HABITABLE ENVIRONMENTS

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INTRODUCTION In 1969 I was asked by NASA to study habitability criteria for long-duration space missions. It became obvious, as mission duration increased from a few weeks to a few months and then to a few years, that a spacecraft would have to become more and more self-sufficient until it contained everything necessary for survival and well being. The question now became: what is everything? This is where habitability became very interesting to us. What is everything that a person needs? What a person needs depends on what is required for psychological and physiological maintenance. However, maintenance to what standard? In a totally open ecological system, man is free to find means to fulfill his needs from the bounty of nature. In the totally closed ecological system of a long-duration spacecraft, all the needs that will be met must be provided for by the designer. As world population increases and societies become more complex and industrialized, the natural habitat of man is becoming more and more closed. In the future, on earth as well as in spacecraft, the needs of man that will be met must be provided for by the designer; but again, to what criteria?

SYMPOSIA My first approach to this problem was to arrange, with my colleagues, a symposium to exchange ideas on the issue of habitability and what must be provided. In May 1970, the first National Symposium on Habitability was held in Venice, California. We invited architects, city planners, physicians, philosophers, artists, engineers, psychologists, and political and social scientists to help us get a perspective on the problem. We decided to make the symposium something of an experiment by designing the symposium itself (from arrangements to meeting rooms). Our intent was to have a symposium environment that would fit our topic. Participants were bused, each day, from the International Hotel near the Los Angeles airport to Venice. The site of our major meeting hall was Robert Irwin's studio at 72 Market Street. The entrance to the hall was through an alley adjacent to a flop house. A hole had been knocked through a brick wall to form the entrance. In contrast with the exterior, the meeting hall was almost pristine in beauty, elegance, and simplicity. The studio was completely white. There were two large skylights with louvered glass inserts. Larry Bell made the lightly colored glass inserts. Consequently, the illumination in the room was really special. Inside the room was an island on which the participants sat. There were no chairs except for those of the discussants. Each day of the meeting, this hall was altered substantially. For example, on the third day of the meeting, one wall was completely open to the street and the local people wandered in to join the symposium.

Lunches were catered each day and as the meeting progressed, the eating patterns varied so that by the third day the whole assemblage was eating lunch while sitting on the curb, feet in the gutter, quite at home.

The afternoon sessions involved smaller discussion groups composed of people with heterogeneous backgrounds. The settings for the discussion group meetings were several rooms in Larry Bell's studio, DeWain Valentine's studio, and Robert Irwin's Mildred Avenue studio, and the adjacent beach. Each of the discussion groups rotated through these different meeting rooms.

These individual meeting rooms were also designed for the symposium by Irwin and Bell. One room was totally white, brilliantly lit, and rounded inside with no corners or edges. Discussants in this room found that they would get nauseous if they did not look at other participants. A second room was highly reverberant and had skewed walls. Participants felt as if they were sitting on a hillside, and they kept moving their chairs closer together to

hear one another talk. A third room was completely black, lighted with one bare bulb. It went unused because each discussion group assigned to it opted to go somewhere else (mostly to the beach). Interviews after the symposium revealed to our amazement that virtually no one was aware of the impact that these rather heavy-handed treatments of the meeting rooms had on their subsequent behavior.

As four days of the meeting progressed, the tenor shifted from very up-tight to a feeling of comradeship at the end. The up-tightness was fostered probably by the initial challenge to each individual's perceptual and conceptual structure. This challenge, we believe, was promoted by the unusual environment, the unique format, the nature of the topic, the differences in dress, the differences in personal background, differences in objectives, etc. The comradeship developed as a new perceptual and conceptual structure was established through sharing new and challenging perceptions, jointly weathering the rough spots, sharing animated discourses, eating and drinking together, etc. Everyone went away feeling that something had been accomplished.

We learned a number of things from this symposium apart from the content of the papers. The most vocalizable were 1) the observation of the interrelations between perceptual and conceptual structure, and 2) that people are generally unaware of how environment affects their behavior.

As a result of the content and process of this experience, we began to think of the habitability of an environment in terms of the environmental factors that influence both the quality of life of the inhabitants and the ways in which they perceive their life quality. These habitability factors seem to operate at three levels: 1) those that can be perceived directly; 2) those that affect our perception of life quality in a covert, subliminal, or interactive fashion; and 3) those that are primarily biological in nature. It is inherent to the nature of the problem of designing habitable environments that effects from all of these levels must be considered simultaneously.

EXPERIMENT AND MEASUREMENT One of the principal problems facing designers trying to design for life quality is that of making some aspects of design a science. This is necessary so that the impact of the design on the inhabitants is known and predictable in advance. In just the last few years, the task of measuring the impact of environments on the inhabitants has been undertaken, and the measurement of habitability is seen as the key to understanding and predicting the impact of the built environment.

Research in habitability attempts to ascertain how the goals of individuals and groups interact with environmental, personal, social, physical, and temporal constraints to affect the adequacy of a situation. Of particular interest are the physical contraints of a situation and their manipulation to help achieve habitability.

Our initial venture into the measurement of habitability was sponsored by NASA as part of the Tektite II program (Nowlis, Wortz, and Watters, 1972). The Tektite II was an undersea habitat anchored off St. John's Island in the Virgin Islands. The Tektite II program, with its emphasis on scientific missions, its relative isolation from the shore support, and its several crews consisting of scientists and engineers, both men and women, provided an opportunity to 1) conduct a direct study to confirm previous hypotheses, and 2) begin to evaluate habitability measurement techniques.

There are four types of data that can provide information on habitability. These are 1) measuring on-going responses and activation of the inhabitants, 2) gathering background data on each person, 3) evaluating the properties of the environment itself, and 4) measuring the physiological and psychological consequences. The measurement instruments we were able to employ in the Tektite program looked only at the first two categories of data.

The focal research point of this study had to do with the evaluations of parameters affecting life quality in underwater living in the habitat by the 48 men and women who became the aquanauts of the program. These were scientists and engineers of unusual intelligence, imagination, and stability who descended into the habitat with important professional tasks to perform.

Some of what we learned from the Tektite experiment was:

(a) We can measure habitability.

(b) Privacy has a very important impact on habitability. The results indicate the need for privacy during which the resident can refresh himself and recover from stress.

(c) Leisure time was very important to the aquanauts, who spend far more time at leisure activities than they or anyone had anticipated.

(d) Food was very important. There were far fewer complaints about food when the aquanauts could select their own food.

(e) The single most important variable in the perceived habitability of this habitat was the degree to which aquanuats found the habitat supporting their professional tasks. It is logical to assume that this finding can be generalized to many other situations.

(f) Although the initial impression of the habitat was highly positive, there was a tendency for these positive attitudes to decline with increasing lengths of stay in the habitat. As the aquanauts habituated to their environment, their moods shifted toward rather flat and unemotional dispositional states. They also tended to work less and sleep more.

(g) The principal personality factors that correlate with adaptation to the habitat are intelligence and lack of suspiciousness.

(h) A unique feature of the habitat was continuous auditory and visual TV feedback between the aquanauts in the habitat and the test crew on shore. A large amount of time was spent with each of these crews watching the other. This type of continuous visual feedback between the two crews kept each other continuously informed of the problems and real life actualities of the other. There was no evidence of the hostility that almost univer-

sally arises in the stressful isolation tests. We feel that this observation on feedback communication has many design and social situation implications.

In summary, the results indicate that task support, variety of stimuli and behavior, privacy, opportunity for self-selection of foods and activities, and visual feedback communication are key parameters to be provided to maintain life quality.

ENVIRONMENTAL RICHNESS The effect of environmental factors such as temperature and noise on human physiology has been reasonably well studied. Now, other factors such as environmental complexity or richness are being demonstrated as affecting such parameters as the IQ of children and the brain weight and behavior of animals. Researchers in the field of child development have found that culturally impoverished children develop more slowly than enriched children. In some cases, it has been demonstrated that the detrimental effects of early impoverishment have been reversible after enrichment programs.

Studies with animals (such as rats and monkeys) indicate both behavioral and neurological consequences of environmental enrichment or impoverishment. Impoverished monkeys and rats tend to be more emotionally reactive, aggressive, and afraid of novel environments than normal animals even after they become adults. The relevant feature of enrichment seems to be a highly interactive relationship between the organism and complex and/or continuously novel environment. Enriched animals have a heavier cerebral cortex (an area of the brain associated with intellectual functioning and information processing) than impoverished animals. It also appears that this effect is not just limited to the polar extremes, but that the effect is a continuum as a function of environmental richness. The implications of this type of research to the design of environments for adults as well as children is profound.

PSYCHOLOGICAL MEDIATING PROCESSES We began wondering about exceptions to the general underlying notion that good habitability response came from good setting design. For example, how is it that an opportunity to express certain ideals or creative needs can make a seemingly poor environment a positive one? We encountered this in Venice, California. Venice is a rundown community and most of the buildings barely pass local building codes, yet it has some well disposed, vigorous residents. Why was it, we pondered, that such citizens report that they actually prefer certain impoverished urban or rural areas over more well-designed, efficient, seemingly supportive areas? It appeared in discussion with such people that an opportunity to be doing things they considered to be meaningful could override many serious and obvious environmental deficiencies.

As another example, we wondered why a highly successful businessman who worked in plush, beautiful designed offices and lived in a home worth several hundred thousand dollars found he was happiest in his crude cabin in the woods during the one-week vacation he gave himself every year?

Then we wondered why poor housing seemed to be correlated with high crime rates and high physical and mental illness in some cities and countries, but not in others.

How might environmental design affect such variables? Our own studies and the research of other environmental psychologists suggest that three main components are involved: 1) individuality, 2) sense of purpose, and 3) sense of choice or options. These three overlapping aspects of man-environment interaction we feel are of major importance in understanding habitability.

Individuality In the 1960's, the University of California at Berkeley erected carefully designed dormitories for graduate students. Rooms in these relatively new and attractive buildings rent inexpensively, but financially have proved to be a serious failure. For some reason the students prefer much more expensive, seemingly poorly designed rooms and apartments in the city. These latter habitats would often rate poorly on many of our habitability tests. The university asked Van de Ryn and Silverstein (1967) to study the problem. After extensive observation and interviewing, the authors concluded that the dormitories were often described as being somewhat like a motel and, to increase efficiency, were designed for one optimal pattern for all users. Not surprisingly, Van de Ryn and Silverstein concluded that students in fact do not behave according to any single pattern; therefore, they tend to prefer environments allowing considerable latitude for individuality and choice.

It can be stated, therefore, that if you design for the average, you design for nobody.

Sense of Purpose In a study of soldiers stationed in the arctic, Washburne (1963) found that when men remain in well-designed stations, morale goes down, especially among the men uncertain of their next assignment. When the same men go out in the field, in some instances sleeping in weather 50 degrees below zero in tiny tents, morale goes up. Presumably, Washburne's results illustrate the way in which sense of purpose can override design in affecting habitability.

Silimarly, Pope and Rogers (1969) have investigated the environmental response of scientists conducting research in the arctic under very adverse conditions. Using psychiatric interviews and various psychological tests, they were unable to predict which scientists would do well in the arctic environment and which would show mental disruption. They found a clear relationship, however, between sense of purpose and successful psychological adaptation to the adverse environment. The scientists who had gone to the arctic merely because it was a job they could do for a while did poorly, even if their psychological health appeared to be excellent.

The studies done in the arctic agree well with results from Tektite II. Although a lot of design effort was invested to ensure that the habitat would be a comfortable one, the scientists who worked in it appeared to have increasingly negative reactions with longer habitation periods, and in retrospect had mostly negative things to say about it. What the de-

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signers apparently forgot was that they were designing the habitat for committed scientists, many of whom were the sort of people who wouldn't care if they had to sleep on the floor as long as they could get serious, meaningful scientific work done while they were there. As the time passed and the novelty of the rather elaborate living arrangements wore off, the inconveniences caused by poor provisions for scientific research in the habitat became increasingly apparent to these scientists.

Sense of Choice (Perception of Options) A number of studies show that freedom of choice can dramatically increase evaluation of food. For example, Kamen and Peryam (1960) found that subjects with an opportunity to plan their own menus from a fixed and limited supply were considerably more satisfied with their meals than those who were fed preplanned menus from the same supply. Serendipitous findings are available from our research on Tektite II. It happened that three missions were given self-selection of foods, requests being filled via the closest market on St. Thomas Island. The other seven missions were given high-quality preprogrammed foods, largely frozen. We had sampled this food ourselves, and it was indeed delicious. To our considerable surprise, in spite of the expense and care spent on the preprogrammed foods, and in spite of the fact that tropical storms occasionally made it impossible for the self-selecting missions to have any food at all while the preprogrammed missions always had ample food, we found that 39 of the total 40 debriefing complaints about food quality came from the missions with preprogrammed food.

As another example, when asking New Yorkers why they live in New York, they would respond in terms of activities they enjoyed such as "the opera." When asked when they had last attended the opera they might respond 15 years ago.

It becomes apparent that the perception of the availability of alternatives is at least as important as the exercise of the choice. Based on these observations I have developed the Wortz hypothesis of wealth. My idea is simply that the function of wealth is to build up the availability of options, i.e., options available = wealth = power of choice.

Conclusions This leads us to the two principal conclusions of psychological mediation. First, what we might call the Nowlis-Wortz first principle of habitability: as environmental influences become more stressful, organismic needs for establishment of individuality, purpose, and choice become stronger. Next, our second habitability principle: if we find a man with a personal sense of his own individuality, with a sense of purpose, and with a perception of the options and choices available to him, we will likely find an environment that, no matter how crude in design, he has found habitable; if we find a man without these three factors, we are likely to find an environment that, no matter how beautifully designed, the man considers to be low in habitability.

In summary, we know that environmental habitability affects health, longevity, behavior, perception of life quality, job satisfaction, moods, attitudes, dispositions, and even brain weight. We know how to get data on habitability to guide our criteria and designs — from existing built environments, by experimentation, by information exchanges, by feedback from our designs, from scientific data, from isolated habitats, and by simulations.

What we need, however, is a major program in which we can design and build environments to specific psychological, social, behavioral, and physiological objectives. We need to build and then test these constructions, tear them down, and then rebuild if need be. In this country we would not think of building sophisticated technological systems without testing them. They wouldn't work. Neither should we build the world in which we live without testing to find out what we are doing.

REFERENCES

Kamen, J. M. and Peryam, D. R. Monotony characteristics of foods. Food Technology, 1960, 14-44.
Nowlis, D. P., Wortz, E. C. and Watters, H. H. Tektite II habitability research program. AiResearch Report No. 71-6192-1, 1971.
Pope, F. E. and Rogers, T. A. Some psychiatric aspects of arctic survival experiments. Journal of Nervous and Mental Disease, Vol. 146, 1968.
Van de Ryn, S. and Silverstein, M. Dorms at Berkeley: an environmental analysis. Center for Planning and Development Research, 1967.
Washburne, N. F. Reliance of stimuli and models of task situation. In: Sells, S. B. Stimulus determinants of behavior. New York, Ronald, 1963.
Wortz, E. C., et. al. First National Sumposium on Habitability, Los Angeles, 1969.

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