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Study on Chinese Sign Language Comprehension of Drug-induced Neurotic Deaf Children after learning language

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Abstract. This study requires the study subjects to complete the tasks of observing and imitating sign language and carries out magnetic resonance examination. Analysis of the activation of the brain region when the subjects observe and imitate sign language.

1. Introduction

Brain function localization refers to the special structure existing in the brain that is closely related to psychological function. Currently, neuropsychologists are keen to use brain function localization methods to study brain function and social information processing systems as an important method to explore social cognitive theory. Besides, researchers in related fields in foreign countries have devoted a lot of efforts to study such cross-over and new research paradigms, and have obtained a lot of research results, showing great theoretical and promotional significance. Based on the above background, some psychologists say that in-depth study of neuroscience can help people better explore the key issues involved in social cognition. The related research in this field is called social cognitive neuroscience.

Sign language belongs to a class of visual and performance language. It mainly displays the corresponding content and concept through the simulation of gestures, and the recipient perceives the content transmitted by others in a visually acceptable way. Such language can effectively integrate expressions, mouth shape, simulation of things and body language. The main advantage is that the written language and spoken language (second signal system) rarely or completely do not have the performance system, the virtual features.

2. Subjects and Research Methods

In this study, all subjects were divided into the following four groups: a total of 14 patients in group I, who belonged to the language of deafness and sign language; A total of 13 patients in group II, who does not understand sign language without hearing loss; A total of 11 patients in group III, who are learning sign language after hearing impaired language; A total of 12 patients in group IV, who are learning sign language after hearing impaired language. After the onset of the language, the onset time of all patients was 2 years old, 12 of which were drug-induced deafness and 2 were hereditary deafness. Before the test, pure tone audiometry was used to observe the binaural frequency exceeding 70dB. For patients with severe sensorineural deafness, the pure tone audiometry operation was performed in the two-layer listening room. The thresholds were selected in order to be 0.25 kHz, 0.5 kHz, 1 kHz, 2 kHz, 4 kHz and 8 kHz. 4 males and 10 females, aged 4 to 26 years old, with an average age of 11.9 years, who do not understand sign language in normal hearing, 5 males and 8 females, aged 4 to 15 years old, with an average age of 8.2 years, normal hearing language pre-learners, 8 males and 3 females, aged 6 to 24 years, mean age 12.2 years, whose parents are monks. They have



been exposed to sign language and Chinese since childhood. Group IV subjects belong to members of the Deaf Association or deaf teachers. There are 5 cases and 7 cases of male and female respectively. The age is in the range of 20 to 26 years old, and the average age is 22.5 years. The group has not received sign language education since childhood. They started learning sign language only after the age of 18, with a contact time of 2 to 4 years, an average of 2.5 years of learning, and a familiar grasp of everyday sign language. The pure tone audiometry results of all hearing impaired persons included in this study indicate that both ears are less than 25dB. The 4 groups of subjects were judged by the Chinese to be right-handed, without serious diseases such as heart, kidney and liver, without a history of mental or neurological disease, without brain malignant tumors or other types of brain lesions.

3. Research Task and Execution

3.1. Research Task

This study requires the study subjects to complete the tasks of observing sign language and imitating sign language. There are a total of 8 sign language pictures, which are the most frequently used sign language in the daily life of the deaf. There are 4 pictures that are needed for this study. Before the study, the subjects are allowed to observe the above pictures, but they are not informed whether they are the pictures needed for the study. Patients, normal hearing and sign language (groups III and IV) know the meaning of the picture, while subjects with normal hearing and no sign language learning cannot know the meaning of the picture. Explain the purpose and research value of this research to the subjects, and obtain their knowledge and consent. After stopping the scan, give all subjects a test list and ask them to fill in the pictures involved in the study and accurately screen them from the pictures. The results show that all the test results are accurate, indicating that they actively and conscientiously cooperate with the research, and can obtain reliable research data.

3.2. Research Execution

Let the subject lie flat on the magnetic resonance examination bed, and the projection screen on the head coil can easily and clearly see the projection screen. In the scanning process, the head of the research object needs to be fixed with a headband and a sponge pad to avoid the head movement, and promptly telling the head movement will have a serious negative impact on the research result, please cooperate with the head still. When scanning RF-FAST sequence and SE sequence, eyes should be closed. When scanning EPI, the research object should keep an eye on the screen and ask the eyeball not to rotate. The preparation of the stimulus program is completed by Visual Basic 6.0 software. At the resting stage, the subject should pay attention to the "+" symbol (72 lbs, black sin, white background) presented on the screen. The following figure illustrates the hints of observing sign language and imitating sign language. The researcher needs to be clear about the specific instructions that are executed, and the researcher should always pay attention throughout the process.

3.3. Stimulus Mode

Block design, resting state for 20 seconds, observe sign language and imitate sign language each of 3 groups, each group of 20 seconds, composed of 4 sign language pictures, each display time is 5 seconds. The composition and order of each group of sign language pictures are consistent.

4. Imaging Method

4.1. Imaging

Magnetic resonance scanning with Marconi Eclipse 1.5T superconducting magnetic resonance imaging, selecting a regular orthogonal head coil. (1) Scan the SE coronal plane to ensure a symmetrical cross-section SE and EPI sequence, correct position. The acquisition parameters are: TR/TE equals 335 ms/12 ms, flip angle = 90°, FOV = 240 mm×240 mm, interval spacing = 0.5 mm, matrix = 196 × 256, slice thickness = 5.5 mm, 17 layers in total, continuous scanning for 55 seconds. (2) Scan the cross section SE T1WI, the following are the specific acquisition parameters: FOV = 240 mm×240 mm, TR/TE = 500 ms/12 ms, matrix = 196 × 256, flip angle = 90°, slice thickness = 6 mm,

interval 0, 20 layers in total, continuous scanning for 3min and 12s. (3) Scan the cross section EPI, the following are the specific acquisition parameters: FOV = 240 mm×240 mm, TR/TE = 3 000 ms/40 ms, flip angle = 90°, matrix = 64 ×64, slice thickness = 6 mm, interval 0, 20 layers in total, 130 frames per layer, a total of 2600, SE T1WI sequence is used for a total of 4min and 20s. (4) The RF-FAST sequence acquires a three-dimensional whole brain image in real time, and then performs three-dimensional reconstruction, spatial registration, and standardization of the image. The acquisition parameters are respectively: TR/TE = 12 ms/4.47 ms, matrix = 196 × 256, FOV = 240 mm×240 mm, flip angle = 20°, slice thickness = 1 mm, interval 0, 182 layers in total, continuous scanning for 8min and 26s.

4.2. Statistical Analysis

The 2D and 3D anatomical image acquisition data (in the format DICOM) is transmitted to the offline workstation, and all the data of the study are processed by AFNI.

5. Imaging Results

5.1. Analysis of the Activation of Brain Regions When the Subjects Observe Sign Language

5.1.1. Comparison of basic conditions of each group of subjects

When data were analyzed for images of individual subjects, 3, 2, 2, and 3 subjects in each of groups I, II, III, and IV had larger head movement range (more than 1/4 of the collected pixels). Their data were rejected. The remaining subjects' image data (four sets of valid data were 11, 11, 9, and 9 respectively) were analyzed, and the variance and chi-square test were performed on the age and gender of the remaining subjects (Table 1). There was no statistically significant difference in age and gender between the groups.

Table 1. Comparison of basic conditions of subjects in each group($\bar{x} \pm s$).

Index	I	II	III	IV	x ² /F	P
Gender(male/ Female)	3/ 8	5/ 6	7/ 2	4/ 5	5.036	0.169
Age(year)	6.55±2.25	9.82±1.72	12.21±1.88	22.44±1.81	0.854	0.474

5.1.2. Comparative analysis of activated brain regions in different groups of subjects when observing sign language

The different groups of subjects observed the same activated key brain regions during the sign language process (≥ 2 groups shared). There were bilateral inferior frontal gyrus, mid-median gyrus, middle iliac crest, upper temporal gyrus, and upper lobular, lower lobule, fusiform gyrus, wedge leaf and lingual gyrus. Table 2 shows the activation area Tournoux, Talairach coordinates and BA partition. The results of analysis of variance showed that there were significant differences in the activation voxels between the superior temporal gyrus, the inferior temporal gyrus, the lingual gyrus, the wedge leaf, and the superior lobule in the different groups. Further comparison between the two groups showed that the upper group of the upper back group was larger than the group III, the lower frontal group I is larger than the group III and IV, the left upper lobules of group III is larger than the group IV, and the lingual gyrus, the wedge leaf, and the upper lobule of group I on both sides were larger than the other three groups ; The rate of change in the intensity of the activated brain regions corresponding to different groups of subjects was only in the left superior temporal gyrus and the group I was larger than the group III, and there was no significant difference in the comparison between the activation factors and the rate of change in other brain regions.

Table 2. Tournoux, Talairach coordinates and BA partitions of key activation brain regions in different groups of subjects when observing sign language.

Partition	x, y, z coordinates (BA partition)			
	Group I	Group II	Group III	Group IV
Right inferior frontal gyrus	51 23 2 (45)	-	45 26 14 (44)	55 14 -6 (45)
Left inferior frontal gyrus	-35 14 -18 (47)	-	-45 8 14 (44)	-57 13 12 (44)
Right middle frontal gyrus	29 -1 57 (6)	27 60 8 (10)	35 -4 45 (6)	27 6 46 (6)
Left middle frontal gyrus	-7 56 18 (10)	-43 7 48 (6)	-45 7 40 (8)	-36 42 -6 (10)
Right middle temporal gyrus	33 3 -37(21)	44 4 -28(21)	59 -55 -1(21)	64 -51 -1(21)
Left middle temporal gyrus	-54 -23 -7(21)	-46 40 -3(21)	-50 5 -27(21)	-51 8 -31(21)
Right superior temporal gyrus	69 -41 4 (42)	-	42 3 -11 (22)	-
Left superior temporal gyrus	-48 10 -3 (22)	-	-53 -39 19 (42)	-
Right superior parietal lobule	27 -67 55(7)	22 -51 57(7)	31 -61 56(7)	17 -61 63(7)
Left superior parietal lobule	-9 -70 58(7)	-33 -58 54(7)	-16 -64 62(7)	-26 -51 61(7)
Right inferior parietal lobule	58 -29 27(39)	-	59 -35 26(40)	-
Left inferior parietal lobule	-40 -41 57 (40)	-	-35 -50 48 (40)	-
Right cuneus	40 -85 19(19)	15 -64 43(19)	21 -76 31(19)	30 -81 43(19)
Left cuneus	-42 -76 -3 (19)	-31 -83 27(19)	-9 -80 43(19)	49 -63 11(19)
Right lingual gyrus	23 -77 -8(18)	19 -79 -14(18)	9 -79 5(18)	38 -85 -8(17)
Left lingual gyrus	-15 -89 -14(18)	-22 -72 -11 (17)	-5 -90 -10 (18)	-37 -71 -10 (18)
Right fusiform gyrus	40 -75 -13(37)	32 -75 -14(37)	49 -66 -12(37)	31 -77 -11(37)
Left fusiform gyrus	-34 -56 -13(37)	-45 -61 -16(37)	-51 -43 -13(37)	-46 -7 -26(37)

Notes: The number in () indicates the BA partition, and - the area is not activated.

5.2. Comparative Analysis of the Activation of Brain Regions When the Subjects Imitate Sign Language in Different Groups

Different groups of subjects imitating the key areas of the same activation during the sign language process have bilateral inferior frontal gyrus, middle frontal gyrus, middle temporal gyrus, superior temporal gyrus, superior temporal lobule, inferior temporal lobule, fusiform gyrus, cuneus, lingual gyrus, paracentral lobule, paracentral gyrus and cerebellar hemisphere. Analysis of variance results showed that significant differences in activation voxels between the bilateral superior temporal gyrus, the inferior frontal gyrus, the lingual gyrus, cuneus, and the superior temporal lobule of the subjects in different groups. Further comparison between the two groups showed that the bilateral superior temporal gyrus of group I was larger than the group III, the bilateral inferior frontal gyrus of group I was larger than the group III and the group IV, the left cuneus of group II was larger than group III and IV, and the bilateral lingual gyrus, cuneus, and the superior temporal lobule of group I were larger than the other three groups. Comparative analysis of activated brain voxels in other brain regions and the

rate of change in intensity of activated brain regions corresponding to different groups of subjects did not differ significantly.

6. Discussion

First, after the hearing loss of the language, the subjects were exposed to sign language from childhood, and it was observed that the functional brain region would have a cross-pattern integration phenomenon. The language function brain area shows a similar spoken language brain area as the normal hearing person, that is to say, the bilateral superior temporal gyrus (Wernicke area), the inferior frontal gyrus (Broca area) and the inferior temporal lobule were performing observation sign language and imitation. The sign language mission was activated and bilaterally balanced.

Second, in the process of imitating sign language, there were greater activation ranges of the bilateral inferior temporal lobule and inferior frontal gyrus (Broca area), providing data support for the Broca area-mediated output sign language, Wernicke-mediated reception and understanding of sign language.

Finally, cochlear implants should be carried out on language post-ear deaf subjects as early as possible to avoid affecting language recovery process and cross-mode integration. When the subject is unable to carry out cochlear transplantation, it is recommended to choose bilingual teaching mode, increasing its perceptual experience, mobilizing its defect compensation mechanism, and effectively improving the cognitive level.

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8. References

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