Expressed Emotion and Auditory Evoked Potentials

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THE expressed emotion (EE) of key relatives has been shown to predict the course of illness in psychiatric patients. In this study, we examined whether there might be physiological correlates to the EE index in nonbiological key relatives of patients with affective psychoses. High-EE and low-EE relatives were compared concerning their slopes of the amplitude/stimulus intensity function (auditory evoked N1/P2-component). We found that the slopes were clearly steeper in the case of low-EE relatives. In comparing the slopes of all key relatives with those of an age-matched control group without psychiatically ill partners, we could find no differences. Therefore, the slope differences between high-EE and low-EE relatives do not seem to reflect differences in the illness of partners. We speculated whether a steep slope as well as low EE could be associated with an action-oriented, impulsive communication style, which would prevent the development of an affectively tense communication pattern.

The expressed emotion (EE) of key relatives, assessed by the Camberwell Family Interview (CFI), has been found to predict not only the relapse rate of schizophrenics (Falloon et al. 1984; Hogarty et al. 1986; Hooley 1985; Leff and Vaughn 1980; Vaughn et al. 1984) but also that of patients with neurotic depression (Leff and Vaughn 1980), major depression (Hooley 1986; Hooley et al. 1986), recent onset mania (Miklowitz et al. 1987) and bipolar affective disorders (Miklowitz et al. 1988). These studies show quite consistently that EE is a psychological variable of clinical relevance (Falloon 1988; Koenigsberg and Handley 1986).

The construct validity of the EE concept has been assessed by studying its relationship to the interaction style in the family (Valone et al. 1983; Miklowitz et al. 1984) and to the psychophysiological reactions of patients (Sturgeon et al. 1984; Tarrier et al. 1979, 1988; Valone et al. 1984).

We were interested in whether a biological correlate of the EE index could be found in nonbiological relatives of psychotic patients. Such a correlate would further support the validity of the EE concept, might be helpful in finding more economic predictors of outcome, and might be useful as an indicator of changes in EE levels during intervention studies.

In several studies it has been found that
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the amplitude/stimulus intensity function (ASF) of sensory evoked potentials is sensitive to personality traits, such as sensation seeking (Buchsbaum and Pfefferbaum 1971; Como et al. 1984; Coursey et al. 1975; Hall et al. 1970; Hegerl et al. 1989; Knorring 1981; Lukas 1987; Lukas and Siegel 1977; Mullins and Lukas 1984; Orlebeke et al. 1984; Stenberg et al., in press; Zuckerman et al. 1974); impulsivity (Barratt et al. 1987); and extraversion (Soskis and Shagass 1974; Stenberg et al., in press). These studies have considered slopes of the ASF indicating amplitude changes with increasing stimulus intensities.

We were interested in whether nonbiological high-EE relatives differ from low-EE relatives in their ASF-slopes of auditory evoked potentials (N1/P2-component). This ASF-slope shows satisfactory test/retest reliability in healthy subjects and is not significantly influenced by co-variables, such as age, gender, or time of assessment (Hegerl et al. 1988).

We studied the relationship between the ASF-slope and the EE index in relatives of remitted outpatients with affective disorders. Since potential slope differences between high-EE and low-EE relatives might be due to differences in the illness of their partners, we compared the slope measures of the key relatives with those of age-comparable healthy controls without psychiatrically ill partners. If the illness of the partners were to influence the slope measures, then differences between these two groups should be expected.

Because the cortical evoked potentials are partly genetically determined (Buchsbaum 1974), we included only nonbiological key relatives.

METHOD

Key relatives of 21 patients with bipolar affective and schizoaffective psychoses were examined with the CFI. Patients had been on prophylactic lithium medication for at least 3 years and were without psychotic symptoms at the time of the interview (Priebe et al. 1989). The CFI was in all cases conducted by the same interviewer (C.W.) and rated by the same rater (S.P). The rater was trained and regarded as sufficiently reliable in EE rating. Moreover the rater was blind toward the clinical features of the patients and was in no way involved in treatment administration.

Four subjects were excluded because they were biological relatives (parents), and two relatives refused to participate in the auditory evoked potential (AEP) recording. The AEP of the remaining 15 key relatives (9 males, 6 females; mean age: 49.6 years; range: 32–70 years) were evaluated. One key relative was a fellow nun of the patient; the others were spouses. One key relative had taken benzodiazepines because of sleep disturbances the day before the recording. Apart from this, relatives were without any psychotropic medication.

Dividing the sample at the median, relatives with <2 critical remarks were classified as low-EE, and relatives with ≥2 critical remarks as high-EE. All relatives scoring >0 on the hostility scale or scoring ≥3 on the overinvolvement scale were within the high-EE group.

Patients living with high-EE relatives, according to this definition, had a significantly poorer course of illness. Prospectively this difference was greater than retrospectively, which confirms the predictive validity of EE assessment in this sample (Priebe et al. 1989).

For the age-comparable control group we had 17 healthy drug-free volunteers (11 males, 6 females; mean age: 48 years; range: 32–63 years) without psychiatrically ill partners. These subjects were well known to the investigators and had been partly recruited from hospital personnel.

In order to rule out any serious deficits in auditory acuity sensation, thresholds to click stimuli were monitored prior to AEP-recording for both groups. AEP-recording took place on the same day as the CFI.

The subjects were seated, eyes open, in a comfortable reclining chair. A black disc on the wall 3 meters in front of the subjects was presented as a point of orienta-
tion although no strict fixation was requested. Binaural clicks (58, 68, 78, 88 dBHL; stimulus duration 0.9 ms; ISI 2.1 sec) were presented in random order through headphones. Stimulus presentation, data collection, and averaging were controlled by a pathfinder II (Nicolet). Bandpass filters (2-pole Butterworth filters with 12 dB/octave role-off) were set at 1 and 30 Hz. Sampling was taken at a rate of 1,280 Hz with a 100 ms pre-stimulus and 300 ms post-stimulus period. We recorded with gold-plated cup electrodes from Cz, C3, and C4, with linked mastoid electrodes as reference. A further electrode was placed 1 cm above the outer corner of the left eye, with linked mastoid electrodes as reference. The responses to the first 30 clicks were excluded in order to avoid habituation effects. To suppress artifact influences, all trials in which the voltage exceeded ±50 μV in any of the 4 leads during the averaging period were automatically excluded. About 80 responses were averaged at each intensity level. FPZ was used as ground. Through-to-peak amplitudes N1/P2 were measured with a cursor spot program on a monitor. The peak N1 was determined as the most negative amplitude value in the period 55-140 ms, and the peak P2 as the most positive am-

![Figure 1](image_url)

**Figure 1.**
Auditory evoked potentials (Cz) to four stimulus intensities in two relatives. The low-EE subject T.U. (0 critical remarks) shows a more pronounced amplitude increase of the N1/P2-component than the high-EE subject S.M. (9 critical remarks).

RESULTS

Comparing the AEPs of the high-EE relatives (mean age: 54.3 years; range: 32-70 years; 3 males, 4 females) with those of the low-EE relatives (mean age: 45.5 years; range: 40-54 years; 6 males, 2 females), we observed a steeper slope of the
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ASF in the low-EE than in the high-EE relatives (Figure 2). The individual ASFs (C) of high-EE and low-EE subjects are shown in Figure 3. Analysis of variance with the factors “group” (high-EE/low-EE) and “lead” (C, C, C) revealed a pronounced “group” effect ($F_{2,19}$; 14, 26; $p < 0.005$) concerning the ASF slope. A significant “lead” effect ($F_{2,25}$; 7.13, $p < 0.005$) was also found, which results from steeper slopes at C than at C or C. No significant interaction of the factors “group” and “lead” ($F_{2,25}$; 2.46, $p = 0.10$) was found.

Concerning the N/P-amplitude, 3-way analysis of variance with the factors “group” (high/low EE) and the repeated measurement factors “lead” (C, C, C) and “intensity” (58, 68, 78, 88 dB HL) revealed an interaction of “group” and “intensity” ($F_{2,39}$; 9.68; $p < 0.001$) corresponding to a more pronounced amplitude increase with increasing stimulus intensity in the low-EE group. Furthermore, main effects were found for the factors “group” (indicating higher amplitudes in the low-EE than in the high-EE group), “intensity” (indicating an amplitude increase with increasing intensities), and “lead” (indicating higher amplitudes at C than at C or C). The additional interaction of “lead” with “intensity” indicates more amplitude increase with increasing stimulus intensity at C than at C or C.

In Figure 4 the ASFs of the key relatives (N=15) and the age-comparable controls (N=17) are shown. A 2-way analysis of variance revealed no differences in the slopes of these two groups.

Furthermore, no relevant differences exist concerning ranges and standard deviations (sd) of the slopes in the key relatives and the controls (key relatives, Cz: minimum = -0.87 uV/10dB, maximum = 5.69 uV/10dB, sd=1.67; controls, Cz: minimum = -0.72 uV/10dB, maximum = 6.21 uV/10dB, sd=1.53).

Concerning the N/P-amplitude, a 3-way analysis of variance with the factor “group” (controls, key relatives) and the repeated measurement factors “lead” and “intensity” showed no “group” effect ($F_{2,39}$; 0.30; $p = 0.61$). Significant effects were again found for the factors “lead” and “intensity” and for the interaction of “lead” with “intensity.”

**DISCUSSION**

In the present examination, the ASF slopes of low-EE relatives were shown to be clearly steeper than those of high-EE relatives. It appears rather unlikely that this difference between high-EE and low-EE relatives is due to variations in the length or severity of the illness of their partners, because key relatives and healthy controls without a mentally ill partner did not differ in ASF slopes. Our findings thus provide evidence for a psychophysiological correlate of the high/low-EE dichotomy.

We have observed steeper slopes of the ASF (AEP, N/P-component) in manic patients (unpublished data) and in high sensation seekers (Hegerl et al. 1988). Other studies found that steep ASF
The individual amplitude/stimulus intensity functions (ASF, Cz) for high-EE and low-EE subjects. The ASFs are steeper in the low-EE subjects.

Figures 3 and 4 show the relationships between stimulus intensity and response amplitude. The ASF slopes are not only related to high sensation seeking or manic symptoms but also to extraversion and impulsivity. Although differences in stimulation techniques, amplitude measures and modalities render it difficult to compare various studies in the field of evoked potentials (Connolly 1987), the findings published so far seem to suggest that a steep ASF slope is related to an action-oriented, impulsive attitude. It is tempting to speculate that we will find these attitudes more often in low-EE than in high-EE subjects.

High EE might be related to an inhibited, latently aggressive communication style, leading to feelings of guilt and an affectively tense atmosphere, whereas low EE might be related to a more open and impulsive way of dealing with interpersonal problems, preventing the accumulation of interpersonal tensions. This explanation is consistent with our impression that critical remarks in the CFI mainly reflect a recriminatory and emotionally tense attitude and a helpless inability to react adequately to problems created by...
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the patient's illness. If the clear relationship between EE and the ASF-slope can be replicated, it would be of interest to examine whether reduction of EE within intervention studies (Leff et al. 1982) can be monitored by an increase of the ASF slope.

REFERENCES


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