

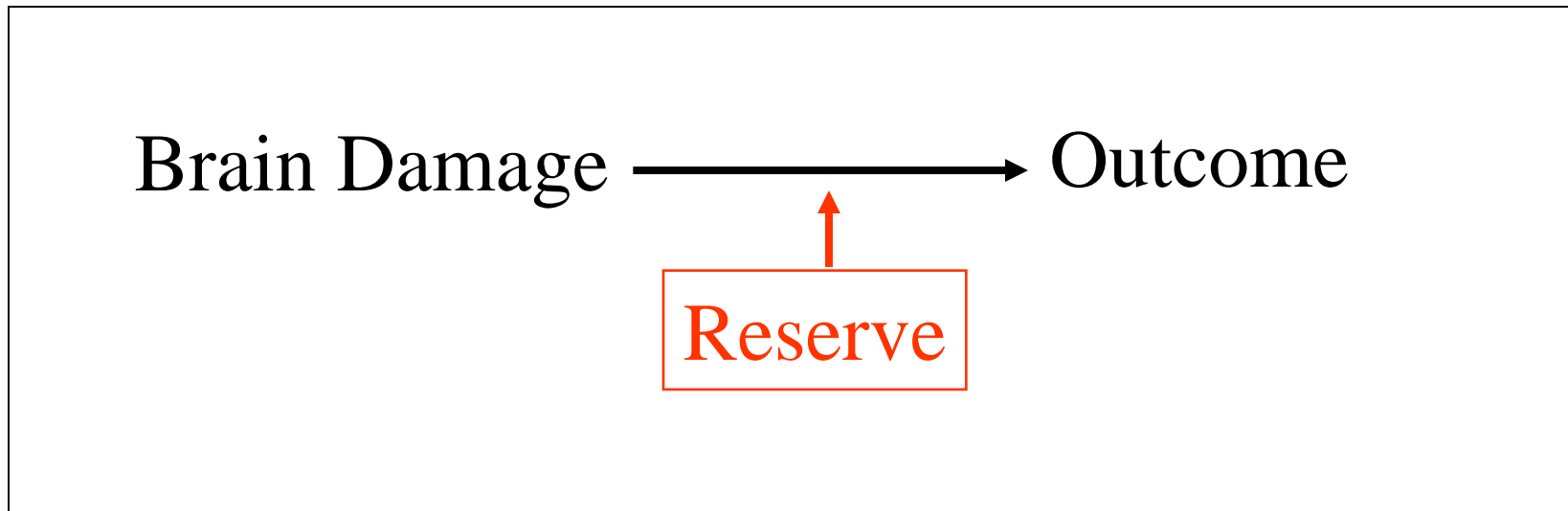


Cognitive Reserve and Successful Aging

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What is Reserve?



Reserve may explain the disjunction between the degree of brain damage and the clinical manifestation of that damage.

Epidemiologic Evidence for Cognitive Reserve

Proxies for cognitive reserve, including IQ, education/ literacy, occupational attainment and leisure activity, are associated with:

- Slower rate of cognitive decline in normal aging
- Reduced risk of incident dementia
- More rapid cognitive decline and mortality in AD

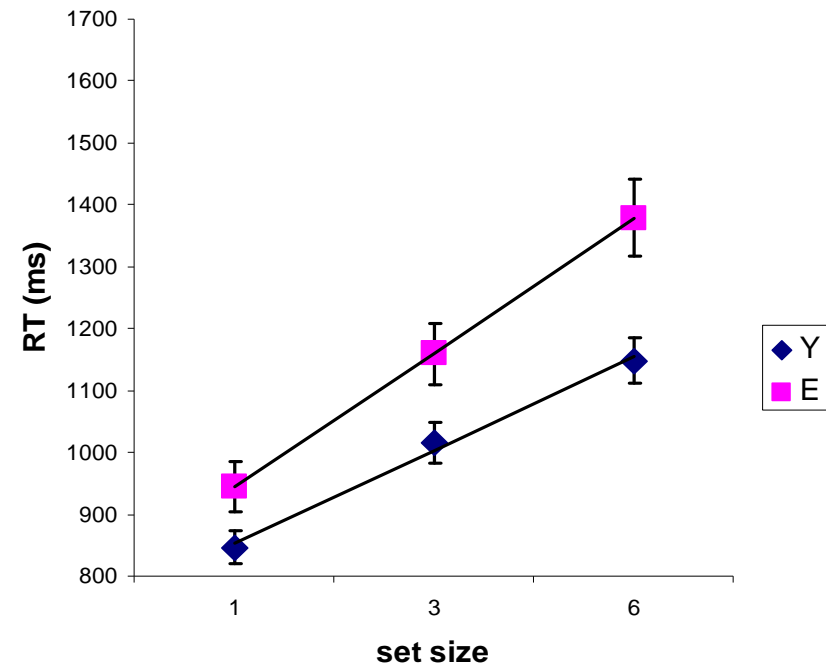
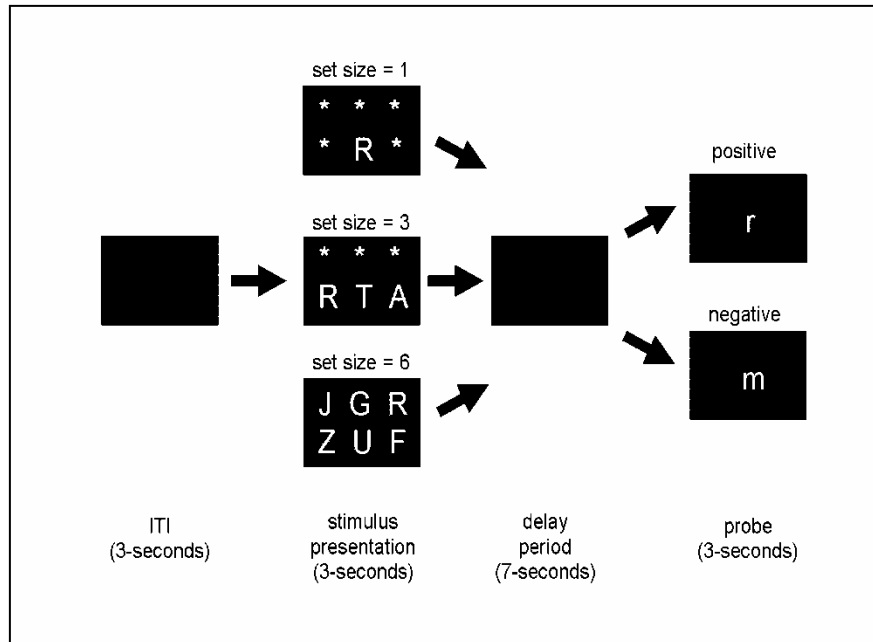
Neural Mechanisms Underlying Cognitive Reserve

- Cognitive Reserve: Resilience/plasticity of cognitive networks in the face of disruption
- Two possible neural implementations of cognitive reserve:
 - Neural Reserve: efficiency/capacity of existing brain networks
 - Neural Compensation: ability to adapt alternate networks or brain areas

Using Functional Imaging to Study Aging and Cognitive Reserve

- Do old and young subjects use the same or different networks to mediate task performance?
 - If they are the same: does age affect the network's efficiency or capacity?
 - If they are different: what is the nature of the compensatory activation?
- In either case are individual differences in activation associated with CR?
- Is there some unique, CR-related activation, that is independent of the specific demands of the task at hand?

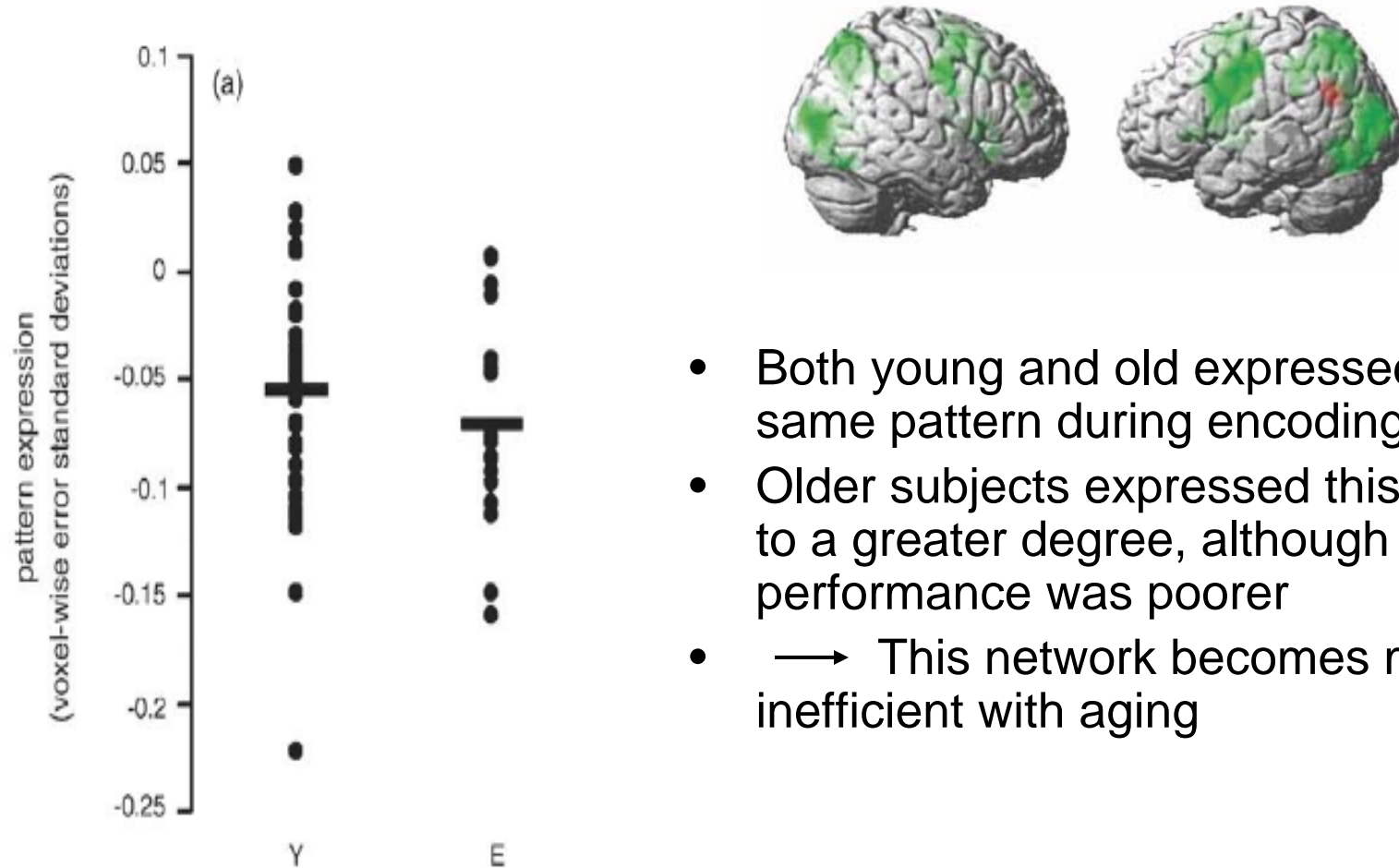
Modified Sternberg Task



”Load-related” activation: the change in activation as set size increases

We focus on load-related activation because CR might be more related to the coping with increases in task demand than to task-specific features.

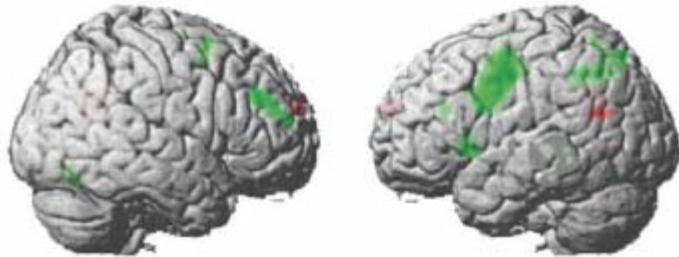
Load-Related Activation During Encoding: Neural Reserve



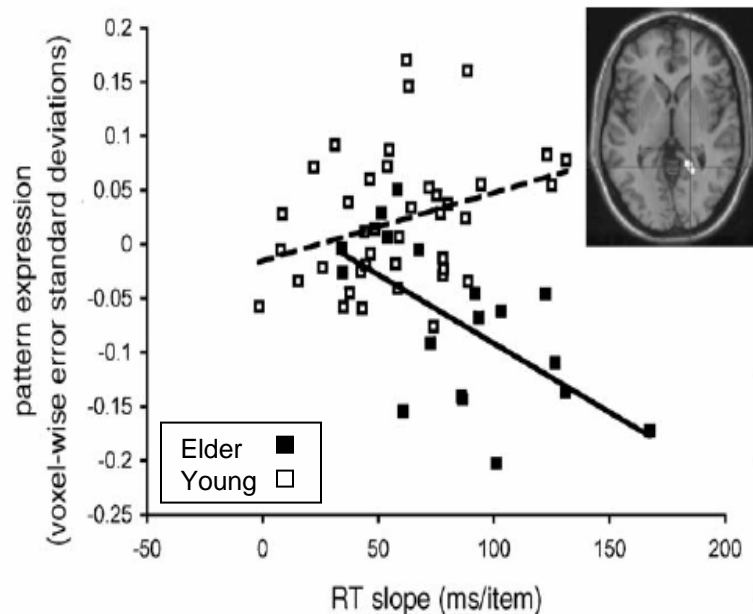
- Both young and old expressed the same pattern during encoding
- Older subjects expressed this pattern to a greater degree, although their performance was poorer
- → This network becomes more inefficient with aging

Load-dependent Activation During Retention: Neural Compensation

Pattern 1

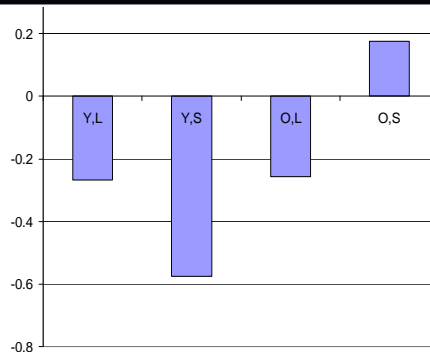
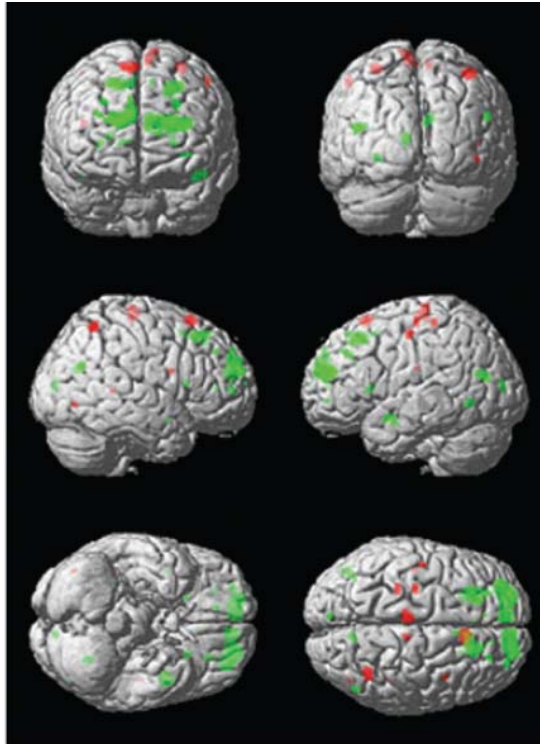


Pattern 2



- 2 spatial patterns were expressed
- Pattern 1 was expressed by both young and old; lower expression was associated with better performance
- Pattern 2 was expressed primarily by the elders; higher expression was associated with poorer performance
- When there was brain atrophy underlying pattern 1:
 - Pattern 2 expression increased
→ Compensation
 - Pattern 1 expression increased, but this increase was mediated by CR

CR-related Brain Activity Common to Two Different Tasks



- fMRI measures: Load-related activation during stimulus presentation *for letters and shapes*
- Measures of CR: NART and Vocabulary
- In the younger subjects, a brain network was identified during the encoding phase of both tasks whose load-related increase in expression correlated with CR
- Expression of this CR-related network was independent of task performance
- In the context of these tasks, this network represents a neural instantiation of CR
- Is this CR-related network expressed during performance of other tasks?

Conclusions

- Epidemiologic evidence supports the concept of cognitive reserve
- Imaging evidence suggests that cognitive reserve may be mediated by:
 - differential efficiency/capacity of existing brain networks:
neural reserve
 - differential ability to enlist new, compensatory networks:
neural compensation
- Cognitive reserve-related networks have been identified that generalize across tasks
- Enhancing cognitive reserve could result in more successful aging

Acknowledgements

Co-Investigators

Christian Habeck

Eric Zarahn

Brian Rakitin

Nick Scarmeas

Roe Holtzer

Truman Brown

Assistance

Joseph Flynn

Arjun Kumar

Elaine Gazes

Rohit Nambisan

Diane Abela

Oksana Tatarina

Support: National Institute on Aging