**Age-related Changes in Processing Emotional Distracters: An fMRI Study**

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**INTRODUCTION**

- The frontal aging hypothesis predicts that functions critically dependent on frontal regions would decline in aging [1,2]. Attentional executive control processes including updating and maintaining information in working memory, shifting between mental sets, and intentionally inhibiting irrelevant information appear to be particularly vulnerable to age-related decline [3].
- Avoiding distraction by emotional events and maintaining goal directed behavior is an important skill in life and critically dependent on attentional executive control.
- In previous studies in young healthy population [4,5], we used an emotional oddball distraction task which evoked activation in dorsolateral prefrontal cortex (dlPFC) by attentional targets and in ventrolateral prefrontal cortex (vlPFC) by emotional distracters. However, age-related neural changes associated with the control of distraction have rarely been examined.
- In current study, the same task was applied in healthy young and elderly volunteers to evaluate aging-associated changes in executive control over emotional distraction.

**RESULTS**

1. The elderly showed less activation to sad distracters (sad vs neutral contrast) compared with the young in the ventrolateral prefrontal cortex (vlPFC), fusiform gyrus (FFG) and visual cortex, but not in the amygdala (* significant difference in peak activation).

2. The elderly showed less activation to attentional targets compared with the young in the dorsolateral prefrontal cortex (dlPFC) and vlPFC, but showed more activation in the supplementary motor cortex, motor cortex, frontal eye field and inferior parietal cortex.

3. There was no significant difference in subjective emotion ratings between older and younger subjects.

4. In the young, greater activations in the right vlPFC evoked by sad contrast and targets were correlated with faster RTs (r > 0.5, p<0.005). The correlations were not found in the elderly.

**CONCLUSIONS**

Attentional targets activated the dorsal attentional executive system including dorsolateral prefrontal cortex (dlPFC) and the dorsal anterior cingulate, while sad distracters activated the ventral emotional system including ventrolateral prefrontal cortex (vlPFC), fusiform gyrus and amygdala in both young and elderly. Consistent with the ‘frontal aging hypothesis’[1,2], the elderly revealed slower reaction time (RT) to attentional targets accompanied by decreased activation in the dlPFC, vlPFC and increase activation in the supplementary motor cortex and motor cortex suggested a compensatory effort. The elderly also showed lower activation in response to sad distracters in the vlPFC, fusiform gyrus and visual cortex, but not amygdala. In the young, greater activity in the IFG evoked by sad distracters and targets was correlated with faster RTs, suggesting that the IFG was instrumental in inhibiting distraction. This correlation was not found in the elderly, suggesting a decline in inhibition processing in aging supported by decreased activation in the elderly in this region in response to both sad distracters and attentional targets. An alternative explanation might be that the sad stimuli might be less distractive.

**REFERENCES**


**METHODS**

**Summary of subjects (* two sample t test, p<0.05)**

<table>
<thead>
<tr>
<th>No. of Subjects</th>
<th>Young</th>
<th>Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Female/male</td>
<td>12/7</td>
<td>10/6</td>
</tr>
<tr>
<td>Age (mean±SD) yrs</td>
<td>36.5±10.5</td>
<td>73.1±5.3</td>
</tr>
<tr>
<td>Reaction time to targets (mean±SD)</td>
<td>590±95ms</td>
<td>652±104ms*</td>
</tr>
</tbody>
</table>

**Experimental design**

- There were 10 runs of 150 images each (3.3% sad, 3.3% neutral, 3.3% targets, 90% standards).
- Sad and neutral pictures were matched for visual complexity and presence of human figures.
- Subjects pushed a button whenever a circle (target) appeared.

**Functional Imaging Acquisition (4T GE Scanner)**

- High-resolution 3-D SPGR structural series (256 ×256 × 68 matrix; 24 cm FOV)
- 34 slices of functional data covering the whole brain acquired along AC-PC line
- BOLD contrast-sensitive images acquired using an inward spiral imaging sequence
- TR = 2 s, TE =31 ms, flip angle = 60°, 642 matrix, 24 cm FOV, 3.75-mm³ isotropic voxels

**Reaction time (RT) recording and emotional rating**

- RT: Subjects pushed a button upon target detection. RT to targets was recorded.
- Emotional Rating: Subject rated the distracter pictures on a 5-point rating scale indicating intensity of sadness. Only those that were rated as neutral, sad and very sad were included in the analysis as neutral and sad stimuli.

**fMRI Data Analysis**

- Voxel-based analysis using random-effects model (p<0.001, FDR corrected threshold).
- Region-of-Interest (ROI) Analysis Using the Activated voxels identified in the voxel-based analysis
- Time-activation waveforms were computed for each hemisphere using mean value of all voxels in each ROI to visualize the HDR time course and compute ANOVAs on peak signal change at peak timepoint (6s after stimuli), p<0.05 were reported as significant.
- Voxel-based Pearson’s correlation analysis on signal percentage change and reaction time (RT)

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