

Neural Correlates of Feigned Hearing

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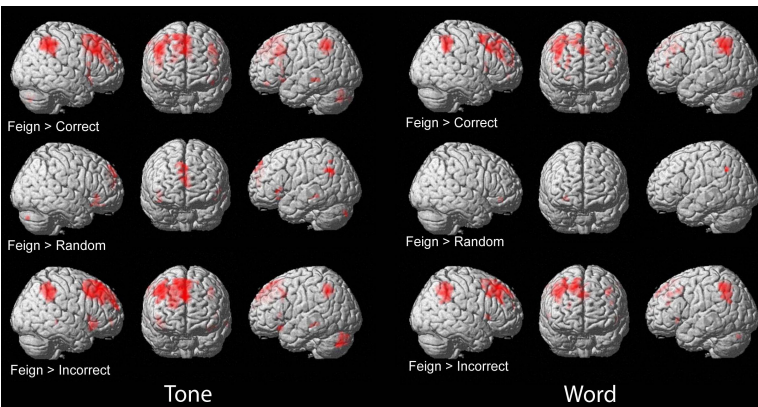
Introduction

Identifying when a person truly has or has not heard a sound can be challenging, particularly when using traditional behavioral measures of hearing on an individual who is trying to feign a hearing loss, usually for the purpose of compensation(1). Behavioral audiology tests combined with psychology tests do not always provide the clear evidence required to confirm or deny the presence of a feigned hearing loss. Recent neuropsychological research into acts of deceptive behavior (such as feigned memory impairment (2) and lying (3-5)) has suggested that these acts have regular neural correlates that can be detected using neuroimaging techniques such as functional magnetic resonance imaging (fMRI). In the present study, we hypothesized that regular neural correlates, particularly pre-response, bilateral activation of prefrontal and neighboring regions of the cortex, would be observed in adult participants asked to feign a hearing loss whilst completing pure tone and speech detection tasks with additional simultaneous fMRI recording.

Methods

In total, 13 participants (8 females and 5 males) completed the tone listening tasks and 14 participants (8 females, 6 males) completed the word listening task, both a forced-choice design. In the tone listening tasks, one or two 1000 Hz pure tones were played; in the word listening tasks, the same word twice or two different words were played (each word being 1s in length, with both words delivered within 2s), to each participant at a level clearly audible above the fMRI scanner noise. The participants were told to respond to the tone and word stimuli in four different ways: correctly, incorrectly, randomly and feigned. These response options were randomly requested in sequential blocks. In a correct block, the participants were told to respond "One" for the single long tone or one word presented twice; and "Two" when two short tones or two different words occurred, and the opposite for the incorrect condition. In a random block, they were asked to alter their responses randomly between correct and incorrect. In a feigned block, the participants were told to "feign a serious hearing loss in both ears by deliberately responding to the sounds we present to you in a way that will give us the impression that you have a hearing loss. To help you to do this, imagine a scenario where your successful feigning of a hearing loss would result in you receiving a substantial sum of money as a compensation payout. You should therefore fake your hearing loss skilfully so that we cannot tell that you are faking."

During both tasks, 285 GE-EPI brain volumes were acquired with a 4T Bruker MedSpec system (36 slices, in-plane resolution of 3.60 mm, slice thickness 3 mm (0.6 mm gap), and TE/TR= 30ms/2.1s). The time series were realigned, coregistered with the subjects' MP-RAGE 3D T1 (TI/TR/TE=700ms/1500ms/3.35ms and a resolution of (0.9mm)³), which was segmented and normalised to atlas space in SPM5. This transformation was applied to the EPI images, which were normalised and smoothed before a fixed effects analysis.



Results

Feigning compared with either Correct or Incorrect trials showed similar areas of significantly greater activations within predominantly right prefrontal areas for the tone or word tasks, although they were more extensive for the tone task (Fig 1). The largest cluster extended from the left superior medial gyrus and left anterior cingulate cortex to right inferior and right middle frontal gyrii, and right middle cingulate cortex. Bilateral inferior parietal lobule activation was also seen in both comparisons, extending on the left to the angular gyrus, and on the right to the supramarginal gyrus. Additional areas were seen in left middle and inferior frontal gyrus, and left cerebellum. In the tone task, there were additional areas in the right inferior frontal gyrus, and left middle temporal gyrus.

Feigning compared with Random trials for the word task showed left supramarginal gyrus and right middle orbital gyrus, but was more extensive for the tone task, and in addition left superior medial gyrus, left middle temple gyrus, bilateral inferior frontal gyrus and smaller clusters bilaterally in the cerebellum (crus 2).

Reaction times from the responses to the Tone and Word tasks are given in Table 1. Feigned condition was significantly longer than Correct or Random trials.

Table 1. Reaction times in ms averaged across all trials or only correct trials. Means (SD).

Condition	Tone (all trials)	Tone (correct only)	Word (all trials)	Word (correct only)
Correct	855.06 (391.37)	838.63 (374.15)	957.42 (420.55)	944.01 (411.36)
Random	777.25 (484.37)	777.25 (484.36)	790.14 (451.54)	790.14 (451.54)
Incorrect	1013.78 (413.06)	1057.84 (657.31)	1262.29 (548.35)	1220.66 (529.99)
Feigned	1075.18 (530.71)	1075.18 (530.71)	1257.29 (542.69)	1259.72 (542.17)

Discussion

We observed more activity in the prefrontal cortices (as measured by functional magnetic resonance imaging) and delayed response times when these participants feigned a hearing loss or responded randomly versus when they responded correctly or incorrectly. These results suggest that cortical imaging techniques could play an important role in identifying individuals

who are feigning hearing loss.

References:

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