



Aging Effects on Rule-Based and Information-Integration Category Learning

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Introduction

- Normal aging affects many cognitive processes, including perception, attention, and memory^[1].
- Category learning is an important cognitive operation that is critical throughout the lifespan.
- Rule-based (RB) category learning is mediated by an explicit hypothesis-testing system that relies on frontal regions, whereas information-integration (II) learning is mediated by an implicit, procedural system that relies on striatal regions^[2,3].
- Normal aging deficits emerge for complex, but not simple RB tasks^[4].
- Normal aging deficits emerge for complex but not simple II tasks^[5].
- Using a complex 4-category RB and II task (related via a simple rotation; see Figure to right), frontal patients showed learning deficits in both tasks^[6]. Lesion analyses suggested that the locus of the RB and II deficit was in mOFC.
- Using the same structures, putamen patients showed no II deficit and an early learning deficit in RB^[7].

Aims of Study

- Examine the effects of normal aging on RB and II category learning using structurally equivalent categories (see Figure to right).
- Use computational models to provide insights into the locus of performance deficits.
- Examine neuropsychological and structural brain volume correlates of performance.

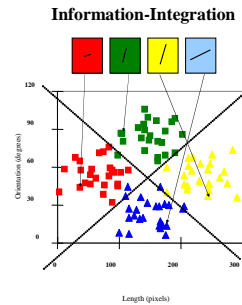
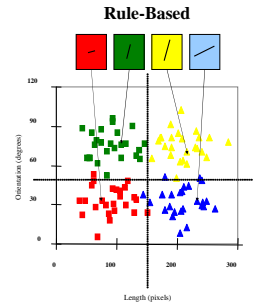
Methods

Participants:

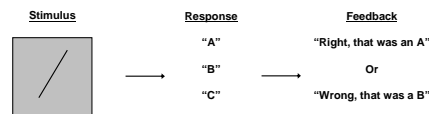
- 31 UT students (aged 18-24)
- 27 healthy elderly adults (aged 60-81)
- Groups matched on scaled WAIS-III Vocab ($t < 1.0$)

Task:

- Categorize lines that varied in length and orientation into one of four categories.
- Each participant completed the II and RB task (below) separated by at least 1 week.
- Each task involved 6 100-trial blocks of categorization.

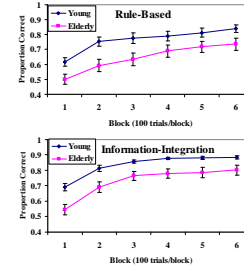


Trial Procedure:



Results

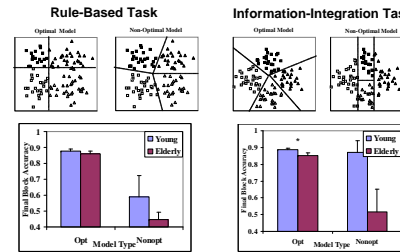
Block-By-Block Accuracy



- Elderly performed worse than Young in RB and II ($p < 0.01$).

Model-Based Analyses

- RB and II models were applied to the final block of data.



-Opt RB: Young = 27/31; Elderly = 19/27; Opt II: Young = 29/31; Elderly = 23/27

- Elderly using optimal strategy in RB task show no performance deficit

- Elderly using optimal strategy in II task still show deficit
- Model parameter suggest poor decision bound learning

Neuropsychological Test Correlates of Aging Performance

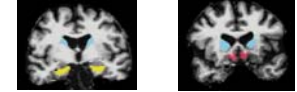
- Final block performance was correlated with several neuropsychological test results.

	Rule-Based	Information-Integration
Stroop interference	.44*	.28
Backward Span	.56**	.33
WCST total cats	.30	.62**
WCST total errors	-.49*	-.70**
WCST perseverations	-.45*	-.71**

* = $p < .05$; ** $p < .01$

Structural Correlates of Aging Performance (12 participants)

- Final block performance was correlated with normalized structural volumes in the cerebellum, caudate (blue), putamen, pallidum, accumbens, hippocampus (yellow), medial OFC (pink).



	Rule-Based	Information-Integration
Hippocampus	.59*	.65*
Cortex mOFC	.74**	.75**
Wh. Matter mOFC	.79**	.78**
Caudate	-.26	-.70**

* = $p < .05$; ** $p < .01$

- Hippocampus and mOFC correlate for both tasks.
- Caudate just for II.
- Putamen did not correlate (relevant to^[7])

Conclusions

- Replicate previous work showing aging deficits for complex RB and II tasks^[4,5].
- Attention/WM tasks correlate with RB, but not II.
- WCST correlates with both RB and II tasks.

- Increased hippocampus and mOFC volumes predict better RB and II. Relevant to Seger's^[8] "motivation loop" hypothesis

- Increased caudate volume predicts better II, but not RB.

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<http://homepage.psy.utexas.edu/homepage/group/MaddoxLAB/>

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