Effects of Temporal Lobe Amnesia, Aging and Awareness on Human Eyeblink Conditioning

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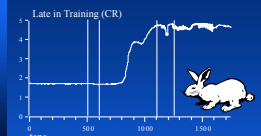
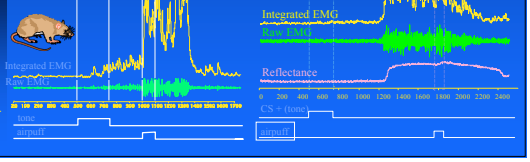
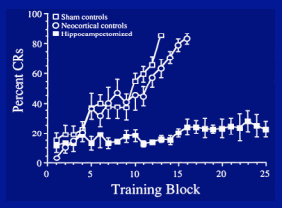
Trace Eyeblink Conditioning Across Species

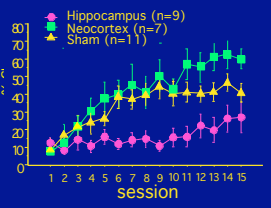


- Pseudoconditioning controls.
- Hippocampus dependent.
- The same task can be used in humans, rabbits, and rats.
- Humans, rabbits, and rats show similar age related impairments.

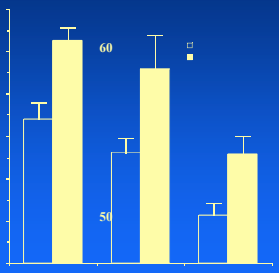


Trace Eyeblink Conditioning is Hippocampally-Dependent

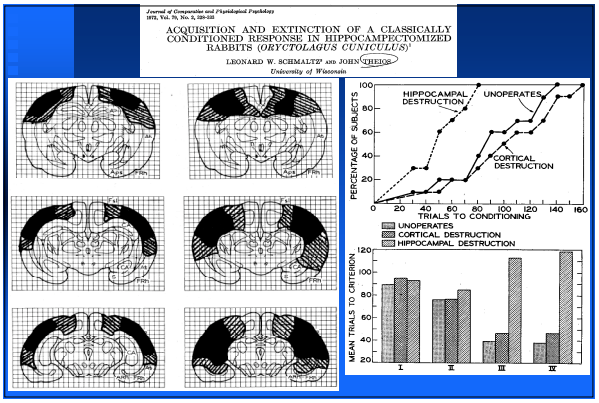




Amnesic Patients are Impaired in Acquiring Trace Eyeblink Conditioning Task

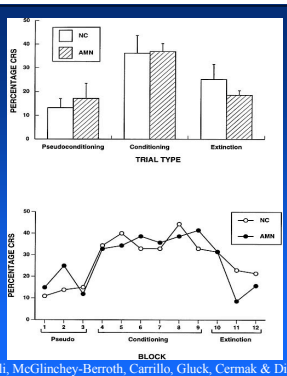


McGlinchey-Berroth et al. 1997



ACQUISITION AND EXTINCTION OF A CLASSICALLY CONDITIONED RESPONSE IN HIPPOCAMPECTOMIZED RABBITS (*ORYCTOLAGUS CUNICULUS*)[1]

LEONARD W. SCHMALTZ[2] AND JOHN THEIOS
University of Wisconsin

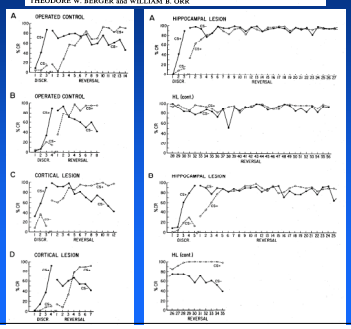


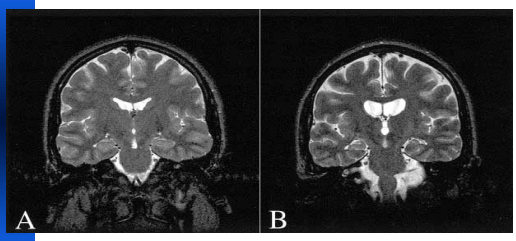
Gabrieli, McGlinchey-Berroth, Carrillo, Gluck, Cermak & Disterhoft *Behav Neurosci* vol.109, 1995.

Behavioural Brain Research, 5 (1982) 49–60

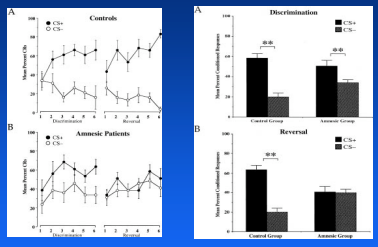
HIPPOCAMPECTOMY SELECTIVELY DISRUPTS DISCRIMINATION REVERSAL CONDITIONING OF THE RABBIT NICTITATING MEMBRANE RESPONSE

THEODORE W. BERGER and WILLIAM B. ORR



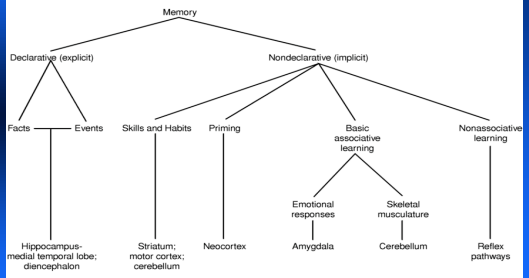


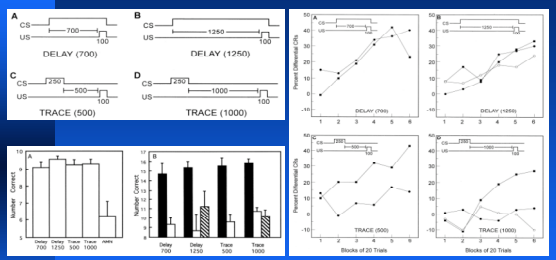
Carrillo, Gabrieli, Hopkins, McGlinchey-Berroth, Fortier, Kesner, & Disterhoft
Behav Neurosci vol.115, December 2001



Carrillo, Gabrieli, Hopkins, McGlinchey-Berroth, Fortier, Kesner, & Disterhoft
Behav Neurosci vol.115, December 2001

FIG 55.1





Clark & Squire *Science* vol.280, April 1998

Table 1. *The 17 critical true/false questions, in the order presented, on the postconditioning questionnaire*

1. I believe the airpuff usually came immediately before the tone.
2. I believe the airpuff usually came immediately before the static noise.
3. I believe the airpuff usually came immediately after the tone.
4. I believe the airpuff usually came immediately after the static noise.
5. I believe the tone usually came immediately before the airpuff.
6. I believe the tone usually came immediately before the static noise.
7. I believe the tone usually came immediately after the airpuff.
8. I believe the tone usually came immediately after the static noise.
9. I believe the static noise usually came immediately before the airpuff.
10. I believe the static noise usually came immediately before the tone.
11. I believe the static noise usually came immediately after the airpuff.
12. I believe the static noise usually came immediately after the tone.
13. I believe the tone and airpuff were always closely related in time.
14. I believe the static noise and airpuff were always closely related in time.
15. I believe the static noise and tone were always closely related in time.
16. I believe the tone predicted when the airpuff would come.
17. I believe the static noise predicted when the airpuff would come.

Clark & Squire *Psychological Science* vol.10, 1999

MMovie Questions:
PPlease answer true or false to the following statements about the movie you just finished watching.

1 The main character in this movie is played by the actor named Charlie Chaplain. T F

2 The main character falls down a snowy hill and turns into a giant snowball. T F

In one scene, a dog was eaten by a hungry man. T F

A bear was shot and killed. T F

A shoe was cooked and eaten for Thanksgiving dinner. T F

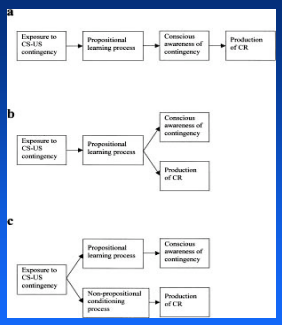
There was a drinking contest between two men. T F

The main character finds a new pair of shoes in the snow. T F

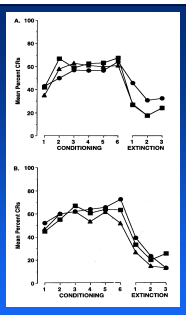
One man's coat catches on fire. T F

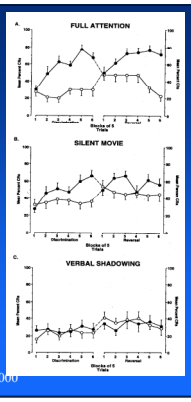
A hungry man thought he saw someone turn into a chicken. T F

One man dies in an avalanche. T F



Lovibond & Shanks *J Exp Psych: Animal Behav Processes* vol.28, January 2002





Carrillo, Gabrieli & Disterhoft *Psychobiology* vol.28, 2000

Correlation of reported awareness with performance in delay EBC

- Hilgard et al ('37): subjects who reported awareness of which CS was reinforced showed better differential EBC in delay discrimination
- Ross & Nelson ('73): "In summary, some addt'l cognitive or awareness process, which are sensitive to a variety of variables that do not affect single-cue conditioning, appear to be involved in differential conditioning…"
- Carrillo et al ('99): performance of a verbal shadowing task or watching a silent movie had a significant effect on a two tone delay discrimination task

No correlation of awareness with EBC performance

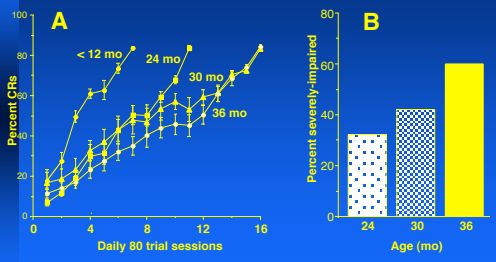
- Grant ('73): awareness of CS-US contingencies is not sufficient and may not be necessary to produce EBC or differential delay conditioning
- Frcka ('83): no significant relationship between measures of awareness and delay discrimination
- Clark & Squire ('98): successful trace discrimination conditioning dependent upon awareness of CS-US contingency, but successful delay discrimination was not dependent upon such awareness

Questions:

Are learning deficits which interact with awareness an ***age-dependent*** phenomenon?

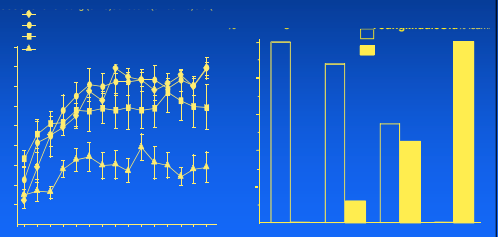
Is awareness related to successful acquisition of trace and/or delay discrimination?

Learning Impairments in Aging Rabbits Are Heterogeneous

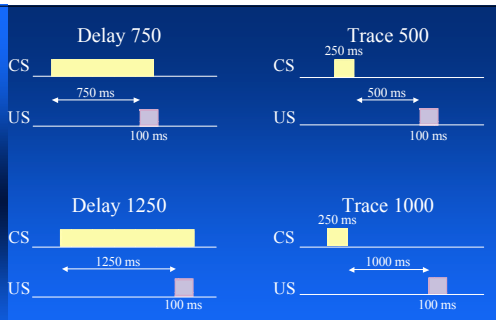


Thompson, Moyer and Disterhoft (1996) *Neurobiol Aging* 17:619-629

Aging Affects Trace Eyeblink Conditioning in the Rat



Kauttinen et al., Neurobiology of Aging, 2001

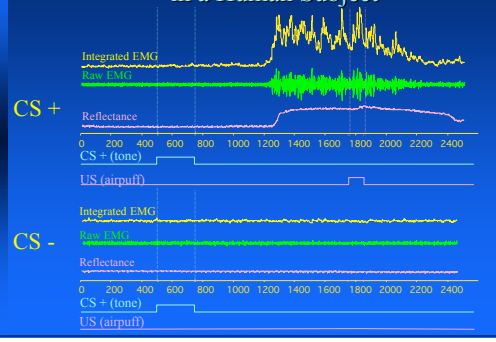


Total subjects: 138 (74 young; 64 aging)
Mean age: young= 25; aging= 65

METHODS

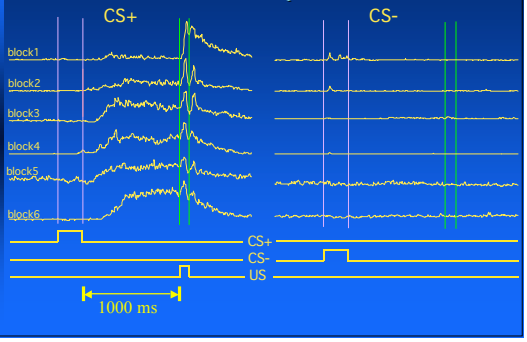
- 4 differential conditioning paradigms with either tone or static noise as CS+
- Training consisted of 60 CS+ and 60 CS- trials randomly presented; subjects instructed to watch a silent movie (*Gold Rush*)
- Eyeblink measures recorded via integrated and rectified EMG responses
- Following conditioning: subjects answered questions about ***movie content*** AND about ***temporal relationships*** between the CS+, CS-, and US

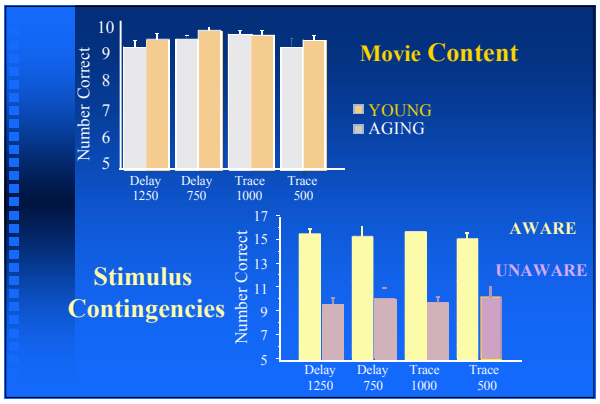
Sample Trace Eyeblink Discrimination Trials in a Human Subject

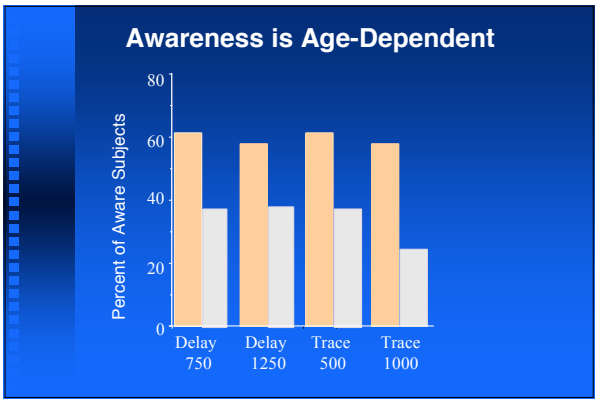


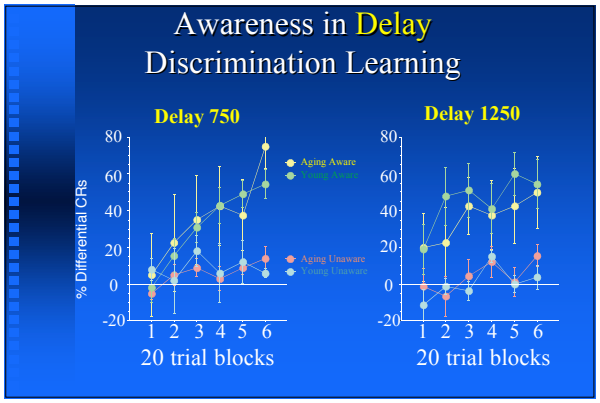
Averaged trials for a young trace 1000 subject.

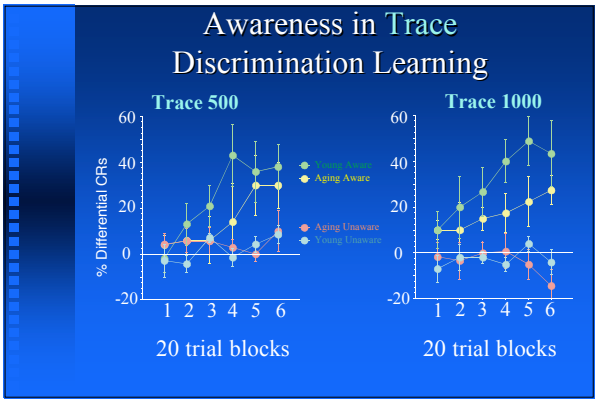
10 CS+ and 10 CS- trials per block.

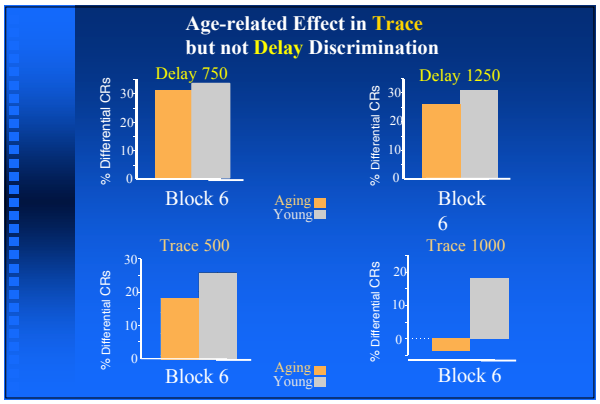






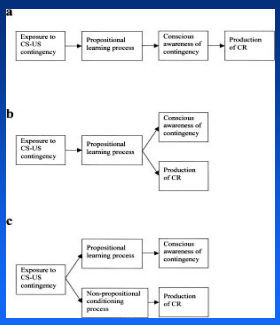






FINDINGS

- Awareness is essential for successful acquisition of both trace and delay discrimination EBC
- Age-dependent deficit in trace, but not in delay discrimination EBC
- Age-dependent effect of awareness during conditioning



Lovibond & Shanks *J Exp Psych: Animal Behav Processes* vol.28, January 2002

Collaborators

Human Eyeblink Conditioning

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Maria Carrillo (Rush Medical School)
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Regina McGlinchey-Berroth (Harvard Univ)
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Alison Preston (Stanford Univ)
Craig Weiss

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National Institute of Aging, National Institute of Mental Health,
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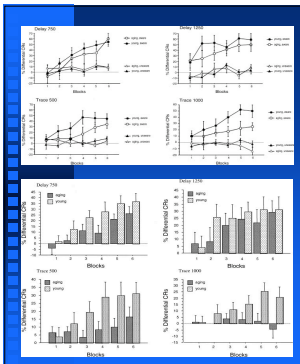

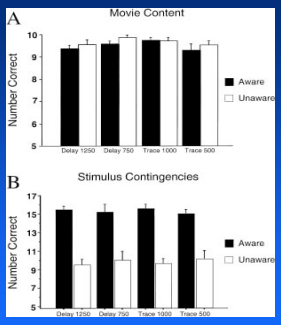

Knuttinen, Power, Preston & Disterhoft *Behav Neurosci* vol.115, August 2001

Table 1
Patient Demographic and Neuropsychological Characteristics

Patient no.	Age (years)	Education (years)	WAIS–R Verbal IQ	WMS–R General Memory	WMS–R Attention	WMS–R Delay
1	67	18	126	102	114	50
2	37	12	104	88	108	71
3	55	16	105	76	92	51
4	58	20	109	65	89	61
5	67	18	103	68	93	66
6	45	16	111	81	107	69
7	39	13	96	92	98	80
8	34	13	90	70	87	50

Note. The WAIS–R and the WMS–R scaled scores yield a normalized, age-adjusted mean of 100. WAIS–R = Wechsler Adult Intelligence Scale—Revised; WMS–R = Wechsler Memory Scale—Revised.

Table 2
Discrimination and Reversal: Mean (± SD) Percentage of Conditioned Responses (CRs), Amplitude, and Latency

Task and group	CS+	CS−	CS+ CR AMP (mV)	CS+ CR LAT (ms)	CS+ UR AMP (mV)	CS− CR AMP (mV)	CS− CR LAT (ms)	CS− UR AMP (mV)
Discrimination								
Control	56.3 ± 17.6	22.9 ± 16.3	2,543.5 ± 556.5	416.8 ± 48.4	2,940.5 ± 298.8	1,837.9 ± 658.4	426.6 ± 86.6	1,177.8 ± 520.7
Amnesic	55.8 ± 14.8	34.2 ± 11.6	2,199.1 ± 713.1	364.4 ± 53.3	2,672.6 ± 589.3	1,921.7 ± 533.0	365.9 ± 64.3	1,441.6 ± 720.1
Reversal								
Control	62.5 ± 14.6	14.6 ± 8.5	2,663.4 ± 659.0	410.5 ± 44.1	2,824.0 ± 677.0	2,083.0 ± 571.0	383.8 ± 75.6	1,084.3 ± 810.8
Amnesic	44.2 ± 12.6	39.6 ± 10.5	1,961.2 ± 730.7	388.0 ± 47.9	2,679.0 ± 889.6	2,041.8 ± 629.5	376.9 ± 63.1	1,632.9 ± 509.4

Note. CS = conditioned stimulus; AMP = amplitude; LAT = latency; UR = unconditioned response.

Carrillo, Gabrieli, Hopkins, McGlinchey-Berroth, Fortier, Kesner, & Disterhoft
Behav Neurosci vol.115, December 2001