“I Know You Can Hear Me”: Neural Correlates of Feigned Hearing Loss

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Abstract: In the assessment of human hearing, it is often important to determine whether hearing loss is organic or nonorganic in nature. Nonorganic, or functional, hearing loss is often associated with deceptive intention on the part of the listener. Over the past decade, functional neuroimaging has been used to study the neural correlates of deception, and studies have consistently highlighted the contribution of the prefrontal cortex in such behaviors. Can patterns of brain activity be similarly used to detect when an individual is feigning a hearing loss? To answer this question, 15 adult participants were requested to respond to pure tones and simple words correctly, incorrectly, randomly, or with the intent to feign a hearing loss. As predicted, more activity was observed in the prefrontal cortices (as measured by functional magnetic resonance imaging), and delayed behavioral reaction times were noted, when the participants feigned a hearing loss or responded randomly versus when they responded correctly or incorrectly. The results suggest that cortical imaging techniques could play a role in identifying individuals who are feigning hearing loss. *Hum Brain Mapp* 33:1964–1972, 2012. © 2011 Wiley Periodicals, Inc.

Key words: deception; hearing loss; fMRI

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 attempting to feign a hearing loss. A feigned hearing loss is often referred to as a functional hearing loss and can occur where the hearing assessment is being conducted for the purpose of compensation [Austen and Lynch, 2004]. In these cases, individuals may feign a total hearing loss or they may exaggerate the extent of their true hearing loss.

The current “gold standards” for identifying hearing loss are pure tone audiometry and speech audiometry. These behavioral tests typically require the person to indicate (by pressing a button or raising their finger) when they hear pure tones or simple words played through earphones. Although other behavioral tests [Boyd et al., 1991] and physiological tests such as otoacoustic emissions [Chan et al., 2004], acoustic reflexes [Gelfand, 1994], and auditory evoked potentials [Hone et al., 2003] can be used to support or cast doubt on pure tone audiometry and speech audiometry findings, these extra tests do not

Contract grant sponsor: University of Hong Kong Research; Contract grant number: 10207882.

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Received for publication 2 March 2010; Revised 21 February 2011; Accepted 4 April 2011

DOI: 10.1002/hbm.21337

Published online 14 July 2011 in Wiley Online Library (wileyonlinelibrary.com).

always provide the clear evidence required to confirm or deny the presence of a feigned hearing loss.

Recent neuropsychological research into acts of dissimulation has suggested that such acts are associated with pre-response, bilateral activation of prefrontal, and neighboring regions of the cortex [Christ et al., 2009]. In particular, a growing body of research indicates that deceptive behaviors such as lying [Kozel et al., 2009; Langleben et al., 2005; Lee et al., 2002], feigned memory impairment [Lee et al., 2005], falsifying memories [Abe et al., 2007], and concealing information [Bles and Haynes, 2008; Gamer et al., 2009] have regular neural correlates that can be detected using neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography. Furthermore, indirect evidence that such neural correlates may occur is seen in the delayed reaction times to auditory stimuli in individuals feigning a hearing loss [Wood et al., 1977] and more generally in other dissimulation studies [Vrij, 2000].

In the present study, we hypothesized that fMRI recording would identify regular neural correlates in the form of prereponse, bilateral activation of prefrontal, and neighboring regions of the cortex, in adult participants instructed to feign a hearing loss (simulated malingering) whilst completing pure tone and speech detection tasks.

SUBJECTS AND METHODS

Participants

Fifteen (8 females and 7 males) healthy, right handed, native English speaking participants volunteered for this study. Their average age was 26.33 years ($SD = 7.38$), and their average years of education (YE) were 16.9 years ($SD = 2.47$). Handedness was assessed with the 10-item Edinburgh Handedness Inventory [Oldfield, 1971], and the mean laterality quotient (LQ) was 91.8 ($SD = 9.82$). Hearing levels were assessed using pure tone audiometry before scanning to ensure all participants had thresholds within the normal range in both ears. A Madsen Electronics Micromate 304 screening audiometer with ME70 noise-excluding headset and TDH39 earphones, calibrated to IEC 60645-2002 standards, was used to assess air conduction hearing in the left and right ears across the octave frequencies from 500 to 4,000 Hz at a 25 dBHL screening level in a quiet office environment. Thirteen participants (8 females and 5 males) completed the tone listening task (mean age = 27.0, $SD = 7.74$; mean YE = 17.04, $SD = 2.6$; mean LQ = 92.1, and $SD = 9.92$) and fourteen participants (8 females and 6 males) completed the word listening task (mean age = 26.57, $SD = 7.6$; mean YE = 16.89, $SD = 2.56$; mean LQ = 91.2, and $SD = 9.92$). One subject was excluded from analysis as he failed to follow the instructions, and one subject failed to complete one of the tasks as he became uncomfortable and terminated the scan. Informed consent was obtained from all participants, and the experimental protocol was approved by the University

of Queensland's Medical Research Ethics Committee and Wesley Hospital's Uniting Health Ethics Committee.

Tasks

Each participant completed a series of forced-two-choice tasks involving tones and words within a single MR session. A personal computer (PC) was used to present the stimuli to each participant via MR-compatible insert earphones. After each stimulus was presented, each participant was instructed to press the left or right button on an MR-compatible, two-button mouse that matched the left or right location of the words "One" and "Two" on the PC's screen image. This was projected to the participants via an MR-compatible mirror located above their head in the MR scanner. The left or right positions of the "One" or "Two" options on the computer screen were randomly alternated across all presentations. Participants were given 2.5 s in which to choose "One" or "Two" and were instructed that a "no response" choice was invalid. Performance feedback was given visually by the display of the chosen alternative turning red for 250-ms postresponse.

For the forced-two-choice tasks involving tones, the "One" stimulus condition consisted of a 1 s tone and the "Two" stimulus condition consisted of two 400 ms tones separated by a 200 ms gap. All tones were created in Adobe Audition (version 1.0; Adobe Systems Incorporated) and were 1,000 Hz in frequency, sampled in mono at 16-bit and 44.1 kHz, and normalized to 0 dB.

For the forced-two-choice tasks involving words, the "One" stimulus condition consisted of a 1-s monosyllabic word played twice (e.g., "fog fog") and the "Two" stimulus condition consisted of two different 1-s monosyllabic words each played once (e.g., "hug cheese"). One hundred and forty-four words were chosen from the Australian English recording (male speaker) of the Arthur Boothroyd (AB) wordlists recorded onto CD by the National Acoustic Laboratories (NAL) [Travers, 1990; Wilson et al., 1998]. The words used in the "Two" stimulus presentations were matched to ensure that their phonological components were sufficiently different to reduce any confusion. All words were sampled from the NAL AB Words CD into Adobe Audition (version 1.0; Adobe Systems Incorporated) in mono at 16-bit and 44.1 kHz and normalized to 0 dB.

Scanner noise is generally at high levels [Amaro et al., 2002], but the tones and words were delivered at an intensity that was clearly distinguishable above the fMRI ambient noise, as confirmed by the participant's audiometric results and by the researchers asking the participants if they had heard any stimuli at all after the participants had completed each task.

Instruction Protocol

Participants were given different instructions for the four conditions of the tone and word tasks: Correct,

Incorrect, Random, and Feigned. These conditions were presented in blocks. Before each block, the condition label appeared on the PC screen for 3 s. There were six events in a condition block, and each condition was repeated four times in a Latin-square design; a total of 96 trials. The order of the tones or words was also randomized in a Latin-square design and varied for each subject.

In a Correct block, the participants were told to respond "One" for the "One" stimulus condition (one tone or one word played twice) and "Two" for the "Two" stimulus condition (two tones or two *different* words). In an Incorrect block, the participants were told to respond "Two" for the "One" stimulus condition and "One" for the "Two" stimulus condition. In a Random block, the participants were asked to alter their responses randomly between correct and incorrect. In a Feigned block, they were asked 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 skillfully so that we cannot tell that you are faking". This was analogous to instructions used in earlier deception studies [Lee et al., 2002, 2005].

Reaction Times

The reaction times for each participant to every stimulus were recorded by the PC as the time from the end of a stimulus presentation to the time the participant activated the mouse button to indicate his or her response. As each participant provided multiple responses to the same stimuli during each condition block (Correct, Incorrect, Random, and Feigned), each participant's final reaction times for each block were taken first as the average of the reaction times to all stimuli in that block and second as the average of the reaction times for only the correct responses in that block (where a response was deemed incorrect if the subject responded incorrectly during a Correct trial, correctly during an Incorrect trial, or did not respond within the 2.5-s response window).

Image Acquisition

Images were acquired using a 4 T Bruker MedSpec system, using a transverse electromagnetic head coil for radiofrequency transmission and reception [Vaughan et al., 2002]. T2-weighted gradient echoplanar images were used to obtain blood oxygen level dependent [Ogawa et al., 1990] images during the tone and word listening tasks, with an echo time (TE) of 30 ms. During the tone listening task, 238 brain volumes were acquired, each volume consisting of 36 planes, with an in-plane resolution of 3.60×3.60 mm and a slice thickness of 3 mm (0.6 mm gap), and

a repetition time (TR) of 2.1 s. During the word listening task, 285 brain volumes of identical parameters to those of the tone listening task were acquired. Geometric distortions in the echo planar images caused by magnetic field inhomogeneities at high-field were corrected on the scanner console using a point-spread mapping approach [Zaitsev et al., 2003]. The first five volumes were ignored, and so tissue magnetization could reach a steady state. Foam padding was used to limit head movement. A high-resolution MP-RAGE 3D T1 image was acquired within the same session, with an inversion recovery time (TI) of 700 ms, TR of 1,500 ms, TE of 3.35 ms, and a resolution of $(0.90 \times 0.90 \times 0.90)$ mm³.

Data Analysis

Reaction times

Initial analysis of the reaction time data showed no major breaches of parametric assumptions (as shown on histograms, Q-Q plots, and analyses of skewness, kurtosis, and sphericity). As a result, all reaction times were analyzed using a 2×4 repeated measures ANOVA analysis at the 5% level, where the first factor was stimulus type (tone or word), and the second factor was test condition (Correct, Incorrect, Random, or Feigned). Where significant ANOVA results were obtained, post hoc analyses were conducted using Tukey's Honest Significant Difference (THSD) analyses at the 5% level. These analyses were conducted both for all responses and for correct responses only (e.g., a "correct" response during an "Incorrect" trial).

fMRI

The functional images from each participant were realigned using rigid body motion correction and a mean image generated [Freire et al., 2002]. This mean image was coregistered with the subject's MP-RAGE 3D T1 image, and the latter segmented and normalized to the standard T1 template image in MNI atlas space using statistical parametric mapping software (SPM5; Wellcome Department of Imaging Neuroscience, University College London, UK). The resulting transformation to atlas space was next applied to the functional time series from which the mean had been generated, and the normalized volumes subsequently resampled to 3 mm³ voxels and smoothed with an isotropic Gaussian kernel (full width half maximum = 8 mm). Global signal effects were estimated and removed using a voxel-level linear model [Macey et al., 2004].

A fixed effect analysis was conducted for each participant's data and each task within SPM5. Both tasks involved regressors for the four conditions: "Correct," "Incorrect," "Random," and "Feigned." Blocks of stimuli were modeled with a synthetic hemodynamic response function with derivatives according to their respective durations. Serial correlations were modeled in the context of the AR(1) model. Low frequency fluctuations were removed with a

TABLE I. Reaction time in ms from Tone and Word listening tasks, averaged across all trials or only correct trials

Condition	Tone (all trials; ms)	Tone (correct only; ms)	Word (all trials; ms)	Word (correct only; ms)
Correct	861 (218)	851 (202)	958 (218)	944 (205)
Random	789 (327)	789 (327)	792 (301)	792 (301)
Incorrect	1017 (215)	1062 (282)	1266 (232)	1230 (233)
Feigned	1089 (337)	1089 (337)	1268 (302)	1268 (302)

Note: Data are means with standard deviations in parentheses.

128-s high pass filter. Five main contrasts of interest were generated; each of the three involved conditions versus Correct and Feigned compared to Random and Incorrect.

In a second-level group random effects analysis, linear contrasts of the parameter estimates were subjected to one-sample *t*-tests. Functional activations were assigned anatomical labels using a probabilistic cytoarchitectonic map (Eickhoff et al., 2006, 2007).

RESULTS

Overall, the participants responded correctly in more than 94% of trials for both the tone and word listening tasks, where a response was deemed incorrect if the subject responded incorrectly during a Correct trial, correctly during an Incorrect trial, or did not respond within the 2.5-s response window. The percentage correct responses for the tone listening task were 95.5% for the Correct condition; 92.0% for the Incorrect condition; 93.4% for the Feigned condition; and 96.9% for the Random condition. The percentage correct responses for the word listening task were 93.1% correct for the Correct condition; 87.8% for the Incorrect condition; 96.1% for the Feigned condition; and 99.7% for the Random condition. (Note: 100% scores were not achieved for the random response trials as some participants failed to respond to some stimuli).

Reaction Times

The mean and standard deviation of the reaction times for the tone and word listening tasks are presented in Table I. Reaction times were assessed both for all responses and for correct responses only (e.g., a “correct” response during an “Incorrect” trial).

The ANOVA analyses showed significant main effects for test condition (correct, incorrect, random, or feign; $P < 0.00005$) but not for stimulus type (tone or word). For the tone task, the THSD analyses showed the reaction times in the Feigned and Incorrect conditions were significantly longer ($P < 0.05$) than in the Correct and Random conditions. For the word task, the THSD analyses showed the reaction times in the Feigned and Incorrect conditions were significantly longer ($P < 0.05$) than in the Correct condition which, in turn, were significantly longer ($P < 0.05$) than in the Random condition. All of the above results were found both for all responses and for correct

responses only (e.g., a “correct” response during an “Incorrect” trial).

fMRI Group Results

The whole-brain activations surviving a height threshold of $P < 0.001$ and a cluster threshold of >20 voxels are presented for the tone listening task in Figure 1, with MNI voxel coordinates of peak maxima in Tables II and III for the individual contrasts.

Feigned compared to either Correct or Incorrect trials for the tone listening task showed activations of predominantly right prefrontal areas; the largest cluster extending from the left superior medial gyrus and left anterior cingulate cortex to right inferior frontal gyrus, right middle frontal gyrus, and right middle cingulate cortex. Right supramarginal gyrus was activated in both comparisons in a large cluster including right inferior parietal lobule, as was left inferior parietal lobule, left inferior frontal gyrus (pars triangularis and pars orbitalis; Brodmann areas 44–45), left middle frontal gyrus, left cerebellum, and left middle temporal gyrus.

Only small regions of activation survived the thresholds comparing Incorrect and Correct blocks for the tone listening task, including both left and right supramarginal gyrus; a cluster extending from left middle to left precentral gyrus; a medially positioned cluster linking left and right middle cingulate gyri, with peak maxima at the left superior medial gyrus; left inferior frontal gyrus (76% of the cluster within Brodmann area 44); and left inferior frontal gyrus (pars triangularis; 60% of the cluster overlapping Brodmann area 45). However, for this contrast, no clusters survived when thresholded at 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with 20 voxels per cluster. This was similar for the Feigned compared to Random tone listening condition.

When contrasting the Random versus Correct conditions for the tone listening task, activations were apparent in right supramarginal gyrus with the cluster extending into the right inferior parietal lobule (within hippocampus 1, hippocampus 2 and Brodmann area 2); left inferior parietal lobule (40% of the cluster was in left hippocampus 2, and 17% within Brodmann area 2); right middle and superior frontal gyrus; left middle frontal gyrus; right inferior frontal gyrus (pars triangularis); right superior frontal gyrus; and left cerebellum. For this contrast no clusters survived

Figure 1.

Whole-brain functional activations surviving $P < 0.001$ and greater than 20 voxel cluster thresholds for the tone listening task. Each of the contrasts are represented on a single-rendered brain; one each line as labeled.

TABLE II. Peak maxima for the main effect of Feigned > Correct in Tone listening task

Brain region	Coordinates (x, y, z)	Z-score	Cluster size
Left superior medial gyrus	0, 39, 33	5.31	2,079
Right supramarginal gyrus	51, -45, 42	5.27	519
Left inferior frontal gyrus (p. triangularis)	-42, 21, 36	4.69	462
Left inferior parietal lobule	-54, -54, 48	4.61	386
Left middle temporal gyrus	-57, -36, -6	4.14	67
Left cerebellum (crus 2)	-36, -72, -39	4.04	287
Right cerebellum (VII)	30, -75, -42	3.89	67
Left inferior frontal gyrus (p. orbitalis)	-42, 45, -15	4.6	23

Peak coordinate regions surviving an α threshold of 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with a cluster threshold of >20 voxels.

when thresholded at 0.05 corrected for multiple comparisons using the FDR method with 20 voxels per cluster.

Functional activations for the word variation of the forced choice task are presented in Figure 2, with MNI voxel coordinates of peak maxima in Tables IV–VI for the individual contrasts.

Activations resulting from Feigned versus Correct or Incorrect for the word listening task are similar to those for the tone listening task, with the clusters generally less extensive. Significant areas of activation were observed within predominantly right prefrontal regions, with one large cluster extending from the left superior medial gyrus to right middle frontal and right superior medial gyrii, and separate activation of both the right superior frontal gyrus and right inferior frontal gyrus (extending into pars opercularis; percentages of the cluster within Brodmann area 44 and area 45 for both condition comparisons). 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. The Feigned versus Incorrect comparison showed more extensive right supramarginal gyrus activation, extending to the right angular gyrus and right superior temporal gyrus. All clusters survived when thresholded at 0.05 corrected for multiple comparisons using the FDR method with 20 voxels per cluster.

Comparison of the Correct and Incorrect trials for the word listening task revealed similar results to those for the analogous tone listening task, with a small region of activation in the right middle frontal gyrus but with no clusters surviving when thresholded at 0.05 corrected for multiple comparisons using the FDR method with 20 voxels per cluster. In the Feigned versus Random comparison for the word listening task, no clusters survived a height threshold of $P < 0.001$ and a cluster threshold of >20 voxels. This was similar to the findings for the Feigned versus Random comparison for the tone listening task.

The Random versus Correct significant areas were more extensive in the right supramarginal and inferior parietal gyrii and right middle frontal and superior medial regions in the word listening task than the tone listening task, although less of the left inferior parietal lobule was activated. The right inferior frontal gyrus (pars opercularis) showed significant activation (37% of the cluster within area 44 and 31% in area 45), as did the left cerebellum. The majority of clusters survived when thresholded at 0.05 corrected for multiple comparisons using the FDR method with 20 voxels per cluster.

DISCUSSION

For both the tone and word listening tasks, the Feigned hearing loss trials elicited greater activations in prefrontal cortical regions compared to Correct or Incorrect trials, particularly left and right inferior frontal gyri. This finding is consistent with previous dissimulation studies that show lying requires more prefrontal cortical activity than telling the truth [Bles and Haynes, 2008], especially activity in orbitofrontal cortex, ventrolateral and dorsolateral prefrontal cortex, and anterior cingulate cortex [Abe et al., 2007; Bles and Haynes, 2008; Christ et al., 2009; Langleben et al., 2002; Lee et al., 2002, 2005]. This increased activity is thought to reflect the need to inhibit truthful responses and generate false responses when dissimulating.

Both the tone and word listening tasks also showed significant activation of the cerebellum in Feigned conditions. This was also consistent with previous fMRI studies [Abe et al., 2007; Ganis et al., 2003; Kozel et al., 2004] that suggest that the cerebellum has a possible role in many cognitive functions required for effective dissimulation, including working memory [Desmond et al., 2005; Ravizza et al., 2006]. The reaction times in both the tone and word listening tasks were also longer in the Feigned conditions, consistent with longer reaction times for dissimulation

TABLE III. Peak maxima for the main effect of Feigned > Incorrect in Tone listening task

Brain region	Coordinates (x, y, z)	Z-score	Cluster size
Right middle frontal gyrus	36, 36, 39	4.93	1,716
Left cerebellum (Crus 2)	-36, -72, -42	4.88	317
Right inferior frontal gyrus (p. orbitalis)	39, 21, -15	4.72	176
Right supramarginal gyrus	54, -45, 39	4.71	351
Left middle frontal gyrus	-36, 18, 39	4.52	99
Left inferior parietal lobule	-51, -54, 45	4.51	205
Left inferior frontal gyrus (p. orbitalis)	-42, 21, -12	3.88	109
Left middle temporal gyrus	-63, -33, -9	3.66	41

Peak coordinate regions surviving an α threshold of 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with a cluster threshold of >20 voxels.

Figure 2.

Whole-brain functional activations surviving $P < 0.001$ and greater than 20 voxel cluster thresholds for the word listening task. Each of the contrasts are represented on a single-rendered brain; one each line as labeled.

tasks noted in fMRI studies [Spence and Kaylor-Hughes, 2008] and behavioral studies [Wood et al., 1977].

Interestingly, for both the tone and word listening tasks, the Feigned hearing loss trials showed similar brain activity but longer reaction times compared to the random

response trials. This suggests that in a forced-choice design, the most successful feigning strategy could be to respond randomly. However, whether the subject was a clever faker (employing a random strategy, with shorter reaction times) or a novice at feigning (employing another

TABLE IV. Peak maxima for the main effect of Feigned > Correct in Word listening task

Brain region	Coordinates (x, y, z)	Z-score	Cluster size
Left inferior parietal lobule	-51, -48, 54	4.89	393
Right middle frontal gyrus	42, 36, 27	4.70	838
Right supramarginal gyrus	48, -48, 36	4.38	279
Left cerebellum (Crus 2)	-39, -78, -33	3.94	76
Left middle frontal gyrus	-36, 27, 42	3.92	40
Right superior frontal gyrus	24, 57, 27	3.74	56

Peak coordinate regions surviving an α threshold of 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with a cluster threshold of >20 voxels.

strategy in order to deceive, with longer reaction times), their cortical activity may still differ from that of an individual giving a truthful response.

With minor exceptions, the patterns of activation for Feigned versus Correct or Incorrect were task independent, particularly in the feigned versus correct comparison, indicating that brain activity is linked to employment of a similar strategy for both tone and word listening tasks.

There were a number of limitations inherent in this study. Defining a gold standard (verified truth) in naturalistic studies of deceptive behavior is a challenging issue. In this study, prior pure tone audiometric assessments were used as the gold standard for normal hearing thresholds. In routine audiological assessment, speech audiometry and other measures, such as auditory evoked potential recordings, are often used in a test battery approach to detect whether an individual has or has not heard a stimulus. In future studies in this area, it would enhance face validity if such assessment techniques were included in the research protocol. A further limitation was the small sample size of the present study, which restricted the analysis options. Future studies with a larger sample size would allow for detailed examination of the screening utility of this imaging procedure. For example, estimates of the positive and negative predictive value of the test could be derived.

TABLE V. Peak maxima for the main effect of Feigned > Incorrect in Word listening task

Brain region	Coordinates (x, y, z)	Z-score	Cluster size
Right middle frontal gyrus	36, 36, 42	5.09	732
Left inferior parietal lobe	-51, -51, 51	4.81	241
Right supramarginal gyrus	51, -48, 42	4.21	300
Left middle frontal gyrus	-42, 15, 48	3.96	60

Peak coordinate regions surviving an α threshold of 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with a cluster threshold of >20 voxels.

TABLE VI. Peak maxima for the main effect of Random > Correct in Word listening task

Brain region	Coordinates (x, y, z)	Z-score	Cluster size
Right supramarginal gyrus	54, -48, 45	4.90	588
Right middle frontal gyrus	24, 15, 57	4.76	792
Right inferior frontal gyrus (p opercularis)	54, 15, 6	4.28	60
Left cerebellum (Crus 1)	-36, -81, -27	4.10	96
Right superior frontal gyrus	18, 60, 24	3.35	25

Peak coordinate regions surviving an α threshold of 0.05 corrected for multiple comparisons using the false discovery rate (FDR) method with a cluster threshold of >20 voxels.

CONCLUSIONS

The results of this study suggest that patterns of brain activity can be used to detect when an individual is feigning a hearing loss to either tonal or word stimuli as such feigning leads to bilateral activation of prefrontal and neighboring regions of the cortex in a manner similar to that seen in other acts of dissimulation. These results indicate that cortical imaging techniques could play a role in identifying individuals who are feigning hearing loss. A specific barrier to imaging assessment of hearing is the high level of acoustic noise produced by the present generation of fMRI systems but recording strategies exist that minimize noise effects [Amaro et al., 2002].

Future research that aims to categorize dissimulation/truth in individual listeners from a single fMRI trial and studies that investigate the cortical response of listeners who are either (a) responding truthfully or (b) responding deceitfully and later conclusively found to have functional hearing loss based on behavioral and/or existing physiological tests is required to confirm the validity and reliability of this new approach to auditory assessment.

ACKNOWLEDGMENTS

We thank Tatia MC Lee for preliminary discussions and advice regarding this study and Peter Hobden for acquiring the images.

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