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A more realistic approach, using dynamic stimuli, to test facial emotion recognition impairment in temporal lobe epilepsy

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ABSTRACT

To explore potentially impaired social functioning in patients with mesial temporal lobe epilepsy (MTLE), we evaluated facial emotion recognition (FER) using dynamic facial stimuli. We evaluated FER in 88 patients with MTLE, including 25 posttemporal lobectomy (PTL) patients, when they watched videos of actors expressing the six basic emotions of happiness, sadness, anger, fear, surprise, and disgust. Thirty-two healthy subjects were examined as controls. The relationships between task, performance, and neurophysiological and radiological variables potentially affecting the ability to recognize moving facial emotions were examined by multivariate analysis. Both the patients with MTLE and the PTL subset demonstrated significantly impaired FER compared with healthy controls. Of the six emotions, they showed impaired recognition of sadness, fear, and disgust. Facial emotion recognition was impaired in patients with chronic MTLE, particularly those with bilateral damage. Failure to recognize emotional expressions, particularly fear, disgust, and sadness, may contribute to difficulties in social functioning and relationship building.

1. Introduction

Recognition of emotions, via facial expression or body language, is critical to social functioning and important to nonverbal communication. Facial expressions provide important cues to guide contextually appropriate behaviors and responses and to optimize the value or safety of social interactions. Fear, happiness, anger, sadness, disgust, and surprise are recognized as the basic emotions and are conveyed by facial expressions that are common across cultures.

Impaired facial emotion recognition (FER) has been reported in several studies involving patients with mesial temporal lobe (MTL) epilepsy (MTLE) [1–6]. The degree of impairment depends on both the nature of the seizure syndrome and on the emotion expressed. Early-onset epilepsy, right-sided foci, and bilateral foci are known to exacerbate deficits in FER [4], while recognition of fear, sadness, and disgust appears to be more impaired compared with recognition of happiness and anger [1].

Previous reports of FER used photographs or pictures [1,3–6]. But these do not test the ability to recognize transient emotional expressions in real social situations. In fact, a static photograph may not capture many essential elements of facial expressions and contains no dynamic information. This dynamic information is important to actual interpretation of facial expression. A recent report suggests that there may be different neural correlates for the perception and decoding of static and dynamic emotional expressions [7]. Therefore, we measured FER using videotaped faces as stimuli in this study. In this study, we analyzed the variables, such as epilepsy duration and side of focus, that may influence FER scores.

Drug-refractory MTLE often necessitates surgical intervention, including partial lobectomy. Several studies have examined the effects of temporal lobe surgery on emotion recognition [3,8–10] using static images. We extended these studies by examining FER in both presurgical and postsurgical (PTL) patients with MTLE using a moving video task and found significant deficits in FER, particularly the recognition of negative emotions, in patients with MTLE.

2. Methods

2.1. Subjects

A total of 88 patients with MTLE were selected for the study, including 25 treated by anterior temporal lobectomy or selective amygdalohippocampectomy for medically intractable seizures. The subjects were prospectively recruited from the Epilepsy Centre of the Neurology Department, University of Occupational and Environmental Health School of Medicine, Kitakyushu, Japan.

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Table 1
Demographic features of controls and patient groups.

	N	Age (years)[a] median (IQR)	Sex[b] (M/F)	Years of education[c] median (IQR)
HCs	32	33.0 (26.0–47.5)	7/25	14.0 (12.0–16.0)
MTLE	63	41.5 (33.0–60.0)	32/31	12.0 (12.0–14.0)
PTL	25	43.0 (28.8–58.0)	9/16	12.0 (12.0–14.0)

HCs, healthy controls; MTLE, mesial temporal lobe epilepsy; PTL, posttemporal lobectomy MTLE.
[a] The HC group was younger compared to both patient groups ($p < 0.05$).
[b] Chi-square test ($p < 0.05$).
[c] The HC group had a higher number of years of education compared to both patient groups ($p < 0.05$).

The diagnostic criteria for MTLE included a history of complex partial seizures, the presence of interictal anterior temporal spikes in the scalp-recorded electroencephalogram (EEG), and either the presence of hippocampal abnormalities on 3.0-Tesla magnetic resonance imaging (MRI) or temporal lobe abnormalities revealed by functional brain imaging. Hippocampal abnormalities in this patient group included volume decreases on T1-weighted images and high signal intensities in fluid-attenuated inversion recovery images. Most patients were also examined by single photon emission tomography (SPECT) and/or positron emission tomography (PET). Abnormalities revealed by functional imaging included decreased iomazenil affinity on SPECT and decreased glucose metabolism in the temporal region on PET. All clinical data were evaluated by a board-certified epileptologist who diagnosed MTLE and determined the side of focus by ictal video/EEG recording or interictal EEG and neuroimaging. All diagnostic tests were performed for clinical purposes only as part of the comprehensive evaluation of epilepsy. Patients who had toxic blood levels of antiepileptic drugs, mental retardation (with a full intelligence quotient below 70), or clinical depression were excluded from the present study.

The patients with epilepsy were compared with 32 healthy controls (HCs) with no history of neurological or psychiatric disorders. All patients and control participants were of native Japanese ancestry, and all gave written informed consent after the nature of the procedure had been fully explained. The present study protocols were approved by the Ethics Committee of the University of Occupational and Environmental Health School of Medicine (UOEH # H23-73).

2.2. Moving FER task

To assess the ability to recognize dynamic facial expressions, we used a previously published protocol [11]. The task was standardized in 76 healthy volunteers and showed more than 80% agreement across subjects [12]. The stimuli were videos of the faces of professional male and female actors expressing the six basic emotions of anger, happiness, sadness, surprise, disgust, and fear. The stimuli depicted neutral–emotional–neutral changes in expression, with emotional expressions lasting for 2 s [11]. The display angles were head-on and at 45°. Consequently, participants viewed 24 videotaped facial expressions (6 emotions × 2 display angles by male and female actors). The faces were displayed in color and at the same size on a 12.1-inch display. The videos contained no sound so that the facial expressions were the only indicator of emotional state.

2.3. Experimental design

The experiment was conducted in a comfortable and silent room. The stimuli were randomly presented one at a time on a computer display. Before the task, all subjects were asked to explain the meaning of the six basic emotions to ascertain that they understood the meanings of the words we used to describe each of the six emotions for subsequent standardized responses. After the presentation of each video clip, the subjects were told to select from a list of verbal labels the one basic emotion that best described the emotional state represented in the video. There was no time limit on the response, and the recorded facial stimuli were presented repeatedly if requested.

2.4. Surgery

Patients with drug-refractory epilepsy were treated surgically under general anesthesia. The surgical procedure comprised the excision of the middle and inferior temporal gyri, followed by the microsurgical resection of the amygdala and the complete *en bloc* resection of the hippocampus and the parahippocampal gyrus. Selective amygdalohippocampectomy used an approach through the middle temporal gyrus. Specific surgical treatments were chosen by the attending neurosurgeon on the basis of clinical requirements only.

2.5. Statistical analysis

Comparisons of the characteristics of the three groups were made as univariate analysis using the Kruskal–Wallis test for continuous or ordinal variables and the chi-square test for the categorical variables. To compare the total recognition score of the basic emotions (anger, happiness, sadness, surprise, disgust, and fear) between the study groups, the Mann–Whitney U test was used. The level of statistical significance was set at 0.05, and Bonferroni adjustments were made for multiple pairwise comparisons.

Multiple regression analysis was used to analyze factors associated with FER. The FER was set as the target variable, and the explanatory variables evaluated were the following: gender, age at testing, total years of education, side of seizure origin (1 = right; 0 = left), the presence of epilepsy (1 = yes; 0 = no), and operation history (1 = yes; 0 = no). The stepwise selection method was used to find an optimal model. To check the correlations between variables that might affect task performance, Spearman rank-order correlations were calculated. All the statistical analyses were performed using StatFlex ver. 6.0 (Artech Co., Osaka).

Table 2
Clinical and MRI findings of the group with MTLE and the PTL group.

	MTLE (n = 63)			PTL (n = 25)	
Side	Right	Left	Bilateral	Right	Left
No. of subjects	17	26	20	11	14
Age at epilepsy onset (years), mean (±SD)	26.4 (±20.1)	28.4 (±20.0)	37.7 (±25.0)	11.8 (±6.7)	14.1 (±10.4)
Years with epilepsy, mean (±SD)	16.8 (±12.6)	13.9 (±12.1)	8.6 (±15.5)	26.6 (±11.6)	25.4 (±14.5)
MRI findings					
Mesial temporal sclerosis	8	7	5	9	10
Other lesions	2	2	3	0	0
No lesion	7	17	12	2	4

Healthy control; MTLE, mesial temporal lobe epilepsy; PTL, posttemporal lobectomy MTLE; other lesions: tumor, Binswanger, and cortical dysplasia.