INTRODUCTION

IMPLICIT SEQUENCE LEARNING describes non-conscious sensitivity to sequential regularities

GRAY MATTER SUBSTRATES include frontal cortex (DLPFC, premotor, supplementary motor), striatum (caudate, putamen), and cerebellum (Jenkins et al., 1994; Pasqual-Leone et al., 1996; Rauch et al., 1997)

OLDER ADULTS often show smaller implicit sequence learning effects than younger adults (Curran, 1997; Howard, et al., 2004)

• May reflect age differences in underlying brain regions (e.g. volume decline in gray matter substrates; frontal-striatal neurotransmitter disruption) (Heida & Gabrieli, 2005; Kennedy & Raz, 2005; Rauch, 2000; Raz et al., 2005)

WHITE MATTER SUBSTRATES of implicit sequence learning are unknown

• Implications for aging because of robust age-related differences in white matter (Pfefferbaum et al., 2005; Raz & Rodrigue, 2006; Wallin & Pfefferbaum, 2006)

PRESENT STUDY ASSESSED:
• White matter correlates of implicit sequence learning
• Age differences in white matter integrity-implicit sequence learning relationships

METHOD

PARTICIPANTS
14 younger adults (18.9 ± 0.7 years; 9 female)
13 older adults (67.8 ± 3.2 years; 10 female)

GENERAL PROCEDURE
• DAY 1: Diffusion Tensor Imaging (DTI)
• DAY 2: Alternating Serial Reaction Time (ASRT)

DTI METHODS
• 3T Siemens Trio
• One EPI sequence acquired per participant
  - Diffusion weighted gradients b=0 and b=1000 s/mm² applied in 35 orthogonal directions
  - 55 axial interleaved slices
  - 2.5 mm² spatial resolution
  - TR/TE=7700/100ms
  - FOV=240x240 mm
• FMRIB’s diffusion toolbox (Smith et al., 2004)
  - EddyCorrect: corrected eddy current distortion
  - BET binary brain mask: limited tensor fitting to brain space
  - DTIfit: independently fit diffusion tensors to each voxel
  - Fractional Anisotropy (FA) maps derived from eigenvalues of the diffusion tensor
  - T-test showing voxels where FA is higher in Younger versus Older adults (dark blue)
  - Correlations from masked voxels (light blue) that have age differences in FA and that correlate with sequence learning

AGE DIFFERENCES IN WHITE MATTER INTEGRITY
• T-test showing voxels where FA is higher in Younger versus Older adults (dark blue)
• Correlations from masked voxels (light blue) that have age differences in FA and that correlate with sequence learning

WHITE MATTER INTEGRITY-SEQUENCE LEARNING RELATIONSHIP
• Separate FA x ASRT last epoch learning voxel-wise positive correlations for Younger and Older adults

SUMMARY AND DISCUSSION

There are age differences in white matter correlates of implicit sequence learning

• In younger adults, superior learning in the ASRT task was related to higher white matter integrity in frontal regions (adjacent to the striatum; right dorsolateral prefrontal cortex, DLPFC; and right premotor cortex) and the cerebellum
  - Consistent with activation patterns from functional imaging studies of implicit sequence learning
  - Older adults showed similar correlations in one frontal region (near premotor cortex) and the cerebellum
  - Plus additional regions (bilateral frontal coronal radiata, corpus callosum, bilateral posterior superior longitudinal fasciculus)

Results are reminiscent of age-related compensation seen in functional imaging studies
• No group differences in learning
• Age differences in white matter correlates of learning
• Age-related decline in underlying white matter integrity