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ts showed a time-related rise in antici- conductance, coupled with the finding the fearful and nonfearful subjects d specific responses of equal magnitude e slides, suggests that the distinction en self-reported fearfulness and nonfear- s may be reflected by the time specific- the autonomic response rather than by agnitude of response. It is clear, for in- , that Fenz and Epstein's (1967) enced jumpers, who described them- as nonfearful, showed autonomic re- es that were as great at the moment of mp as those of the novice jumpers. The ction between them was in the time- c quality of their elicited autonomic nses, not in the magnitude. Our data st that this approach to the distinction en subjects who describe themselves as l and nonfearful may be fruitful.

REFERENCES

ein, D. A., & Allen, G. J. Fear Survey Sched- (II): Normative data and factor analysis based a large college sample. *Behaviour Research Therapy,* 1969, *7,* 403–408.

e, D. P., & Marlowe, D. A new scale of social ability independent of psychopathology. *Jour- of Consulting Psychology,* 1960, *24,* 349–354.

, F. H., & Mealica, W. L. Dissimulation and l desirability in the assessment of fears. *Be- or Therapy,* 1971, *2,* 101–102.

W. D., & Epstein, S. Gradients of physio- al arousal in parachutists as a function of an oaching jump. *Psychosomatic Medicine,* 1967, 3–51.

J. H. The development of a scale to measure . *Behaviour Research and Therapy,* 1965, *3,* 3.

J. H. Fear and autonomic arousal. *Journal of ormal Psychology,* 1966, *71,* 253–255.

, E. S., & Deitz, S. R. Systematic desensitiza- . In W. F. Prokasy & D. C. Raskin (Eds.), *trodermal activity in psychological research.* York: Academic Press, 1973.

, G. D. GSR responses to fear-related stimuli. *eptual and Motor Skills,* 1967, *24,* 401–402.

, J., & Lang, P. J. A fear survey schedule for in behaviour therapy. *Behaviour Research and rapy,* 1964, *2,* 27–30.

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Attentional Style and the Self-Regulation of Mode-Specific Attention: An Electroencephalographic Study

Richard J. Davidson, Gary E. Schwartz, and Larry P. Rothman
Harvard University

The present study was designed to assess the cortical concomitants of selective mode-specific attention in subjects differing in the capacity for sustained attentional involvement. A total of 10 high- and 10 low-scoring subjects on the Tellegen Absorption Scale were required to (a) simply attend to either a randomly flashing light or a randomly produced tapping sensation on the forearm during one block of trials and to (b) count the flashes and the taps during another trial block. The electroencephalogram was recorded from the left occipital and left sensorimotor regions and was filtered for alpha activity and quantified on line. The results indicated that selective mode-specific attention produced reliable shifts in cortical patterning between kinesthetic and visual attention trials. During the counting condition, high-scoring subjects on the Tellegen Absorption Scale showed significantly greater specificity in cortical patterning than did low-scoring subjects. This difference was primarily a function of the high-scoring subjects' ability to inhibit activation in the occipital region while counting taps. These findings suggest that high scores on the Absorption scale are associated with a flexible attentional style and that, given the requisite task demands, attentionally absorbed subjects show greater mode-specific cortical patterning during selective attention than do low Absorption scale scorers.

Although individual differences in the capacity to attend selectively have been noted since at least the time of James (1890/1950), little systematic research has been performed on the neural substrates of these biocognitive differences in humans (see Callaway, 1975). The study of attentional style has proceeded largely on the basis of behavioral and questionnaire data, much of it revolving around the study of attentional dysfunction in psychopathology (e.g., McGhie, 1969; Silverman, 1964; Wachtel, 1967).

A number of different methods, all involving cerebral psychophysiological measures, have recently been used in the study of attentional processes. For example, in an experiment designed to assess mode-specific selective attention, Spong, Haider, and Lindsley (1965) presented subjects with alternating visual and auditory stimuli while the subjects attended to one or the other class of stimuli. Averaged evoked potentials (EPs) were recorded from the occipital and temporal cortex. The results indicated that when subjects were attending to the visual stimuli, the amplitude of specific peaks of the occipital EP (to the visual stimuli) was greater than the same EP indices obtained while subjects were attending to the clicks. Similarly, when subjects were attending to the clicks, the amplitude of specific peaks in the temporal EP (to the clicks) was greater than the same EP index obtained when the subjects were attending to the flashes. This phenomenon has been replicated and extended by others (e.g., Hillyard, Hink, Schwent, & Picton, 1973; Picton & Hillyard, 1974).

It is interesting that a wide range of individual variation on measures of cortical involvement during attentional tasks has been

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observed in many of these studies. For example, in reviewing the literature on evoked potential measures of selective attention, Tecce (1970) has observed significant individual differences. He suggests that "the striking variability among individuals raises an issue previously discussed, namely, that some Ss [subjects] may be able to direct their attention to the EP stimuli better than others" (Tecce, 1970, p. 337). Tecce offers this suggestion on the basis of data that suggest that although many individuals show enhancement of various EP components to attended stimuli, others do not. A wide range of individual variability during attentional tasks has also been noted in studies in which the dependent measure has been the contingent negative variation (e.g., Tecce, 1971) and changes in background electroencephalogram (EEG) activation (e.g., Mulholland, 1973).

If one could predict the individuals who show appropriate task-relevant shifts in cortical patterning during voluntary selective attention, then additional insight into the neural substrates of such differences might be gleaned. Recently, a psychometric instrument designed to assess attentional absorption (which is functionally independent of introversion–extroversion and neuroticism) has been developed (Tellegen & Atkinson, 1974) and offers promise in accounting for some of the individual variability in studies of the cerebral concomitants of selective attention. The Tellegen Absorption Scale (TAS) has been interpreted as one that assesses the disposition for having episodes of total attention that fully engage one's representational resources. Among other things, Tellegen and Atkinson (1974) suggest that people scoring high on the TAS are relatively impervious to normally distracting events.

A number of additional lines of research all suggest that absorption is associated with the capacity to attend selectively. For example, absorption has been found to correlate with hypnotizability in the range of .4 (Spanos & McPeake, 1975; Tellegen & Atkinson, 1974). It is important that differences in attentive ability have been observed between high- and low-hypnotizable subjects using both behavioral (e.g., Van Nuys, 1973) and electrophysiological (e.g., Galbraith, Cooper, & London, 1972) measures. High-hypnotizable subjects have been found to be superior to low-susceptible subjects on measures of selective attention. It is also interesting that people practicing meditation have been found to score higher on the TAS than nonmeditators (Davidson, Goleman, & Schwartz, 1976) and that in longitudinal research, meditation has been found to be accompanied by gains in selective attentive ability (e.g., Linden, 1973; Pelletier, 1974).

The present study was designed to assess the cortical concomitants of selective attention in subjects scoring at the extremes of the distribution on the TAS. The main dependent measure in the present study is abundance of EEG activity in the alpha band (8–13 Hz). The presence of such activity recorded from scalp electrodes is interpreted as reflecting an absence of active information processing (e.g., Shagass, 1972). When alpha activity is blocked in the waking subject, it is assumed that the EEG frequency increases (to the beta range—13 Hz and above), and the presence of such fast frequency activity is interpreted as a sign of activation (see Lindsley & Wicke, 1974; Shagass, 1972). Therefore, in the present study, a change from relative alpha abundance to relatively little alpha in a particular scalp region is indicative of a shift to greater activation in that area. Such a procedure has been frequently employed in studies that assess specificity of hemispheric activation during cognitive tasks (e.g., Davidson & Schwartz, 1976; Doyle, Ornstein, & Galin, 1974; Schwartz, Davidson, & Pugash, in press).

The present experiment is based in part on a recent study from our laboratory that found enhanced specificity of EEG activation from occipital and sensorimotor regions in subjects trained in the self-regulation of attention (all such subjects practiced a specific meditation technique that emphasized active attentional control) compared to controls (Schwartz, Davidson, & Margolin, Note 1). In the present experiment, subjects were requested to either attend to or count visual or kinesthetic stimuli while EEG was recorded

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Method

Subjects

A total of 150 right-handed Harv
undergraduates completed the TAS. (Th
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tion scale used by Tellegen and Atkins
It consisted of a 37-item scale that was
with 38 additional filler items to make
questionnaire. The 12 highest and low
representing the top and bottom 8% of
were asked to participate in the exp
total of 10 high and 10 low scores were
recruited. The mean TAS score for the
was 17.1 ($SD = 3.00$); for the high gr
35.3 ($SD = 1.06$). The experimenter w
the group to which each subject be
subjects were paid volunteers.

Apparatus and Physiological Recor
Procedure

Subjects were seated on a reclining
sound-attenuated room. Monopolar EE
corded from the left occipital area and
motor area (termed O1 and C3, respe
Jasper, 1958), and each EEG lead was re
linked ears with Beckman miniature
chloride electrodes. All electrode resist
below 5,000 Ω. Subjects were grounded v
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timuli while EEG was recorded

from occipital and motor regions of the brain. A large body of data has suggested that specifically designed tasks are associated with predictable patterns of cortical excitation and inhibition in relevant brain regions, both interhemispherically (e.g., Davidson & Schwartz, 1976; Galin & Ornstein, 1972) and intrahemispherically (Schwartz et al., Note 1; Lenson, Davidson, & Schwartz, Note 2). Based on these data, it was predicted that across all subjects, visual attention should result in relative occipital EEG activation and kinesthetic attention should elicit relative activation in the motor region. It was further hypothesized that, compared to low-scoring subjects, subjects scoring in the upper extreme of the distribution on the TAS would show greater cortical specificity (i.e., activation of the relevant area concomitant with inhibition of the irrelevant area), particularly during the counting condition (which maximized the attentional demands of the situation).

METHOD

Subjects

A total of 150 right-handed Harvard female undergraduates completed the TAS. (The TAS used in this study was an updated version of the Absorption scale used by Tellegen and Atkinson, 1974.)[1] It consisted of a 37-item scale that was interspersed with 38 additional filler items to make a 75-item questionnaire. The 12 highest and lowest scorers, representing the top and bottom 8% of the sample, were asked to participate in the experiment. A total of 10 high and 10 low scores were eventually recruited. The mean TAS score for the low group was 17.1 ($SD = 3.00$); for the high group it was 35.3 ($SD = 1.06$). The experimenter was blind to the group to which each subject belonged. All subjects were paid volunteers.

Apparatus and Physiological Recording Procedure

Subjects were seated on a reclining chair in a sound-attenuated room. Monopolar EEG was recorded from the left occipital area and left sensorimotor area (termed O1 and C3, respectively; see Jasper, 1958), and each EEG lead was referenced to linked ears with Beckman miniature silver-silver chloride electrodes. All electrode resistances were below 5,000 Ω. Subjects were grounded with a plate electrode on the left forearm. All measures were recorded on a Grass Model 7 polygraph, and each EEG channel was filtered for 8–13 Hz activity and displayed on two additional channels that were individually calibrated to yield a pen deflection of 1.5 cm for an average peak alpha burst. Grason-Stadler logic modules were used to detect and automatically count bursts of criterion alpha on-line. An arbitrary criterion of .5 cm was utilized so that alpha activity had to be at least 33.3% of the average peak amplitude to be counted. Bursts of four alpha waves within a maximum of .5 sec were required to activate the counter and constituted one alpha unit; this effectively removed any movement artifact from being counted as alpha and provided a reliable conservative measure of alpha activity. Such a procedure has been used successfully in previous research from our laboratory on both interhemispheric and intrahemispheric cortical patterning (e.g., Davidson & Schwartz, 1976; Schwartz et al., Note 1; Lenson et al., Note 2).

Heart rate was also recorded with plate electrodes from the right arm and left leg. These data will not be reported here. Kinesthetic stimuli were delivered by taping a miniature, 3 in. (7.62 cm) radio speaker to the right forearm of each subject and wrapping the forearm in sound-attenuating foam. A 6-V pulse was introduced across the speaker terminals, thereby producing an inaudible pop which resulted in a mild tapping sensation that was easily discriminable to all subjects. The visual stimulus consisted of a small flashing light that was located approximately 6 ft. (1.80 m) from the subject, at eye level.

Procedure

Subjects were exposed to 30-sec trials during which either the visual stimulus or the kinesthetic stimulus was presented. Stimuli were presented randomly with a mean of 55 presentations per 30-sec trial. Four basic trial conditions were presented to each subject. During attend trials, subjects were asked to concentrate actively on either the flashing light or the tap. Each subject was required to attend to the light and to the tap for two trials each. During count trials, subjects were requested to count the number of stimuli that were being presented and instructed to use the counting to help them focus their attention on the target stimulus. Each subject was exposed to two count–visual and two count–kinesthetic trials.[2]

After each count trial, subjects were asked how many stimuli occurred during the previous trial. All subjects provided accurate counts of the number of stimuli, and no subject deviated by more than 5 from the actual number presented. All trials were counterbalanced within and between subjects. Three 30-sec rest periods were provided during which subjects were simply requested to focus their attention on their breathing while keeping their eyes open. The first rest period preceded all task trials, the second occurred after four trials, and the third came

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[1] We thank Auke Tellegen for providing us with copies of the TAS.

[2] Subjects were also exposed to a number of additional tasks that will not be presented in the present report.

after all the attend and count tasks. The intertrial interval was approximately 30 sec.

Following the presentation of the attend and count trials, subjects were exposed to two additional types of 30-sec trials, each presented twice in counterbalanced order. During this phase, rest periods were interspersed between every two task trials. During the tap trials, subjects were instructed to tap the fingers of their right hand on the arm of the chair from pinky to thumb and then back from thumb to pinky. During clench trials, subjects were told to clench and then release their right hand about once per second. These trials were included for two reasons: (a) to assess whether between-groups differences in cortical specificity during attentional tasks generalize to other forms of self-regulation and (b) to gather data on the specificity of cortical activation during the generation of motor behavior. It was specifically hypothesized that the self-generation of motor behavior in the right hand would result in significantly greater activation (i.e., alpha blocking) at C3 compared with O1.

All trials were performed with eyes open. Subjects were instructed to keep their eyes focused directly in front of themselves. All subjects were monitored on closed circuit video to insure compliance with instructions.

RESULTS

The EEG data were evaluated with two basic methods. To assess the relative activation of O1 versus C3, a ratio score was derived representing the difference in alpha units between O1 and C3 over the sum of alpha at O1 and C3 $(O1 - C3)/(O1 + C3)$. This ratio score served to correct the obtained values for individual differences in absolute amount of alpha activity. Similar ratios have frequently been used in EEG studies of hemispheric asymmetry (e.g., Davidson, Schwartz, Pugash, & Bromfield, 1976; Galin & Ornstein, 1972). Higher ratios are indicative of greater relative C3 activation (i.e., less relative C3 alpha). Analyses of variance were then computed with condition as a within-groups variable and group (high versus low on the TAS) as a between-groups variable.

The second method of EEG analysis entailed the use of raw EEG scores. Analyses of variance with EEG site (O1 and C3) as a within-groups variable (in addition to the condition and groups variables) were performed, and interactions of condition and groups with EEG site were examined. All analyses were computed on the mean EEG alpha score for the two repetitions of each condition, except for the rest data gathered during the attend and count trials, for which analyses were based on the mean EEG alpha score for the three repetitions of rest.

Separate one-way analyses of variance were performed to determine whether any differences in resting, eyes-open alpha abundance existed between the groups on both the raw O1 and C3 alpha scores as well as on the EEG ratio score. No significant differences between the high- and low-absorption groups during rest were found on any dependent measure.

During the attend condition, an analysis of variance revealed a significant main effect for modality of attention on the EEG ratio score, $F(1,18) = 4.82$, $p < .05$, indicating that subjects showed relative O1 activation during attend–visual versus attend–kinesthetic conditions (or conversely, relative C3 activation during attend kinesthetic vs. attend visual). There were no significant main effects for group, nor was there a Group (high-

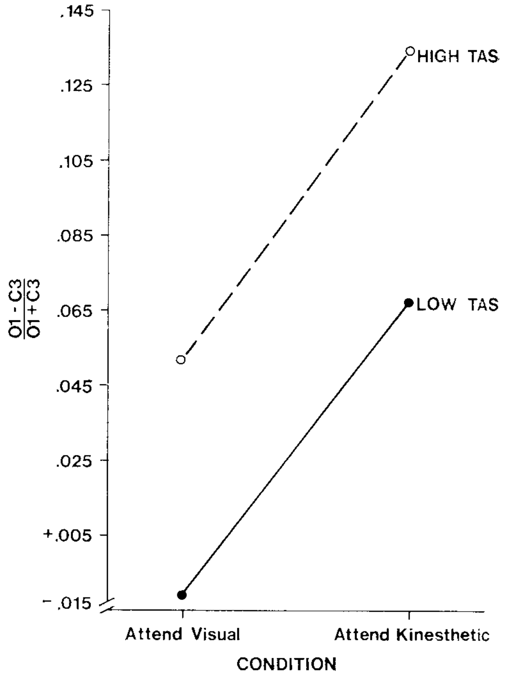

FIGURE 1. Mean EEG alpha ratio score $(O1 - C3)/(O1 + C3)$ for attend visual versus attend kinesthetic separately for high- ($n = 10$) and low- ($n = 10$) absorption subjects. (TAS = Tellegen Absorption Scale. Lower values are indicative of greater relative occipital activation.)

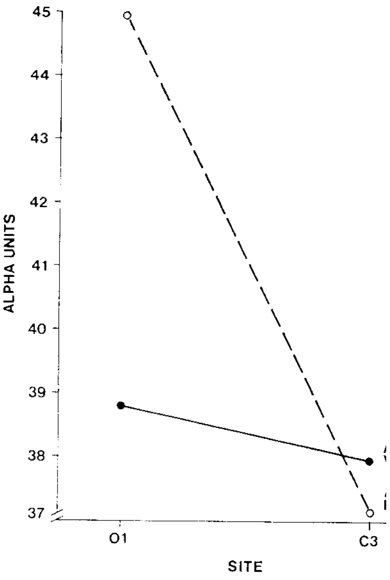

FIGURE 2. Mean alpha units by condi
visual and attend kinesthetic) separately
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Analysis was then performed o
EEG scores to determine the preci
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Condition (attend visual vs. att
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$t(19) = 2.85$, $p < .02$, indicating o
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tention. There were no significant
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between-groups effects.

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attend and count trials, for which
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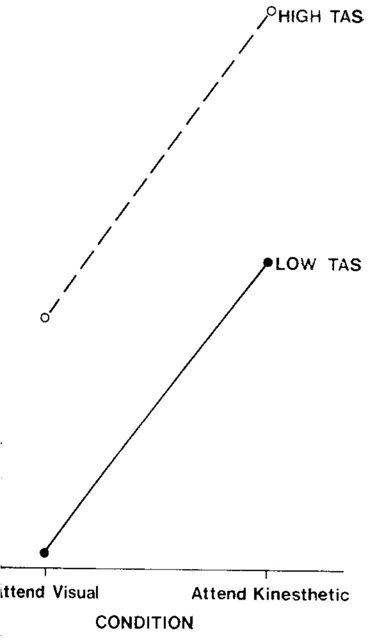
up, nor was there a Group (high-scoring vs. low-scoring subjects) × Condition (attend visual vs. attend kinesthetic) interaction. Figure 1 illustrates the main effect for condition separately for the high- and low-absorption subjects.



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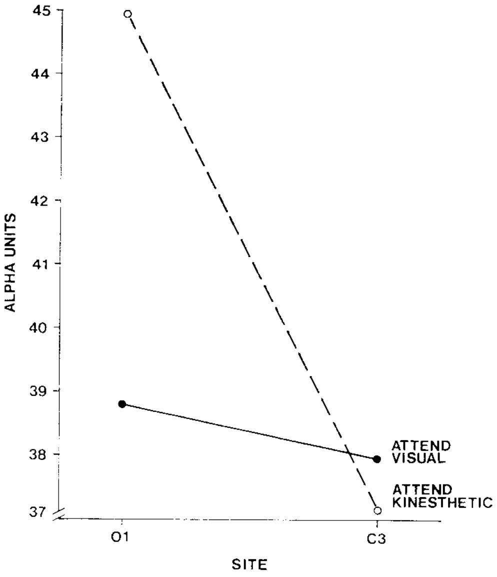

FIGURE 2. Mean alpha units by condition (attend visual and attend kinesthetic) separately for O1 (left occipital) and C3 (left sensorimotor) sites, averaged across groups. (It should be noted that since the data are displayed in terms of alpha activity, activation is associated with *fewer* alpha units.)

Analysis was then performed on the raw EEG scores to determine the precise locus of the attention effect. As predicted, a significant Condition (attend visual vs. attend kinesthetic) × Site (O1 vs. C3) interaction was obtained, $F(1, 18) = 6.98$, $p < .02$, and is illustrated in Figure 2. Two-tailed t tests revealed that this effect is primarily a function of significantly greater O1 alpha during the attend–kinesthetic versus attend–visual trials, $t(19) = 2.85$, $p < .02$, indicating occipital inhibition during kinesthetic versus visual attention. There were no significant differences between conditions in C3 alpha. It is interesting that within the attend–visual condition no significant differences were observed between O1 and C3 alpha, whereas during kinesthetic attention, subjects showed significantly more O1 versus C3 alpha, $t(19) = 2.57$, $p < .02$. There were no significant between-groups effects.

The EEG patterning during the count conditions was examined next. As was found during simple attention, a marginally significant main effect for the modality of counted stimulus was obtained on the EEG ratio score, $F(1, 18) = 4.28$, $p < .06$, indicating that subjects show greater relative O1 activation while counting visual stimuli than while counting kinesthetic stimuli. It is important to note that unlike the simple attend condition, a significant Condition (count visual vs. count kinesthetic) × Group (high vs. low absorbers) interaction was obtained, $F(1, 18) = 4.43$, $p < .05$, and is illustrated in Figure 3. Low-absorption subjects showed virtually no difference in EEG ratio between the count–visual versus the count–kinesthetic conditions. Alternatively, high-absorption subjects showed a large and significant difference in EEG ratio between these conditions, $t(9) = 3.00$, $p < .02$, thus revealing significantly greater mode-specific cortical specificity in high- versus low-absorption subjects when they are

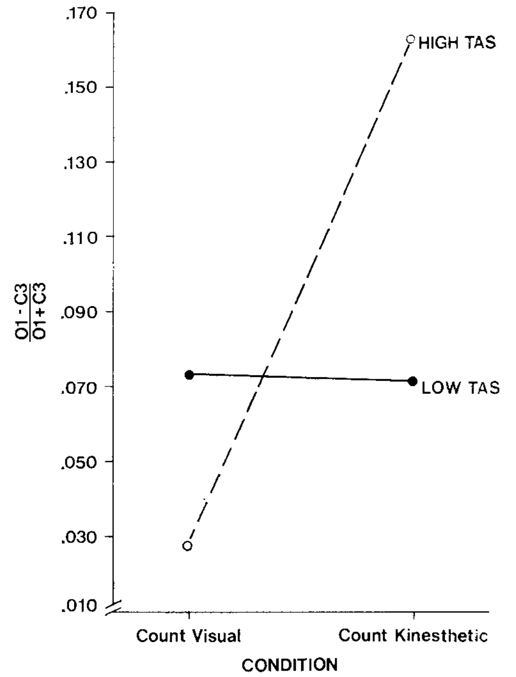

FIGURE 3. Mean EEG alpha ratio score for count–visual versus count–kinesthetic conditions separately for high- and low-absorption subjects. (TAS = Tellegen Absorption Scale.)

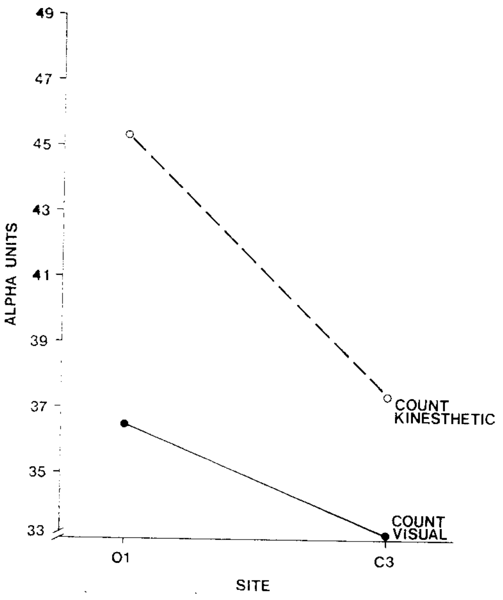

FIGURE 4. Mean alpha units by condition (count visual and count kinesthetic) separately for O1 (left occipital) and C3 (left sensorimotor) sites, averaged across groups.

asked to count stimuli selectively in different modalities. There were no significant between-groups differences within each condition.

As in the simple attend conditions, analysis of the raw EEG scores revealed a significant Condition (count vsiual vs. count kinesthetic) × Site (O1 and C3) interaction, $F(1,18) = 4.50$, $p < .05$, which is illustrated in Figure 4. This interaction is primarily a function of the significantly greater O1 alpha during count–kinesthetic versus count–visual trials, $t(19) = 2.90$, $p < .01$, which is indicative of greater occipital inhibition during kinesthetic versus visual counting. There were no significant differences in C3 alpha between these conditions. Within the count–kinesthetic condition, there was significantly more O1 versus C3 alpha, $t(19) = 2.09$, $p < .05$, whereas there was no significant difference in the amount of alpha between sites within the count–visual condition.

It is interesting that there was also a significant main effect for condition (across group and site), $F(1,18) = 9.18$, $p < .01$, indicating that on the average, counting visual stimuli elicited greater overall alpha blocking than did counting kinesthetic stimuli. It should be noted that the same comparison during the simple attend condition was not significant.

In addition to the interaction of condition and EEG site across groups, analysis of variance revealed a significant Group (high vs. low absorbers) × Condition (count visual vs. count kinesthetic) × Site (O1 vs. C3) interaction, $F(1, 18) = 7.36$, $p < .02$, which is illustrated in Figure 5. The t tests indicated that only the high-absorption subjects showed significant differences in O1 alpha between the count–visual versus the count–kinesthetic conditions, $t(9) = 3.04$, $p < .02$, with more O1 alpha (i.e., less activation) present during the latter. Furthermore, there was a nonsignificant difference between groups on O1 alpha during the count–kinesthetic condition, $t(18) = 2.00$, $p < .10$, suggesting that when high absorbers count kinesthetic stimuli they inhibit other sensory-irrelevant areas more than do low-absorption subjects. There were no significant

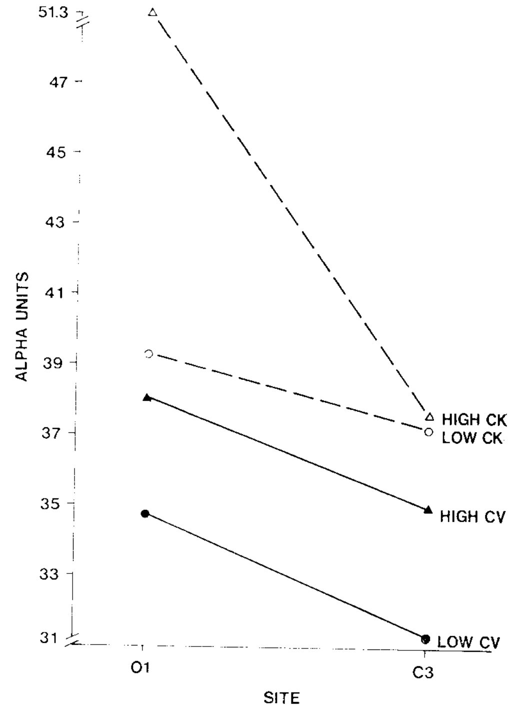

FIGURE 5. Mean alpha units by condition (count visual and count kinesthetic) separately for O1 (left occipital) and C3 (left sensorimotor) sites and for high- and low-absorption subjects. (CV = count visual; CK = count kinesthetic.)

TABLE 1

CORRELATIONS OF O1 WITH C3 ALPHA
MINUS KINESTHETIC DIFFERENCE
FOR EACH CONDITION BY GRO

Condition	Low absorb
Attend visual – attend kinesthetic	.38
Count visual – count kinesthetic	.89

Note. O1 = left occipital and C3 = left senso
* $p < .001$.

differences in O1 alpha between gr
the count–visual conditions.

There were no significant diff
tween conditions for either the hi
absorption groups in C3 alpha. I
no significant differences emerge
groups within either condition or
measure. These data suggest that
ferences were primarily in amo
alpha during the count–visual ve
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As an alternative method of
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1, 18) = 7.36, $p < .02$, which is il-
n Figure 5. The t tests indicated
he high-absorption subjects showed
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9) = 3.04, $p < .02$, with more O1
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thermore, there was a nonsignificant
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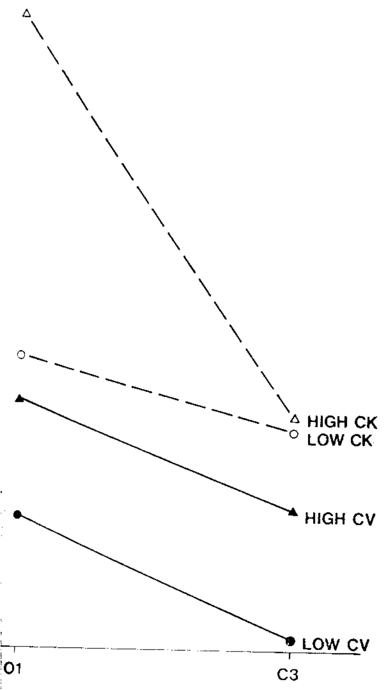

Mean alpha units by condition (count
unt kinesthetic) separately for O1 (left
d C3 (left sensorimotor) sites and for
low-absorption subjects. (CV = count
count kinesthetic.)

TABLE 1

Correlations of O1 with C3 Alpha for Visual Minus Kinesthetic Difference Scores for each Condition by Group

Condition	Group	
	Low absorbers	High absorbers
Attend visual – attend kinesthetic	.385	−.083
Count visual – count kinesthetic	.893*	.252

Note. O1 = left occipital and C3 = left sensorimotor.
* $p < .001$.

differences in O1 alpha between groups within the count–visual conditions.

There were no significant differences between conditions for either the high- or low-absorption groups in C3 alpha. In addition, no significant differences emerged between groups within either condition on the same measure. These data suggest that group differences were primarily in amount of O1 alpha during the count–visual versus count–kinesthetic conditions.

As an alternative method of analyzing group differences in cortical specificity during attentional tasks, one might ask to what degree the two EEG sites are integrated (i.e., show high correlations between them) as opposed to differentiated (show low correlations) when going from visual to kinesthetic attention. The basic prediction is that low-absorption subjects should show more integration (i.e., less specificity) between sites than the high-absorption subjects. Accordingly, difference scores (visual minus kinesthetic attention) were computed separately for O1 and C3 alpha during the simple attend and count conditions. The O1 and C3 difference scores were then intercorrelated. The results of this analysis are presented in Table 1.

It can be seen that high-absorption subjects show less integration (i.e., more cortical specificity) than do the low-absorption subjects. In fact, for the low-absorption subjects during the counting conditions, the change in alpha at one site from the visual to the kinesthetic condition accounts for approximately 80% of the variance at the other site. The comparable figure for the high-absorption subjects is 6%.

Finally, the tap and clench data were evaluated by comparing changes from rest to task trials in O1 and C3 alpha for high- and low-absorption subjects. Since there were no significant main effects for group nor any Group × Condition interactions on the tap and clench trials, all of these data are presented across groups. As predicted, an analysis of variance revealed a highly significant Condition (rest vs. tap vs. clench) × Site (O1 and C3) interaction, $F(2, 36) = 28.16$, $p < .001$, which is illustrated in Figure 6. Both the tap and the clench conditions resulted in highly significant reductions in C3 alpha (i.e., increases in C3 activation) relative to rest: for clench versus rest, $t(19) = 7.94$, $p < .001$; for tap versus rest, $t(19) = 8.29$, $p < .001$. During the tap conditions, subjects showed 43% as much C3 alpha as during rest, whereas during clench, the comparable figure was 45%. Subjects also showed significant reductions in O1 alpha during the tap and clench conditions as compared to rest: for clench versus rest, $t(19) = 2.38$, $p < .05$; for tap versus rest, $t(19) = 2.89$, $p < .01$, although

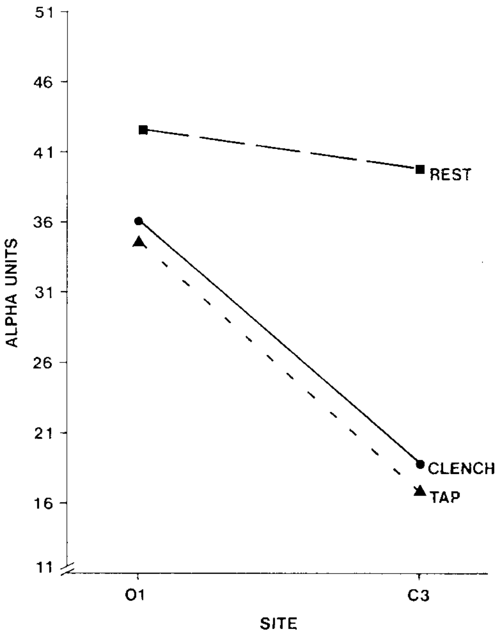

Figure 6. Mean alpha units for rest, tap, and clench conditions separately for each EEG site (O1, left occipital, and C3, left sensorimotor), averaged across groups.

the magnitude of the attenuation was less than that for C3 alpha. During the tap condition, subjects showed 81% as much O1 alpha as during rest, whereas for the clench condition, this figure was 85%.

When differences in amount of O1 and C3 alpha were examined within each condition, the results revealed no significant differences within rest. However, during both the tap and clench conditions there was a highly significant difference between O1 and C3 alpha, with more alpha being present at the occipital site: for tap, $t(19) = 5.38$, $p < .001$; for clench, $t(19) = 5.51$, $p < .001$.

Discussion

The results of this study support the general hypothesis that voluntary mode-specific attention elicits predictable patterning of EEG activity at primary sensory regions. The present data also suggest that subjects differing in degree of dispositional attentional absorption (as assessed by the TAS) show different patterns of EEG activation during an attentionally demanding task. Although no group differences in O1 and C3 activation were observed during simple attention, requiring subjects to count the stimuli uncovered significant between-groups differences. High-absorption subjects showed greater cortical specificity than did low-absorption subjects. This difference was primarily a function of the ability of the high absorbers to inhibit activity in the occipital region (reflected in greater O1 alpha) during kinesthetic attention. The data suggest that the between-groups difference was not in the ability to activate selectively the modality-relevant area per se but rather in the inhibition of the modality-irrelevant area.

The correlational data further support the notion of differences in cortical specificity between the low- and high-absorption groups. The former type of subject consistently showed higher correlations between occipital and sensorimotor EEG alpha activity than did the high-absorption subjects. The latter group showed low and insignificant between-site correlations.

It is interesting that no group differences were found on any dependent measure during rest. Other investigators have reported a significant association between alpha abundance during rest and hypnotizability (e.g., London, Cooper, & Engstrom, 1974; London, Hart, & Leibovitz, 1968; Nowlis & Rhead, 1968) although Evans (1972) failed to replicate this effect. It should be noted that during resting trials subjects in the present study performed with the eyes open, whereas in studies examining the relation between alpha abundance and hypnotizability, subjects performed with the eyes closed. Furthermore, Evans (1972) interprets the apparent association between alpha abundance and hypnotizability observed in some studies as reflecting the operation of certain situational variables that elicit anxiety and apprehensiveness, both of which, in turn, are associated with less alpha abundance and less responsiveness to hypnosis. It may be that the trait absorption is not as related to such situational demands as is the trait hypnotizability. The confirmation of this suggestion, however, must await future research.

The fact that the between-groups difference was observed only during the counting trials raises a number of interesting questions regarding the nature of the trait absorption. High-absorption subjects showed a greater difference between the visual and kinesthetic conditions in the EEG ratio score during the counting versus simple attend conditions, whereas the low-absorption subjects showed the reverse (compare Figures 1 and 3). When asked to pay particular attention to a given class of sensory events by counting them, the low-absorption group actually showed less EEG differentiation between tasks than when simply attending.[3] One possible interpretation of these findings is that high absorption is associated with a flexible attentional style in

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[3] It should be noted that when the raw alpha scores are examined, a slightly different picture emerges. For the low-absorption subjects, the changes in alpha at one site from the visual to the kinesthetic tasks account for about 65% *more* of the variance at the other site during counting versus simple attention. The comparable figure for the higher absorption subjects is 5%. Thus, on the raw alpha measure, both groups show less EEG specificity during counting versus simple attention, although the difference for the low group is greater than the difference for the high group.

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The findings obtained during th
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which, given the requisite task demands, focused, mode-specific attention with resistance to distraction from irrelevant modalities may be engaged. Those subjects falling on the low end of distribution on the TAS may find it difficult to resist distraction from irrelevant modalities when task demands for mode-specific attention are increased. These findings parallel precisely those obtained by Galbraith, Cooper, and London (1972) in their study of evoked responses during selective visual and auditory attention in high- and low-hypnotizable subjects. When instructed to count the visual stimuli, low-susceptible subjects actually showed an enhancement of the vertex-evoked response to the auditory stimuli—that is, to the irrelevant modality. The high susceptibles, on the other hand, showed predictable increases in amplitude of evoked responses to relevant stimuli and decrements in response to irrelevant stimuli.

This interpretation may be described alternatively to emphasize the possibility that the simple attention conditions versus counting conditions differ not only in degree of attentional involvement but also in the quality of attention deployment. Recent investigators have identified an effort component in selective attention (e.g., Kahneman, 1973; Pribram & McGuinness, 1975). It may be that given the requisite task demands, the high-absorption subjects are more adept at engaging this effortful type of attention and that the groups do not differ during tasks requiring receptive attention (e.g., Deikman, 1971).[4] Future research with independent measures of effortful and noneffortful attentional performance is needed to evaluate this hypothesis.

The findings obtained during the clench and tap conditions indicate two important points. First, they show that the production of motor behavior in the right hand is associated with (a) large magnitude reductions in alpha activity (i.e., increases in activation) in the left sensorimotor area—the cortical region that is responsible for processing kinesthetic events (see Luria, 1973)—and with (b) much smaller reductions in left occipital alpha. These data reveal that EEG recordings from selected scalp regions show a degree of specificity that has not been sufficiently recognized in the past (e.g., Lindsley & Wicke, 1974). Second, the tap and clench data suggest that group differences in cortical specificity may be present more during attentionally demanding tasks than in motorically demanding tasks.

It should be noted that although some of the tasks, in combination with the dependent measures used in the present study, revealed differences between high- and low-scoring TAS subjects, other investigators employing other physiological dependent measures with different task requirements have found no significant between-groups effects. Roberts, Schuler, Bacon, Zimmermann, and Patterson (1975) compared high- and low-absorption subjects (who also differed in hypnotizability) on the ability to self-regulate skin temperature of the hand with the aid of auditory biofeedback. Although reliable learning effects were observed, they were independent of the trait absorption. The findings from the present study suggest that physiological differences will be found between individuals who differ in the capacity for absorbed attention only on those dependent measures that closely reflect attentional processes and only when the appropriate task demands are placed on the subjects. Future research on this topic might fruitfully employ other dependent measures known to be sensitive to these attentional processes, such as evoked responses.

Finally, the present data highlight the usefulness of recording patterns of biological processes (see Schwartz, 1975) in the study of complex brain behavior interactions. The use of such a procedure in the present study revealed predictable patterns of occipital and sensorimotor EEG activity during visual and kinesthetic attention and uncovered differences in cortical patterning between subjects

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[4] However, it may be that the high-absorption subjects experience such relatively demanding tasks as effortless because of their apparent facility at attentional self-regulation. One may hypothesize that once the requirements for a particular selective attention task exceed a certain critical level, performance on such a task would be effortful for the high-absorption subjects and the degree of cortical specificity elicited might again be comparable between the two groups.

who differed in the capacity for sustained attentionl involvement during attentionally demanding tasks.

REFERENCE NOTES

1. Schwartz, G. E., Davidson, R. P., & Margolin, R. A. *Meditation and the self-regulation of attention: Intrahemispheric EEG changes.* Manuscript in preparation, 1976.
2. Lenson, R., Davidson, R. J., & Schwartz, G. E. *Patterns of temporal and parietal lobe activation during memory rehearsal and retrieval.* Manuscript submitted for publication, 1976.

REFERENCES

Callaway, E. *Brain electrical potentials and individual psychological differences.* New York: Grune & Stratton, 1975.

Davidson, R. J., Goleman, D. J., & Schwartz, G. E. Attentional and affective concomitants of meditation: A cross-sectional study. *Journal of Abnormal Psychology,* 1976, *85,* 235–238.

Davidson, R. J., & Schwartz, G. E. Patterns of cerebral lateralization during cardiac biofeedback versus the self-regulation of emotion: Sex differences. *Psychophysiology,* 1976, *13,* 62–68.

Davidson, R. J., Schwartz, G. E., Pugash, E., & Bromfield, E. Sex differences in patterns of EEG asymmetry. *Biological Psychology,* 1976, *4,* 119–138.

Deikman, A. J. Biomodal consciousness. *Archives of General Psychiatry,* 1971, *25,* 481–489.

Doyle, J. C., Ornstein, R., & Galin, D. Lateral specialization of cognitive mode: II. EEG frequency analysis. *Psychophysiology,* 1974, *11,* 567–578.

Evans, F. J. Hypnosis and sleep: Techniques for exploring cognitive activity during sleep. In E. Fromm & R. E. Shor (Eds.), *Hypnosis: Research developments and perspectives.* Chicago: Aldine-Atherton, 1972.

Galbraith, G. C., Cooper, L. M., & London, P. Hypnotic susceptibility and the sensory evoked response. *Journal of Comparative and Physiological Psychology,* 1972, *80,* 509–514.

Galin, D., & Ornstein, R. Lateral specialization of cognitive mode: An EEG study. *Psychophysiology,* 1972, *9,* 412–418.

Hillyard, S. A., Hink, R. F., Schwent, F. L., & Picton, T. W. Electrical signs of selective attention in the human brain. *Science,* 1973, *182,* 177–180.

James, W. *The principles of psychology.* New York: Dover, 1950. (Originally published, 1890.)

Jasper, H. H. The ten twenty electrode system of the International Federation. *Electroencephalography and Clinical Neurophysiology,* 1958, *10,* 371–375.

Kahneman, D. *Attention and effort.* Englewood Cliffs, N.J.: Prentice-Hall, 1973.

Linden, W. Practicing of meditation by school children and their levels of field dependence–independence, test anxiety, and reading achievement. *Journal of Consulting and Clinical Psychology,* 1973, *41,* 139–143.

Lindsley, D. B., & Wicke, J. D. The electroencephalogram: Autonomous electrical activity in man and animals. In R. F. Thompson & M. M. Patterson (Eds.), *Bioelectric recording techniques, Part B.* New York: Academic Press, 1974.

London, P., Cooper, L. M., & Engstrom, D. R. Increasing hypnotic susceptibility by brain wave feedback. *Journal of Abnormal Psychology,* 1974, *83,* 554–560.

London, P., Hart, J., & Leibovitz, M. EEG alpha rhythms and susceptibility to hypnosis. *Nature,* 1968, *219,* 71–72.

Luria, A. R. *The working brain.* New York: Basic Books, 1973.

McGhie, A. *Pathology of attention.* Baltimore, Md.: Penguin Books, 1969.

Mulholland, T. Objective EEG methods for studying covert shifts of visual attention. In F. J. McGuigan & R. A. Schoonover (Eds.), *The psychophysiology of thinking.* New York: Academic Press, 1973.

Nowlis, D. P., & Rhead, J. C. Relation of eyes-closed resting EEG alpha activity to hypnotic susceptibility. *Perceptual and Motor Skills,* 1968, *27,* 1047–1050.

Pelletier, K. R. Influence of transcendental meditation upon autokinetic perception. *Perceptual and Motor Skills,* 1974, *39,* 1031–1034.

Picton, T. W., & Hillyard, S. A. Human auditory evoked potentials. II. Effects of attention. *Electroencephalography and Clinical Neurophysiology,* 1974, *36,* 191–200.

Pribram, K. H., & McGuinness, D. Arousal, activation, and effort in the control of attention. *Psychological Review,* 1975, *82,* 116–149.

Roberts, A. H., Schuler, J., Bacon, J. G., Zimmermann, R. L., & Patterson, R. Individual differences and autonomic control: Absorption, hypnotic susceptibility, and the unilateral control of skin temperature. *Journal of Abnormal Psychology,* 1975, *84,* 272–279.

Schwartz, G. E. Biofeedback, self-regulation and the patterning of physiological processes. *American Scientist,* 1975, *63,* 314–324.

Schwartz, G. E., Davidson, R. J., & Pugash, E. Voluntary control of patterns of EEG parietal asymmetry: Cognitive concomitants. *Psychophysiology,* in press.

Shagass, C. Electrical activity of the brain. In N. S. Greenfield & R. A. Sternbach (Eds.), *Handbook of psychophysiology.* New York: Holt, Rinehart & Winston, 1972.

Silverman, J. The problem of attention in research and theory in schizophrenia. *Psychological Review,* 1964, *71,* 352–379.

Spanos, N. P., & McPeake, J. D. Involvement in everyday imaginative activities, attitudes toward hypnosis, and hypnotic suggestibility. *Journal of*

Personality and Social Psychology, 1
598.

Spong, P., Haider, M., & Lindsley, D.
attentiveness and cortical evoked
visual and auditory stimuli. *Science*
395–397.

Tecce, J. J. Attention and evoked poten
In D. I. Mostofsky (Ed.), *Attention*
rary theory and analysis. New Yor
Century-Crofts, 1970.

Tecce, J. J. Contingent negative variati
vidual differences. *Archives of Genera*
1971, *24,* 1–16.

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y, D. B., & Wicke, J. D. The electroenceph-
am: Autonomous electrical activity in man
animals. In R. F. Thompson & M. M.
rson (Eds.), *Bioelectric recording techniques,*
B. New York: Academic Press, 1974.

, P., Cooper, L. M., & Engstrom, D. R. In-
ng hypnotic susceptibility by brain wave
ack. *Journal of Abnormal Psychology,* 1974,
54–560.

, P., Hart, J., & Leibovitz, M. EEG alpha
ms and susceptibility to hypnosis. *Nature,*
219, 71–72.

A. R. *The working brain.* New York: Basic
s, 1973.

, A. *Pathology of attention.* Baltimore, Md.:
ain Books, 1969.

land, T. Objective EEG methods for studying
t shifts of visual attention. In F. J. McGuigan
A. Schoonover (Eds.), *The psychophysiology*
inking. New York: Academic Press, 1973.

D. P., & Rhead, J. C. Relation of eyes-
l resting EEG alpha activity to hypnotic
ptibility. *Perceptual and Motor Skills,* 1968,
047–1050.

, K. R. Influence of transcendental medita-
upon autokinetic perception. *Perceptual and*
r Skills, 1974, *39,* 1031–1034.

T. W., & Hillyard, S. A. Human auditory
d potentials. II. Effects of attention. *Electro-*
halography and Clinical Neurophysiology,
36, 191–200.

, K. H., & McGuinness, D. Arousal, activa-
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l Review, 1975, *82,* 116–149.

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, R. L., & Patterson, R. Individual differ-
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rature. *Journal of Abnormal Psychology,*
84, 272–279.

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ning of physiological processes. *American*
ist, 1975, *63,* 314–324.

z, G. E., Davidson, R. J., & Pugash, E.
itary control of patterns of EEG parietal
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, in press.

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field & R. A. Sternbach (Eds.), *Handbook*
ychophysiology. New York: Holt, Rinehart
nston, 1972.

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1964, *71,* 352–379.

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Personality and Social Psychology, 1975, *31,* 594–598.

Spong, P., Haider, M., & Lindsley, D. B. Selective attentiveness and cortical evoked responses to visual and auditory stimuli. *Science,* 1965, *148,* 395–397.

Tecce, J. J. Attention and evoked potentials in man. In D. I. Mostofsky (Ed.), *Attention: Contemporary theory and analysis.* New York: Appleton-Century-Crofts, 1970.

Tecce, J. J. Contingent negative variation and individual differences. *Archives of General Psychiatry,* 1971, *24,* 1–16.

Tellegen, A., & Atkinson, G. Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology,* 1974, *83,* 268–277.

Van Nuys, D. Meditation, attention and hypnotic susceptibility: A correlational study. *International Journal of Clinical and Experimental Hypnosis,* 1973, *21,* 59–69.

Wachtel, P. L. Conceptions of broad and narrow attention. *Psychological Bulletin,* 1967, *68,* 417–429.

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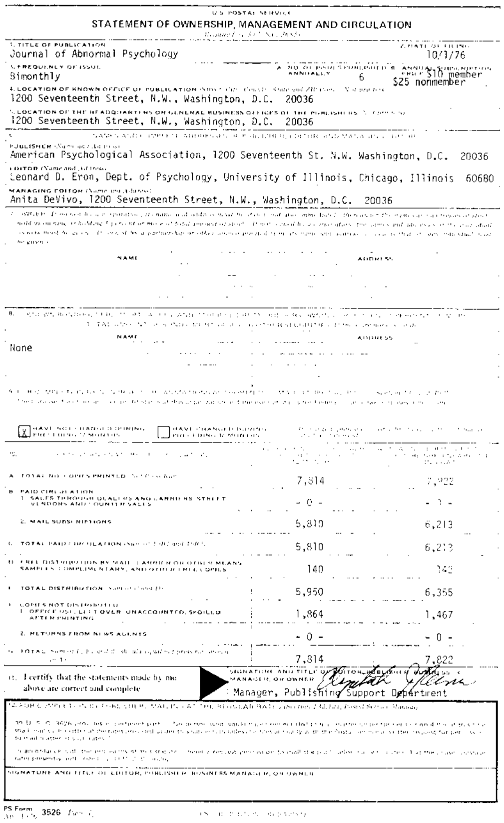

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