The Surprising Dynamics of the Aging Brain

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Once upon a time all the world was young because most of us left the party early.

Now we hang on so much longer that there are more old people alive than at any time during recorded history.

Soon there will be many more.
Proportion of individuals with Alzheimer’s Disease and Other Dementias

- White
- African-American
- Hispanic

<table>
<thead>
<tr>
<th>Age Group</th>
<th>White</th>
<th>African-American</th>
<th>Hispanic</th>
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</thead>
<tbody>
<tr>
<td>65-74</td>
<td>2.9%</td>
<td>9.1%</td>
<td>7.5%</td>
</tr>
<tr>
<td>75-84</td>
<td>10.9%</td>
<td>19.9%</td>
<td>27.9%</td>
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<tr>
<td>85+</td>
<td>58.6%</td>
<td>62.9%</td>
<td>30.2%</td>
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~5%   
~15%  
~35%

alz.org, 2014
what is normal aging?

“pretending to be deaf”
“deliberate loud gasping”
“explosive sneezing”
“food on the cardigan”
“smells”
CAN WE STOP AGING?

There are scientists who believe we can and will—but would we really want to?
“In this experiment, we are interested in how good your *memory* is”
“You will be tested on your *memory* of this information in phase two”

“In this experiment, we are interested in your ability to learn facts”
“You will be tested on this information in phase two”

About 4 hours are required to boil an ostrich egg.

Seven suicides are recorded in the Bible.

Cut flowers become sleepy and wilt in the presence of apples.

Rahal et al., *Psych & Aging*, 2002
both popular and scientific literature is dominated by stories of decline.

we call these negative cultural beliefs about the impact of aging on cognition stereotype threat.

why is consciousness of this bias important for brain research?
a test case:

bilateral activation
(or, A Tale of Two Experiments)
a test case:

bilateral activation
(or, A Tale of Two Experiments)
these studies were largely observational

what drives the bilateral activity pattern we see in so many studies?
Functional Connectivity
Structural Connectivity
Davis et al., *Cereb Cortex*, 2012
What functional networks are active during this experiment?

Younger Adults

Older Adults

y = 15
thus, cross-hemispheric communication seems to benefit performance

how well would these results generalize to more natural conditions?
John understood that BORING COLLEAGUES ARE particularly annoying. IS bad for is career.

Naturalistic

Behavioral Results

Syntactic Demand

Low

High

(only heard in no-task version)

Acceptable?

YES

NO

Davis et al., Neuropsychologia, 2014
What Networks are Active?

the frontotemporal network is consistently activated across experiments performing a task on the same stimuli engenders additional networks
Effects of age

Frontotemporal

Opercular

Frontoparietal

Bilateral MFG

all networks remain stable across the lifespan

Davis et al., *Neuropsychologia*, 2014
Effects of age-related differences emerge with the inclusion of the task manipulation.

Davis et al., *Neuropsychologia*, 2014
Why is this interesting?

What is the role of the bilateral prefrontal network?

Is the same bilateral network that is increased during a task the same one that would be activated by any exogenous stimulus?

In other words, is cross-hemispheric communication ‘special’?
The TURTLE was under the TREE.
The GENERAL was eating a PEAR.
SNOW fell on the VILLAGE
The TEACHER made a JOKE.

Behavioral Paradigm

Encoding

TURTLE - TREE
SNOW - PEAR

Retrieval

TEACHER - JOKE
The TURTLE was under the TREE.
The GENERAL was eating a PEAR.
SNOW fell on the VILLAGE.
The TEACHER made a JOKE.

Encoding

Retrieval

Memory Localizer: Encoding Success Activity (ESA)
Subsequently Remembered > Forgotten Trials

Behavioral Paradigm

subject-specific TMS targets in left PFC
Effects of Memory Success
Later Remembered > Forgotten

Effects of Stimulation
5Hz (excitatory) > 1Hz (inhibitory)

Overlap:
16% of activated nodes
12% of sig edges

Only a subset of more region pairs are susceptible to the effects of stimulation.

Balls: Greater Activity
Sticks: Greater Connectivity

p < 0.05   p < 0.005
The bilateral network is not merely an artefact of aging
Summary

Stereotype threat in aging studies is important and can affect the interpretation of study results, as well as how the study is performed.

Bilateral patterns of activity appear to aid in directed, task-based performance on challenging episodic and semantic memory tasks.

But beware generalizations of what networks or patterns “benefit aging” or “benefit older adults”
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