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The Physiological Effects of Flotation REST

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There is an emerging research and clinical tool which may facilitate the exploration of interrelationships between mind and physiology. This tool is Restricted Environmental Stimulation Technique or (REST). This chapter will introduce you to the psychophysiological framework of REST by presenting some basic human research studies which we have performed over the past 10 years. There are several REST formats which have been investigated, with the two most common being chamber (room) REST and flotation REST. In the former, an individual is in solitude in a room with greatly limited external contact for an extended period (24 hours). In flotation REST, the individual lies supinely for 30-60 minutes in thermoneutral, buoyant fluid with minimal photic, auditory and tactile stimulation.

Early studies of sensory isolation, performed in the 1950s and 1960s by researchers such as Donald Hebb (1955a) and John Zubek (1969b), demonstrated that this condition could be highly stressful. However, even in these endurance studies lasting from eight hours to days, monitored parameters such as blood pressure (BP), heart rate (HR), respiration rate, electromyogram (EMG), and measures of adrenal activity indicated that the first 60-90 minutes of these isolation experiences were relaxing. John Lilly, one of these early investigators,

recognized this and designed the first flotation REST environment for the purpose of deep relaxation. Subjective reports by many users of Lilly's environment, then called "the tank," described the experience as deeply relaxing (Lilly, 1977). In the context of this background, we set out to examine the psychophysiology of flotation REST (henceforth, REST).

The REST environment used in all of these studies was a plastic or fiberglass chamber, approximately 1.1 m. x 1.3 m. x 2.5 m., filled to a 25 cm. depth with saturated epsom salts ($Mg\ SO_4$) solution having a specific gravity of 1.28 and temperature maintained at 34.5° C. The chamber was light-free and the sound level was <10 decibels, with further attenuation due to submersion of the ears in the solution. The general protocol consisted of 30-40 minute sessions repeated approximately every third day with a total number ranging from 4 to 20 sessions per study.

Both within-session and across-session assessments were made. With a few exceptions subjects were normal, healthy students ranging in age from 20-35 years and REST was compared to a relaxing control condition in which subjects reclined on a bed or reclining chair in a quiet (<30 db) dimly lit (<20 lumens) room.

The first parameter we addressed was the subjective report of the REST experience. Indices of subjective reports included the Spielberger state anxiety scale, Zuckerman multiple affect adjective checklist (Turner & Fine, 1990a), profile of mood states (POMs) (Turner et al., 1989) and subjective rating scales of relaxation. Marked pre-post and across-session changes indicating relaxation were found in all studies. In addition, an analysis of well over 1,000 descriptions of the REST experience, indicated more than 90% of subjects found REST deeply relaxing.

In choosing physiological parameters of the REST effect on relaxation, we simply worked from the basic physiological and biochemical hormonal changes associated with stress responding. Physiological parameters measured included BP, EMG, and HR.

Hormonal parameters included adrenal axis hormones such as ACTH, epinephrine, norepinephrine, cortisol and aldosterone and hormones not mediating stress responding (luteinizing hormone and testosterone). Both within and across-session decreases have been observed in various hormones. Hormones directly associated with stress responding (cortisol, ACTH and epinephrine) showed decreases during REST, whereas luteinizing hormone, which was not associated with stress responding showed no change (Turner & Fine 1983). Likewise, across-session decreases were observed in adrenal-associated hormones (cortisol, aldosterone, renin activity) while a hormone unrelated to stress responding (testosterone) did not shown across-session changes (Turner & Fine, 1990a). Furthermore, cortisol, which has received more attention than the other hormones, and BP, have been shown to maintain the REST effect after cessation of repeated REST sessions (Turner & Fine, 1983). This phenomenon suggests that the REST effect may be more than a simple, immediately reversible response.

Interestingly, in comparing hormonal and BP changes in REST with these changes in another relaxation condition (biofeedback), REST consistently showed greater hormonal effects but similar BP effects to biofeedback-assisted relaxation (McGrady et al., 1987). This led us to consider that REST was either mechanistically different from the biofeedback (since it affected cortisol levels when other methods did not) or was simply more powerful (i.e., REST reached the threshold for cortisol change but biofeedback did not).

Can we determine which of these possibilities is true or are both true? Direct proof is very difficult in the face of the many variables. However, several considerations seem worth examining. Some data would support the "power difference" hypothesis. Decreased plasma or urinary cortisol has been reported in association with transcendental meditation or biofeedback in some studies (Jevning et al., 1978; Michaels et al., 1976; McGrady et al., 1979, 1981), suggesting that these methods are, under some conditions, capable of reducing cortisol and several other hormones. In addition, the responses were usually greater in subjects who had prior training in the method. In contrast, REST subjects showed these hormone reductions whether the subjects were experienced or naive. In addition, significant Pearson correlations have been shown for BP and cortisol decreases in REST, although no cause-effect relationship has been established (McGrady et al., 1987). In support of the consideration that REST may be mechanistically

different from biofeedback is the difference in the process between the two methods, with biofeedback effectiveness requiring the learning of a task and REST effectiveness being the consequence of reduced environmental demands.

Another consideration of possible mechanistic differences between REST and biofeedback comes from a preliminary electroencephalographic (EEG) study. Single channel monitoring of EEG frequency and amplitude using a frontal (forehead) monopolar active electrode and two bipolar reference electrodes on the nose demonstrated in 10 subjects a marked domination of theta activity. This was reflective of decreased arousal (stage-1 sleep) as compared to two other relaxation conditions (non-REST) showing more alpha (greater arousal than theta) activity. One condition was lying on a mattress while the other consisted of lying in a modified REST environment in which a pliable 15 mm. polymer membrane separated the floater from the fluid (henceforth, REST-Dry). This condition was associated with considerable tactile stimulation and low humidity, and subjects wore underclothing. Thermoneutrality (i.e., comfort, no sweating) was approximately 29.5° C. Sound levels were <20 decibels in the air, and the ears were not submerged.

The marked EEG differences between standard REST (henceforth, REST-Wet) and REST-Dry prompted us to investigate exactly what aspect or aspects of sensory reduction were essential for the REST-Wet effect. Because it was the simplest manipulation, our first effort in this direction examined the effect of the presence or absence of light, using BP and plasma cortisol as endpoints. One group experienced repeated REST-Wet with a 15 watt incandescent light illuminating the chamber, while the other group experienced REST-Wet without light. Both BP and plasma cortisol decreased significantly across sessions in both groups, suggesting no effect of *dim* light or illumination on the REST experience. It is possible, however, that light of higher intensity could have an effect.

Are there other aspects of the reduced stimuli which can be pinpointed as essential for the REST effect? For example, how important are tactile stimulation, quiet, buoyancy and thermoneutrality? To begin addressing these questions, we compared blood pressure and plasma cortisol responses in REST-Wet (n=10) and REST-Dry (n=9). Across eight sessions BP decreased in both groups but plasma cortisol decreased only in REST-Wet (Turner et al., 1991a).

Clearly, REST-Wet is associated with greater overall sensory reduction than REST-Dry. Of the variables mentioned above, tactile stimulation is probably the one which is most different between REST-Wet and REST-Dry. Further studies in this direction are needed before conclusions can be made regarding the minimum degree and type of sensory reduction necessary to permit the deep relaxation response.

The need for examining another aspect of the REST response has emerged from our analysis of subjective reports which indicated that up to 80% of floaters experience feelings ranging from an enhanced sense of well-being to mild euphoria immediately after a REST session. This led us to consider a possible REST effect on the endogenous opioid system. In a preliminary double-blind study, four experienced floaters each experienced four REST sessions. At the outset they received a Naloxone (opioid receptor blocker) injection or a saline placebo injection. Treatment was random, but each person received two injections of each type across the four sessions. After each session they guessed which type they had received, and pre and post session they filled out a Zuckerman mood checklist. All subjects guessed correctly in all cases and all showed mood improvement only in the placebo sessions (Turner & Fine, 1990a). These results suggested that the REST experience either increased CNS availability of opioids or the ability of the floater to distinguish between the two injections.

We, therefore, performed an experiment to measure within and across-session changes in plasma beta-endorphin in REST (n=15) and a relaxing control (n=12) condition. Although no pre-post session changes were observed, endorphin decreased across-sessions in REST but not in the control condition (unpublished results).

While within-session changes may have been masked by large inter-sample variability, the across-session effect clearly demonstrated a REST effect on endogenous opioid activity.

The decrease was not unexpected since adrenal activity is decreased with REST, and adrenocorticotropin (ACTH) and pituitary beta-endorphin which are part of the same parent pituitary hormone, are

released concomitantly (Guilleman et al., 1977). Furthermore, the decrease peripherally may not be contradictory to the hypothesis that REST increases central beta-endorphin activity since there are data from several laboratories which indicate that central and peripheral beta-endorphin pools can be separate and inversely related in activity (Muller & Genazzani, 1984; Rossier et al., 1977). The implication of the REST effects on endogenous opioids in terms of potential applications to pain therapy and immunoenhancement therapy is significant, and further examination of this phenomenon is warranted.

To date, most REST studies have focused on pre-post and across session changes in the parameters measured. We felt that it could greatly enhance the potential for understanding REST if we could monitor biochemical changes *during* the REST experience. We, therefore, set about developing a method for continuous blood sampling during REST.

Plasma cortisol was monitored in each of four normal subjects experiencing a baseline (non-REST, waterbed) session followed by four REST sessions (Turner et al., 1991b). All sessions were 60 minutes with continuous blood sampling occurring for 40-60 minutes in the baseline and in the fourth REST session. An intravenous (i.v.) line was placed in the dorsal forearm vein. The line was heparinized (outside of the body) by infusion of heparin at 51 units/min. and blood was removed continuously at a rate of 1.4 ml/min. via peristaltic pump. The i.v. site was kept out of the $MgSO_4$ solution by resting the hand on a small buoyant pad. Subjective relaxation rating scales indicated no differences between sessions with and without sampling. Although no within session changes in cortisol were observed, all cortisol values were in the normal range. In addition, cortisol values in the fourth REST session were lower than in baseline, a response consistent with other studies.

We are hopeful that the continuous sampling methodology will provide us with a new window for observing REST, including the opportunity to monitor acute subject responses to challenges and tasks presented during REST.

This brings us to a point of some synthesis on the nature of the REST experience. Based on our data, we have developed a simple psychophysiological model for the actions of REST within the context

of cybernetic theory. At a given moment an individual exists physiologically in a state ranging from Physiology UP to Physiology DOWN and from Attention EXTERNAL to Attention INTERNAL (to self). In REST, by virtue of reduced external input, the situation is Physiology DOWN and Attention INTERNAL. The extreme degree of input reduction permits extreme down regulation of physiological function and associated opportunity for unhindered self-attention. The combined relaxation and self-attention processes enhance the opportunity for integration and improved self-regulation. Included in this process is a cognitive feedback loop for appraisal of the experience. If appraisal moves toward ACCEPTANCE, the REST experience will achieve maximum potential. If appraisal moves toward REJECTION, the REST experience will be hindered. We hypothesize that repeating the exposure to REST helps to move appraisal toward acceptance.

Is there evidence to support this hypothesis or parts of it? Certainly the Physiology DOWN part of the model has been documented. One experiment which we have performed may contribute to evaluating the attention portion of this hypothesis. We have demonstrated in a controlled study that the ability of subjects to increase or decrease heart rate is greater in REST than in a control relaxation condition. In 21 subjects maximum change in HR was greater and latency to maximum change was shorter in REST than in the control condition. Furthermore, when correlations of HR and psychological data were made, interesting information on self focus emerged. Subjects were divided into repressors and non-repressors based on their coping style, with repressors defined as individuals who reported experiencing little distress in everyday situations and are inaccurate in their perceptions (i.e., are deceiving themselves, using a repressive copying style) (Schwartz, 1990). Based on this concept, repressive subjects would not only be less aware of self processes, but also would be less able to attend to controlling them due to the detraction of active repression. In the present study repressors relative to non-repressors showed poorer control of HR in control relaxation, as expected, but performed like non-repressors in the REST condition (Turner & Fine, 1985a). This suggests that REST may have interfered with the normal repressive coping style, i.e., repressors become less repressive in REST.

Assuming that self-attention occurs in REST, is there any evidence of enhanced self-regulation in REST? We have completed one study which addresses the possible contribution of REST to self-regulation. In cybernetic theory, the amount of variability around a mean value of a parameter can be considered a reliable measure of the regularity or "well being" of the loop. In general, decreasing variability means better regulation. In a study of REST effects on plasma cortisol, we observed a decrease in both mean cortisol levels and their variability across REST sessions, but not across control relaxation sessions.

Determination of coefficient of covariance demonstrated that this effect was not due to lower cortisol levels per se (Turner & Fine, 1991). These data, combined with the data showing maintenance of effect beyond treatment suggest that REST can influence the dynamic regulation of physiological systems and their organization. Regarding appraisal, we have no data as of yet. Evaluation of this critical component of our model will receive high priority as we continue to explore the REST phenomenon.

Despite years of research in several laboratories, REST remains poorly understood. It is our opinion that the psychophysiological changes which have been observed in association with REST are substantive and representative of the powerful potential of REST. We hope that this chapter will help to manipulate your attention to a focus on REST.

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