EXPRESSED EMOTION AND AUDITORY EVOKED-POTENTIALS

HEGERL, U; PRIEBE, S; WILDGRUBE, C; MULLEROERLINGHAUSEN, B

Expressed Emotion and Auditory Evoked Potentials

Ulrich Hegerl, Stefan Priebe, Christiane Wildgrube and Bruno Müller-Oerlinghausen

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 N_1/P_2-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 psychiatrically 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

Ulrich Hegerl, MD, is Research Assistant, Laboratory of Clinical Psychophysiology, Department of Psychiatry, Free University of Berlin, Eschenallee 3, D-1000 Berlin (West) 19, Federal Republic of Germany.

Stefan Priebe, MD and Diplom-Psychologist, is Senior Registrar, Department of Social Psychiatry, Free University of Berlin, Berlin (West), FRG.

Christiane Wildgrube, MD, is Research Fellow, Department of Psychiatry, Free University of Berlin, Berlin (West), FRG.

Bruno Müller-Oerlinghausen, MD, is Professor of Pharmacology and Toxicology, and Head of Laboratory of Clinical Psychopharmacology and Lithium Clinic, Department of Psychiatry, Free University of Berlin, Berlin (West), FRG.

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 (N_1/P_2-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 prestimulus and 300 ms poststimulus period. We recorded with gold-plated cup electrodes from C_z, C_3, and C_4, 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 uV 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. Trough-to-peak amplitudes N_1/P_2 were measured with a cursor spot program on a monitor. The peak N_1 was determined as the most negative amplitude value in the period 55-140 ms, and the peak P_2 as the most positive amplitude value within the period 100-235 ms. The averaged AEPs at the 4 stimulus intensities (C_z) are shown for a high-EE and a low-EE relative in Figure 1. A measure of the rate of increase of the amplitude N_1/P_2 with increasing stimulus intensity was obtained by adjusting a straight line to the amplitude values obtained at each intensity level using the least-square technique. The slope of the line indicates the amplitude change with increasing stimulus intensity.

High-EE and low-EE subjects, and key relatives and controls were compared with reference to their slope values by analysis of variance with the factor "group" and the factor "lead" (C_z, C_3, C_4) as repeated measurements. Additionally, the groups were compared with reference to their N_1/P_2-amplitudes using a 3-way-analysis of variance with the additional factor "intensity."

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

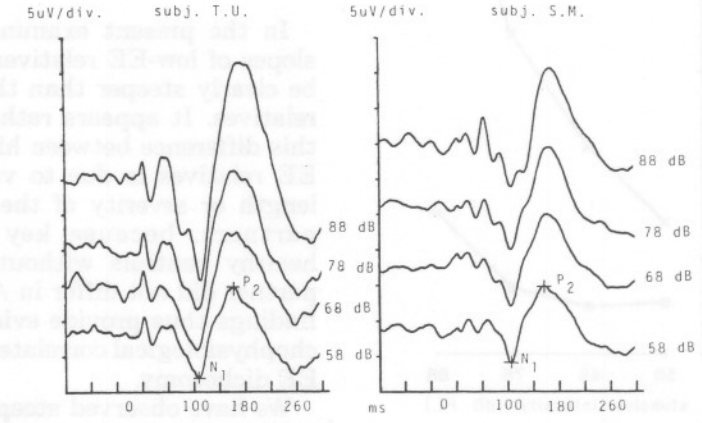

Figure 1.
Auditory evoked potentials (C_z) to four stimulus intensities in two relatives. The low-EE subject T.U. (0 critical remarks) shows a more pronounced amplitude increase of the N_1/P_2-component than the high-EE subject S.M. (9 critical remarks).

ASF in the low-EE than in the high-EE relatives (Figure 2). The individual ASFs (C_z) 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_z, C_3, C_4) revealed a pronounced "group" effect ($F_{(1,13)}$: 14, 26; $p < 0.005$) concerning the ASF slope. A significant "lead" effect ($F_{2,26}$: 7.13, $p < 0.005$) was also found, which results from steeper slopes at C_z than at C_3 or C_4. No significant interaction of the factors "group" and "lead" ($F_{2,26}$: 2.46, $p = 0.10$) was found.

Concerning the N_1/P_2-amplitude, 3-way analysis of variance with the factors "group" (high/low EE) and the repeated measurement factors "lead" (C_z, C_3, C_4) and "intensity" (58,68,78,88 dBH1) revealed an interaction of "group"and "intensity" ($F_{(3,39)}$: 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_z than at C_3 or C_4). The additional interaction of "lead" with "intensity" indicates more amplitude increase with increasing stimulus intensity at C_z than at C_3 or C_4.

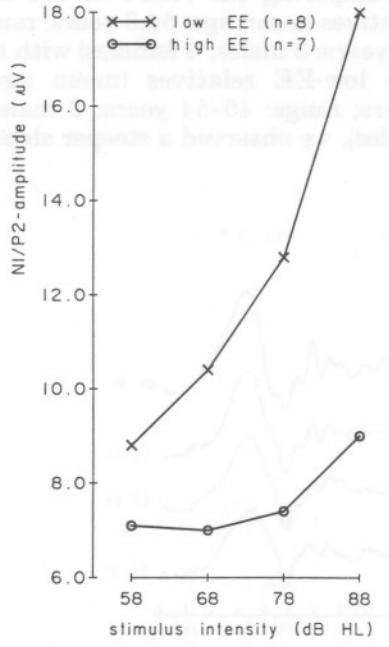

Figure 2.
Amplitude/stimulus intensity function (Cz) of the high-EE (≥2 critical remarks) and the low-EE (≤2 critical remarks) groups.

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, C_z: 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_1/P_2-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 ($F_{(3,90)}$: 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_1/P_2-component) in manic patients (unpublished data) and in high sensation seekers (Hegerl et al. 1988). Other studies found that steep ASF

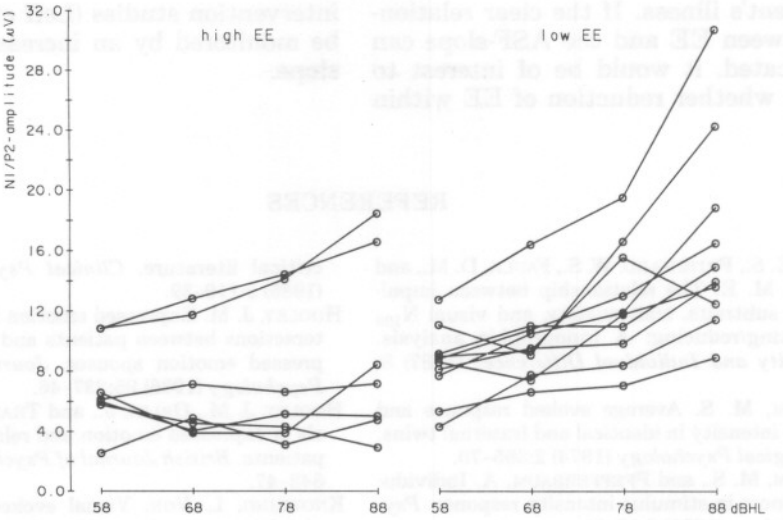

Figure 3.
The individual amplitude/stimulus intensity functions (ASF, C_z) for high-EE and low-EE subjects. The ASFs are steeper in the low-EE subjects.

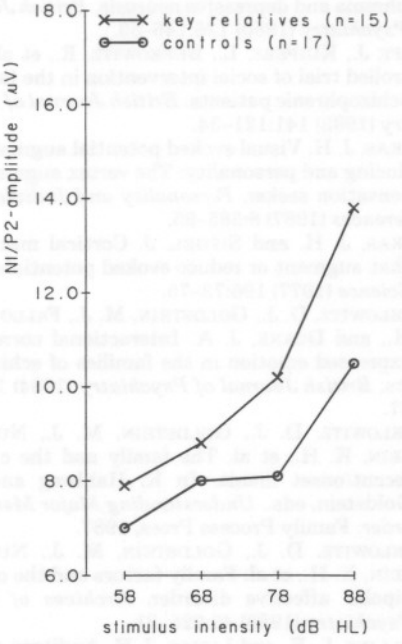

Figure 4.
Amplitude/stimulus intensity function (Cz) for key relatives and controls.

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

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

BARRATT, E. S., PRITCHARD, W. S., FAULK, D. M., and BRANDT, M. E. The relationship between impulsiveness subtraits, trait anxiety, and visual N_{100} augmenting/reducing: A topographic analysis. *Personality and Individual Differences* (1987) 8: 43–51.

BUCHSBAUM, M. S. Average evoked response and stimulus intensity in identical and fraternal twins. *Physiological Psychology* (1974) 2:365–70.

BUCHSBAUM, M. S., and PFEFFERBAUM, A. Individual differences in stimulus intensity response. *Psychophysiology* (1971) 8:19–25.

COMO, P. G., SIMONS, R., and ZUCKERMAN, M. Psychophysiological logical indices of sensation seeking as a function of stimulus intensity (abstract). *Psychophysiology* (1984) 21:589.

CONNOLLY, J. F. Commentary: ERPs suggest the importance of subcortical mechanisms in activities typically associated with cortical functions. In R. Johnson, J. W. Rohrbaugh and R. Parasuraman, eds., *Current Trends in Event-related Potential Research* (EEG Suppl. 40). Elsevier, 1987.

COURSEY, R. D., BUCHSBAUM, M. S., and FRANKEL, B. L. Personality measures and evoked responses in chronic insomniacs. *Journal of Abnormal Psychology* (1975) 84:234–44.

FALLOON, I. R. H. Expressed emotion: Current status. *Psychological Medicine* (1988) 18:269–74.

FALLOON, I. R. H., BOYD, J. L., and MCGILL, C. W. *Family Care of Schizophrenia*. Guilford Press, 1984.

HALL, R. A., RAPPAPORT, M., HOPKINS, H. K., and GRIFFIN, R. B. Evoked response and behavior in cats. *Science* (1970) 170:998–1000.

HEGERL, U., PROCHNO, J., ULRICH, G., and MÜLLER-OERLINGHAUSEN, B. Are auditory evoked potentials suitable for predicting the response to lithium prophylaxis? A study on the effects of repeated measurement, age gender, and personality on the amplitude/stimulus intensity function in healthy volunteers. *Pharmacopsychiatry* (1988) 21:336–37.

HEGERL, U., PROCHNO, J., ULRICH, G., and MÜLLER-OERLINGHAUSEN, B. Sensation seeking and auditory evoked potentials. *Biological Psychiatry* (1989) 25:179–90.

HOGARTY, G. E., ANDERSON, C. M., REISS, D. J., et. al. Family psychoeducation, social skills training, and maintenance chemotherapy in the aftercare treatment of schizophrenia. *Archives of General Psychiatry* (1986) 43:633–42.

HOOLEY, J. M. Expressed emotion: A review of the critical literature. *Clinical Psychology Review* (1985) 5:119–39.

HOOLEY, J. M. Expressed emotion in depression: Interactions between patients and high- vs. low-expressed emotion spouses. *Journal of Abnormal Psychology* (1986) 95:237–46.

HOOLEY, J. M., ORLEY, J., and TEASDALE, J. D. Levels of expressed emotion and relapse in depressed patients. *British Journal of Psychiatry* (1986) 148: 642–47.

KNORRING, L. VON. Visual evoked responses and platelet monoamine oxidase in patients suffering from alcoholism. In H. Begleiter, ed., *The Biological Effect of Alcohol*. Plenum Press, 1981.

KOENIGSBERG, H. W., and HANDLEY, R. Expressed emotion: From predictive index to clinical construct. *American Journal of Psychiatry* (1986) 143:1361–73.

LEFF, J., and VAUGHN, C. The interaction of life events and relatives' expressed emotion in schizophrenia and depressive neurosis. *British Journal of Psychiatry* (1980) 136:146–53.

LEFF, J., KUIPERS, L., BERKOWITZ, R., et al. A controlled trial of social intervention in the families of schizophrenic patients. *British Journal of Psychiatry* (1982) 141:121–34.

LUKAS, J. H. Visual evoked potential augmenting/reducing and personality: The vertex augmenter is a sensation seeker. *Personality and Individual Differences* (1987) 8:385–95.

LUKAS, J. H. and SIEGEL, J. Cortical mechanisms that augment or reduce evoked potentials in cats. *Science* (1977) 196:73–75.

MIKLOWITZ, D. J., GOLDSTEIN, M. J., FALLOON, I. R. H., and DOANE, J. A. Interactional correlates of expressed emotion in the families of schizophrenics. *British Journal of Psychiatry* (1984) 144:482–87.

MIKLOWITZ, D. J., GOLDSTEIN, M. J., NUECHTERLEIN, K. H., et al. The family and the course of recent/onset mania. In K. Hahlweg and M. J. Goldstein, eds., *Understanding Major Mental Disorder*. Family Process Press, 1987.

MIKLOWITZ, D. J., GOLDSTEIN, M. J., NUECHTERLEIN, K. H., et al. Family factors and the course of bipolar affective disorder. *Archives of General Psychiatry* (1988) 45:225–31.

MULLINS, L. F., and LUKAS, J. H. Auditory augmenters are sensation seekers—if they attend the stimuli (abstract). *Psychobiology* (1984) 21:589.

ORLEBEKE, J. F., KOK, A., and ZEILLEMAKER, C. W. Augmenting/reducing (disinhibition) and the pro-

cessing of auditory stimulus intensity (abstract). *Psychophysiology* (1984) 21: 591.

PRIEBE, S., WILDGRUBE, C., and MÜLLER-OERLINGHAUSEN, B. Lithium prophylaxis and expressed emotion. *British Journal of Psychiatry* (1989) 154:396–99

SOSKIS, D. A., and SHAGASS, C. Evoked potential test of augmenting-reducing. *Psychophysiology* (1974) 11:175–90.

STENBERG, G., ROSEN, J., and RISBERG, J. Personality and augmenting/reducing in visual and auditory evoked potentials. *Personality and Individual Differences*, in press.

STURGEON, D., TURPIN, G., KUIPERS, L. et al. Psychophysiological responses of schizophrenic patients to high and low expressed emotion relatives: A follow-up study. *British Journal of Psychiatry* (1984) 145:62–69.

TARRIER, N., VAUGHN, C., LADER, M., et al. Bodily reactions to people and events in schizophrenics. *Archives of General Psychiatry* (1979) 36:311–15.

TARRIER, N., BARROWCLOUGH, C., PORCEDDU, K., and WATTS, S. The assessment of psychophysiological reactivity to the expressed emotion of the relatives of schizophrenic patients. *British Journal of Psychiatry* (1988) 152:618–24.

VALONE, K., NORTON, J. P., GOLDSTEIN, M. J., and DOANE, J. A. Parental expressed emotion and affective style in an adolescent sample at risk for schizophrenia spectrum disorders. *Journal of Abnormal Psychology* (1983) 92:399–407.

VALONE, K., GOLDSTEIN, M. J. and NORTON, J. P. Parental expressed emotion and psychophysiological reactivity in an adolescent sample at risk for schizophrenia spectrum disorders. *Journal of Abnormal Psychology* (1984) 93:448–57.

VAUGHN, C. E., SNYDER, K. S., JONES, S., et al. Family factors in schizophrenic relapse. *Archives of General Psychiatry* (1984) 41:1169–77.

ZUCKERMAN, M., MURTAUGH, T. M., and SIEGEL, J. Sensation seeking and cortical augmenting-reducing. *Psychophysiology* (1974) 11:5352–42.