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# AUTOBIOGRAPHICAL MEMORY AND AFFECT UNDER CONDITIONS OF REDUCED ENVIRONMENTAL STIMULATION

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**Abstract**

Two experiments were conducted to study the effects of 1-hour sessions of flotation REST (restricted environmental stimulation technique) on mood and autobiographical memory. In Study 1, flotation was shown to produce a significant decrease in self-rated anxiety and arousal. Subjects in Study 2, who experienced similar changes in mood and arousal, reported that autobiographical memories retrieved in REST were more pleasant and intense, and had been more frequently recalled in the past, than those recollected in a control environment.


## Introduction

The history of research on sensory deprivation—now usually called restricted environmental stimulation technique (REST)—shows a wide range of psychological and psychophysiological consequences arising from a profound lessening of ambient stimulation. Although some early results have been impossible to replicate, and may be attributed to confounds between the effects of REST and those of experimental artifacts, others are well established (Zubek, 1969; Suedfeld, 1980). Extrapolations from basic findings have led to uses of the technique in psychotherapy, health psychology and performance enhancement (Suedfeld *et al.*, 1990; Barabasz & Barabasz, 1993).

It appears theoretically reasonable that a reduction in ongoing stimulation would have an impact on such processes as memory consolidation and interference, and therefore on retrieval. The first review of the REST and memory literature (Suedfeld, 1969) indicated that of 27 studies addressing this issue, only four reported memory decrements. The use of meaningless stimulus materials such as nonsense syllables or geometric designs was a necessary, although not a sufficient, factor in these four studies. Of studies using meaningful material, more than half reported improved memory. Later reviews (see Suedfeld, 1980) confirmed this pattern over a larger number of studies.

Most of the experiments included in these reviews used the dark, soundproof chamber REST technique in which subjects lay on a bed for periods lasting up to several days, and seldom less than 12 hours, with the modal session being 24 hours. This method produces a range of cognitive and other effects that have been investigated in many studies (see Zubek, 1969; Suedfeld, 1980). The chamber technique has somewhat fallen out of use with the invention of the flotation tank REST technique. Here, the subject floats on his or her back in a supersaturated, skin-temperature solution of magnesium sulfate (Epsom salts) in water. The tank is dark and sound-reducing. Flotation sessions typically last for approximately 1 hour, which makes this procedure much more acceptable to potential participants and therefore much more practical.

Flotation consistently leads to relaxed alertness, decreased negative and either stable or somewhat increased positive affect (e.g. Suedfeld *et al.*, 1983; Jacobs *et al.*, 1984; Francis & Stanley, 1985; Forgays & Belinson, 1986; Barabasz *et al.*, 1990), and psychophysiological signs of lowered stress and activation (e.g. Barabasz, 1990*a*; Turner & Fine, 1983, 1991).

It may be that the most important impact of chamber REST is on cognitive and motivational pro-

cesses, whereas that of flotation REST is on emotional state and psychophysiological arousal (Suedfeld & Ballard, 1984). Changes in each of these categories interact with processes in all of the others, and the easy and nonreactive induction of an altered emotional state may make the tank an excellent place for research on the role of mood and arousal as mediators of memory.

Little systematic research has been undertaken on the memorial effects of flotation REST. Two such studies both reported improved memory for meaningful materials, especially if learning and testing were both conducted in the tank (Smith & Sinha, 1987; Taylor, 1990). Subjects in several studies have also mentioned having especially vivid memories, but objective tests have not supported these claims unequivocally (Suedfeld *et al.*, 1985–86; Barabasz, 1990*b*).

The focus of the present investigation is a relationship that has not been explicitly tested before—that between memory and the levels of mood and arousal induced by REST. Recent research has established that various methods of mood modification—music, hypnotic suggestion, instructions, odors, etc.—can influence the emotional quality of retrieved memory. In general, the findings have confirmed the hypothesis of mood congruence, i.e. memories retrieved while a subject is in a pleasant or unpleasant (happy or sad) mood tend to be pleasant or unpleasant accordingly (Bower, 1981; Blaney 1986; Ellis & Ashbrook, 1989; but cf. Singer & Salovey, 1988).

Some of these manipulations are so transparent as to risk serious expectancy effects. Subjects can distinguish the emotional implications of musical or verbal passages, facial expressions, and odors. The experimental procedures may cue cognitive processes that in turn bias the selection and evaluation of memories either as a direct function of subject compliance (Bower, 1981) or indirectly, as the outcome of the subjects' attempting to sustain the desired mood (Blaney, 1986; but cf. Parrott, 1991).

Few flotation studies have used currently standard approaches to measuring memory effects. Thus, the use of REST in a study of mood congruence can advance the understanding of REST effects on both emotion and cognition. Such an approach can also elucidate memory processes under conditions of minimal exogenous cuing and interference, and—more particularly—the relationship between relaxation without specific mood induction and subsequent memory retrieval. The absence of specific mood induction characterizes REST, where ambient cues are at a practicable minimum.

The studies presented here first tested the effect of flotation REST on self-rated mood and arousal, and then provided an unobtrusive measure of the effects of mood change on autobiographical memory. One major prediction was that the lower levels of arousal and a net increase in pleasant affect produced by REST will lead to more positive affective qualities in retrieved memories. Previous reports of vivid imagery in REST (see Suedfeld *et al.*, 1994) implied that memories retrieved in REST may also be more vivid, and therefore perhaps more emotionally intense, than those recalled in a control condition. We also predicted that lowered arousal would result in longer retrieval latency in REST. Last, although some chamber studies have found that REST has adverse effects on divergent or original thinking (as measured by, e.g. remoteness and uncommonness of associations; Wilson *et al.*, 1954), the data are not unequivocal (for a review, see Suedfeld *et al.*, 1994). The evidence concerning flotation REST somewhat favours a positive effect on originality (Suedfeld *et al.*, 1987; Forgays & Forgays, 1992; Suedfeld *et al.*, 1994). In any case, the connection between divergent thinking and memory processes is not clear. Thus, we cannot make a definite prediction concerning the rarity (frequency of previous retrieval) of memories occurring in flotation.

## Method: Overview

Some procedural characteristics were the same for the two experiments. All participants were recruited through posters and announcements directed at university students. Because there is no theory or previous finding that would lead one to expect differences between the reactions of men and women to REST, or differences on the basis of age (at least, in the range of young adulthood to late middle age), no attempt was made to control for these factors in recruitment. The university's standard procedures for ethical clearance (informed consent, etc.) were followed.

Procedures for REST were identical in the two studies. Subjects were familiarized with the tank, which resembles a large covered bathtub. The participant floats in a shallow, dense solution of skin-temperature water and Epsom salts, with the face and ventral portions of the body above the water surface. Each participant is permitted to float either nude or wearing a bathing suit; most choose the

former. The environment is silent and completely dark. An intercom allows the subject to communicate with a monitor in the next room (although unnecessary communications are discouraged), and the monitor listens continuously to check on excessive movement or possible problems. Subjects were taught how to exit the tank prior to the end of the scheduled 1 hour session if they wished; none did so. The profile of mood states (POMS) was administered once before each REST session, and twice afterward: once over the intercom immediately before the subject left the tank and again after he or she had showered and dressed. All subjects were fully oriented to the environment, signed an informed consent form, and took a shower and shampoo before and after each float.

The selection of an appropriate control treatment for REST has been a perennial problem (see, e.g. Rossi, 1969). Flotation REST is a multimodal manipulation, which imposes particular conditions of visual, auditory, tactile, and thermal stimuli; a particular and limited set of bodily positions; a liquid surrounding much of the body; and restricted mobility. How to control for all of these factors is a puzzle. There are two frequently used control procedures. One is to restrict the subjects to a room or building so that there is some limitation and monitoring over their surroundings and activities. This procedure results in a highly homogeneous experience during the pre- to post-test interval for all members of the control group; however, it is a partial REST situation, and therefore a milder form of the experimental treatment rather than a true control condition. The alternative is to allow subjects free activity and argue that the proper comparison is globally between a normal environment and REST. This may be a more appropriate contrast to REST, but it permits an uncontrolled range of environments and activities between test administrations. In the current research, we used the first option in Study 1 and the second in Study 2. We did not assess subjects' activities before they reported to the laboratory, nor during the intertest interval for Study 2 Control subjects.

## Study 1

### *Subjects*

The initial experiment included 32 university graduate and undergraduate student volunteers (26 men, 6 women; age range, 20–35, mean age=25).

### *Procedure*

Participants were randomly assigned to one of two treatment groups ($n$=16 each): 1 hour either in the flotation tank under REST conditions or in a control environment. Control subjects were briefed and signed a consent form. They were then asked to remain in the Psychology Building and return to the laboratory after 1 hour. The POMS (McNair *et al.*, 1971) was administered before and after the 1-hour interval. Scores on the POMS subscales were combined to measure responses on the two overall dimensions of interest: anxiety (items drawn from the POMS Tension subscale: *anxious, tense, nervous* and *relaxed*) and activation (from the POMS Vigor subscale, the items *alert, active,* and *energetic*; and from the Fatigue subscale, the item *listless*). The items were scored so that on the two combined scales high scores indicate higher anxiety and higher activation.

### *Results*

The POMS results, analysed by ANOVA, showed post-float REST subjects to be significantly lower than controls on both scales. For anxiety, the REST mean score was 14·25 and the control mean was 38·50, $F(1, 30)=17{\cdot}27$ $p<0{\cdot}001$; for activation, REST $M=45{\cdot}19$, control $M=63{\cdot}50$, $F(1, 30)=7{\cdot}22$, $p<0{\cdot}02$.

## Study 2

### *Subjects*

Twenty-four university undergraduate volunteers (7 women and 17 men, age range 18–22, mean=21) participated in the second study.

### *Procedure*

Subjects were randomly assigned to equal-sized REST and control groups. REST subjects were oriented to the tank procedures as in Study 1, and signed the informed consent form. They then filled out two self-rating forms (used in other REST studies and involving minimal disruption of the reduced-stimulus environment), assessing their current levels of mood (specifically, pleasure–displeasure) and arousal (high–low) on separate 9-point (+4 to –4) scales. After showering, they floated in the tank for 1 hour; no subject terminated the session prematurely. At the end of the session, with the lights still off and the subject still floating, the

mood and arousal forms were re-administered over the intercom. These were followed by one of two equivalent lists, each containing 12 common, emotionally neutral probe words. The subject had 120 seconds to retrieve a specific autobiographical memory in response to each probe word, and to signal that retrieval had occurred. The subject was then asked to date the event (month and year) and to rate it on each of the seven scales described in Table 1. These scales were adapted from prior research on mood congruence in autobiographical memory (Eich *et al.*, 1990; Eich *et al.*, 1994).

Upon completion of the recall and rating tasks, the subject left the tank, showered and dressed, and was debriefed.

The control environment was the subject's normal pre-session condition. Upon arrival in the laboratory, control subjects were taken to the room where the tank was located and asked to sit in a chair. The lights were on during the entire testing session, which included a mood and arousal rating, followed by the memory retrieval and memory ratings described above. After finishing the tasks, control subjects were debriefed and were offered a flotation session in the tank.

## Results

*Mood and arousal ratings.*

After floating, the REST group showed significantly higher mean ratings on positive mood (pleasure) than controls, $M$=2·33 vs 1·33, $t(22)$=1·79, $p$<0·05, 1-tailed, and significantly lower ratings on arousal, $M$=–0·75 vs +0·17, $t(22)$=1·95, $p$<0·05, 1-tailed.

*Memory retrieval and ratings.* All subjects succeeded in retrieving 12 memories within the 2-minute time limit allowed after each probe word. Although REST subjects showed longer latencies, $M$=9·81 vs 6·98 seconds, the difference did not reach statistical significance.

Memories retrieved in REST were marginally more pleasant than those in the control condition, $M$=0·48 vs 0·27, $F(1, 22)$=4·1, $p$<0·06. REST subjects rated more of their recalled events as pleasant than did controls, $M$=66 vs 51%, $F(1, 22)$=5·5, $p$<0·05. The only other significant effect related to memory pleasantness was that the events were rated as having been more pleasant when they had occurred than when they were being remembered, irrespective of condition: $M$=0·26 vs 0·17, $F(1, 22)$=7·1, $p$=0·01.

REST subjects rated their memories as more intense than did controls, $M$=5·31 vs 4·37, $F(1, 22)$=7·8, $p$=0·01. Predictably, events were rated as having been more intense at the time of original occurrence than at the time of recall, $M$=5·76 vs 3·92, $F(1, 22)$=122·5, $p$<0·01. REST memories were marginally more vivid than those in control, $M$=6·07 vs 5·20, $F(1, 22)$=3·6, $p$<0·07.

Events recalled in REST had previously been remembered more often than those recalled in the control condition, $M$=4·00 vs 3·01, $F(1, 22)$=8·8, $p$<0·01. No other differences between memory ratings reached significance.

TABLE 1
*Rating scales for autobiographical memories*

1. *Pleasantness of event—Then* (i.e. at the time the event occurred): 3-point scale ranging from 1 (pleasant) through 0 (neutral) to –1 (unpleasant).
2. *Pleasantness of event—Now* (i.e. as event is assessed at the time of its retrieval): 3-point scale ranging from 1 (pleasant) through 0 (neutral) to –1 (unpleasant).
3. *Intensity of event—Then*: 9-point scale ranging from 1 (neutral) to 9 (extremely intense).
4. *Intensity of event—Now*: 9-point scale ranging from 1 (neutral) to 9 (extremely intense).
5. *Vividness of recollection* (i.e. how clearly the event is currently pictured in the mind's eye): 9-point scale ranging from 1 (vague recollection) to 9 (extremely vivid recollection).
6. *Recollective frequency* (i.e. how often the event was previously recollected): 9-point scale ranging from 1 (never until now) to 9 (recollected extremely often).
7. *Rarity of event*: 9-point scale ranging from 1 (no other event like it has ever occurred) to 9 (the event reflects an extremely common experience).

## Discussion

Systematic self-ratings in both studies confirmed common anecdotal reports of serenity and pleasant relaxation induced by flotation REST. The finding of reduced anxiety and activation was compatible with the few systematic measures obtained in the studies cited earlier.

The findings of Study 2 support the hypothesis that neither an explicit mood induction nor the recognition that such an induction was being attempted is necessary for the occurrence of mood congruence in autobiographical memory. The more relaxed REST participants retrieved memories that were more pleasant, more vivid, and were experienced with more intense emotion than control subjects. Previous research using mood-induction techniques established the evocation of mood-congruent

memories, not merely changed ratings of affective impact (Clark & Teasdale, 1982; Eich *et al.*, 1990), which lends strength to our interpretation of the findings. We found no evidence of mood regulation via incongruent recall—i.e. happy subjects remembering bad experiences and vice versa (Parrott & Sabini, 1990).

The trend for floaters to take more time in retrieving a memory after the cue was given is compatible with their lower levels of arousal. The events remembered by the REST group had been more frequently recalled before than those retrieved by control subjects. The higher frequency of previous recall may be related to higher pleasantness ratings of the memories occurring in REST, consistent with the hypothesis that sheer familiarity leads to liking (Zajonc, 1968). However, while the higher pleasantness ratings of REST-related memories would thus be explained, we are still left with the problem of understanding why the memories retrieved in REST were more familiar in the first place.

If one views REST as a topic of research in itself, the current study provides the first information as to the mediation of memory effects by the changes in mood and arousal level that occur during flotation. Viewing REST as a technique for exploring substantive issues in psychology, the study supports the expectation that drastic reduction of ambient stimulation through floating can be used to produce a psychological state which is convenient for research on mood congruence on autobiographical memory, and perhaps on other mood–cognition relationships.

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