Discrimination of Sensorimotor EEG (12–15 Hz) Activity: A Comparison of Response, Production, and No-Feedback Training Conditions

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ABSTRACT

The current study was concerned with the discrimination of 12–15 Hz (15μV) surface cortical EEG, recorded over the dominant hemisphere. This EEG bandwidth is sometimes called the SMR (sensorimotor rhythm), and has been associated with seizure reduction. Thirty-six normal subjects were divided into three groups and exposed to three methods of discrimination training: response feedback, production feedback, and no-feedback control. In the initial assessment session, all subjects were asked to detect the presence of SMR by pressing a response button in the absence of feedback. Over the next 4 training sessions, the control group continued without feedback, while the response feedback group received feedback (tone) for correct discriminations, and the production group received feedback for producing the SMR signal. Discrimination performance was assessed during a 15-min no-feedback test period, following each feedback segment. The final session took place two weeks after training had been completed and was the same as session 1. The results showed that both experimental groups improved discrimination accuracy over baseline, and relative to the control group. Performance of the groups at baseline was not significantly different, ranging between 16% and 29% correct. Peak performance during training showed that both experimental groups improved over baseline and relative to the control group, averaging 17%, 43% and 78% correct for the control, response and production feedback groups, respectively. In the final assessment, all groups deteriorated in performance, but the production group remained significantly above baseline levels. No changes in average SMR time or frontal EMG were noted. However, time spent in the occipital alpha bandwidth 8–13 Hz (25 μV) did increase in the best discriminators. This may indicate some discrimination of subjective sensations associated with SMR discrimination training.

DESCRIPTORS: SMR (sensorimotor rhythm), EEG, Biofeedback, Seizures, Psychophysical discrimination.
knowledge of a correct discrimination response was provided. Black, Cott, and Pavloski (1978) failed to replicate Kamiya's (1969) work when response probabilities were adjusted to .50. The failure may have been due to an insufficient number of training trials. In another EEG discrimination experiment, Antrobus and Antrobus (1967) noted that sleeping subjects could be trained to discriminate between Stage 1 and Stage 2 non-REM sleep, when awakened, and provided with feedback for correct performance.

The discrimination of EEG activity may be a more difficult task than discrimination of autonomic events, due to the nature of stimuli associated with central vs. autonomic events. Autonomic events are likely to produce a variety of afferent stimuli which may be utilized in the detection (Brener, 1974), but not necessarily the control (Lacroix, 1981), of a physiological response. External feedback may function to call out the salient features of the discriminative stimulus from the spectrum of physiological events occurring concomitantly with the activity to be discriminated. However, EEG activity is a central event, with little available afferent stimuli. As Schwartz (1978) has aptly pointed out in the "brain self-regulation paradox," the brain may be incapable of peering in on itself, and the regulatory process of most central events may occur completely out of the individual's awareness.

How then, might EEG activity be discriminated, if at all? Perhaps one way would be to provide more extensive feedback which could have a greater opportunity to overlap with more easily discriminated stimuli associated with the criterion EEG signal, e.g. concomitant changes in EMG activity or noticeable changes in subjective states of consciousness. Such a technique might emphasize the production of criterion EEG changes and provide many opportunities for the subject to be exposed to the criterion stimulus and its sensory correlates. Another technique may be to utilize an efferent approach in which the subject is trained to discriminate changes in the effort required to produce a signal of a given strength. The efferent model of discrimination (Stilson et al., 1980) has been used successfully in EMG discrimination experiments.

The EEG studies discussed so far do not really present a clear picture of whether or not EEG discrimination is possible. Furthermore, a comparison of the studies may provide only minimal information about the effectiveness of a training procedure due to different methodologies and discriminative stimuli, the absence of a no-feedback control group and, perhaps most importantly, the absence of a sufficient number of training experiences. The current study addressed some of these issues through a comparison of two types of feedback and a no-feedback control. One type of feedback involved knowledge of results for a correct discrimination response, and the other involved the presentation of a signal to indicate the presence of the EEG stimulus. The discriminative stimulus was EEG activity between 12–15 Hz, recorded over the dominant hemisphere. This bandwidth has been referred to as the Sensorimotor Rhythm (SMR) (Sterman & Friar, 1972).

The SMR was chosen as a discriminative stimulus because of its potential clinical relevance to the treatment of seizure disorders. The SMR is typically blocked by active movements and unaffected by changes in visual stimulation (Sterman & Friar, 1972). Increases in SMR activity during instrumental conditioning have been attributed to increased relaxation in cats (Roth, Sterman, & Clemente, 1967), and associated with increased resistance to seizure-inducing drugs (Sterman, 1973). Decreased clinical seizures were later documented among trained epileptic patients (Sterman, 1977). Other studies have suggested that a human analog of the SMR found in cats may be difficult to define (Kuhlman, 1978) and that biofeedback training in a broad band of EEG activity (8–15 Hz) may be effective in reducing seizures (Sterman & Shouse, 1980). However, the focus of the current study was not on the clinical efficacy of biofeedback training for seizures, but rather, to determine whether or not an intact subject could learn to detect the presence or absence of a minute, centrally mediated physiological event. Subjects were provided with several training sessions and discrimination accuracy was assessed prior, during, and two weeks after formal training. A no-treatment control group was included to assess changes in performance over time, in the absence of specific training.

Method

Subjects

Eighteen male and 18 female undergraduate and medical students/volunteers served as subjects. Subjects ranged in age from 18–24, and were generally in good health. All subjects were right handed.

Measurement and Apparatus

All recording sessions took place in a sound attenuated room adjoining the psychophysiological laboratory. During each session, the subjects' frontal EMG, occipital alpha, and sensorimotor EEG (SMR) were monitored. Surface EMG was recorded following standard skin preparation including alcohol swab of the forehead and mild abrasion with a skin cleanser (Bravisol). Beckman electrolyte gel and Ag/AgCl electrodes, ½ cm in diameter, were used to record the EMG signal. The two active electrodes were placed laterally, and
centered about 1 in. above each eyebrow. Raw and integrated EMG signals were amplified and displayed using a Grass 7P3 wideband AC preamp and Model 7D polygraph. Bipolar electroencephalographic measurement for SMR activity was accomplished using Grass Ag/AgCl cup electrodes placed over T3 and C3 and O1 and O2 for alpha activity, as per the International 10-20 electrode system (Jasper, 1958).

It should be noted that most SMR-feedback studies employ a modified C3-T3 placement. This procedure is typically used to reduce EMG artifact. The standard C3-T3 placement used in the current study should result in little active SMR difference and was chosen to improve reliability and standardization of placement among the research assistants, since they had been previously trained on the C3-T3 procedure. The potential for EMG artifact was reduced through logic programming and by requiring the subjects to use their left hand for the experimental task (see below). Thus muscle related interference due to the button press should be minimal over the left hemisphere. Bipolar alpha levels provide an index of transhemispheric changes and it may be reasoned that these changes would be an index of the electricortical action not common to the visual, and to some extent, motoric and auditory processing required by the experimental procedures.

At the end of a session, electrode sites were remarked with india ink for use on the next session. Subject skull measurements were recalculated on the next session if the previous markings were not intact. Scalp preparation for EEG included mild abrasion followed by alcohol and acetone cleansing. Electrodes were positioned using Beckman EEG electrode adhesive and held in place with a 2 in. x 2 in. square of transparent tape. A ground electrode was placed over the left earlobe. Electrode resistance was measured prior to data collection and recleaning was initiated if resistance was above 8,000 ohms. Raw EEG signals were amplified using Grass 7P5 wideband AC EEG amplifiers. The raw signals were fed into a series of Med Associates (EEG-500) active 10-pole Butterworth filters (30dB/octave rolloff). Raw sensorimotor activity was filtered using a 12–15 Hz bandpass while alpha recording utilized an 8–13 Hz bandpass window. The filtered signals were then displayed on the polygraph.

All physiological signals were interfaced with a TRS-80 microcomputer using a Bus Extension (Med Associates 1081-01) and Med Associates Logic equipment. The raw EMG signal was fed into a Med Associates analog/digital converter (ANL-940) and through the bus extension and microprocessor. The filtered EEG signals were rectified using a Med Associates dual following integrator (ANL-610). Two separate Schmidt triggers (Med Associates, ANL-300) were set to detect rectified sensorimotor activity at an amplitude of 15μV, and alpha activity at an amplitude of 25 μV. Responses below this level were not counted as criterion SMR or alpha activity. The output of the Schmidt triggers was interfaced with a series of msec time bases and and-gates such that the total amount of time in criterion SMR (12–15 Hz) and alpha (8–13 Hz) could be accumulated. The microprocessor provided a minute by minute accumulation of total time in SMR, alpha and digitized EMG values. The EMG values corresponded to the average μV/min of activity.

**Procedure**

Subjects were randomly assigned to three groups: No-feedback control, Response feedback, and Production feedback. The groups were balanced for sex, and contained 12 members each. All subjects participated in six 55-min sessions. Sessions 1–5 were separated by 2–3 days each. The experiment was divided into three phases. Session 1 served as the pretraining baseline phase (BL). During sessions 2–5, feedback training took place within the experimental groups. Session 6 served as the posttraining no-feedback followup assessment of the subject's performance and took place two weeks after formal training had been completed. The procedures were implemented as follows:

**Habituation.** The first 15 min following electrode hook-up served as the habituation phase for each session. During habituation all subjects were allowed to adapt to the experimental surroundings and achieve resting levels of physiological activity.

In session 1, subjects were read some general instructions and given an orientation to the experiment following habituation. Subjects were also told that the purpose of the experiment was to determine how well an individual can learn to detect a specific type of brain wave activity called the SMR. They were asked to rest quietly and avoid sudden movement or changes in muscle tension. Subjects were told that SMR was being recorded over the left side of their brain and that the SMR signal may sometimes be associated with an absence of movement, muscular relaxation, and alert state of consciousness (not sleep). They were asked to attend to any interoceptive cues associated with these states.

**Baseline.** Following the habituation phase of session 1, subjects were asked to detect the presence of an SMR signal by depressing a hand-held contact closure response button, placed in their left hand (minimal pressure was required). Subjects were instructed to press and hold the button for as long as they felt they were within the SMR bandwidth. They were also told that it would not be a useful strategy to either keep the button depressed, or released for the entire duration of the session. Subjects were told that they could experiment with different thoughts or feelings such as imagining action oriented scenes, mathematical calculation, or relaxing scenes such as floating on the water, etc. Subjects were given a 5-min warmup period during which they made the discriminative response without feedback. The warmup was used only to familiarize the subject with the procedure, and these data were not analyzed. Following the warmup period, instructions were clarified if needed and the subjects were asked to continue making the discriminative response for the remaining 35 min. No other information or feedback was given at this time.

**Training.** Sessions 2–5 were divided into four segments: habituation, prefeedback/warmup, feedback,
and postfeedback/test segment. The habituation and prefeedback/warmup phases were the same duration and nature as described above for session 1, except that on the day of the first feedback session subjects were given some feedback in the last minute of warmup to familiarize them with the feedback task. The actual feedback phase lasted 20 min and varied depending on the subjects' group assignment. All subjects were asked to press the response button whenever they detected sensorimotor activity. In the Response feedback group, a 6000 Hz low volume tone was sounded following a correct discrimination response (button press plus SMR). The tone remained on for the duration of a correct response. In the Production feedback group, the tone onset each time the subject produced criterion SMR activity, and remained on for as long as the subject was in the bandwidth. In the Control group, no tone was provided in the segment designated as feedback for the two experimental groups. Subjects were reread baseline instructions and asked to continue to respond to the best of their ability. During training, all subjects were asked to attend to any interoceptive cues which might be associated with subsequent SMR and to experiment with different thinking strategies as suggested for session 1. In the experimental groups, subjects were encouraged to use the tone as an indicator of salient interoceptive or cognitive stimuli.

Immediately following the feedback segment of sessions 2–5, a 15-min postfeedback test segment was initiated. During the test, all feedback was withdrawn from the experimental groups and the subjects were instructed to continue making a button press each time they felt they detected SMR. They were told that the tone would be absent and they should apply any strategies they might have learned during the feedback phase to aid in SMR detection. This segment provided an assessment of the subject's discrimination performance, immediately following training. Control subjects were given the same instructions as for the baseline phase.

Post-Training Followup. Session 6 was conducted two weeks after formal training ended. Session 6 was exactly the same as session 1, and served as a no-feedback, posttraining assessment of the subject's performance.

Results

Using the logic and programming equipment previously described, the following measures were calculated: a) Hit Time—This measure was derived by activating a msec timer whenever the subject depressed the response button and was actually in the SMR bandwidth. This measure began accumulating only after the subject had been in the SMR condition for at least 100 ms. Hit Time was not accumulated if the subject's concurrent EMG exceeded 10 μV, as detected by a Schmidt trigger set to respond to a rectified EMG signal on the polygraph. This was done as a precautionary measure to prevent the subject from manipulating frontal EMG, producing movement of the EEG electrodes and a spurious SMR signal; b) Total time button pressed—This measure was the total time, in msec, during which the subject depressed the response button; c) The main dependent variable was percent correct discriminations. Percent correct was derived by dividing the total hit time by the total amount of time during which the button was depressed. Thus, this measure yields an index of the subject's discrimination accuracy relative to the total amount of responses made. Although other measures such as d' (Swets, 1973) may provide a sensitive index of discrimination accuracy, the d' index is inappropriate for the continuous response paradigm used in the current study. The percent correct index allows the subject's hit rate to be adjusted relative to his total responses thus controlling for the subject who may have held the button depressed a disproportionate amount of time within the interval.

Correct rejections (not pressing the button when SMR did not occur) may also be considered as a legitimate measure of a correct response. However, due to the variable response rates in this study correct rejections were not included in the data analysis. Counting correct rejections could have spuriously raised the percent correct and could lead to unjustified conclusions about discrimination, particularly in subjects who showed low SMR activity or low response rates. It seems more reasonable, and scientifically conservative, to use hit time, adjusted for total responses, to provide an index of active discrimination. Also, the non-SMR brain state could be associated with a variety of other electrocortical changes, not previously investigated or measured in this study and thus, one would not be able to reliably describe what the subjects were (not) responding to.

The most important intergroup comparison is an evaluation of the percent correct data for the postfeedback test phase, across sessions 2–5, and the no-feedback performance of sessions 1 and 6. The postfeedback test data provided an immediate test of the subjects' discrimination accuracy following feedback training and an evaluation of a learning trend across sessions. In addition, the data of sessions 1 and 6 provided a pre/post assessment of discrimination performance over the entire duration of training and allow for evaluation of the deterioration in performance following training termination.

The percent correct discrimination data for all groups, for the postfeedback test phases of sessions 2–5 and the baseline phases of sessions 1 and 6 are presented in Figure 1. The data were accrued over
The percent correct discrimination data were also subjected to a two-way repeated measures ANOVA with groups (control, production, response) as the between factor and sessions (1–6) as the within factor. Significant effects due to groups, $F(2/889) = 91.673$, $p<.001$, and sessions, $F(2/889) = 14.12$, $p<.001$, and a significant group × session interaction, $F(10/889) = 12.03$, $p<.001$, were observed. Post hoc analysis using Tukey's HSD procedure (Lindman, 1974) was carried out on all pairwise comparisons. The results of the post hoc analysis showed that all groups were equivalent at session 1/baseline ($p>.05$) averaging 27%, 16% and 29% correct for the control, response and production groups, respectively. During the test phase, the performance of both experimental groups was significantly better than the control group ($p<.01$) on each measurement occasion. The production feedback group also exceeded the performance of the response feedback group ($p<.05$) during all test situations of sessions 2–5. The peak performance levels following training during sessions 2–5, were 17%, 43% and 78% correct for the control, response and production groups, respectively. In the final session, the production feedback group showed some deterioration in performance to a level of 51% correct but remained significantly higher ($p<.05$) than either the control or response groups, who averaged 26% and 29% correct, respectively. The control and response groups did not significantly differ from each other ($p>.05$) during session 6.

The post hoc procedures were also used to analyze the data within each group, across all sessions. The results of this within group comparison showed that both experimental groups improved in discrimination accuracy following training with the production feedback group faring the best. It should be noted that the percent correct data used here may yield values much lower than 50%, even under conditions of random responding and an SMR signal present 50% of the time. Hit time is intimately related to the amount of time a subject presses the button and in order to detect 50% of the correct SMR events a subject responding randomly might conceivably have to press the button very frequently, thus lowering his overall percent correct.

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The average time in SMR (per minute) during sessions 1 and 6 and the test segments of sessions 2–5 are presented in Figure 2. The average time in SMR data were analyzed in the same fashion as the percent correct data. As shown in Figure 2, there is much across session variability within the groups. The results of the ANOVA showed significant effects due to groups, $F(2/889) = 9.945$, $p<.01$, and sessions, $F(5/889) = 4.97$, $p<.01$, and a significant group × session interaction, $F(10/889) = 4.66$, $p<.01$. The results of this analysis should be interpreted in a way that would provide the most conservative test of the subjects' discrimination ac-
accuracy. Therefore, the across session variability within groups is less important than the session by session comparison between groups on the total time variable. To properly evaluate the discrimination data, it is necessary to show that on each session the groups have an equal opportunity to discriminate the presence of an SMR signal by spending equivalent amounts of time in the bandwidth. Post hoc analysis (Tukey’s HSD) showed no differences in total time in SMR among the three groups for any individual testing phase of sessions 2-5 (p<.05) or the baseline/no-feedback condition of session 6. Thus, all groups had equal opportunity to respond during any given testing situation, and in the final session. During the baseline/no-feedback assessments of session 1 the production feedback group showed less time in SMR (p<.05). The lower SMR values of the production group may serve as a more conservative test of the production group’s initial discrimination results since their discrimination performance exceeded that of the other groups, even with a lowered opportunity in the SMR bandwidth.

The relative equivalence of the groups in SMR may also be documented by examining the average percent time each group spent in the bandwidth. During the feedback segments of sessions 2-5, the SMR signal for the control group ranged between 45% and 61%, averaging 52%; while the production group ranged between 52% and 62%, averaging 57%; and the response feedback group ranged between 56% and 65%, averaging 58% SMR time. During the postfeedback test segments of the same period the control, response and production feedback groups averaged 58% (range 54%-64%), 60% (range 56%-63%), and 54% (range 52%-68%) time in SMR.

These data also provide further justification for the use of percent correct as a dependent measure since percent correct is most accurate when the criterion stimulus is available 50% of the time.

The average times in alpha, during the actual feedback segments of sessions 2–5 and the baseline assessments of sessions 1 and 6, are presented in Figure 3. There is a small but steady rise in total alpha time for the production group from sessions 1 to 6, averaging about 17.5 s for sessions 2–5 and 11.5 and 17.2 s for sessions 1 and 6, respectively. The feedback group showed an initial rise in alpha after session 1, averaging 12.2 s for sessions 2–5 followed by a decline in session 6, to a level of 6 s. The control group showed the highest alpha level during session 1, averaging 18 s, but declined to an average level of 13 s during sessions 2–5, and slightly rebounded on session 6 to a level of 15.5 s. The data were analyzed in exactly the same fashion as the percent correct data, and a significant group × session interaction was observed, F(10/889) = 5.75, p<.001. Post hoc results on all pairwise comparisons showed significant differences during session 1, with the control group showing higher levels than the two experimental groups. However, the production feedback group spent significantly more time in alpha than the control and response feedback groups during sessions 3 and 4, and also showed more alpha than the response feedback group in sessions 5 and 6.

The average times in alpha for the testing segments of sessions 2–5 were analyzed in the same way as the actual feedback data. Except for the group differences already noted for sessions 1 and 6, no significant differences in average alpha time were observed during the discrimination test phases of sessions 2–5.
The EMG data were analyzed in the same fashion as the percent correct data. No significant changes in EMG levels were observed between the groups or sessions ($F<1.0$). Thus, it does not appear that subjects attempted to change EMG levels in order to manipulate SMR during feedback or actual testing.

**Discussion**

The results of the current study indicate that intact human subjects can learn to discriminate the presence of 12-15 Hz sensorimotor EEG activity. Feedback based upon the production of a criterion EEG signal was more effective than knowledge of a correct discrimination response or no training at all. In addition, the production feedback group showed the least deterioration in performance of all the groups following two weeks of feedback withdrawal. The results of individual session by session testing were not attributable to any changes in the total SMR distribution since all groups spent an equivalent amount of time in the bandwidth during the testing sessions. Thus, all groups had equal opportunity to detect the criterion EEG stimuli on almost all testing occasions.

Since the focus of the experiment was on discrimination and not on ways to maximize SMR production, the current paradigm does not provide an adequate test of the effects of SMR production feedback on tonic or phasic changes in SMR activity. However, it may be interesting to speculate on the relationship between discrimination and control observed over the training period. The data on percent time in SMR during feedback and post-feedback suggest that subjects may be able to improve their discrimination yet show little, immediate feedback influenced changes in total SMR. These SMR results would be consistent with other studies which suggest that feedback influenced control may not be a prerequisite for discrimination of a physiological response (Lacroix & Gowen 1981; Lacroix, 1981). Subjects may typically require more extensive feedback training than provided in the current study, before changes in SMR activity can be observed (Sterman, 1981). However, some shifting of EEG patterns toward increased alpha and decreased slow wave activity (1-7 Hz) has been observed following SMR feedback (Sterman & Shouse, 1980; Sterman, 1977; Kuhlman, 1978). Interestingly, in the current study alpha activity was reliably enhanced during periods of SMR production feedback. This may reflect an association between SMR and an increase in a broader spectrum of EEG activity (8-15 Hz). The production feedback may have provided an efficient medium for general relaxation and inhibition of movement, since it was available to the subjects on a continuous basis as opposed to the discrete feedback of the response group. The potential clinical benefits of production feedback need to be evaluated in future applications.

The results of the current study are also in agreement with other studies on discrimination of psychophysiological responses (e.g. Cinciripini et al., 1979; Epstein et al., 1977; Steptoe, 1979). However, the present results represent the only clear indication of discrimination of electrocortical activity in humans. There may be several reasons to explain the variance between the current data and previous EEG discrimination studies. In particular, the negative results of Black et al. (1978) may have been due to insufficient training opportunities. Only 40 min of feedback training was provided in contrast to the 80 min of feedback in the current study. In addition, the results of Stevens (1962) may have involved discrimination of an EEG signal (paroxysmal discharge) which occurred below the threshold of the individuals' consciousness and which may have required more extensive training. The subjects in the Stevens study were experiencing clinical seizures at the time of the study and in fact, the only subject who learned the discrimination task did report the presence of a subjective "warning" signal corresponding to the discriminative EEG changes. It should also be noted that in the present study all groups' performance levels at baseline were considerably below 50% correct, and that only one, the production group, improved over time. It is unclear why the performance for the response and control groups never reached 50%, but it is most likely due to high, non-selective response rate.

The final question to be asked concerns the delineation of the actual discriminative cue. It has been suggested that psychophysiological discrimination may depend on the subject's increased awareness of the afferent cues which correspond to the changes in the discriminative stimulus (Brener, 1974). If the brain self-regulation paradox (Schwartz, 1978) is operative for cortical EEG events, then the mechanism for discrimination may not totally involve afferent processes. An efferent process (Lacroix, 1981) may also be postulated which involves some effortful activity on the subject's part, designed to effect the criterion stimulus. Both trial and error and production feedback may provide the subject with an opportunity to test out various strategies to manipulate the tone and corresponding EEG activity. The production feedback setting may have offered a more efficient method than the response feedback for testing these strategies. In fact, Rosenfeld and Hetzler (1973) have suggested that animals trained to discriminate physiological events may learn to produce a mediating physiological state
which is not present during baseline. In the case of cortical EEG, these alternative neural events may correspond to efferently mediated changes in physiological events, other than the criterion stimulus. Thus, there need not be any changes in the overall distribution of SMR if an efficient mediating strategy is applied since subjects may learn to discriminate a response in the absence of control (Lacroix & Gowen, 1981). Subjects may have performed active, efferent strategies in order to relax and inhibit movements in an attempt to enhance SMR production. Once in a more relaxed state, subjects may have had greater opportunity to filter out the nonessential “physiological noise” and become more aware (afferent) of the salient features of events correlated with (produced by) the SMR signal, such as a change in the subjective state of consciousness. The changes in alpha production during SMR feedback offer some support for this view, since increased alpha activity and a variety of nonelectroencephalographic changes associated with attempts at alpha enhancement (Plotkin, 1979) may correlate with changes in subjective relaxation (e.g. Hardt & Kamiya, 1976). Subjects in the production group showed both the best discrimination and the most changes in alpha production.

REFERENCES


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**Announcements**

**Forty-First Annual Meeting**  
American Psychosomatic Society

From March 8th through 11th, 1984, the Forty-First Annual Meeting of the American Psychosomatic Society will be held at the Hyatt on Hilton Head Island, Palmetto Dunes, South Carolina. The program theme is *New Horizons for Psychosomatic Medicine*.

For further information, contact the American Psychosomatic Society headquarters, 265 Nassau Road, Roosevelt, New York 11575.

**Fifth Annual Meeting**  
The Society of Behavioral Medicine

From May 23rd through 26th, 1984, the Fifth Annual Meeting of the Society of Behavioral Medicine will be held at the Franklin Plaza Hotel in Philadelphia, Pennsylvania. The theme for the meeting is *Behavioral Medicine and Women's Health Issues*.

For further information, contact the SBM National Office, P.O. Box 8530, University Station, Knoxville, Tennessee 37996 (615/974-5164).

**Second International Meeting**  
International Organisation of Psychophysiology

From July 16th through 19th, 1984, the Second International Meeting of the International Organisation of Psychophysiology will be held at Charing Cross and Westminster Medical School, Hammersmith, West London, UK. The deadline for submission of abstracts is April 24, 1984.

Guidelines for paper submission and details about registration may be obtained from: Dr. John Gruzelier, Charing Cross Hospital Medical School, Department of Psychiatry, 22/24 St. Dunstans Road, London, W6 8RP.
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