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Stress, Stimulus Intensity Control, and the Structural Integration Technique

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Abstract. This paper reports on the effects of the structural integration technique on measures of psychological and physiological function (several EEG averaged evoked response procedures, an eye-movement procedure, and a battery of biochemical tests). The investigation was carried out by a team of psychophysiologists and biochemists. Inferences and conclusions from the data are based upon a relatively new biophysical model of how individuals modulate environmental stimulation. Changes after structural integration were indicative of increased openness and better modulated sensitivity to environmental stimulation.

In recent years, important developments in the field of neurophysiology have led to major discoveries regarding the sensory and motor nervous systems. Computer techniques for analyzing brain waves have made possible new uses for the electroencephalogram in studies of sensory and perceptual functioning.

A number of studies have indicated systematic relationships between electrophysiological, biochemical and sensory-perceptual events in the central nervous system [e.g. SILVERMAN *et al.*, 1969]. Other researches have suggested that muscle tension patterns, certain biochemical characteristics and 'styles' of perceiving and thinking are intercorrelated and that they all are important aspects of personality functioning [KEEN, 1970]. The aim of the present report is to describe how a number of these

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psychophysiologic variables may be affected by manipulation of muscle tension patterns. Using the body manipulation technique of structural integration [ROLF, 1973], a group of subjects was administered a series of treatments involving systematic manipulation of connective tissue (muscle and fascia). The myofascial component of connective tissue is considered by ROLF to provide cohesiveness and fluid exchange for the musculoskeletal system. Biochemical, electrophysiological and perceptual measurements were recorded before and after a series of ten treatments according to the structural integration method. This approach to body organization is conceptualized as, basically, two-fold: by manipulation of the fascia in all of the major muscle groups, the soft tissue is brought toward its normal movement which in turn facilitates the realignment of the entire physical structure. Deep emotional discharge typically occurs during these manipulations and is associated with subjective changes in response to stress situations.

Studies at the National Institute of Mental Health and elsewhere [e.g. EPSTEIN, 1967; BUCHSBAUM and SILVERMAN, 1968; SILVERMAN *et al.*, 1969] have indicated important complex relationships between *stress responsiveness, emotionality, motor activity,* and the ways in which individuals *modulate sensory stimulation.* The theoretical precursors of these studies are found in the writings of WILLIAM JAMES [1890] and in the theories of PAVLOV [1941] and FREUD [1959] who equated marked tension, anxiety, and severe stress with *overstimulation* and inefficiency in modulating stimulation. In order to make clear our approach, a perspective and brief review of the relevant literature are presented first.

The ordinary conditions of life involve constant change in the relations of the body to its environment and complex biopsychological adjustments are necessary to sudden variations in stimulus intensity. These adjustments are protective in nature; they mediate the impact of increased stimulation (or reduced stimulation) and they exclude stimuli from awareness. The physiological adjustments to sensory stimulation of individuals under extreme stress are different than those of normal subjects under less stressful conditions.

Highly stressed individuals, such as novice parachutists, schizophrenics, depressives, do not change their levels of physiological responsiveness to correspond to changing stimulation in the same way as do less stressed subjects [e.g. BUCHSBAUM and SILVERMAN, 1968; EPSTEIN, 1967; FENZ and VELNER, 1970]. Marked under-responsiveness and/or variability of response are found on certain electrophysiological measures at upper levels of stimulus intensity [INDERBITZIN *et al.*, 1970; SILVERMAN, 1970]. Other researches suggest a relationship between physiological adjustments to changes in stimulus intensity and excitation or tension in the peripheral musculature. Thus, EPSTEIN and FENZ [1970] reported a relationship in normal subjects between physiological responsiveness to sensory stimulation and degree of striated muscle tension. Individuals who reported a 'moderate' degree of striated muscle tension (on a specially designed scale) evidenced greatest initial autonomic reactivity (galvanic skin response) and pronounced habituation to a 115-decibel sound. Individuals in 'low' and 'high' muscle tension categories evidenced lesser initial autonomic reactivity and pronounced habituation. The reaction of the 'moderate' muscle tension group was viewed as the most adaptive one in that it indicated greater receptivity to stimulation as well as the capacity to stop reacting when the stimulus no longer contained new information. In a series of studies by WHATMORE and his colleagues [e.g. WHATMORE, 1966; WHATMORE and KOHLI, 1968], a physiopathological condition of the muscle system, 'hyperponesis' was described in psychotic patients. Hyperponesis is a condition of hyperactivity in the motor neuronal pathways; the hyperactivity (high muscle action potentials) extends from motor and premotor cortical neurons of the central nervous system down through pyramidal and extrapyramidal tracts to the peripheral musculature. The hyperactivity is measured with an electromyograph. Emotionally disturbed schizophrenic patients exhibit a persistent hyperponesis during acute episodes but a labile (high variability) hyperponesis when in remission. Emotionally disturbed depressive patients exhibit hyperponesis during and between their depressive episodes. Recently, MELTZER [1968] has reported that individuals in acute psychotic states have abnormally high amounts of a *muscle enzyme,* creatine phosphokinase. HUBBARD *et al.* [submitted for publication] have induced this biochemical effect in animals by greatly restraining their overt movements. It appears that the combination of relatively little overt motor activity and high muscle action potentials (such as occurs in 'essential' schizophrenic reactions and depressive reactions) is integrally associated with high creatine phosphokinase production. In psychotics, the trait pattern of reduced muscle action potentials, reduced creatine phosphokinase, and increased large muscle movements is associated with less emotional turmoil and anxiety and clinical improvement. Patterns of activity in motor neuronal pathways, biochemical and neurophysiological, are experimentally linked with levels of psychological stress.

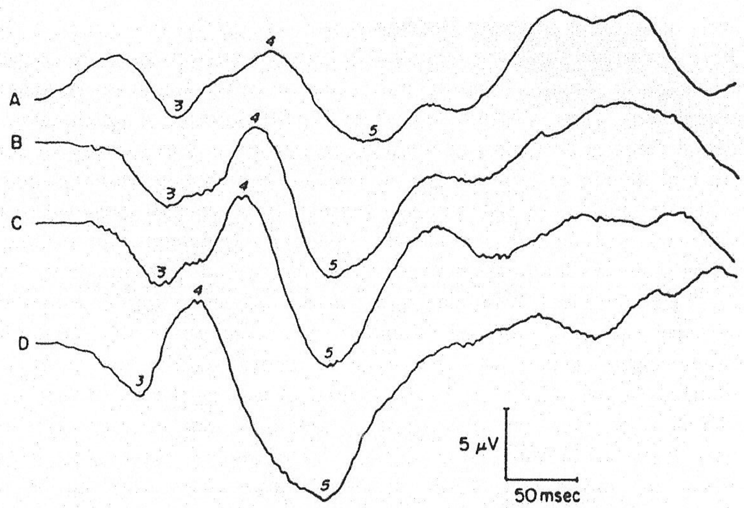


Fig. 1. A typical series of AER waveforms to four intensities of photic stimuli [from BUCHSBAUM and SILVERMAN, 1968]. Note: peaks are identified by numbers following system of KOOI and BAGCHI [1964]. Light values in lumen seconds: $A = 32$, $B = 70$, $C = 118$, $D = 980$.

Electrophysiological studies of sensory functioning have indicated that unique patterns of modulating sensory stimulation are associated with differences in degree and kind of psychological stress. These studies have employed cortical evoked response techniques which record responses to sensory stimulation using a modification of standard electroencephalographic procedure. Ordinarily, these evoked responses (evoked electrical potentials) are of such small amplitude as to be obscured by random larger amplitude EEG fluctuation. However, advantage is taken of the fact that an evoked response is always related in time to a sensory stimulus (this is not true for random EEG fluctuations). A subject's evoked response pattern is recorded by presenting him with a long series of stimuli, such as light-flashes, and for a brief-time interval after each stimulus, summing the EEG, using a computer of average transients. An averaged evoked response (AER) wave-form is produced which is similar from person to person to the extent that specific peaks and latencies of the AER waveform can be named and compared (fig. 1). Several characteristics of the evoked response waveform have been found to be

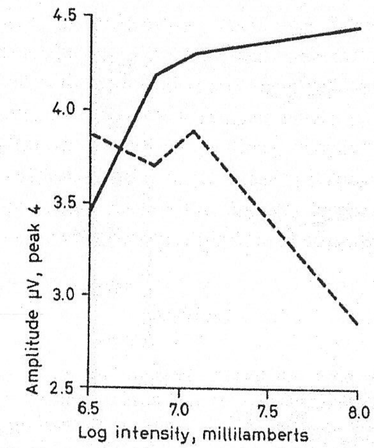
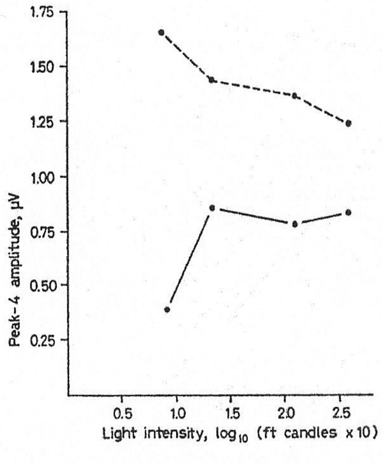


Fig. 2. AER amplitude-intensity functions of nonpsychiatric (normal) augmenter (——) and reducer (-----) groups [from BUCHSBAUM and SILVERMAN, 1968].

associated with specific aspects of sensory information processing: (a) the absolute amplitude of the AER waveform, (b) the degree of variability (similarity) between individual AER, and (c) the relationship between changes in AER amplitude in relation to changes in stimulus intensity. The latter relationship is expressed in terms of the *slope* of a linear function relating amplitude to stimulus intensity (fig. 2). A high slope, one reflecting relatively large increases in amplitude of the AER with respect to increasing stimulus intensity, is considered to be indicative of evoked response augmentation. A low or negative slope, reflecting relatively small increases or decreases in the AER amplitude with respect to increasing stimulus intensity, is indicative of evoked response reduction. Both augmentation and reduction are inferred from AER which occur in a moderate-to-high range of stimulus intensities. Studies measuring the three AER variables have indicated that: (a) higher amplitudes are linked with an open, more receptive orientation to external stimuli [e.g. BEGLEITER and PLATZ, 1969; SHEVRIN, 1970]; (b) lower variability is linked with greater capacity for efficient organization of sensory information [e.g. INDERBITZIN *et al.*, 1970; JONES and CALLAWAY, 1969]; and (c) AER *reduction* is found in hypersensitive normal and psychiatric subjects [e.g. SILVERMAN *et al.*, 1969; SILVERMAN, 1969].



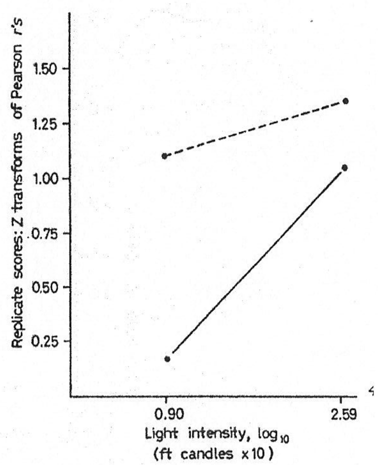


Fig. 3. Amplitudes of AER to four intensities of photic stimulation. Note: peak-4 designation is based upon numbering system of KOOI and BAGCHI [1964]. Light values are in $\log_{10}$ (ft candles ×10) and range from 0.90 to 2.59. ●- - -● = Post S. I.; ●——● = Pre S. I.

Fig. 4. AER variability measure for two light intensities. Replicate indexes of 0.90 and 2.59 $\log_{10}$, ft candles × 10, Z-transformed. •- - -• = Post S. I.; •——• = Pre S. I.

Thus, both nonparanoid schizophrenic and retarded depressive patients evidence a marked tendency to *reduce* responsiveness to strong stimulation on the AER procedure [BORGE *et al.*, 1971; BUCHSBAUM and SILVERMAN, 1968; SHAGASS *et al.*, 1969]. Schizophrenic patients also evidence high variability both on the AER procedure and on perceptual tests [INDERBITZIN *et al.*, 1970]. Chlorpromazine, an antipsychotic drug, sharply curtails AER reduction responsiveness and also hyperponesis. Reduction responsiveness on the AER procedure is found in human subjects who are hypersensitive to low intensity stimulation and in animals who are withdrawn and who do not explore their surroundings [HALL *et al.*, 1970; SILVERMAN, 1969]. These findings and others [e.g. SILVERMAN, 1969; SILVERMAN *et al.*, 1969] suggest that in highly stressed individuals reduction responsiveness may also be a compensatory adjustment to a condition of overstimulation.

It was hypothesized on the basis of all of these studies (and others to be cited) that muscle tension manipulation, by the structural integration

method, would have the following effects on laboratory measures of stimulus intensity modulation and stress responsiveness:

(1) Receptivity to environmental stimulation will be increased.

(2) Responsiveness to ordinary stimulation will be greater and responsiveness to strong stimulation will be relatively reduced.

(3) Individuals evidencing the most balanced structural reorganization will also evidence the most significant changes toward greater receptivity to stimulation and more efficient modulation of stimulation.

Method

Subjects

15 male subjects, between the ages of 25 and 45, were selected on a volunteer basis to participate in this study. None had any gross physical or psychiatric disability. A battery of electrophysiologic and biochemical tests was administered before, during and after a series of 10 sessions of structural integration which extended over a 5-week period. Since two subjects did not complete the test battery after the 10th session, final data analyses were carried out on 13 subjects.

Electrophysiological Procedures

1. EEG AER-'stimulus intensity'-procedure. This EEG averaging procedure, designed to be a measure of stimulus intensity control, is described in greater detail elsewhere [BUCHSBAUM and SILVERMAN, 1968]. During the procedure, the subject sat in a darkened room in a comfortable chair. Four intensities of light-flashes (0.8, 2.4, 12.6, 38.8 ft candles) were presented in 8 blocks of 56 randomized flashes; the interval between individual stimuli was 1 sec; the duration of flash was 15 msec. Each intensity of light was presented 112 times for a total of 448 stimuli. EEG was recorded, on analogue tape between vertex (C_z) and right ear, with left ear ground. Grass silver disk electrodes were used; electrode resistance was between 8 and 12 kΩ. The recorded EEG was passed through a 40-H_z low-pass filter and then was summed separately for each intensity, using a TMC computer of average transients. An X-Y plotter recorded the curves for measurement. AER amplitudes were measured peak-to-trough from peak 3 to peak 4 [BUCHSBAUM and SILVERMAN, 1968] of the AER waveform, 100–140 msec for each stimulus intensity.

The relationship of AER *amplitude* and *stimulus intensity* is expressed in terms of the slope of a linear function relating these two variables. A high slope, one reflecting relatively large increases in amplitude of the AER with respect to increasing stimulus intensity, is termed stimulus intensity 'augmentation'. A low or negative slope, reflecting relatively small increases or decreases in the AER amplitude, is termed stimulus intensity 'reduction'. Both augmentation and reduction are inferred on the electroencephalographic procedure from averaged evoked responses which occur in a moderately high range of stimulus intensities. Test-retest reliabilities of the AER slope measure are relatively stable from day to day in several different studies; reliability coefficients have ranged from 0.71 to 0.91 [BUCHSBAUM *et al.*, 1971].

A second AER measure was derived by computer program rather then from hand-eye measurement of the X-Y plots. The measure was obtained in the following way: for 2 of the intensities of light-flash (0.8 and 38.8 ft candles, dim and bright), the 112 trials were provided (split-half) into two groups of 56 and averaged separately. Product moment correlations were computed between all pairs of waveforms of the 4 AER (using the ordinate for each time value). The two AER, each formed by summing one half of the stimulus presentations, odd and even numbers of responses, respectively, for any given intensity, are referred to as a 'replicate pair'. Correlation coefficients were computed between each of the replicate pairs, one for each intensity, and were Z-transformed; these are referred to as 'replicate indexes'.

A third AER score was obtained by measuring for each subject, the distance between the maximum positive peak and maximum negative peak of the overall AER waveform for each of the four stimulus intensities.

2. *Saccadic eye movement procedure.* Saccadic eye movements are rapid, flick-like, jumping movements, which on the average occur between once and twice a second, even when an individual is fixating a minute portion of the visual field. The occurrence of these momentary discontinuous oculomotor adjustments is considered essential for detailed vision [e.g. DICHTBURN and FENDER, 1955; GAARDER, 1966]. This procedure was included in the battery on the basis of evidence that saccadic eye movement rates: (a) are associated with augmentation-reduction on the AER procedure [SILVERMAN and BUCHSBAUM, unpublished data]; (b) are higher in highly stressed individuals [e.g. SILVERMAN and GAARDER, 1967]; and (c) are reduced in response to high-arousal stimuli in schizophrenic patients [SHIMAZONO *et al.*, 1965]. Measurement of saccadic eye movement was made during a 1-min period while *S* fixated a target image in the center of the visual field. The saccadic-rate measuring device, a photoelectro-mechanical system, described in detail elsewhere [GAARDER *et al.*, 1967; KRAUSKOPF *et al.*, 1966], focuses infrared light on the corneal-scleral margin of the eye. When the eye moves, the amount of infrared light which is reflected from the eye changes. The reflected light is collected in a photocell which is positioned in the same optical system. The photocell's amplified electrical output is non-linearly proportional to the movement of the eye. The apparatus is capable of detecting eye movements of from less than 1° of arc to 20° of arc. During an eye-movement recording session, *S's* head was rigidly held in place by a bite board. He was instructed simply to fixate, for a 'brief' time period, the center of a small target image which was positioned 20 in from his eyes. The saccadic-rate-per-second score is obtained by dividing the minute-long recording period into six 10-sec periods. A fixation rate per second is derived by adding the number of blinks in each 10-sec period to the number of saccades in that period; this gives an overall average fixation-per-second score. The inclusion of blinks is based upon the consideration that a blink changes the pattern of stimulation on the retina in a way which is similar to that which occurs during a saccade.

3. *EEG AER 'perceptual differentiation' procedure.* This procedure, although not a direct measure of stimulus intensity control, was included on the basis of work relating preceptual differentiation to stimulus intensity control [e.g. SILVERMAN, 1970]. The subject sat 50 cm in front of a cathode ray tube (CRT) display
VERMAN, 1970]. The subject sat 50 cm in front of a cathode ray tube (CRT) display
in a completely darkened room. The test stimuli were a series of tilted line

segments, or rods, created by a special signal generator and displayed on an 8×10-cm CRT. The line segments were 6 cm long and were displayed in one of four positions of tilt to the right of vertical. The center of the line segments always appeared at the same position on the display screen. The lines appeared light green on a dark background. The CRT intensity was adjusted low enough so that the CRT tube face did not glow; only the line segment was visible. The signal generator was not in the same room as the display screen and stimulus presentation was entirely silent. For each of the four degrees of tilt, the rod stimuli were presented in random order 1 sec apart with a duration of about 50 msec. The test, which was comprised of 448 stimulus presentations, lasted about 8 min. The subject was instructed how to minimize movement artifacts by not making any vocal or motor response.

The EEG data were obtained from the electrode placement described previously (bipolar recordings with active vertex and the right ear lobe as reference). The potentials were amplified and passed through a 40-Hz low pass filter. Evoked responses were computed by the CRT. Electrode resistance was 8–12 kΩ. As a control condition, a 10 kΩ-resistor in place of the subject yielded an almost straight line pattern of AER.

Evoked responses were computed for 500 msec following the beginning of the stimulus presentation. Responses were averaged separately for two of the four degrees of tilt from vertical (0 and 6°). The 112 trials for each degree of tilt were randomly subdivided into two sets of 56 so that a total of 4 evoked responses, two replicates for each degree of tilt (0 and 6°) were computed. The replicate technique was utilized to provide a measure of reproducibility or reliability of the evoked response. The difference in evoked-response waveform between amounts of tilt was estimated using a discrimination index. Product-moment correlation coefficients were computed between all of the evoked potential waveforms; they were transformed into a Fisher 7 score for the replicate pairs and the mean Z score for all other nonreplicate pairs. Thus, the 0–6° index is the mean of the correlations between the 0° replicates and between the 6° replicates minus the mean of the correlations between the 0 and 6° curves. A positive value indicates that the independent AER replicates for the same stimulus (degree of tilt) resemble each other more than they resemble the dissimilar stimulus. High-positive indexes signify that markedly different AER waveforms are produced by different degrees of tilt.

All electrophysiological measurements to be reported were made before structural integration session 1 and 10 days after session 10.

Biochemical Procedures

1. *17-Hydroxycorticosteroid (17-HCS).* Variations in secretions from the adrenal cortex of 17-HCS (urinary) have been shown to be linked both to stimulus intensity control responses and to responses to emotional stress [HENKIN and DALY, 1968; RUBIN and MANDELL, 1966; SILVERMAN *et al.*, 1969]. In the present study, a sample of each subject's urine was collected at approximately the same hour of the day before structural integration sessions 1, 4, 7 and 10, and 10 days after session 10. Assays for Porter-Silber chromogens were performed according to the method described by ELLMAN and BLACKER [1969].

2. *Creatine phosphokinase (CPK).* Recent studies by MELTZER [e.g. MELTZER *et al.*,

1969; MELTZER and MOLINE, 1970] have indicated that serum CPK is found in abnormally high amounts in certain schizophrenic and depressive patients. Isozyme studies established that the increased CPK is of the *muscle* type, rather than brain or liver. HUBBARD *et al.* [submitted for publication], induced this chemical effect in animals by greatly restraining their overt movements. On the basis of these studies, it is suggested that a combination of high muscle action potentials and relatively little overt muscle activity is a precursor of high CPK production. In this study, blood samples were obtained according to the same schedule as for the other procedures. CPK determinations were made from serum according to the technique described by MELTZER *et al.* [1969].

Other enzymes whose activity is known to be increased during physical stress were also surveyed in the serum of our subjects: (3) serum glutamic oxalacetic transaminase (SGOT), (4) lactic dehydrogenase (LDH), and (5) aldolase. [For descriptions of the spectrophotometric methods employed in these enzyme determinations, see references 12 through 15 in MELTZER *et al.*, 1969.]

All biochemical measurements to be reported were made before structural integration session 1 and 10 days after session 10.

Each subject was given two sessions of structural integration each week for a 5-week period. They were processed alternatively by two practitioners, Dr. IDA ROLF and Mr. P. MELCHIOR. No subject received more than five processings from either practitioner.

Results

Electrophysiological Measures

On the three AER measures from which stimulus intensity control responsiveness is inferred, poststructural integration (post-SI) values were found to be significantly different from prestructural integration values (pre-SI). On the amplitude measure, *all* subjects evidenced increases in the amplitudes of their evoked response waveforms. This measure was obtained by calculating, for each subject, the distance between the maximum positive peak and maximum negative peak of the overall AER waveform for each of the four stimulus intensities. On the augmenting-reducting slope measure, a significant change toward greater reduction responsiveness was found ($n = 13$, $t = 3.64$, $p<0.005$). Pre- and postaugmenting-reducing amplitudes and slopes are presented in figure 3. On the replicate index measure, significantly higher values were found in the post-SI than in the pre-SI condition (int. 1, $t = 5.23$, $p<0.001$; int. 4, $t = 2.21$, $p<0.025$). Pre-post replicate indexes are presented in figure 4. (Recall that the replicate index measure refers to the stability of the AER.)

Although slight trends were found in the expected directions on both the saccadic eye movement measure and on the AER perceptual differentiation (PD) measure, these pre-post differences were not statistically significant. Saccadic eye movements during fixation of the target stimulus tended to be lower in the post-SI condition. The mean 0–6° index on the AER PD measure was slightly higher in the post-SI condition. Table I summarizes the electrophysiological pre- and post-SI findings.

Table I. Mean values of electrophysiological measures before and after structural integration (n=13)

Measure	Pre-SI		Post-SI		Diff.	p value
	M	SD	M	SD	t	(1-tailed)
AER						
Amplitude intensity						
1	0.3938	0.1417	1.6653	0.4913	7.9861	<0.001
2	0.8593	0.3937	1.4492	0.4682	5.7975	<0.001
3	0.7532	0.4230	1.3618	0.5681	3.5569	<0.005
4	0.8326	0.3701	1.2376	0.6667	2.1077	<0.05
Aug./red. slope	0.0061	0.0093	–0.0086	0.0186	3.7692	<0.005
Replicate index intensity						
1	0.1780	0.5739	1.1045	0.3174	5.2338	<0.001
4	1.0608	0.4254	1.3511	0.2840	2.2143	<0.025
PD (0–6° index)	–0.0723	0.1453	–0.0245	0.1979	0.6183	NS
Saccadic rate	0.6730	0.4451	0.5268	0.5313	0.9018	NS

Biochemical Measures

The average rate of excretion of 17-HCS for each subject pre-SI and post-SI was calculated. (The analysis was conducted on urine samples from 11 subjects since samples could not be collected on two subjects.) Post-SI values tended to be lower than pre-SI values, as expected. However, the difference was not statistically significant (for $n = 11$, $t = 1.38$, $P = 0.10$, 1-tailed). CPK values, which in an unpublished study had been found to decrease following 10 sessions of structural integration were not significantly changed. Indeed, a slight unexpected tendency toward increased CPK was found in the post-SI condition. Also unexpected was a highly significant increase in SGOT. Table II summarizes the biochemical findings for the pre-SI and post-SI conditions.

A cluster analysis of subjects was then performed on all of these variables except the amplitude measure which was inadvertently omitted. Us-

Table II. Mean values of biochemical measures before and after structural integration

Measure	Pre-SI		Post-SI		n	Diff.	p value
	M	SD	M	SD		t	
17-HCS, μg/min	5.40	2.94	4.98	1.98	11	1.38	0.10 (l-tailed)
CPK, IU/l	35.9	27.2	38.5	23.3	13	0.30	NS
SGOT, IU/l	30.9	9.9	50.8	14.7	13	4.71	<0.005
LDH, IU/l	221.4	55.3	229.4	68.4	13	1.15	NS
Aldolase, IU/l	2.41	0.8	2.09	1.3	12	0.87	NS

ing a 'nearest neighbor' Iso-data analysis method, a 4-cluster array was derived [BALL and HALL, 1967]. The uniqueness of the patterns of electrophysiological and biochemical responses was due mainly to between-group differences in those variables summarized in tables III and IV.

The names of the subjects in each of the clusters were then given to an experienced structural integration practioner.[5] He was told nothing about the pattern of results; he was simply asked to look at full-body photographs (post-SI) of the subjects in each cluster and describe any differences in their body organization which he could discern. The following are the verbatim descriptions which he prepared:

(1) The greatest degree of balance between intrinsic and extrinsic muscles was achieved with the subjects in group 1. These subjects can easily be recognized as those with the most change toward normal.

(2) Subjects in group 2 belong to the soft-bodied type in which the *intrinsic musculature* is *hypertense* while the outer muscles are soft and toneless. Although the structural integration processing produced much improvement in this inner/outer balance, they still remain basically unchanged. It would be expected that these models will continue to improve for several months. Further Rolf work is indicated for this group.

(3) Group 3 is the reverse of group 2. These subjects can be viewed as having a soft core structure and a hard outer sleeve structure. As in group 2, much of the inner/outer imbalance still remains even after 10 hours of structural integration and further treatments are indicated.

(4) I am able to make observation on group 4 only by analysis of the three persons who are missing from this group. The three missing models

[5] We wish to especially thank Mr. EMMETT HUTCHINS for his work on this project.

e *III.* 4-cluster Iso-data analysis of subjects based on electrophysiological and biochemical variables

sure	Cluster 1 post-SI (n=4)	Cluster 2 post-SI (n=3)	Cluster 3 post-SI (n=6)	Cluster 4[1] pre-SI (n=10)
./red. slope	most marked reduction	–	–	
licate index	lowest variability	–	highest variability	
plitude				
Low intensity	–	–	–	
High intensity	lowest amplitude		highest amplitude	
adic rate	lowest saccadic rate			
C	lowest CPK (both pre and post)	highest CPK (both pre and post)		
plase	decrease		slight increase	
ICS		highest 17-HCS (both pre and post)		
OT		highest SGOT (post)		

Cluster 4 is an entirely pre-SI cluster. Of the three subjects missing from the pre-SI cluster, two were ted in cluster 3 and one was located in cluster 2. These three subjects' pre-SI scores were not included ie post-SI summary presented here.

show the least change in rib angle giving the least change in the area of the solar plexis, diaphragm, heart cavity, etc.[6]

These cluster descriptions are remarkable in the degree to which they are compatible with the patterns of results obtained with the biochemical and electrophysiological measures and will be considered in detail in the discussion section.

Discussion

The pattern of results obtained in this study indicates that significant psychological and physiological changes took place during the five-week treatment period. Thus, significant differences were found on the EEG

[6] This fourth cluster was made up of all subjects in the study, except three, and was a pre-SI cluster. The first cluster was a post-SI cluster and the other two also were essentially post-SI clusters.

Table IVa. Pre-SI mean values on electrophysiological and biochemical variables for subjects divided on basis of a 4-cluster Iso-data analysis

Measure	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
	M	SD	M	SD	M	SD	M	SD
AER								
Aug./red slope	0.0041	0.0069	0.01	0.01	0.005	0.007	+0.0061	0.0
Amplitude intensity								
1	0.43	0.18	0.37	0.13	0.38	0.11	0.40	0.1
2	0.70	0.17	0.80	0.05	0.96	0.54	0.87	0.4
3	0.62	0.08	0.91	0.58	0.76	0.44	0.72	0.4
4	0.71	0.29	0.98	0.51	0.84	0.30	0.85	0.3
Replicate index intensity								
1	0.16	0.55	0.07	0.34	0.24	0.67	0.08	0.4
4	0.97	0.61	0.99	0.04	1.16	0.35	1.05	0.4
0–6° PD	–0.097	0.14	–0.17	0.06	–0.007	0.14	–0.101	0.1
Saccadic rate	0.36	0.27	0.45	0.17	0.99	0.42	0.528	0.3
17-HCS	4.88	2.64	7.5	0.25	4.56	3.41	4.97	2.9
CPK	21.8	7.15	46.0	12.8	40.3	35.8	30.0	12.9
Aldolase	2.83	1.11	1.90	0.25	2.48	0.54	2.31	0.8
SGOT	25.0	2.23	26.0	8.48	31.3	7.18	28.9	10.4
LDH	188	22.0	273	74.8	176	77.4	217.1	55.9

AER measures. These pre-post differences were indicative of an increased sensitivity and receptivity to environmental stimulation. The increased AER reduction which occurred in our subjects is found in sensitive normal subjects [SILVERMAN *et al.*, 1969] and in hypersensitive drug users and psychiatric subjects [BLACKER *et al.*, 1968; BUCHSBAUM and SILVERMAN, 1968; SILVERMAN, 1969]. The increased AER amplitudes were expected on the basis of other findings which link higher amplitude with a more open, receptive orientation to external stimuli [BEGLEITER and PLATZ, 1969; SHEVRIN *et al.*, 1970]. The increased replicate indexes, signifying increased stability of the evoked response, indicate a significant increase in organization of the sensory information processing system.

(It is instructive to compare the post-SI responses of the subjects in this study with those of nonparanoid schizophrenic subjects studied else-

Table IVb. Post-SI mean values on electrophysiological and biochemical variables for subjects divided on the basis of a 4-cluster Iso-data analysis[1]

Measure	Cluster 1		Cluster 2		Cluster 3	
	M	SD	M	SD	M	SD
AER						
Aug./red. slope	–0.021	0.010	–0.003	0.022	–0.002	0.010
Amplitude intensity						
1	1.71	0.34	1.61	0.32	1.66	0.63
2	1.28	0.33	1.57	0.33	1.50	0.56
3	0.93	0.35	1.60	0.20	1.53	0.65
4	0.68	0.11	1.47	0.79	1.50	0.58
Replicate index intensity						
1	1.41	0.15	0.84	0.09	1.04	0.31
4	1.64	0.11	1.29	0.27	1.25	0.27
0–6° PD	–0.190	0.162	0.048	0.049	0.050	0.20
Saccadic rate	0.254	0.056	0.383	0.125	0.781	0.691
17-HCS	4.20	2.02	6.80	1.48	4.50	1.47
CPK	22.8	2.59	69.0	30.2	33.8	7.69
Aldolase	0.70	0.22	2.97	0.75	2.35	1.25
SGOT	40.0	9.90	64.7	17.5	51.0	8.62
LDH	212.5	44.7	314.7	56.3	198.0	49.2

[1] Cluster 4 is an entirely pre-SI cluster and is therefore omitted.

where [BUCHSBAUM and SILVERMAN, 1968; SHAGASS *et al.*, 1969]. In all of these samples, AER reduction was observed. However, in the structural integration study, subjects [post-SI] did not evidence low amplitudes and increased AER variability [CALLAWAY *et al.*, 1965; INDERBITZIN *et al.*, 1970], which appear to be associated with *over*stimulation [see also GOLDSTEIN and PFEIFFER, 1969]. Nor do the subjective reports of the subjects suggest that they were in an overstimulated state, as do the subjective reports of acute schizophrenics [SILVERMAN, 1969].)

The post-SI subjective reports of our subjects were consistent with the interpretation of the high amplitude, low variability (and reduction) AER findings; both sets of findings suggest an increased openness and receptivity to stimulation. Also consistent with this interpretation was the trend observed of a lower excretion rate of 17-HCS post-SI. Low 17-HCS has been found to be associated with increased sensitivity to low intensity stimulation [e.g. HENKIN and DALY, 1968; SILVERMAN *et al.*, 1969]. Also, low 17-HCS values usually are not found among individuals who are in high stress states unless they are medicated [e.g. ELLMAN and BLACKER, 1969].

The results of the four-group cluster analysis are particularly compelling. The cluster-1 pattern of electrophysiological and biochemical responses was prototypic of our model of an open, receptive, efficient sensory information processor.[7] Thus, the most marked AER reduction slopes, highest replicate indexes, relatively low 17-HCS, CPK, and aldolase values were found in cluster-1 subjects. AER amplitudes to the lower stimulus intensities in cluster 1 were not different from the other clusters; however, cluster 1 AER amplitudes at the highest intensity were smallest. Such a response pattern to low and high intensity stimulation is considered to be a highly adaptive one. It indicates both a sensitivity to stimulation and a capacity to efficiently modulate strong stimulation [see also EPSTEIN and FENZ, 1970].[8] It was the body organization of subjects evidencing this response pattern that was independently evaluated as indicating 'the greatest degree of balance between intrinsic and extrinsic muscles'.

Finally, a recent study by SILVERMAN *et al.* [1973] indicates that a reduction AER slope is characteristic of control groups of normal male subjects but that an augmenting AER averaged slope is characteristic of emotionally disturbed (nonpsychotic) males. In this regard, note the change in subjects' AER slopes from pre- to postexperimental conditions. In the pre-SI condition, the slope was an augmenting one; in the post-SI condition, a high amplitude reduction slope was found. Overall, our data provide preliminary experimental support for the value of the structural integration technique. These data also indicate, in a systematic way, the integral relationship between the human organism's sensory and muscle systems.

7 The only result which was unexpected and difficult to reconcile was the increase in SGOT which occurred in cluster-1 subjects as well as in the others. Note, however, that both pre- and post-SI values tended to be lowest in cluster 1. (Cluster 1 = pre 25, post 40; cluster 2 = pre 29, post 65; cluster 3 = pre 32, post 51.)

8 Personality questionnaire data, available on half of the subjects in the study, also are in accord with this formulation. Post-SI scores on the Myers-Briggs scales and Welsh anxiety scale for the two cluster-1 subjects who completed the questionnaires indicated a relatively high receptivity to internal (emotional) stimuli and a decrease in anxiety.

Zusammenfassung

In diesem Artikel wird über die Wirkungen berichtet, welche das strukturelle Integrationsverfahren auf die Messungen der psychologischen und physiologischen Funktionen ausübt (mehrere EEG-Durchschnitte, evozierte Reaktionsverfahren, ein Augenbewegungsverfahren und eine Reihe von biochemischen Proben). Eine Gruppe von Psychophysiologen und Biochemikern führte die Untersuchungen durch. Folgerungen und Schlüsse aus den Unterlagen stützen sich auf ein verhältnismässig neues biophysikalisches Modell, nach dem das Individuum Umgebungsreize reguliert. Änderungen nach struktureller Integration zeigten erhöhte Offenheit und besser regulierte Empfindlichkeit auf Umgebungsreize.

Résumé

Cet article traite des effets exercés par les processus d'intégration structurale sur certains paramètres psychologiques et physiologiques (réaction EEG moyenne, mesure des mouvements oculaires dans des conditions données, ainsi qu'une batterie de tests biochimiques). L'étude a été réalisée par un groupe de psychophysiologues et de biochimistes. Les déductions et conclusions auxquelles ils sont arrivés procèdent d'un schéma biophysique relativement nouveau, qui affirme que l'individu module les stimuli de son environnement. Les modifications entraînées par cette intégration structurale vont dans le sens d'une plus grande réceptivité et d'une meilleure régulation de la sensibilité aux stimuli de l'environnement.

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