

Cerebral White Matter Fiber Tracking: Adult Age and Attention

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INTRODUCTION

Structural and functional neuroimaging studies suggest that a network of frontal and parietal regions is critical for performance in tasks involving visual attention. Behavioral research has documented that older adults perform worse than younger adults in several aspects of attention, one of which is the ability to switch between different tasks. Little evidence is available, however, to determine whether there is a direct role of white matter integrity in age-related changes in attention.

This research had two goals: First, to investigate age-related change in white matter integrity in the frontoparietal network, using diffusion tensor imaging (DTI) and fiber tracking. Second, to determine whether age-related change in performance in task switching is mediated by white matter integrity in specific components of the frontoparietal network.

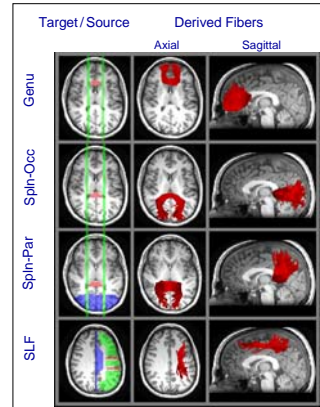
METHODS


Participants:

20 younger (20-28 yrs, $M = 23.90$) and 20 older (63-78 yrs, $M = 69.58$), right-handed, healthy, community-dwelling adults.

Diffusion Tensor Imaging & Fiber Tracking:

MRI conducted at 3T; 52 contiguous near-axial slices parallel to AC-PC; 2.4 mm thick; TR = 17000; diffusion measured in 15 directions ($b = 1000$ sec/mm²) plus 1 image with no diffusion weighting ($b = 0$).

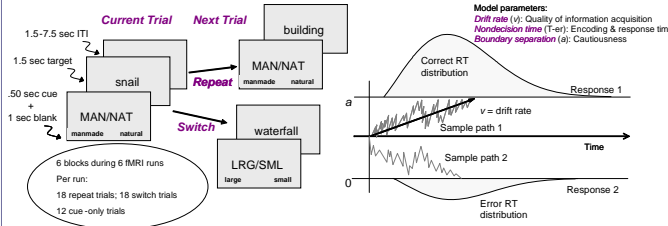


Target Source Exclusion


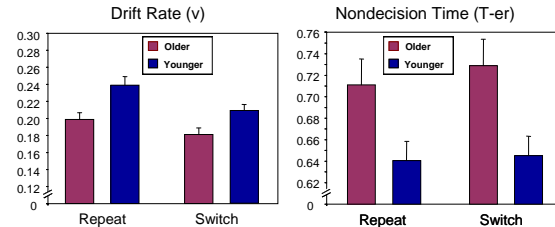
Software:

ROI drawing: ITK_SNAP (www.itksnap.org)
Tensor creation: DTITrack2005 (wwwswp.inria.fr/asclepios/software/MedNRIA)
Tractography: FiberTrack 2.2.1 (www.ia.unc.edu/dev)
Fiber analyses: FiberViewer 1.2.3 (www.ia.unc.edu/dev)

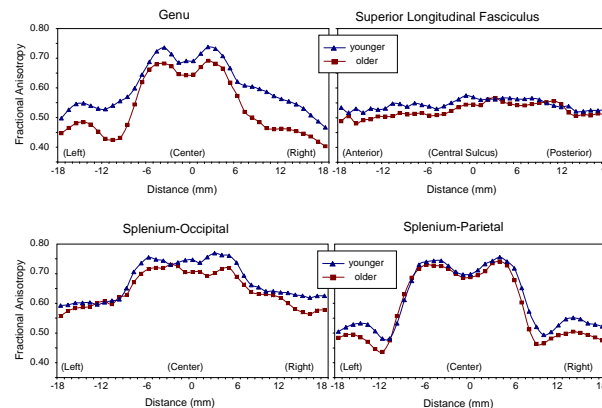
Task Switching:



BEHAVIORAL RESULTS



FIBER TRACKING RESULTS



Testing Mediation

1) Age group difference in mediator:

Genu-left $p < .0001$
Genu-center $.0023$
Genu-right $.0001$

SLF left anterior $.0038$
SLF left posterior ns
SLF right anterior $.0001$
SLF right posterior $.0012$

Splenium -parietal left $.0332$
Splenium -parietal center ns
Splenium -parietal right $.0004$

Splenium -occipital left ns
Splenium -occipital center $.0125$
Splenium -occipital right $.0056$

2) Age group difference in dependent variable(s):

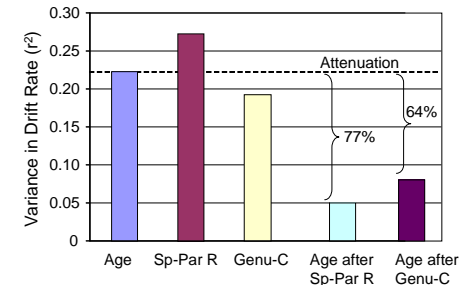
Drift rate (v) $p < .0022$
Nondecision time (T-er) $.0127$

Averaged over switch and repeat because no interaction with age group significant.

3) Significant effects of mediator on performance, covaried for age

Nondecision time (T-er) none $p < .0521$
Drift rate (v) Genu-center $.0521$
Splenium-parietal right $.0269$

Attenuation of Age-Related Variance in Task Switching



CONCLUSIONS

- Age-related decline occurs in behavioral measures of task switching: Evidence accumulation, encoding-response time, and cautiousness.
- Age-related decline occurs in white matter integrity: Decline in FA occurs throughout the frontoparietal network.
- Age-related decline in white matter integrity mediates age-related decline in task switching performance: Performance mediated by white matter integrity in splenium-parietal fibers (right-hemisphere) and central genu.
- Mediation is associated with evidence accumulation, not encoding and response time.