Introduction

- Older adults typically exhibit age-related decline in many cognitive functions (Park et al., 2012), including language production (Burke & Shafto, 2008), and different patterns of functional activation compared to younger adults (Cabeza, 2002; Wierenga et al., 2008).
- Aging comes with lower resting-state connectivity among brain regions within a functional network (e.g., Tomasi & Volkow, 2012), which have been associated with worse behavioral performance across different cognitive domains (e.g., Onoda et al., 2012).
- Few studies have investigated age-related differences in a resting-state language network (BOLD amplitude, and functional connectivity) and its relationship with language ability (Ferré et al., 2019; Gertel et al., 2020; Yin, et al., 2015).

The Present Study

Goal

- The current study investigated both the amplitude of spontaneous brain activity (i.e., ALFF) and the functional connectivity (i.e., degree, the number of strong connections among nodes) in a pre-defined language network (Ferstl et al., 2008) during resting-state and their relationship with age and language ability across the adult lifespan.

Prediction

- Both brain activity amplitude and functional connectivity in the language network would be correlated with age and language ability.
- Age may modulate the relationship between language ability and network characteristics during resting-state.

Methods

Participants

- 154 participants (20-78 years, mean age = 46.9 years, 92 female, 62 male)
- English monolinguals (Mean education years = 16.9)
- MMSE score > 27 (No known psychiatric or neurological disorders)

Neuropsychological Tasks

- Assessing multiple domains of cognitive abilities (e.g., speed, executive function, memory, language).
- Exploratory Factor Analysis
  - Recall Factor
  - Working Memory Factor
  - Processing Speed Factor
  - Language Factor: loaded highly on all language assessments.

Language Assessments  | Mean (SD) | Age Correlation |
-----------------------|----------|----------------|
Verbal Fluency         | 66.1 (14.0) | -.14 |
WAIS Vocabulary        | 54.2 (6.1)  | .02 |
Author Recognition Test| 24.6 (14.5) | .50*** |
Comparative Reading    | 25.3 (4.8)  | .08 |

Resting-State Scanning Parameters

- 3T Siemens Prisma Fit MRI scanner with a 64-channel head coil.
- Stay still in the scanner with their eyes open and to look at a fixation cross.

<table>
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<th>TR (ms)</th>
<th>TE (ms)</th>
<th>FOV (mm²)</th>
<th>Duration (min)</th>
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<tr>
<td>Resting-State Images</td>
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</tbody>
</table>

Results

Language Network (13, 6-mm radius sphere ROIs)

- Language Network (3T Siemens Resting-State Scanning Parameters)

The Relationship between Age, Language Factor Score, and Language Network ALFF

- Increased age was associated with higher ALFF.
- Higher Language Factor Scores were associated with lower language network ALFF.
- Age by Language Factor Score interaction: Only in the younger group (YA), but not in the middle-aged (MA), or the older group (OA), higher Language Factor scores tended to be associated with lower language network ALFF.

The Relationship between Age, Language Factor Score, and Language Network Degree

- Increased age was associated with lower total degree in the language network.
- The main effect of Language Factor Score, and its interaction with Age were not significant on total degree.
- Increased age was associated with higher BOLD amplitude but decreased connectivity within the language network during resting-state.
- Higher language abilities were associated with lower BOLD amplitude within the language network, and this relationship was the strongest among younger adults.

Discussion & Conclusions

- The age-related increased BOLD amplitude in the language network during resting-state, along with the overall negative relationship between BOLD amplitude and language ability, indicate that increases in BOLD amplitude is cognitively detrimental across the lifespan.
- Increased age was related to decreased within-network connectivity in the language network, consistent with previous studies, suggesting network dedifferentiation with aging (Ferré et al., 2019; Betzel et al., 2014; Chan et al., 2014; Varanis et al., 2019).
- Highlights the role of BOLD amplitude (i.e., ALFF) as a potential biomarker in characterizing the relationships between resting-state brain activity, age, and cognition.

References & Acknowledgments


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