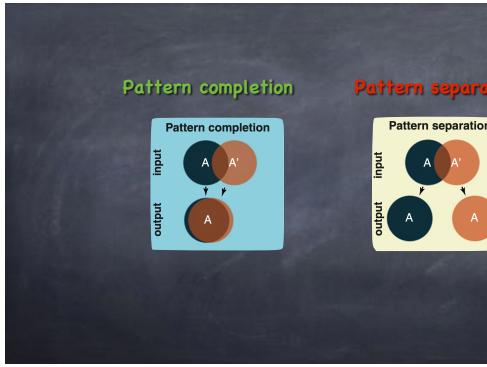
Feature binding
Pattern separation

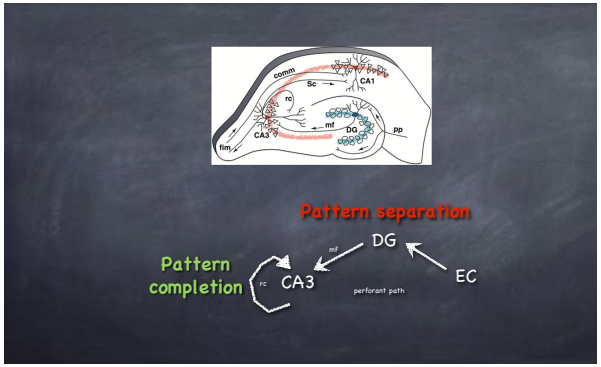
trieval

"Golden Gate?"

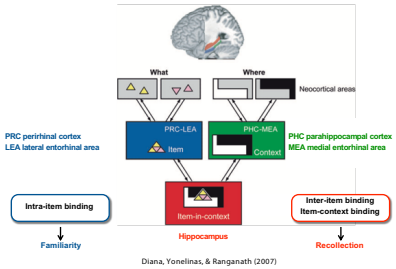
ie
activation

Pattern completion

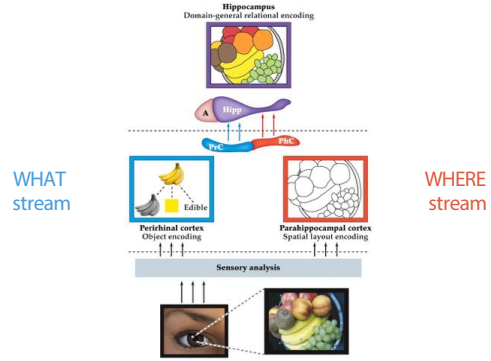




MTL Memory Model



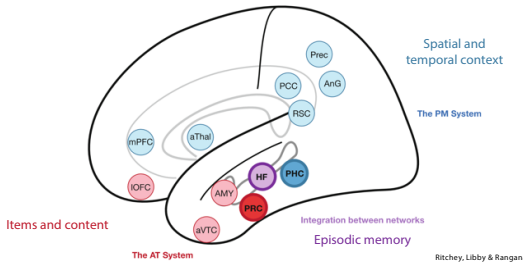
Diana, Yonelinas, & Ranganath (2007)



WHAT stream

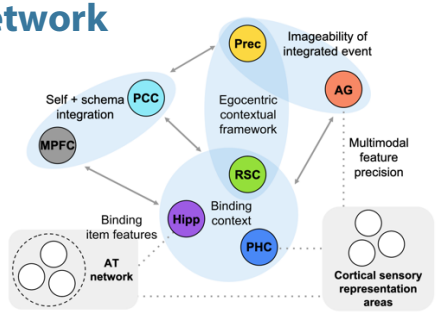
WHERE stream

The PMAT framework



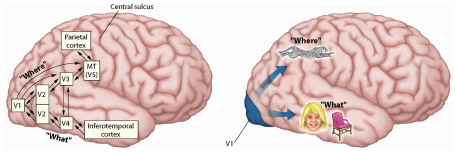
Ritchey, Libby & Rangan

PM network

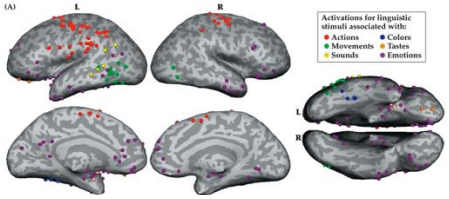


Cooper (2020) TICS

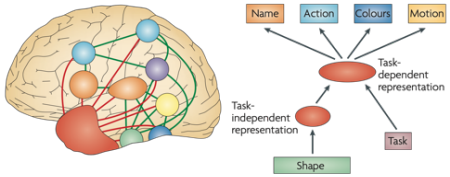
AT network Semantic memory



Multiple property models



Semantic memory



Patterson et al. (2007). Nat Rev Neurosci

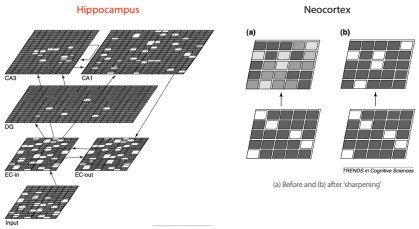
Complementary Learning Systems Framework

Two incompatible goals		Remember specifics	Extract generalities
Example:		*Where is car parked?*	*Best parking strategy?*
Need to:		Avoid interference	Accumulate experience
Solution:	(1)	Separate representations (keep days separate)	Overlapping representations (integrate over days)
	(2)	Fast learning (encode immediately)	Slow learning (integrate over days)
	(3)	Learn automatically (encode everything)	Task driven learning (extract relevant stuff)
System:		Hippocampus	Neocortex

O'Reilly & Norman (2002) TICS

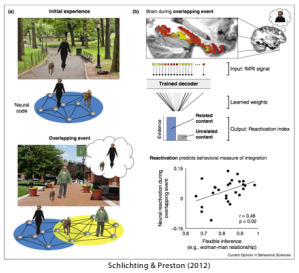
TRENDS in Cognitive Sciences

Complementary Learning Systems Framework

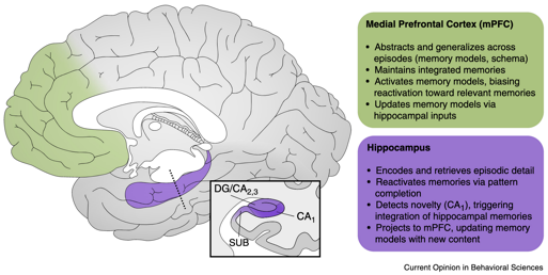


O'Reilly & Norman (2002) TICS

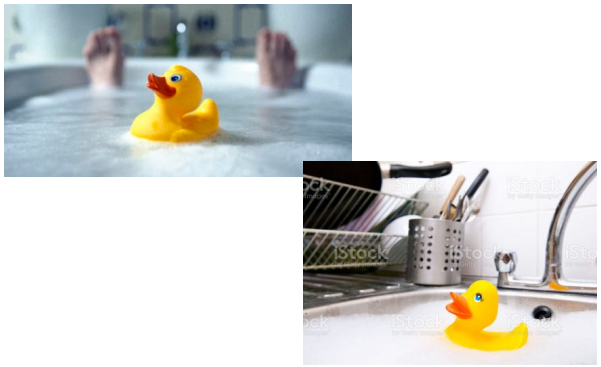
Memory integration



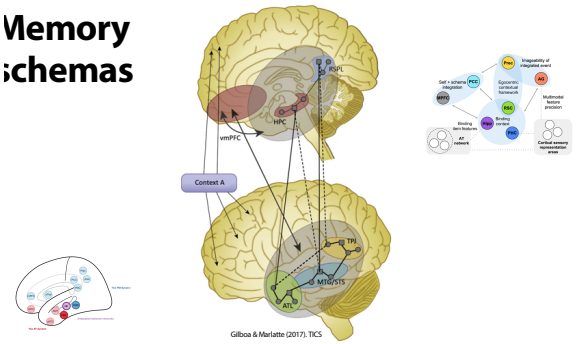
Schlichting & Preston (2012)



Schlichting & Preston (2015). Current Opinion in Behavioral Sciences



Memory schemas



Gilboa & Marlatte (2017). TICS

PFC-MTL Mnemonic Control Mechanisms

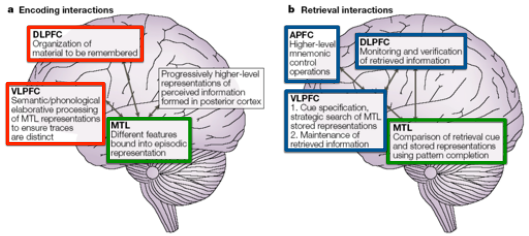
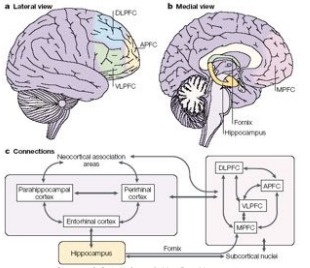


Figure 6 | **Summary of principal interactions between prefrontal cortex (PFC) and medial temporal lobe (MTL) in recollection.**

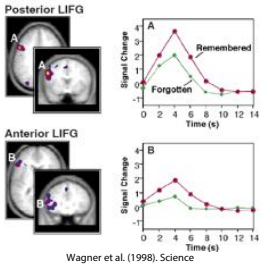
Simons & Spiers (2003). Nat Rev Neurosci

PFC-MTL interactions



Simons & Spiers (2003). Nat Rev Neurosci

Subsequent memory effects in PFC



Wagner et al. (1998). Science

Retrieval Mode

A tonically maintained state (or 'set') entered when there is a need to engage in a particular type of retrieval (e.g. episodic)

Neural correlates should:

- be time-locked to task onset and maintained throughout the task
- be revealed by contrasts between classes of tasks (episodic vs. non-episodic)
- be task invariant (i.e. irrespective of episodic task)

Tulving 1983; Rugg & Wilding , 2000

Design

Encoding

bike
horse
toast
apple
car
lion

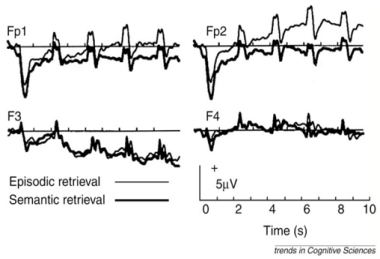
Test

Episodic (old/new discrimination)
bike
lion
horse
phone

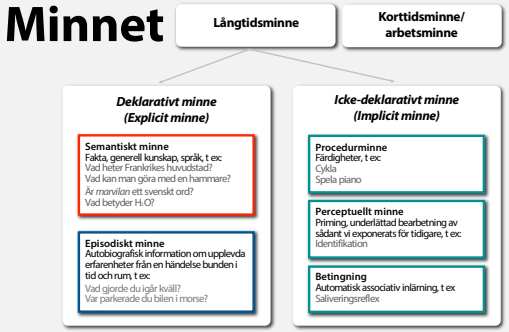
Semantic (living/non-living)
toast
dog
apple
market
car
trumpet
lion
pillow

Düzel et al. (1999)

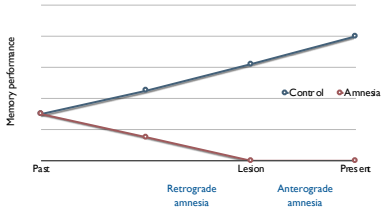
Retrieval mode



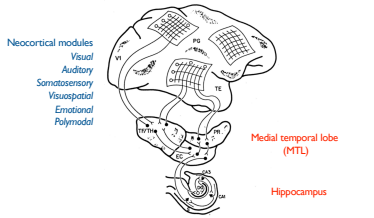
Minnet



Retrograde amnesia

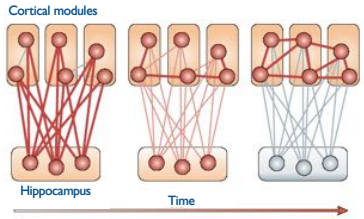


Time-limited role of the hippocampus?



e.g., Squire & Zola-Morgan (1991); Alvarez and Squire (1994); Rolls (2000); Shastri (2002); Norman and O'Reilly (2003).

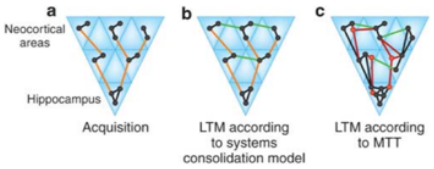
Standard consolidation model



e.g. Squire and Alvarez (1995)

Multiple Trace Theory

Hippocampus always involved in the retrieval and storage of episodic memories



e.g. Nadel & Moscovitch (1997)

Minnet

Långtidsminne

Deklarativt minne (Explicit minne)

Semantiskt minne
Fakta, generell kunskap, språk, t ex:
Vad heter Frankrikes huvudstad?
Vad kan man göra med en hammare?
Är manvilan ett svenskt ord?
Vad betyder H_2O?

Episodiskt minne
Autobiografisk information om upplevda erfarenheter från en händelse bunden i tid och rum, t ex:
Vad gjorde du igår kväll?
Var parkerade du bilen i morse?

Korttidsminne/ arbetsminne

Icke-deklarativt minne (Implicit minne)

Procedurminne
Färdigheter, t ex:
Cykla
Spela piano

Perceptuellt minne
Priming, underlättad bearbetning av sådant vi exponerats för tidigare, t ex:
Identifikation

Betingning
Automatisk associativ inlärning, t ex
Salivering sreflex

Minnets åtkomlighet och tillförlitlighet

Om glömska, falska minnen och annat elände

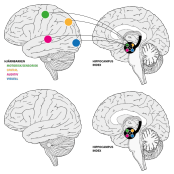
Professor Mikael Johansson
Department of Psychology
Lund University

LUNDS UNIVERSITET

Encoding

Activation

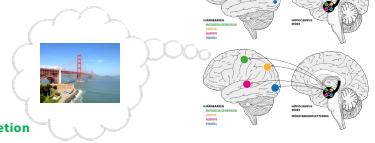
Feature binding
Pattern separation



Retrieval

"Golden Gate?"

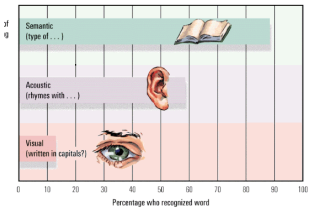
Cue
Reactivation



Pattern completion

tkomlighet

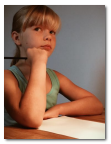
kodning: t ex bearbetningsdjup, imagery



& Lockhart (1972)

Åtkomlighet

Framplockning är ledtrådsberoende



Interna

Ledtråd

Minnesspår

Externa

Åtkomliga vs tillgängliga

Tulving & Pearlstone (1966)

Åtkomlighet

Minnet gynnas av likhet mellan inkodnings- och framplockningssituationer

Extern miljö

Ledtråd

Minnesspår

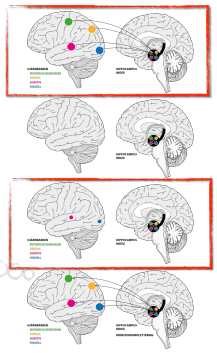
Sinnestillstånd

Encoding-
etrieval Overlap

ding specificity principle
odden & Baddeley (1975)
Transfer appropriate processing
lorris, Bransford, & Franks (1977)

te-dependent memory
Context congruency
Mood congruency

"Golden Gate?"



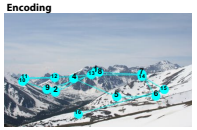
Relationen mellan ögonrörelser och episodiskt minne

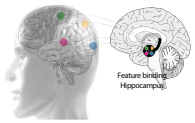
Tracking the mind's eye

sson et al. (2006). Cognitive Science

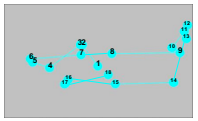
Episodic remembering involves the reinstatement of eye movements

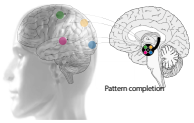
Encoding





Recall

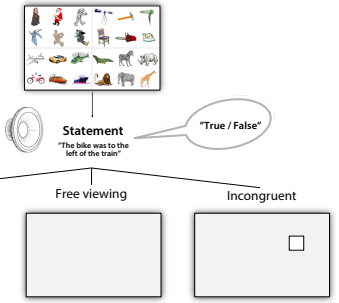




Interesting epiphenomenon?
or
An active role for memory retrieval?

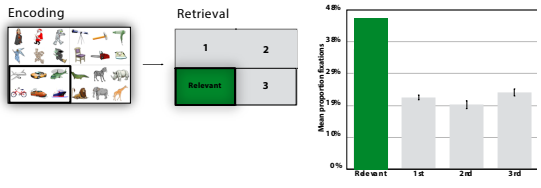
Johansson et al. (2006), *Cognitive Science*
Johansson et al. (2012), *JEP:HPP*

Functional role in memory?



Johansson & Johansson (20

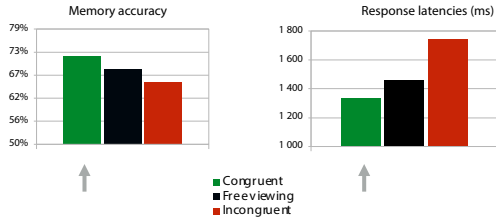
ontaneous eye movements



Johansson & Johansson (2014). Psych Sci

Eye movements

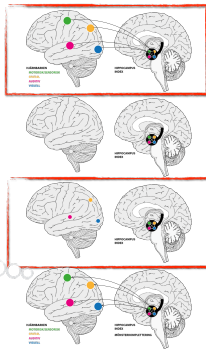
Play a Functional Role in Memory Retrieval !



Johansson & Johansson (2014). Psych Sci

Inkodning

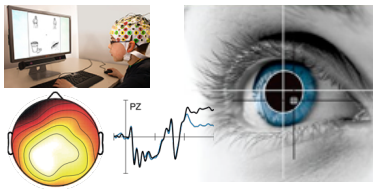
Aktivering



Framplockning

Ledtråd
Reaktivering

Relationship between eye movements and episodic remembering



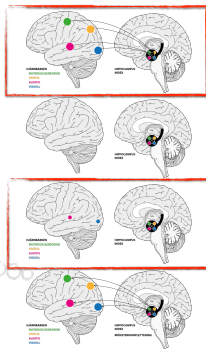
Combined eye tracking and EEG/ERP recording

Encoding-Retrieval Overlap

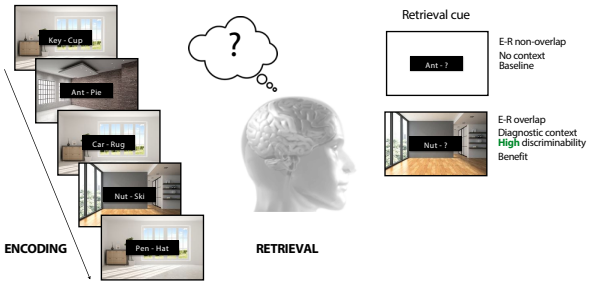
Encoding specificity principle
Godden & Baddeley (1975)
Transfer appropriate processing
Morris, Bransford, & Franks (1977)

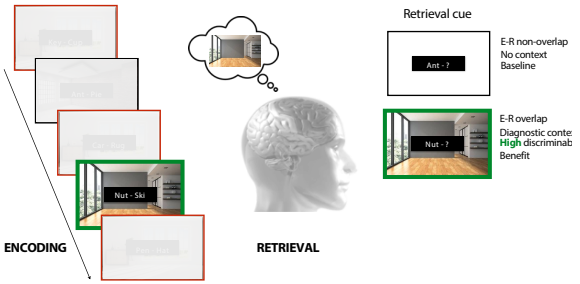
State-dependent memory
Context congruency
Mood congruency

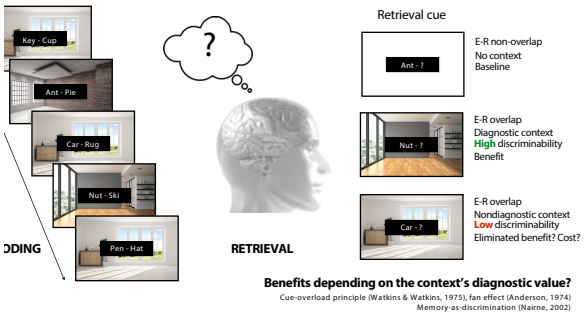
"Golden Gate?"

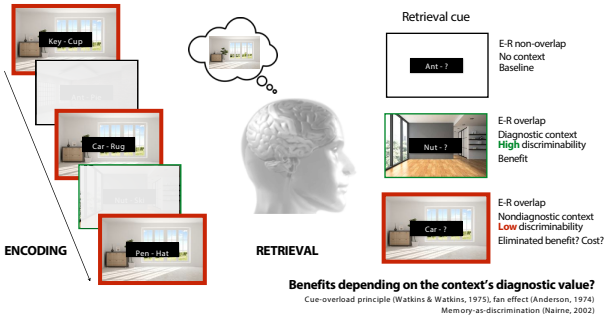


Is an encoding-retrieval overlap always beneficial?
The discriminability of the context

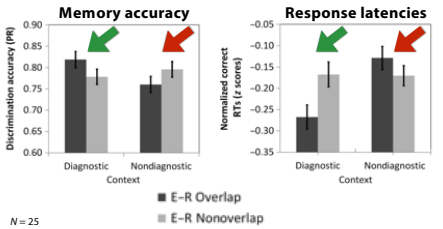




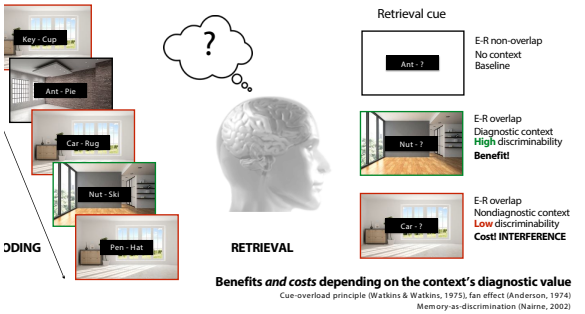




The discriminability of the context



Bramão & Johansson (2016). Journal of Cognitive



Encoding-Retrieval Overlap

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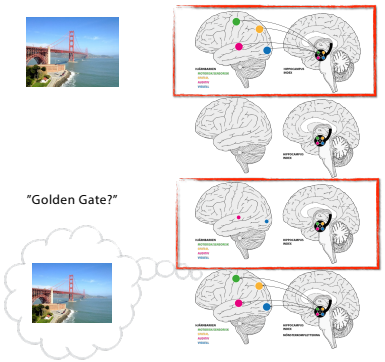
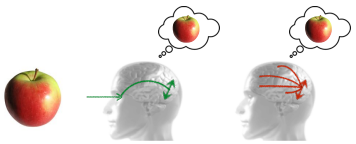
Context congruency
Mood congruency

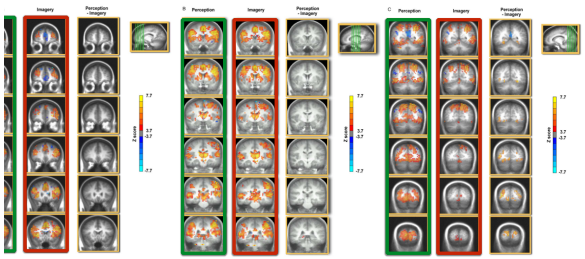


Perception vs imagery

Mental imagery is mediated by the same brain regions as perception

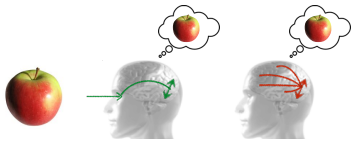


ception
ntal imagery

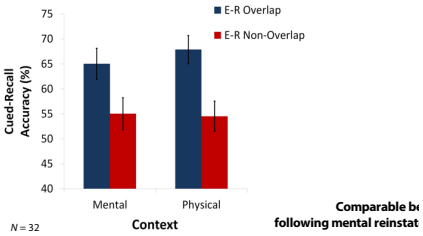


et al., (2004). Cognitive Brain Research

Encoding-retrieval overlap promotes memory
Mental *vs* physical reinstatement of encoding context



Mental *vs* physical reinstatement of encoding contex



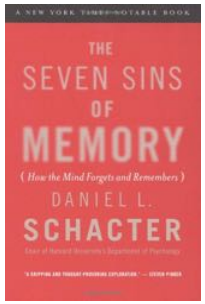
Comparable be
following mental reinstat

Bramão, Karlsson, & Johansson (

illförlitlighet

stematiska förvrängningar

"Many people believe that memory works like recording device, but decades of research has shown that's not the case. Memory is constructed and reconstructed. ***It's more like a Wikipedia page — you can go change it, but so can other people."***



1. **Transience**
2. **Absent-mindedness**
3. **Blocking**
4. **Misattribution**
5. **Suggestibility**
6. **Bias**
7. **Persistence**

Vi konstruerar vår verklighet

Inkodning → **Lagring** → **Framplockning**

Minnesexperiment

Memorera följande ord!

mörk
stearin
lampa
sol
blond
dag
värme
advent
låga
sken
tändsticka
levande
veke
brinna
paraffin

Minnestest

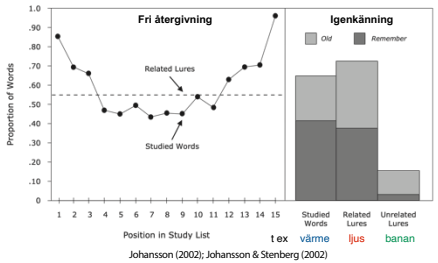
i) Fri återgivning
?

ii) Igenkänning
värme
banan
ljus
advent
tjuv
stearin

← **ljus?**

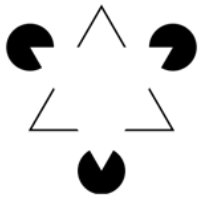
Roediger & McDermott (1995)

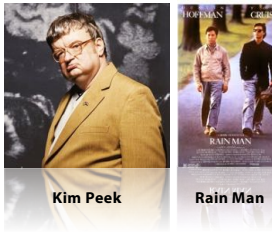
Falska minnen



Johansson (2002); Johansson & Stenberg (2002)

Brister i designen?





illförlitlighet

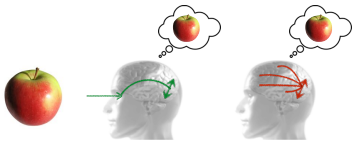
minns händelser så som vi förstår dem!

Tillförlitlighet

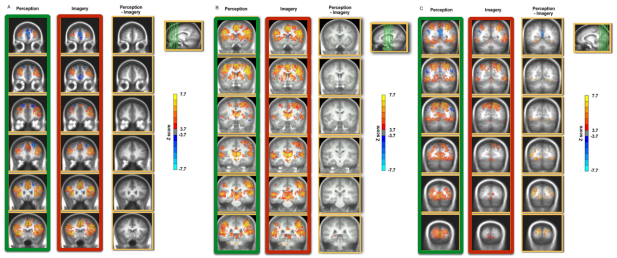
Vilken är konsekvensen av att vi fantiserar och föreställer oss saker?

illförlitlighet

ental föreställning aktiverar huvudsakligen samma områden som perception



Perception
Mental föreställning



Ganis et al., (2004). Cognitive Brain Research

Inkodning

Aktivering

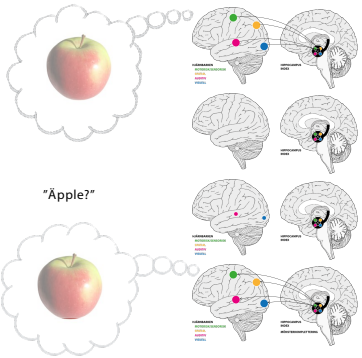
Upprepad föreställning

Framplockning

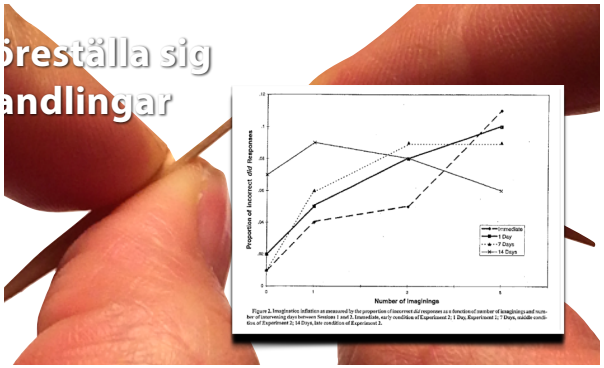
"Äpple?"

Ledtråd
Reaktivering

Ökad risk för minnesfel



föreställa sig andlingar



Inkodning

Aktivering

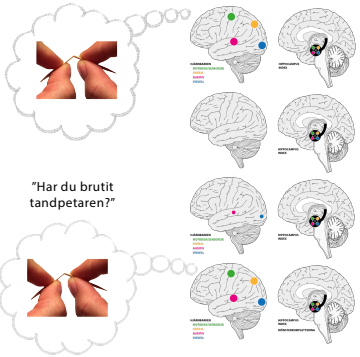
Upprepad föreställning

Framplockning

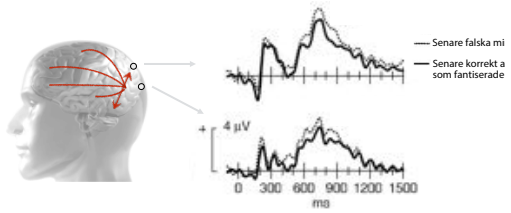
"Har du brutit tandpetaren?"

Ledtråd
Reaktivering

Ökar risken för minnesfel

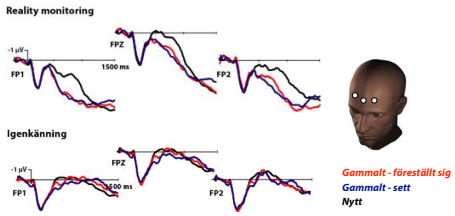


Hjärnaktivitet vid mental föreställning predicerar senare minnesfel



Gonsalves & Paller (2002). Nature Neuroscience

t skilja fantasi från verklighet



sson et al. (2003). Neuropsychologia

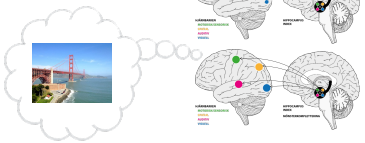
Att skilja fantasi från verklighet

Prefrontala regioner

Specifikation av ledtråd

"Golden Gate?"

Övervakning

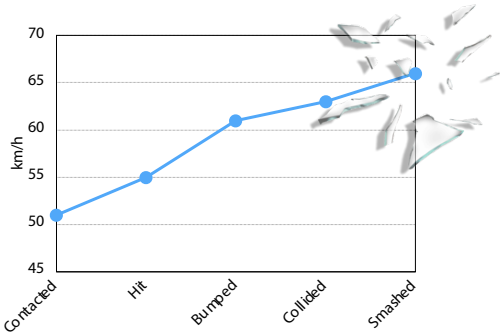


Vilseledande information

linnet är känsligt för påverkan

Film av bilolycka. Därefter frågan:
"How fast were the cars going when they ------
smashed, collided, bumped, hit, contacted?"

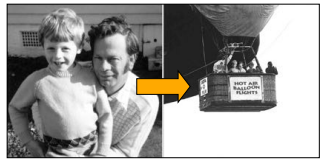
and Palmer (1974)



Loftus and Palmer (1974)

Suggestibility

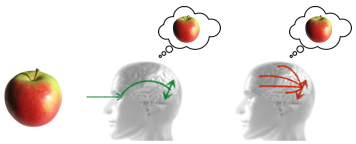
Implanting False Memories v. 2.0



Wade et al (2003)

illförlitlighet

ental föreställning aktiverar huvudsakligen samma områden som perception

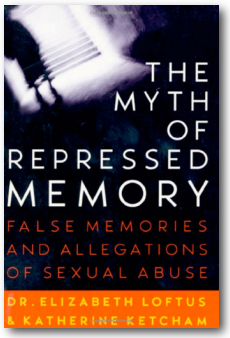


Bortträngda minnen

Mental föreställning aktiverar huvudsakligen samma områden som perception

Spend time imagining that you were sexually abused, without worrying about accuracy, proving anything, or having your ideas make sense … ask yourself these questions: What time of day is it? Where are you? Indoors or outdoors? What kind of things are happening? Is there one or more people with you? … then Who would have been likely perpetrators? When were you most vulnerable to sexual abuse in your life?

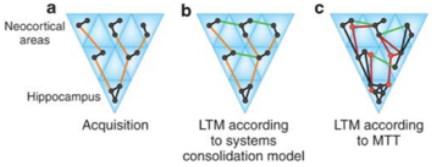
Wendy Maltz (psykoterapeut)



ramplockning förändrar minnet

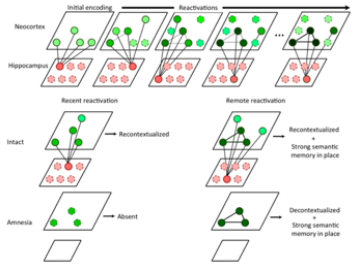
Multiple Trace Theory

Hippocampus always involved in the retrieval and storage of episodic memories

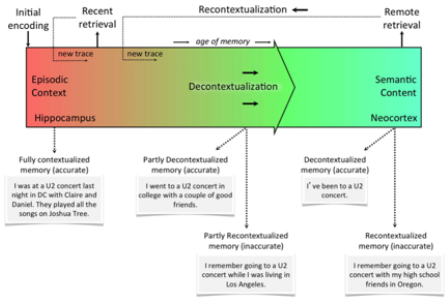


e.g. Nadel & Moscovitch (1997)

Competitive Trace Theory

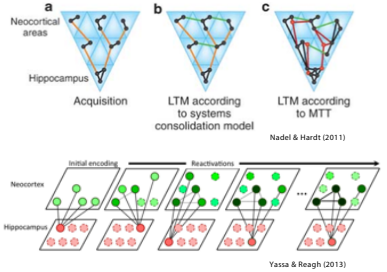


Yassa & Reagh (2013)

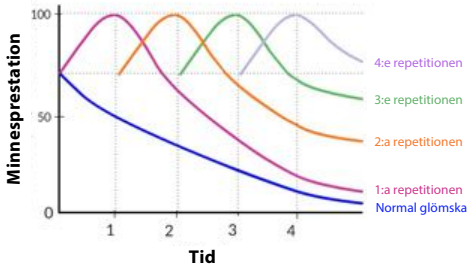


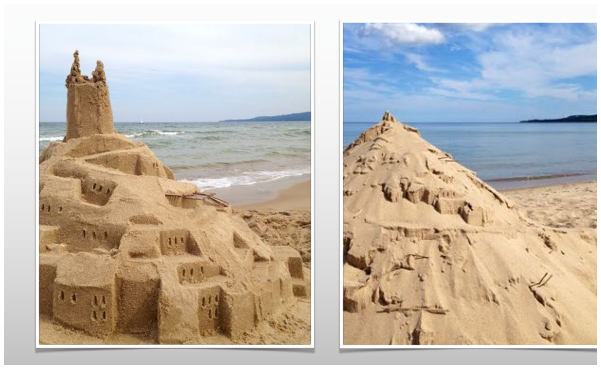
Framplockning förändrar minnet

Reconsolidation



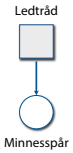
Glömska och gynnsamma konsekvenser av repetition





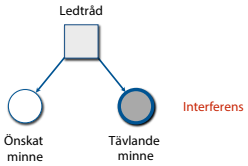
lur når vi våra minnen?

amplockning är ledtrådsberoende



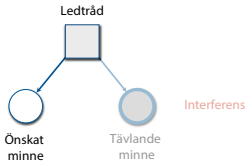
Interferens

Ledtråden aktiverar ofta flera relaterade minnen



Selektiv framplockning

Tävlande minnen trycks undan för att reducera interferens

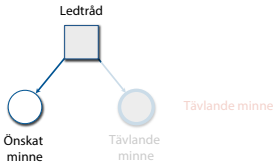


Framplockningsinducerad glömska

Anderson et al. (1994). JEP:LMC

nhibition

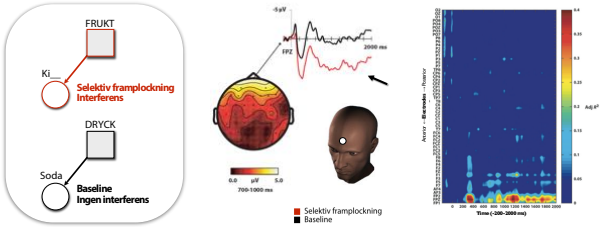
vlande minnen trycks undan för att reducera interferens



Framplockningsinducerad glömska

son et al. (1994). JEP:LMC

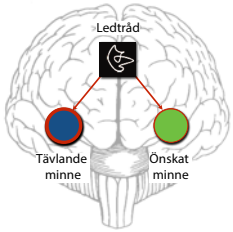
Inhibitorisk kontroll



Johansson et al. (2007). Cerebral Cortex

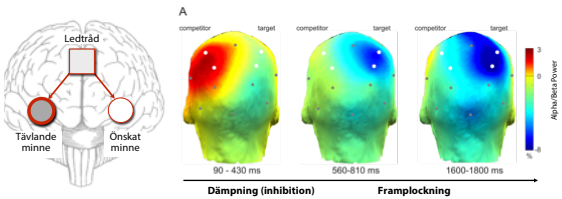
Godartad glömska

Kan vi observera när framplockning leder till glömska?



iodartad glömska

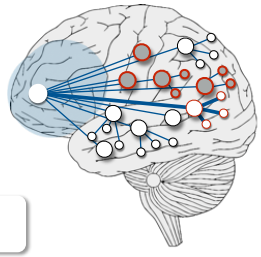
impningen föregår framplockningen av det önskade minnet



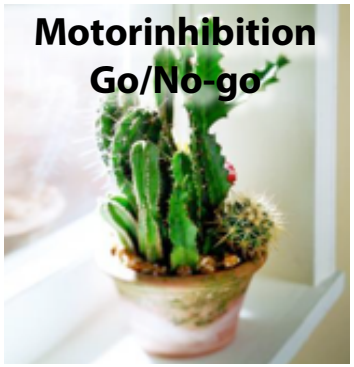
auser et al. (2013). Journal of Neuroscience

Godartad glömska

Inhibitorisk kontroll



Medveten kontroll?
Viljestyrd glömska?



Avbryta/undertrycka minnesframplockning?

Ledtråd ⇨ Minne

Ledtråd ⇨ ~~Minne~~

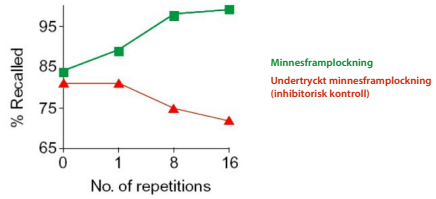
Kan vi glömma med viljekraft?

Think/No-Think Paradigmet

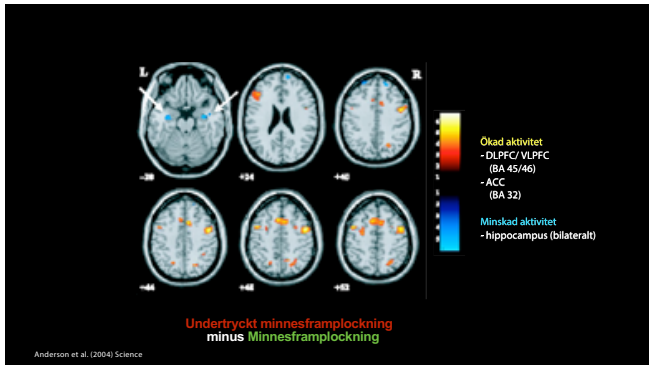
	Inlärning	Think/No-Think	Test
Minnesframplockning	Deg-Salt	Deg	Deg
Undertryckt minnesframplockning	Vitamin-Citron	Vitamin	Vitamin
Baseline	Vila-Säng		Vila

Anderson & Greene (2001). Science

jestyrd glömska



son & Greene (2001). Science



Godartad glömska

Selection is the very keel on which our mental ship is built. And in the case of memory its utility is obvious. If we remembered everything, we should on most occasions be as ill off as if we remembered nothing

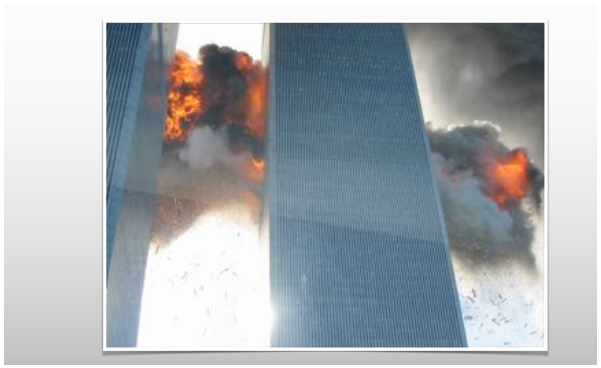
William James (1890)

Glömska hjälper oss att minnas

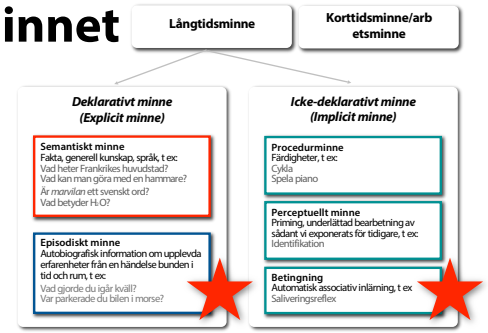
Emotion och minne

An impression may be so exciting emotionally as almost to leave a scar upon the cerebral tissues

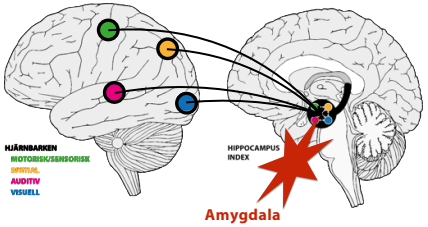
William James (1890)



Minnet

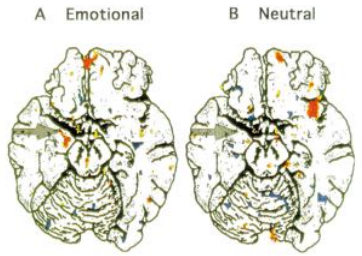


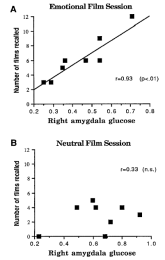
Inkodning av en emotionell händelse



Amygdala

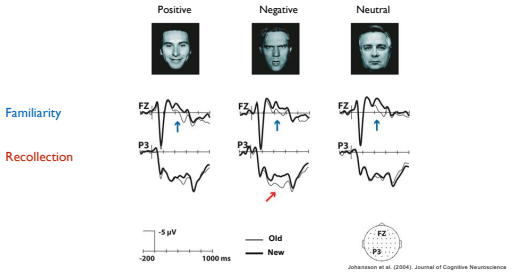
Memory





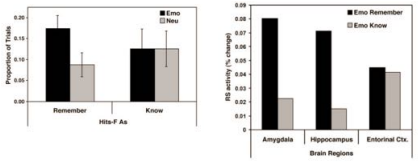
Cahill et al. (1996). PNAS

ERP memory effects



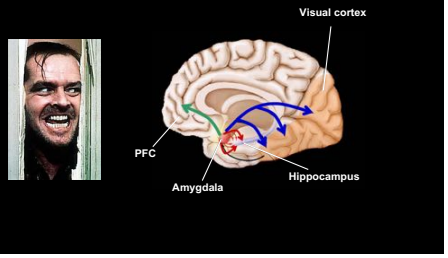
Johansson et al. (2004). Journal of Cognitive Neuroscience

Framplockning efter 1 år

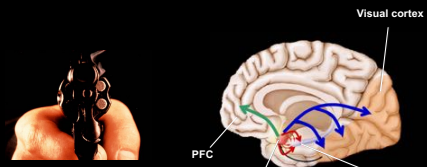


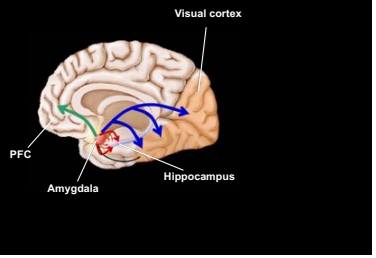
Dolcos et al. (2005)

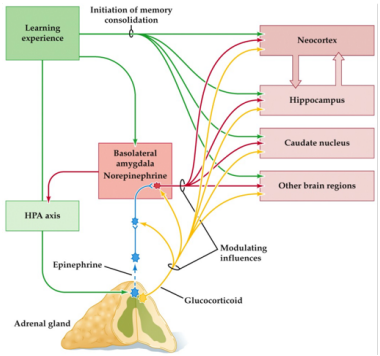
Emotion-induced memory enhancement

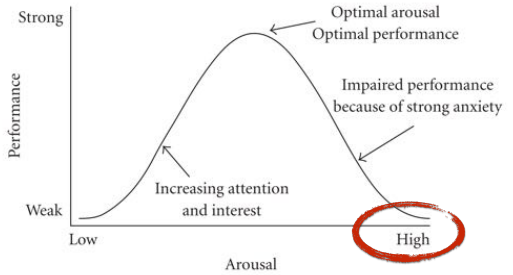


Tunnelminne: t ex vapenfokus

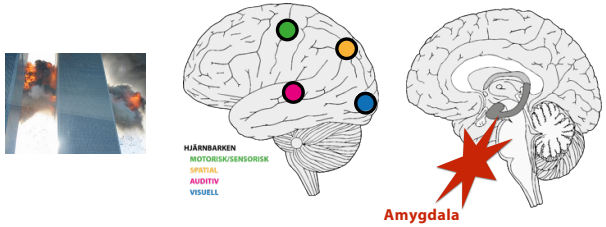


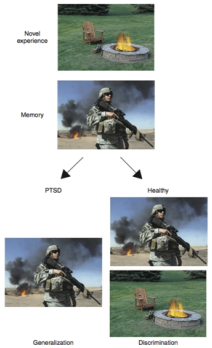


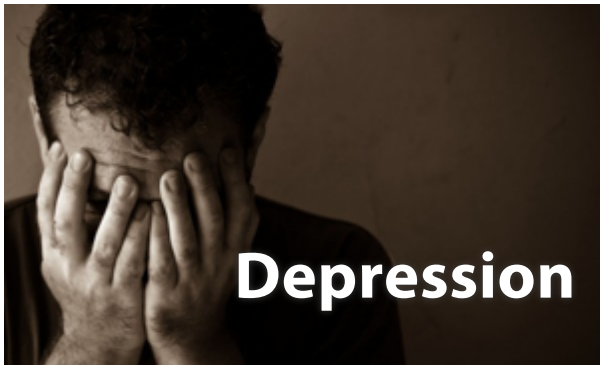




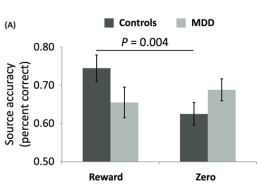
Inkodning av en traumatisk händelse



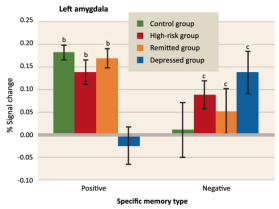




Episodic memory in depression

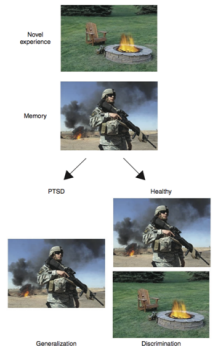


Dillon (2014), SCAN

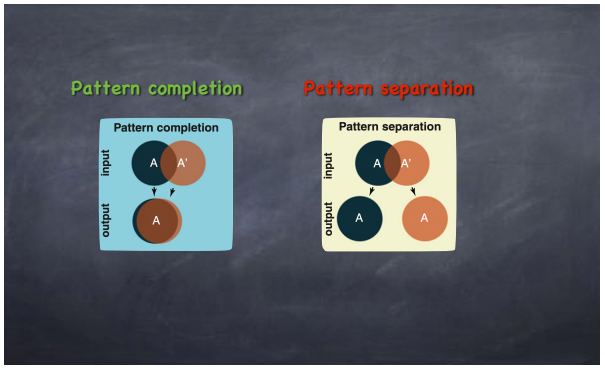


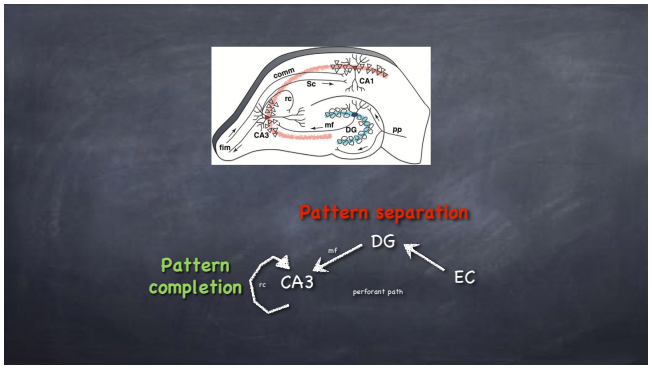
Young (2016), Am. J. Psychiatry

Overgeneralization

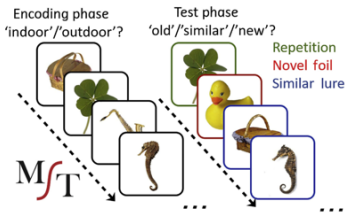


Depression





The Mnemonic Similarity Task



Stark et al. (2019)

Dentate Gyrus - Neurogenesis Pattern Separation

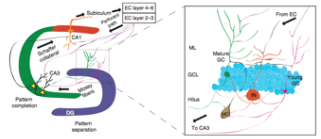


Figure 2 Local circuit properties of the dentate gyrus that facilitate pattern separation. Perforant path inputs from the entorhinal cortex carrying processed sensory information innervate granule cells of the dentate gyrus and pyramidal cells of both CA3 and CA1. In the dentate gyrus, sparseness is achieved by inhibitory interneurons that constrain granule cell firing through feedforward and feedback inhibition. The sparse cohort of granule cells that fire in a specific context can drive CA3 with high fidelity, owing to the robust mossy fiber synapses on CA3 pyramidal neurons. In this way, sparse coding and the mossy fiber–CA3 synapse can facilitate pattern separation. Activation of CA3 can instruct the generation of autoassociative networks in CA3 to facilitate future pattern completion for retrieval of stored representations. DG, dentate gyrus; EC, entorhinal cortex; GC, granule cell; IN, inhibitory interneuron; MC, mossy cell; ML, molecular layer.

Kheirbek et al. (2012)

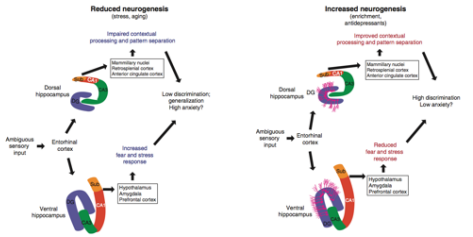


Figure 4 Modulation of pattern separation by adult neurogenesis and its impact on mood. Novel sensory representations can be disambiguated from stored representations through pattern separation on inputs from entorhinal cortex. Under stressful conditions, neurogenesis is low, leading to low discrimination and to generalization of contexts with substantial emotional valence. This may lead to increased anxiety owing to impaired contextual processing through modulation of exploration through dorsal outputs and increased stress responses by influencing outputs from the ventral pole. In conditions with high neurogenesis, such as enrichment or antidepressant treatment, enhanced pattern separation leads to high discrimination and greater ability to disambiguate similar contexts with differing emotional valence. This may influence output of the dorsal hippocampus to increase exploration and contextual encoding, and the ventral hippocampus to modulate stress responses. DG, dentate gyrus; Sub, subiculum.

Kheirbek et al. (2012)

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Mnemonic discrimination of object and context is differentially associated with mental health

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Keywords:
Pattern separation
Overgeneralization
Depression
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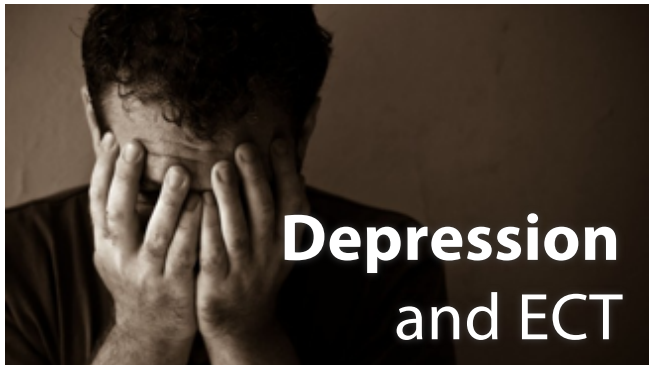
ABSTRACT

Episodic memories are formed by hippocampal binding of the "what" and "where" features of everyday events. The hippocampus minimizes interference between related similar episodic memories by pattern separation. Stress and psychopathology are associated with lowered pattern separation. While current behavioral paradigms typically use correct rejections of single object or context lures rather than composite stimuli, it is not known if object and context pattern separation differentially associate with mental health. We reasoned that an object-in-context paradigm would be more sensitive to mental health state than current implementations, given increased task demands. We found that non-clinical depression and anxiety symptom severity were associated with reduced lure rejection for both object and context and that only the object domain was associated with a concomitant increase in lure overgeneralization. Therefore, we argue that reduced lure rejection and increased overgeneralization must not be conflated. Although our object-in-context paradigm was not more sensitive to variation in mental health, we show that lure rejection and overgeneralization rate in one domain (e.g. object) was affected by the status of the other domain (e.g. context target versus lure). Finally, as several metrics of pattern separation exist in the literature, we evaluated the association of different metrics with mental health.

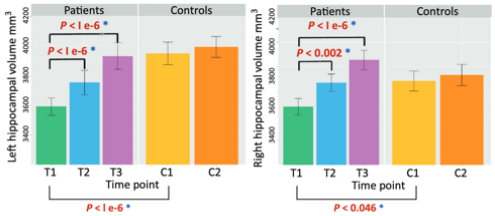
Depression and anxiety – orer pattern separation and more overgeneralization

	BDI			BAI		
	Object	Context	OiC	Object	Context	OiC
P_r	0.044	−0.183	0.058	−0.021	−0.209	−0.015
$LDI_{similar}$	−0.235*	−0.175	−0.221*	−0.260*	−0.238*	−0.256*
LDI_{old}	−0.165	−0.177	0.020	−0.159	−0.169	−0.044
LDI_{new}	−0.165	−0.177	−0.171	−0.159	−0.169	−0.190
OI	0.278**	0.054	–	0.249*	0.006	–

Note. $*p < 0.05$ (two-tailed); $**p < 0.01$ (two-tailed). The OI OiC scores were excluded due to a floor effect. BAI: Beck Anxiety Inventory. BDI: Beck Depression Inventory. LDI: Lure Discrimination Index. OI: Overgeneralization Index. OiC: Object-in-Context. P_r: corrected recognition. For object and context, LDI_{new} and LDI_{old} produce equivalent outputs.



Hippocampal volume increases after ECT



Joshi et al. (2016)

HIPPOCAMPUS 26:899–910 (2016)

Effect of Electroconvulsive Seizures on Cognitive Flexibility

Maria Svensson,[1] Matilda Grahm,[1] Joakim Ekstrand,[1] Peter Höglund,[2] Mikael Johansson,[1,3] and Anders Tingström[1]*

ABSTRACT: Electroconvulsive seizures (ECS), an animal model of electroconvulsive therapy, strongly stimulate hippocampal neurogenesis, but it is not known how this relates to the therapeutic effect or to the unwanted cognitive side effects. Recent findings suggest that neurogenesis might be important for flexible learning in changing environments. We hypothesize that animals receiving ECS treatment, which induces hippocampal neurogenesis, will show enhanced cognitive flexibility compared with controls. We have utilized a touch screen-based cognitive test (location discrimination (LD) task) to assess how five consecutive ECS treatments affect cognitive flexibility (measured as reversal of cognitive strategy) as well as spatial pattern separation ability. ECS-treated animals performed more reversals in the LD task earlier than controls over the 9 experimental weeks irrespective of spatial separation of visual stimuli, indicating an enhanced cognitive flexibility but unaffected pattern separation ability after ECS. We observed no correlation between hippocampal neurogenesis and the number of performed reversals during the last experimental week. This is the first study to elucidate the effect of ECS on cognitive flexibility. Our results indicate that ECS improves cognitive flexibility without affecting spatial pattern separation ability. Whether cognitive flexibility is enhanced via neurogenesis or other ECS-modulated processes, remains unknown. © 2016 Wiley Periodicals, Inc.

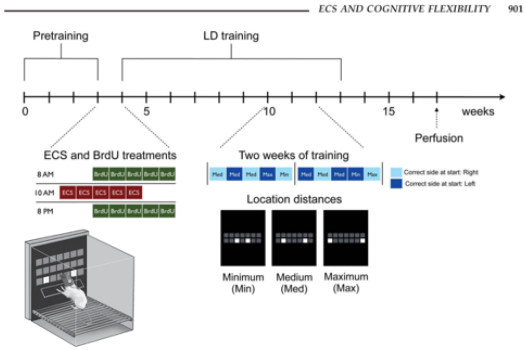
KEY WORDS: electroconvulsive seizures; hippocampus; pattern separation; cognitive flexibility; rat

stimulates adult hippocampal neurogenesis (Madsen et al., 2000; Malberg et al., 2000; Scott et al., 2000). It was recently shown that the antidepressant effect of ECS requires adult hippocampal neurogenesis (Schloesser et al., 2015). This is in line with previous findings, where the antidepressant effect of monoaminergic drugs appeared to require neurogenesis in both mice (Santarelli et al., 2003) and primates (Perera et al., 2011).

Adult hippocampal neurogenesis has also been extensively studied in relation to memory functions, for example pattern separation ability and cognitive flexibility.

Pattern separation is traditionally defined as the process by which similar neuronal inputs are stored as distinct, orthogonal memory representations. This concept was first outlined in a mathematical model by David Marr (1971), and has since been evaluated both in computer simulations and in animal experiments (e.g. Kesner et al., 2004; Rolls and Kesner, 2006; Leutgeb et al., 2007; Hunsaker and Kesner, 2013). The general interpretation is that the granule cells of the hippocampal dentate gyrus (DG) perform

Svensson et al. (2015, 2016). Hippocampus



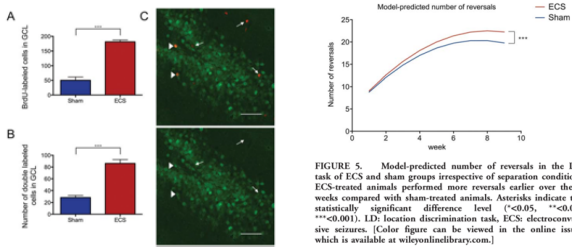
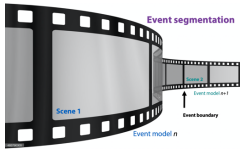
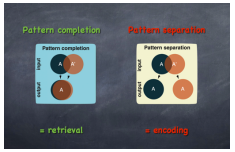


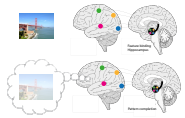
FIGURE 5. Model-predicted number of reversals in the l task of ECS and sham groups irrespective of separation conditic ECS-treated animals performed more reversals earlier over the weeks compared with sham-treated animals. Asterisks indicate t statistically significant difference level (*<0.05, **<0.(***<0.001). LDr location discrimination task, ECSc electroconv sive seizures. [Color figure can be viewed in the online iss which is available at wileyonlinelibrary.com.]

Svensson et al. (2016). Hippocampus



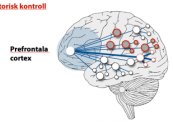


Perception, memory, imagery, future thinking



Minneskontroll

Inhibitorisk kontroll



Nostalgia was better in the old days

Tack för er uppmärksamhet!

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Dear Photograph,
I'll always remember my first fish.
Brian Thurman