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EP Augmenting / Reducing : Personality Correlates and Topographic Distribution

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ABSTRACT

Augmenting-reducing evoked potentials(AREP) were studied in 38 college students to explore the topographic distribution between AR slope and personality. The Zuckerman Seeking Scale(SSS) and Eysenck Personality Questionnaire(EPQ) assessed personality. There was a sigificant positive correlation between AR slope and Extraversion-Introversion(E) in the frontocentral area ; the right posterior area showed a significant negative correlation with E. The Thrill and Adventure Seeking(TAS) subscale showed a significant negative correlation with slope in the right posterior temporal area. The average slope map of all subjects revealed a distribution showing more augmenting in frontocentral areas and more reducing in posterior areas.

KEY WORDS : Visual evoked potential · Personality · Brain mapping.

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Introduction

Although the study of evoked potential(EP) augmenting-reducing(AR)(1) has helped to understand the biological basis of personality in terms of sensory modulation, there are still many unsolved issues. One is the relationship between EPAR and scores on some psychological tests including the Zuckerman Sensation Seeking Scale(SSS)(2) and the Eysenck Personality Questionnaire(EPQ)(2). Some studies have reported a positive relationship between sensation seeking as measured by the SSS and augmenting of the EP. Buchsbaum(4) first reported high sensation seekers tended to be augmenters and low sensation seekers tended to be reducers. Zuckerman et al(5) found a positive correlation of augmenting with the disinhibitory(Dis) subscale. Coursey et al(6) found auditory EP reducing in an insomnia group who showed low scores on the SSS campared to a normal control group. Lukas(7) reported the SSS Dis scale was significantly correlated with Cz slope of visual EP ; high Dis subjects showed augmenting and low Dis subjects showed reducing. Von Knorring and Perris(8) found a positive relationship between the SSS Dis Scale and augmenting of visual EP. However, Haier et al(9) reported EP reducers were more extraverted on the EPQ and more sensation-seeking on the SSS than EP augmenters. They noted differences in methodology and design between their study and the studies indicating a positive relationship between sensation-seeking and augmenting. Principals among these were the scalp location for EP measurement and the brightness of the visual stimuli. Although other studies did not use EP, Eysenck(10) demonstrated

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that extraverted sujects showed greater decrements than introverted ones on the Kinaesthetic Figural After-effects(KFA) test. Petrie(11) reported KFA reducers were less sensitive to pain and KFA augmenters were more sensitive to pain. Although KFA augmenters tend to be EP augmenters and KFA reducers tend to be EP reducres(12), Petrie and Buchsbaum differ with respect to the relationship of AR to extraversion. Whereas for Buchsbaum, EP augmenters should be extraverts, Petrie's KFA augmenters would be introverts (9,13). Another issue concerning EP AR is its topographic distribution. Visual stimuli may show different patterns of response when recording are made across the whole scalp. The vertex(Cz) has been used often in studying augmenting-reducing EPs. EP reducing has been most prominent when EPs are recorded over Cz, whereas recording over Oz tends to show more uniform and linear amplitude/intensity slope(14, 15). However, the differences between augumenters and reducers may reflect indvidual difference in the scalp distribution of the components, rather than merely quantitative reduction(12). The present study was undertaken to explore the topographic distribution of 32 lead EPs in augmenters and reducers, especially the relationship of Cz to Oz, and to investigate further the relationship between EPAR and scores of the SSS and EPQ.

Method

Subjects

Two hundred and seventy one male freshmen at the University of California, Irvine were originally screened on vertex EPs as in Haier et al(9). Each volunteered after a request for re-search subjects was mailed to all freshmen. Forty four of the students who showed augmenting or reducing in the upper and lower 25% of the distribution(16), were selected to participate in a separate topographic EP study. The forty four selected subjects included twenty one who had EPAR slopes ≥ 3.40 and twenty three who had slopes ≤ -2.50. These cutoffs represented the upper and lower 25% of the EPAR slope distribution. When re-tested in the topographic study described below, six subjects blinked more than 67% of trials on the highest intensity light, thus not allowing suitable averaging ; these six were excluded in the EP study. All subjects were 18 years old.

Measures

The Zuckerman Sensation Seeking Scale and the Eysenck Personality Questuinnaire were administered at the original EP screening. The Zuckerman Sensation Seeking consists of a total score, the General (Gen) Sensation Seeking, as well as scores on four subscales derived from factor analysis : Thrill and Adventure Seeking(TAS), Experience Seeking(ES), Diinhibition(DIS), Boredom Susceptibility(BS). The Eysenck Personality Questionnaire has three factor analytically derived scales of core personality dimensions : Extraversion-Introversion(E), Neuroticism (N), Psychoticism(P) plus a Lie(L) scale.

EP Procedures and StaListics

A set of 32 gold disk electrodes attached with Grass electrode paste were used : 19 standar 10-20 system lesds, 3 additional midline leads(Ff and Fc at 10% steps and Oz), 2 additional temporal leads at 5% between T3 and T5, and 8 additional leads at the centers of squares formed by other electrodes(see Fig. 1). Recording were referenced to linked ears. Subjects sat in a darkened room and viewed light flashes on a translucent screen(25×27cm) located 1 meter. in front of them. Four intensities of light were displayed : 6, 37, 84 and 214 ft-c.(measured at the screen, footcandles were equivalent to to footlamberts). Each light flash had a duration of 40msec ; a total of 480 flashes were presented at one per two seconds, with 120 trials at each intensity. The system for displaying the light stimuli used a computer controlled Kodak carousel slide projector fitted with an Ilex No. 4 synchro-Electronic shutter. Intensities were achieved with slides having neural density fitters(0,5,1,2). The order of intensities was random with the additional constraint that each intensity was preceded equally often

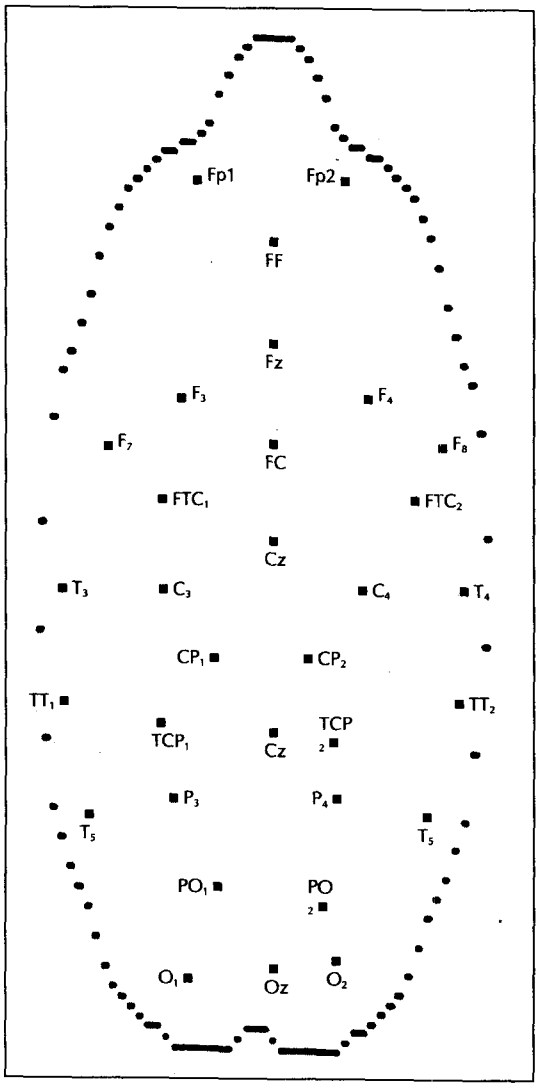

Fig. 1. Positions of 32 electrodes on the top view approximately equal area projection of the scalp (Buchsbaum, 1982).

by each of the four intensities. Subjects were instructed to sit quietly and watch the lights. The EP was recorded using a 32-channel amplifier system designed at the NIMH by Drs. Coppola and Morgan. The amplifier uses a Burr Brown INA101 direct coupled(5Hz 3db single pole RC) to a following stage of amplification at gain 2000. The output is high pass filtered with a corner at 50Hz using a linear phase Reticon 5613 with rolloff approximately 24db per octave. EP activity was digitized at 200 samples per second. There were 128 samples in each epoch of EP. Amplified and filtered multi-leads data were recorded by a stimulus response program(17). Eyeblink and other movement artifacts were automatically excluded from the average for all leads, using a 127μV criterion for Fp1. EPs were first detrended using linear regression and then digitally filtered to remove frequencies below 3.5Hz and above 35Hz, as described (with a different band pass) elsewhere(18). EPs were measured as described elsewhere(19) : by area integration for P100(72-108ms), N120(104-136ms) and P200(128-172ms), this range of each band was chosen from actual wave of average evoked as the EP AR measure : positive slopes indicate augmenting and negative slope indicates reducing. Note this apparatus and the method of defining peaks are different from the ones used in the original EP screening. Maps of EP distribution were created by interpolation from the 32 known values on an approximately equal area projection of the sagittal cortical surface(20). This projection was developed from sagittal sections of the brain. Thus each individual's brain is adjusted to mean shape by the percentage proportionately to the 10-20 International system. Correlations between scores of SSS, EPQ and AR slopes on 32 electrodes were computed with BMDP statistical software(21).

Results

For the group of 38 subjects, the mean AR slope at Cz was 0.96, SD=1.12. Correlations between personality scores and AR slope on 32 leads were tested, Then a correlation map was created(Fig. 2). Summary correlations are presented in Table 1. On Cz only the E scale showed a significant positive correlation($r=0.40$, $P<0.01$). However, correlations between personality scores and AR slope varied depending on leads and subtests. Although there was a significant positive correlation($r=0.34$ on Fz, $r=0.40$ on Cz) in the frontocentral area with E, the right posterior area showed a significant negative correlation(rd=0.47 on

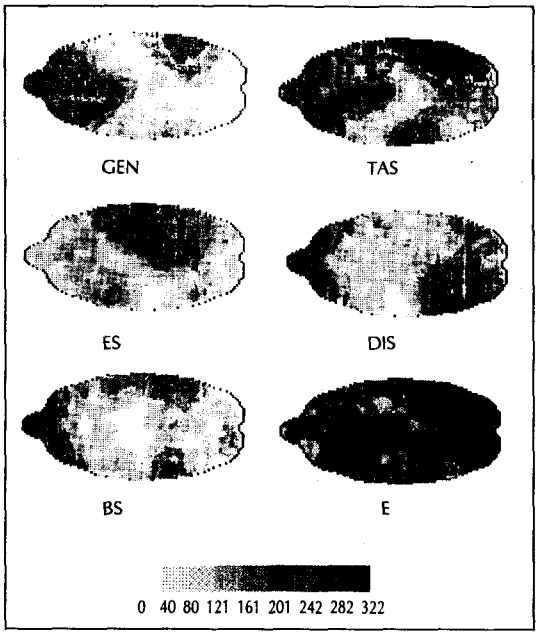

Fig. 2. Correlation maps between 32 leads slope and personality tests(GEN, TAS, ES, DIS, BS and E). The absolute r values were used in creating maps. Black areas show $r \geq 0.322$, which indicates statistical significance($p < 0.05$). Significant negative correlations were noted in the right posterior temporal area with TAS and in the right posterior area with E. A significant positive correlation was on the vertex area with E.

TT_2) as seen in Table 1 and Fig. 2. The TAS subscale showed a significant negative correlation($r = -0.5$, on TT_2) with AR in the right posterior temporal area (Table 1, Fig. 2). When maps of all subjects were averaged, a distribution showing more augmenting in frontocentral areas and more reducing in posterior

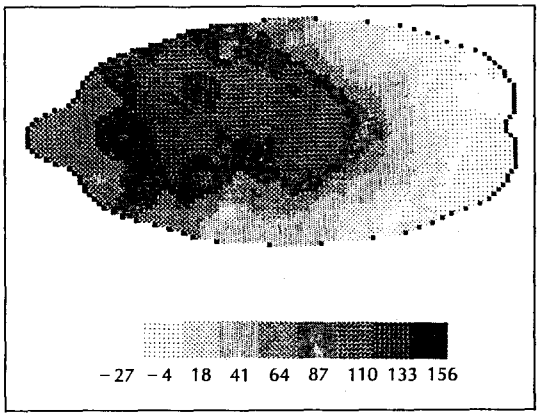

Fig. 3. The averaged slope map of all subjects(n=38). Dark areas show augmenting

areas was found, although there were individual differences in topographic distribution(Fig. 3).

Discussion

Based on Cz which has been used in many studies of AR EPs, only E scores showed a positive correlation which supports Zuckerman's previous findings (15). However, as shown in Table 1 and Fig. 2, correlations between personality tests and slopes varied depending on leads and subtests. There were significant negative correlations in the right posterior temporal area with TAS and right posterior area with E. Other personality subtests(Gen, ES and BS) also showed the highest negative correlations around the same right posterior temporal area(Fig. 2), although their correlations did not reach significance. The right posterior

Table 1. Correlations between SSS, EPQ and AR slopes at different locations

Scales	Slopes				
	Fz	Cz	Oz	$TT1^{+}$	$TT2^{++}$
Gen	0.263	0.142	0.036	-0.074	-0.308
TAS	0.203	0.241	-0.124	-0.184	-0.502**
ES	0.100	-0.076	0.042	-0.141	-0.187
DIS	0.101	0.060	-0.052	-0.265	-0.107
BS	0.036	-0.002	-0.145	0.043	-0.278
E	0.342*	0.405**	-0.348*	-0.477**	-0.465**
N	-0.275	-0.182	-0.079	-0.036	0.122
P	0.177	0.184	0.141	-0.019	-0.135

df=37, *P<0.05 **P<0.01 ; two tailed test.
$^{+}$interpolated lead between T3 nad T6 $^{++}$interpolated lead between T3 nad T5

area has been known to be related to visuospacial function including visual scanning(22,23). The component N120 used in our AR study has been known to be most firmly linked with selective attention and vigilance(19). Higher negative correlation in the right posterior temporal area in this study may imply that this area in closely related with the sensory modulation of visual attention. Connoly and Gruzelier (15) reported vertex reducing was accompanied by occipital augmenting and vice versa. Although there were trends of vertex augment being accompanied by occipital reducing in our average map, there was no significant negative correation between slopes on Cz and on Oz($r=0.07$) in our data. Eye blinking has been suggested as one of the artifacts which may influence the slope at Cz. In this study there was no significant correlation between numbers of blinks and slope on Cz($r=-0.01$). Also, from the topographic map we obained, no apparent connection was noted between slope at the prefrontal area where blinking would have a strong effect and slope at the central area. Some methodological limitations of this stydy should be noted. The subjects were already selected on the basis of screening on Cz. This may influence results based on other leads. But there was no significant correlation of Cz slopes between screening data and later topographic data. This suggests that any bias from the screening test may not be strong. The other difference in method from other existing studies is the duration of stimuli. In this study, stimuli were only given for 40msec. whereas it was for 500msec. in other studies. But numbers of averaging EPs were large enough to compensate for this($n=480$, 120 trials at each intensity) and it was also confirmed by visual inspection that all evoked potentials had regular shapes in each component. Moroever, each band was decided from the actual wave of average evoked potentials for each subjects.

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증감뇌유발전위와 성격의 상호 관계영상

연정 뇌기능연구소

이 성 훈

＝국문초록＝

증감뇌유발전위와 성격의 상호관계의 영상적 분포를 조사하기 위해 38명의 대학생에게 증감뇌유발전위를 검사하였다. 그리고 Zuckerman의 추구척도와 Eysenck 성격설문지로 그들의 성격을 조사하였다. 외향 및 내향성 척도와 증감뇌유발 전위 사이에 후 전두엽 부위에서는 유의한 정상관관계가 있었으나 우측 후반구에서는 유의한 부상관 관계를 보였다. 스릴과 모험추구 척도와는 우측 후 측두엽에서 유의한 부상관 관계를 보였다. 모든 검사자의 평균 증감뇌유발전위는 전두엽 부위에서는 증가 경사도를 보였으나 후반구 부위에서는 감소경사도를 보였다.

중심 단어 : 시각 뇌유발전위 · 성격 · 뇌전기활동도.