FMRl evidence for HIV-induced acceleration of aging in middle-aged women

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ABSTRACT

- Studies have shown that HIV-associated neurocognitive disorders (HAND) are more severe in older people with HIV disease than their younger counterparts, and it has been suggested that the increased vulnerability might be due to HIV-induced accelerated aging.
- In cognitive aging, it has been proposed that age-related cognitive decline might be due to age-related neural deactivation, i.e., a decrease in neural specificity, which precedes the onset of significant behavioral changes, as shown in recent functional magnetic resonance imaging (fMRI) studies of aging. Here we hypothesize that HIV-induced acceleration of aging will lead to a decrease in neural specificity in middle-aged adults, similar to those observed in older adults, probably due to synaptic damage and/or increased neural noise.
- We present a study, using two advanced fMRI techniques—fMRI rapid adaptation (fMRI-RA) and local region heterogeneity (Hcorr)—both capable of measuring neural specificity more directly than conventional fMRI techniques, we directly tested this hypothesis.

IMRF-RA functional Magnetic Resonance Imaging - rapid adaptation

A fundamental problem limiting the ability of conventional fMRI is that the average activation level observed in fMRI experiments may not necessarily reflect neural specificity. Because of the limited spatial resolution of fMRI, a particular voxel response could be obtained by a neuron in the voxel which each responds selectively to many different stimuli (low neural specificity), or by a large number of highly selective neurons which each respond only to a few stimulus (high neural specificity), yet these two scenarios have very different implications for behavioral discrimination ability.

fMRI RA is a technique that uses a rapid adaptation procedure to measure neural specificity. The rapid adaptation technique can be used to measure Hcorr, and that the degree of adaptation depends on neural similarity, with repetitions of the same stimulus causing the greatest suppression. Several studies have provided evidence that parametric changes in visual object parameters (shape, orientation, or viewpoint) are reflected in systematic modulations of the fMRI-RA signal, and can be used as an indirect measure of neural population tuning, i.e., neural specificity.

METHODS

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Participants: Twenty-nine middle-aged (45-58 years old) women with no major psychiatric disorders or other confounding health problems (10 HIV-negative controls) and 19 HIV-positive women (13 HIV-infected and 6 HIV-uninfected) were recruited through the Washington DC site of the Women’s Interagency HIV Study. Participants in this study. The two groups were matched in age, education, and socioeconomic status (SES). The Mini-mental status examination (MMSE) was used to screen for potential dementia.

Experimental design:

- Stimuli—Inverted face

- Functional localizer scans:
  - M6
  - M12

- Event-related scans (fMRI-RA):

- Hcorr
  - HIV-(p<0.05)
  - HIV+(p<0.05)

RESULTS AND DISCUSSION

DEMOGRAPHICS & MMSE

PSYCHOPHYSICS

CONVENTIONAL fMRI

DISCUSSION

While behavioral and conventional MRI techniques failed to identify subtle neuronal dysfunction in asymptomatic HIV+ patients, two advanced fMRI techniques, fMRI-RA and Hcorr, revealed a decrease in neural specificity in HIV-positive patients, suggesting an age-related neural deactivation due to the acceleration of aging, similar to those observed in cognitive aging, providing a direct support to the accelerated aging theory.

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