PROFOUND EXPERIMENTAL SENSORY ISOLATION

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The nature and range of psychophysiological phenomena evoked in intact humans experimentally exposed in solitude to an environment which profoundly diminishes absolute amounts of sensory inputs has been suggested by Lilly(1). Lilly and Shurley (2) attempted to define relevant physical, physiological, psychological and social conditions for such experiments. Beginning with Bexton, Heron and Scott in Hebb's laboratory(3, 4, 5, 6), many workers(7, 8, 9) have described effects of minimal or partial experimental interference with sensory inputs, or the normal, varied patterning of these, with or without solitude. Bennett (10) and Camberari(11) have used immersion techniques; their findings are more comparable with those reported here. In an attempt to eliminate further some shortcomings of the early experiments, the author redesigned the apparatus and altered critical aspects of the technique. These modifications are briefly reported here, together with an account of some experimental findings.

METHOD AND PROCEDURE

At the physical level (Figure 1), we aimed at the provision of a constant environment allowing the maximum achievable reduction of ambient physical stimuli, plus the maintenance of a constant level of those inputs impossible to eliminate, such as temperature. A special two room laboratory was constructed at the Oklahoma City Veterans Administration Hospital. The laboratory enabled us to achieve a marked diminution of light, sound, vibration, odor, and taste inputs. A large tank of slowly flowing water maintained at approximately 93.5 degrees F. (34.5°C.) provided simulated weightlessness, a uniform tactile field, elimination of body wastes, and other advantages for our purpose. Inspired air was kept at a constant low pressure, at 70°F., a relative humidity of 45%, and free of odor and other pollution. Automatic controls and continuous tape recorders completed a virtual self-operating system requiring infrequent attention.

At the physiological level, we aimed at the absolute elimination of all sources of pain and discomfort from body position, pressure ischemia and hollow viscus distention. The subject was positioned so as to remain comfortable, though motionless, for relatively long periods. He was under instruction to inhibit body movements to the maximum degree consistent with comfort. Design of the mask and breathing system (Figure 2) allowed effortless breathing without reduction of oxygen tension and without carbon dioxide pile-up. Neutral buoyancy of the body was carefully achieved by appropriate, low stimulation placements of weights or buoyant, soft plastic material around the mask or body.

At the psycho-social level, we sought subjects with distinct personal attributes. The experimental situation per se required a somewhat self-selected volunteer with presumed ability for sensitive and accurate self-observation, and better than average memory, recall, and descriptive powers. In the experiment the subject needed to assume the role of a relatively passive, self-maintaining sensor, recorder, recaller and reproducer, with free time, motivated to communicate his experience fully, freely, and with minimal omission and distortion to the interested, relaxed, minimally active and minimally coercive experimenter (Figure 3). With these qualities as relatively constant factors, we collected data related to: A. subject variables: sex; occupational identity (lawyers, journalists, physicians, psychoanalysts, technicians, nurses, artists and performers); chronological age (24 to 74); and personality type; B. four con-

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ditions, in terms of separation in time and space, of experimenter from the subject in the tank; and C. two alternatives in reporting: immediately following the run, and during the run itself. (Subjects were permitted free choice between alternative conditions of experimenter distillation, and of reporting.)

Certain considerations seemed relevant at this level, and were observed rigidly. The experimenter and his assistants prepared for the observer role by first using themselves as subjects; the subject was familiarized thoroughly with the experimental conditions by a step-wise series of time-limited runs prior to definitive endurance runs. The identity, and longest times of all subjects were known only to the experimenter.

Strenuous efforts were made to eliminate any suggestion to the subject by project personnel of what might or might not occur. Spontaneous reporting by the subject was encouraged and all queries by the experimenter were general and open-ended in the interviews between the subject and the experimenter. Naturally, the anonymity of each subject and the confidential nature of all personal data were made explicit to the subject and were scrupulously observed. Permission to limit or eliminate participation at any time without prejudice, was specifically granted each subject in advance.

Together, these measures resulted in a state described afterwards by one subject as, "an extremely monotonous state of massive comfort, with built-in confidence and security, yet with an air of fascinating mystery about the outcome."

**FINDINGS**

Detailed consideration of the manifold aspects of the extensive data is obviously not possible here, and many of the observations lend themselves poorly or not at all to quantitative reporting. A portion of the data are here presented to two ways: first, a condensed, narrative account, much of it in the subject's own words; second, a summary of selected data from many experimental runs by many subjects.

**FINDINGS IN ONE SUBJECT**

The following is a chronological report from a tape recording of the experience of a 29-year-old married male, college-trained journalist, who desired to write a feature story from first-hand experience, and who felt that the experience might resemble that of the first astronaut.

The familiarization run occurred three days prior to his experimental run and only slightly dampened his enthusiasm, despite the fact that just prior to the run, he unexpectedly panicked when he placed the mask over his head (a thing he previously had done a number of times without undue anxiety). He had to remove and replace the head mask several times before he felt comfortable enough to enter the tank. The experimenter who was standing by, was mildly surprised and reminded the subject that he could stop participation if he wished.

The subject declined, however, and once the run started, he continued to its pre-set limit of 3 hours, with the observer in the outside, monitoring position. The familiarization run revealed that the mask leaked badly, and that the tank water at 92° F. was too cold, resulting in chilling. The subject experienced headache and severe stomach cramps, had a vivid fantasy of shopping for a private plane, and was startled to learn that only he had heard dogs barking at one point. He reported afterwards that "that was more peace and quiet than I've ever had by myself," and that he felt unusually calm and relaxed for the remainder of the day. He viewed the total experience as "enjoyable."

**EXPERIMENTAL RUN**

The subject appeared at the laboratory at 8 a.m. on a Saturday, with a day free of obligations or plans until 7 p.m. His vital signs were normal, and a half-hour saw him launched on his run, with a comfortable mask which leaked considerably less than the one he had used before, yet proved to require self-bailing every half to three-quarters of an hour. He denied anxiety about the mask and expressed great puzzlement as to what had caused his previous panic. With the observation that "the knowledge you are right across that wall impairs the feeling of being alone," he dismissed the experimenter from the immediate scene to a point where he would be available by telephone from 10 minutes away. The subject revealed that he was determined to use his time this day to prepare in his mind an important report and a budget, both due within a week. He elected to report his experience as
it occurred, with tape recorder running. "Every-
thing," he said, "pointed to a 'good' run," and he anticipated a pleasant time.

His first half-hour was spent motionlessly, excep-
t for a monologue of his everyday thoughts and concerns. These were: anxiety over a strange and entirely unusual somnambulistic act of his wife's two nights before; guilt over disappointing his boy's expectations of him on that day; curiosity about an unex-
pected letter from a girl friend unheard from for years; philosophizing about life, and over "What it all means"; pleasure and pride in his job. ("I've got a front row seat at the greatest show in the world!") irritation over and dis-
approval of the attitudes and behavior of the younger generation of journalists. Following each shift of thought, he would digress briefly into some childhood memory associatively con-
ected. In listening to this tape later, the experi-
menter was forcibly struck by a curious quality about each remark; namely, that each was expressed in ambiguous language that, on a different level, invariably could be construed as a comment on a popular fear about the sensory isolation experience. For the above series, this went as follows: embarrassment at doing something slightly ridiculous or crazy; anxiety over loss of contact with firm ground; regret over failure to establish a good com-
munication link with another in advance; con-
cern over being brain-washed; frustration in the effort to derive some deeper meaning out of the apparently meaningless and ambiguous situation (i.e., the structureless experimental sensory isolation situation) and a turning to the reca-
collection of rich personal sensory experiences enjoyed in the past.

In the second hour his comments concerned his self-thwarted, increasing urgency for "ex-
cercise" and physical activity; amazement at his lack of appetite for a cigarette; his state of utter loneliness and solitude, save for "my very real companions, my thoughts and mem-
ories"; compassion for the little space-monkey, Sam, who received only half an apple and a glass of water for his dinner after his historic trip 55 miles into space; thoughts of food and sudden, intense hunger pangs.

He whistled, and then sang the refrain from a popular tune which went, "I'll never get rid of that - - - . . . . - - - !" Apparently he dropped off into a short (less than two minutes) nap; he woke with a start and the eerie feeling he had just been "out of this world," and with a very vivid, "long" dream, which he struggled to re-
call. He succeeded in recalling only a part—"a sawdust cream cone."

In the third hour he questioned and then asserted he heard the very faint sound of water trickling (the tape records the sound); asserted he heard dogs barking (not present on the tape); and commented on a "crackling sound" (unable to verify from the tape). At intervals he sang, increasingly louder, the refrain from a slightly obscene ditty which began, "Roll me over—"

Increasingly strong impulses to action came:
"I had an urge to make like a porpoise, but those darned hoses (air supply) won't let me!" Briefly, he seemed to be in quite an ebullient, elated mood. Suddenly, he plunged into grief and tears with the expressed thought, "How many people really think about what it's all about? How many people ever, ever think—just once—about love?"

Within seconds, the depressed mood van-
ished and he was again joking, whistling, and laughing. A make-believe dialogue ensued, as he asked, anxiously, "Joe, what do you do when your engine quits at 200 feet?" and replied, in a peal of laughter, "You land the son of a bitch!"

Immediately following, his tone shifted and he uttered an angry command; "You voice! Keep quiet up there! Quiet!" He, himself, obeyed, and was silent, but only briefly. He hummed. He sang. He sighed deeply. He yawned. He seemed utterly bored.

His thoughts turned to his plan to compose his report and his budget, and the belated recognition he had not even begun to ac-
complish this. In a half-hearted explanation to himself, he said "I just allowed my thoughts to drift." Futility and resignation hung from his tone of voice. He then remarked briskly, "I seem kind of wide awake. I ought to get out!"

For a period following this, there was more singing, more humming. Then, "I don't know, but it seems like I heard voices. Somewhere. Male voices. Men's voices. Too bad! (laugh-
ter) It should have been a bunch of dolly's!" He laughed again. More singing came.

In a tone of extreme annoyance, he blurted out, "I might just as well be Sam, for all I can be or do or think or hear or be or smell or taste!"

Over the next 10 minutes he argued himself into the position that he was "just wasting time." "After all, I feel fine." "This is ridicu-
los" (here he referred to his being a grown man bobbing around in the dark in a tank of water in a hole under the hospital). "Besides" he added, "This run isn't producing any data for the doctor, anyway!"

Again, he commented and questioned whether he really was hearing "some noises."
Abruptly, he pulled off the mask and left the tank.

Over the 4½ hours of his run, his longest mute period had been less than 6 minutes.

In the observer room, he dried, dressed, took his pulse (80), his temperature (98.2°) and respiration (16). He guessed that it was now 12:35, and was elated to discover, on uncovering the clock, that it was 1:00 P.M. He picked up the interview card, and dictated into the recorder his response to the first instruction: Give a spontaneous account of the run.

This one was a calmer thing, from the beginning to the very end. I don't know if you got any material out of it you can really use. I enjoyed this one to a degree. I have no specific recollections, except that I seemed to doze quite a bit at first. I don't believe I dictated as much as last time. I don't feel as subdued as after my first run. I feel like I'd like to go out and hunt bear! I feel more exhilarated, refreshed, and rested than I did after that first one. I'm sorry, I don't have a lot to say. [Apologetically], I noticed I thought a lot about women this time.

In response to the question, why terminate now?, he replied,

I had the feeling there were some things I ought to be doing . . . I don't know now, though, what they were . . . I felt like I was "coming to," and I was getting bored, and it just didn't seem like I should stay. That's why I quit now.

Coincidentally, the experimenter returned to the scene at this point, intending to check the operation of the automatic equipment in the outer chamber, and discovered the subject busily interviewing himself. The experimenter remained, listening passively, while the subject continued his report and occasionally injected, or replied to a question. He noted that the subject seemed unusually buoyant, gay, and energetic. He was amazed to hear the subject calmly report that on several occasions he had seen a brilliant white light, that "looked like the sun through a peep-hole," and once had seen an inverted "V" in brilliant blue and white flame moving through dark space toward him. This occurred about half way through the run. Shortly after this he experienced an "extremely strong" and persistent feeling that "someone," identified as friendly, had entered the chamber and was "in the room with me." After these and several similar accounts of experiences in isolation, he apologized, "I have so little to offer this time."

As he neared the end of the interview, he waxed increasingly angry. These feelings reached a climax with the vehement assertion, "I honestly believe, if you put a person in there, just kept him and fed him by vein, he'd just flat die!"

One further observation by the subject deserves mention. He commented on what was to him a curious, paradoxical fact. Although he could visualize his complete budget sheet with photographic clarity in his mind's eye (a feat he is incapable of in everyday life) he simply could not "hold on to it and work with it." "Everything I thought of came to mind much more vividly than it would outside, but I simply could not concentrate." In addition, he noted that certain mental images experienced on a previous trial run could be recalled as freshly as if they had just happened.

The post-run interview lasted an hour and a half, during which time he lit one cigarette, but took only one or two puffs (he is almost a chain-smoker in everyday life). He also ignored a proffered cup of coffee, which turned cold on the table before him—a thing he ordinarily would never have allowed.

His buoyant mood and unaccustomed energy persisted throughout the day, and he reported that "nothing else unusual—nothing at all" had occurred when he was queried a week later. However, a colleague of the experimenter's happened to hear him reading a newscast on the evening following the day of the run, and noted that the subject, usually a facile and accomplished speaker, hesitated momentarily and stumbled in pronouncing the words "water" and "Medical Center," but gave no indication of awareness that he did so.

The news feature which he planned remained uncompleted 4 months later.

FINDINGS IN GENERAL

Results under the two alternatives of reporting (i.e., retrospective or both simul-
taneous and retrospective reporting) permit the observation that simultaneous reporting generally was much richer in detail and appeared to inhibit less the revelation of marked deviations from usual feeling states, imagery, and thought content. Retrospective accounts, however, were most revealing. Put another way, the healthy ego seemed to possess an incredible degree of ability to utilize repression and other defensive mechanisms that drastically limited the full reporting of experience. With only an occasional exception, persons having had considerable subjective experience of analytic-type psychotherapy consistently reported fuller and less distorted retrospective accounts of what is called "ego-alien" or "primary process" experience. Subjects with experience as analysts reported even more of this experience and with even less distortion.

No generalizations are possible as yet regarding the effects of temporal and spatial distanziation between subject and experimenter. It was obvious that anxieties of both were significant in determining what was requested and allowed, but other factors also are involved.

For many reasons, the reporting of findings in the area of mental imagery is exceptionally difficult, yet one of the most dramatic findings of these experiments concerns this very area. Mental imagery phenomena, broadly conceived, invariably were present in every run of every subject in our series, although conditions of reporting dictated that in some instances they were inferential, rather than direct. The variety of these experiences defies classification and description. For example, consider how one would classify this: "I strongly felt that I was stirring with my left leg, and it was a spoon in an iced tea glass, just going round and round. I came to with a start to realize that my leg was going round and round." By contrast, the following seems easy to classify: "I suddenly saw in the darkness before me a field of golden toadstools, with the sunlight brightly reflected from the stem of one." The latter experience might be described as purely visual, three dimensional, and in color. The subject was able to paint a picture of what she saw. A fuller description of data on mental imagery soon will be available elsewhere (12).

Under the extreme conditions of our experiment, clear limits of what might be expected (for example, what might be heard) were non-existent. Two physician subjects independently reported having been startled to hear, without benefit of stethoscope, their own heart sounds at ear-filling intensity. One of them reported having heard repeatedly the snapping sound of his own aortic cusps closing at the end of each systole. A third physician subject reported in awe that for the first and only time of his life he heard the gliding sound made by moving his large joints. Such reports, if verified, raise the interesting question of whether they are to be regarded as instances of enhanced sensory acuity, lowering of sensory thresholds, or enhanced ability to fix attention.

There was a general tendency, following a run, for pulse, respiratory rate and blood pressure to drop moderately, and for body temperature to rise slightly, although exceptions were noted. Nine of the 12 subjects made runs exceeding 180 minutes, but none exceeded 400 minutes. Within this range, post-exposure feeling states varied both between subjects, and for the same subject between runs. We saw marked calmness and extreme irritability, buoyancy and lethargy, vigilance and somnolence.

Most frequently we observed a peculiar, mixed state characterized by calm, clear mental vigilance, coupled with lethargy, muscular relaxation and a decided disinclination for exercise, but without any sense or sign of fatigue.

DISCUSSION

The single run reported here is not atypical. There are wide individual variations in specific mental content, but much fewer variations in form and sequence of events.

When one takes out light and sound, one perform's puts in darkness and silence; when one takes out change and structure, one puts in monotony and non-structure. When one takes away gravity, a state of weightlessness obtains. Thus, every "negative" state has "positive" consequences. In terms of these consequences, the former (or
negative) state may be far more potent, regardless of how much physical energy input or stimulus is denied. As a matter of fact, for a conscious human, the absolute elimination of any sensory input, save for special modalities within very narrow limits (e.g., visible light), is impossible, and can be approached only asymptotically.

**Conclusions**

A feasible and effective method has been described for studying a wide range of psychophysiological phenomena under circumstances permitting exceptionally effective isolation and demonstration of discrete elements in the complicated, interconnected patterns and sequences underlying even the simplest human act or experience.

A number of hypotheses relating to very fundamental issues can be erected from these observations and can be subjected to experimental testing. In due course, such experiments may contribute to a more adequate understanding of human behavior.

**Bibliography**


**Discussion**

John C. Lilly, M.D. (St. Thomas, Virgin Islands).—The importance of this work seems to lie, not in its testing and extension of research on isolation and confinement in water which I began in 1954, but in the fact that a group is doing profound isolation and confinement in a water immersion situation. It has been my impression, and my published opinion, that this kind of isolation, in which all possible sensory inputs and information exchanges with the physical and social surroundings are reduced towards zero, will be a fertile source of knowledge of the human mind in a short term and in a long term sense.

When this work was initially presented in 1956 in the Psychiatric Research Reports No. 5 (Lilly) it was inadvertently linked up with a negative aura conditioned by the brain washing milieu in which similar studies were being carried out in the laboratory of Dr. Donald Hebb. It also suffered from being born in an atmosphere of research on mental illness. I do not feel that either of these bedfellows can benefit except by products from the research. The research itself should be on a much broader biological and psychological basis. To put it very simply, our curiosity about the functioning of human minds can be satisfied and intrigued by these techniques as by no others. The amount of information which can be, and is, generated by each subject in these experiments in a few hours can be mountainous and overwhelming, even as it can be by a freely associating person lying on a couch. The advantage of the watertank over the couch is that the conditions are more extremely isolating and there is a
FIGURE 1
Schematic Elevation of Experimental Sensory Isolation Laboratory

FIGURE 2
Subject Wearing Headmask for Underwater Breathing
FIGURE 3

The Post-Run Interview. The Automatic water input controls and the tape-recorders are seen in the background in the observer room of the laboratory.
greater degree of true aloneness achievable in the tank. For healthy subjects this has the distinct advantage of lessening the feeling of someone looking over one's shoulder watching one's thinking processes. One can, as it were, really be free of supervision, the necessity of exchanges and the necessity of organization of one's thinking for the purposes and activities of others.

The truly individual aloneness achievable by this method allows one to find out the following basic facts:

1. The human mind is not a solipsistic cesspool of circuitous internal feedbacks. "Pure thought thinking of itself" is not the net result of such work.

2. The human mind in this situation can be seen to be a true source of continuous new information, some recorded in the past but inevitably generating new relationships interwoven with information recently derived from social realities and from the anticipated future.

3. Demonstrations of the portions of the human psyche which are not under the immediate control of one's own self are shown in a dramatic and immediate fashion to those who are ready to see them.

4. In my own experience, and apparently in that of some others, who have been through these experiences (and similar ones in prisons, small sailing vessels and polar huts), one gains an increased awareness of, and a willingness to move with, power, speed and integrity along the lines of one's life situation along which one really and truly wishes to move. The long term effects of repeated satisfactory exposures to these extreme conditions in several cases have been quite rewarding.

In contrast to most other isolation experiments, there seems to be an underlying thread of a reward balance in the reward and punishment account book in the immersion type experiments. Once a satisfying solution to the technical matters is provided for the subject, I found, as have Shurley and Bennett, that the subjects want to repeat their exposures and seek out opportunities to do so. One may ask if addiction might develop. My answer is No, eventually one becomes weaned from such artificial aids for exploring one's mind. In my experience practically everyone who has been through this has been very much impressed with the experience. No one has yet called it trivial.