STUDIES TOWARD A MORE RESPONSIVE ENVIRONMENT

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SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF
BACHELOR OF ARCHITECTURE
at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
June, 1969

Signature of Authors

Department of Architecture, May 23, 1969

Certified by

Thesis Supervisor

Accepted by

Chairman, Departmental Committee on Theses
ABSTRACT

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Submitted to the Department of Architecture on 23 May 1969
in partial fulfillment of the requirement for the degree of Bachelor of Architecture

The object of this study is to design a process for evolving environments that maximize the communication between the client/user and the architect/advocate. The environment acts as a medium through which the users communicate their explicit and implicit needs and desires to the advocate. It also provides a structure within which the user can more clearly experience his own actions and reactions.

A construction game was developed and used by children in a free play situation to simulate the interaction of user, environment, and advocate. The game was structured according to suppositions developed in a model of the learning process called the 'dialog model':

1. A vocabulary of pieces (child size and with varied information content) was developed and tested which enabled children to build their own full scale play environments;
2. Loosely structured rules were formulated for the active participation of all parties;
3. Techniques and methods for recording and analyzing the actions and reactions of participants were developed in an effort to clarify the use-associations and modes of operation of the children. Attempts to respond to the structure and content of the children's actions were made by altering these three parts of the game. The responses were initiated for two purposes: (1) To clarify the children's understanding of their own built environments, and (2) to increase our understanding of the children's responses.

The game was a test vehicle for a learning process that would allow users to play a more integral, if not primary, part in the design and structuring of their own environments. Therefore, the intent is to produce environments that are more relevant and meaningful to their users, not simply information rich and manipulable.

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Title: Assistant Professor of Architecture
ACKNOWLEDGEMENTS

To the teachers at the Cambridge Montessori School, Mrs. Batter and Mrs. Scott, for their complete cooperation and interest.

To Jackie and Robbie for their aid and comfort during times of crisis.

To the children at Cambridge Montessori School for their cooperation and expertise.
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PART I: Rationale

In recent years environmental researchers have begun to apply sophisticated analysis techniques to the design situation. Certain methods, previously associated with the hard or physical sciences, are being adapted for this task. A whole new field concerned with the development and study of design method and decision-making has arisen. Attempts are being made to write algorithms that would systematically design, dissect, or predict actions in the real world. The object of this work has been to produce a body of scientific theory about the use and meaning of the environment so that designers could produce greater physical and psychological congruence between the designed environment and its users.

From within this area, however, serious doubts are beginning to arise about the applicability of these techniques and concepts to human environmental circumstances. We do not simply mean that there is a danger of misapplying the small body of hard data by designers who are eager to substantiate their decisions. We mean that gathering and organizing of hard, systematic data about small controlled situations may not be the best way to understand or promote environmental design for intelligent (non-random, non-systematic) behaving individuals. The new interest in the psychology and topology of space and method has largely neglected the role of intelligent users as key participants in the evolution of physical, social, and temporal environments. This interest has instead tended to think of these users as subjects in the traditional
way. Our experience with the concept and development of "advocacy planning" has led us to the conclusion that a meaningful environment can only evolve through close cooperation with and knowledge of the client. In the same way, our contact and interest in the fields of cybernetics and linguistics (which are not physical sciences) has led us to consider the environment as a medium for communication between equals.

There are two main reasons for our decision to leave the mainstream of environmental research:

1) The desire to make the users participants in the design process
2) The extreme difficulty, if not impossibility, of producing hard conclusions or generalizations about intelligent behavior under environmental conditions.

Reason 1

We are seeking ways to make environments meaningful to individuals, not some general extension of all men. In order to do this we propose that the environment be more responsive, in small, immediate time grains, to change and growth on the part of the user through learning and experience. In any design situation certain relevant portions of information about the problem (e.g., user desires and preferences, predictive results of decisions, tradeoff possibilities and priorities, etc.) are unavailable and, perhaps, not even able to be explicitly stated. Traditionally, the role of the designer has been to somehow generate, or supply this
missing data. He has always done this, usually in the context of aesthetic preference. In a practical sense we are saying that since we can never have all of the important or relevant information to make hard decisions, a priori, we should: (1) give environments the latitude and ability to evolve in interaction with the user, thus better accommodating his diverse and elusive needs and desires; (2) maintain a frequent, if not constant, communication with the user so that the medium is always responsive to his initially unskilled probes for meaning within it.

Reason 2

Data analysis is an attempt to generate and recognize patterns residing in the data. Unfortunately, the machine or hand techniques that we are most familiar with now do relatively simple operations on the data. Complex, interrelated variable systems which behave in probabilistic ways are very difficult to process with these techniques. When choices are made by other than explicit decision strategies, when decisions are based on values and unaccessible motives, or when the subject himself is unable to explain why a choice was made, we find that simple, straightforward analysis and aggregation techniques do not work very well. In effect, we are forced to develop low resolution procedures which emphasize our interaction with the real situation in real time. Fortunately, the most sophisticated and complex pattern recognition and meaning-extracting capabilities we know reside in the human being. These perceptual information organizing abilities are generally known as
intelligence. Thus, we propose to use these intuitive capabilities, linked to certain perceptual aids, to process our complex data.

In a human dialogue, an individual is not able to perceive another person's thoughts. He senses only the other person's actions and responses in the real world. Because those actions are rich in information, an individual is capable of finding patterns and correspondences to his own experience, and he is able to give those actions meaning. The meaning that he assigns to any action is at first subjective because it is independent of the other person's experience. However, as the dialogue continues, the experiences that are common to both individuals increase, and it is in the context of that common set of experiences that the objective meaning of an action emerges.

In a dialogue design process, the actions and responses of an individual are directed through the material environment. The material environment thus becomes the medium through which mutual understandings develop, and it is a reflection of those understandings.

The diagram in Fig.1 describes the dialogue design process in greater detail. For the sake of simplicity we assume that there are only two actors in the dialogue, and that at any given moment only one actor is operating on the environment. His operations evolve for four basic reasons: (1) to shape the environment to his needs (2) to communicate his needs and values (3) to understand past responses (4) and to test the capabilities and limitations of the environment. The envi-
**Figure 1  DIALOG PROCESS MODEL**

<table>
<thead>
<tr>
<th>Actor</th>
<th>Physical Environment</th>
<th>Another actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience</td>
<td>Operation</td>
<td>Operation</td>
</tr>
<tr>
<td>ENVIRONMENTAL CHANGE OF STATE</td>
<td><strong>perception</strong></td>
<td>take some action on envirnmt.</td>
</tr>
<tr>
<td>current state of experience</td>
<td>test for:</td>
<td>Step A</td>
</tr>
<tr>
<td>a. information</td>
<td>b. relevance</td>
<td>Step B</td>
</tr>
<tr>
<td>c. intelligibility</td>
<td>chose appropriate action/response</td>
<td></td>
</tr>
<tr>
<td>new (altered) state of experience</td>
<td>take some action on envirnmt</td>
<td>Step C</td>
</tr>
<tr>
<td>ENVIRONMENTAL CHANGE OF STATE</td>
<td>perception</td>
<td>current and so on.....</td>
</tr>
</tbody>
</table>
Environment subsequently responds through the operation of the other actor. Each time an exchange of action and response occurs, a complex set of reactions takes place.

The individual perceives the action (Step A) and in small time grains he predicts the type, content, and continuity of the incoming sensations. The sensations are then processed according to his predictions (Step B).

1. Are they different from what was expected or predicted, i.e., is there information?
2. Is the information intelligible?
3. Is the information relevant, i.e., can he relate it to his own experience?

This process begins to identify appropriate levels of response for the individual (Step C). He may store the information and continue his previous line of thought. He may wish to clarify the information or elaborate upon it. He may find some meaning in the information that he wishes to pursue.

The exchange of information through action and response builds a body of experience that is common to both actors. It is experience through which they establish rapport. The language that evolves from that experience has a special value. It is a language that is commonly understood and it reflects the particular history of their interaction.
PART 2: The Evolution of the Project

The following part of this report presents an overview of the development and evolution of the project over time up to the present date. Each stage of the project will be represented in an abbreviated form with an attempt to show important aspects in the development:

1. LANGUAGE: The reasons for the language form and language changes
2. ACTION: The flavor of the activity
3. CONTEXT: The changes made in the social, physical, and temporal contexts

Fig. 2 represents the hierarchical nesting of attributes or variables that were present in the system over the course of the project. Time in the diagram runs from left to right. If a line is traced from the farthest right elements to the beginning, the attributes of a piece currently in the system will be enumerated. It can be seen, then, that any piece chosen is a piece which contains many levels of interconnected variables. A deterministic answer to why any particular piece was chosen becomes increasingly difficult as this nested complexity develops. This is why the dialogue design process is helpful. It does not seek to produce answers to the above question; it simply aids in the formation of new questions or probes in the form of language changes or con-
text shifts. It is, then, through intelligent analysis that both we and the children come to understand and develop the meaning of particular parts, actions, and special configurations.

The next section is organized as a continuous flow, related to the time line of the project. It is an attempt to show how the project (i.e. our techniques, the language changes, and the children's actions) evolved over the course of two semesters. To be understood easily, it must be read as three continuous, separate but related, strips of information. The middle section is a description of the action. Related to this directly in time is the language, directly above the action, and the context for our look at the action, which is below the action.

In addition, all of this is related to the time plot of the evolution of the variables (Fig. 2) by the stage numbers.
Stage 1  The Original Set
Language: "The language develops out of a set of slotted, rectangular, cardboard parts. The parts are child sized, relatively stiff, and easy to manipulate. Information is designed into the parts in terms of properties that change from part to part....Most of the information in the language is contained in the geometry of the parts: their size, their internal organization,

typical parts

Action: In the first action series "the objectives were to establish a rapport with the children, to familiarize the children with the language, and to experiment with workable game situations. The game was introduced very simply, and the children were invited to play with the 'construction rectangles' if they were interested....The construction was to be completed, used in a free-play situation, and then dismantled at the end of the period."2

"The children responded to the game with enthusiasm....However, their

Context: The construction game was played as a free-play exercise for the duration of the first semester. The initial social context was group activity. However, after some difficulty in separating the actions of different participants, it was decided to concentrate on individuals until a few of the children gained some experience with the pieces. No attempt was made here to affect the temporal context, although we did store the action on color slides."
and the location of their slots. Five colors (red, orange, yellow, green, blue) organize the pieces into families of similar slot configurations. The rectangular parts are organized by a 6" module which defines smaller areas within the plane and possible locations for slots.\(^1\) Although there are five possible locations on the large pieces, we are limiting the number of slots to 3 on the large pieces, and 2 on the small, to make the choice of slots more specific.

skill at connecting the parts and producing stable configurations was understandably limited. Frequently the constructions fell over, and the children used them wherever they came to rest.\(^3\)

"In general, the number of children working at any one time remained at four. However, the characters and leadership within the group changed frequently....The spirited group dynamics made the game more complicated than we had anticipated."\(^4\)
Stage 2  The First Edited Set
Language: The language in the second stage was edited on the basis of the performance of the pieces, not the performance of the children. The first stage had given us such confused data that we were unable to make any reasonable responses to what the children were building other than a change in the mode of operation (i.e. the rules of the game). The language at this stage consisted of fourteen (14) pairs of slotted rectangular cardboard parts, each having a reasonable amount of supportable area when used in a horizontal orientation.\(^7\)

Action: This session was the first time we were able to examine the children's manipulation of the game over time. The children also gained considerable experience with the game, discovering procedures and relationships that worked consistently well. As competence increased and the children were able to control their moves better, they explored different configurations by testing them in play situations. After building a construction to their satisfaction, they asked their friends in to play. The games improvised in the environment depended upon the impression of the visitors

Context: Our role as an intelligent partner in the dialog was twofold: (1) we personally helped the child build the construction, i.e. we asked him questions about what he was building, trying to enrich his effort, and to encourage him to work out any structural problems; and (2) we monitored his progress for later analysis by taking sequential slides of each explicit move that he made.\(^8\)
In an attempt to understand the structure of the language, we analyzed the sequential slides of the children building. Specific data about their operations was compiled by noting: "(1) move sequence, (2) name of the piece (equals slot configuration), (3) color, (4) size, (5) attitude (horizontal, vertical, frontal), (6) intension (addition, subtraction), (7) quadrant (orientation of the piece in relation to some fixed orientation), (8) slot connection (which available slot was used), (9) name of the piece to which the new piece was added, (10) color of the existing

as much as the intentions of the child who constructed the environment. Often elaborate play organizations were developed in which the children assigned and exchanged roles and invented details and situations in an indeterminant, evolutionary manner.

"Play is the activity for the use of the spaces. Play is serious activity. Play is fun. When play is loosely structured, it admits a wide range of choices and exposes the spaces to a wide range of uses. The children are free to draw from their experience and to improvise purposes for as their play progresses. An activity, however, is simply a context for use and not the use itself. Use is related to the human needs that the environment serves: the needs to learn, develop, and grow; the need to rest and be nourished; the to elicit human response. The uses with
piece, (11) size, (12) its attitude, (13) its slot connection, (14) the number of slot connections left after addition, (15) the height from the floor of the slot being used on the existing piece."

From this data we developed a developmental diagram which is a linear plotting of the child's moves. "Using this diagram we can illustrate whether the child was (1) working in a sample or complex additive way, (2) exercising some form of self-criticism, and (3) planning some moves ahead or making multiple moves. Perhaps even more important,

which we have been chiefly concerned are those that relate to the development of the child's reciprocal understanding of himself, and his world. A child crawls into a box. He learns its size directly, and at the same time learns something about his own size. Later, he measures things indirectly, applying this new knowledge, reciprocally learning what is bigger or smaller than he. He shares an experience with a friend. The place, in part, gives form to that friendship and to that experience, and through the experience he understands himself."
though, the developmental diagram enables us to view the construction as a series of decision strings, each representing a separate line of development.

This analysis, which is essentially syntactical, did not adequately describe the child's dynamic interaction with the pieces. Our next attempt will try a different, softer, approach.

intent of the dialog design techniques, and evolutionary environments is to promote this understanding.
Stage 3 The Second Set
Language: The vocabulary in Stage I was a very complete set of choices that developed from a small number of variables. The low degree of redundancy in Stage I meant that the child had to discover or choose the different slot relationships that worked well together. The results of Stage II provided a set of eleven slot relationships in two sizes of rectangles that were used consistently by the children. In Stage III the addition of one slot in each size rectangle reduces choice to four different combinations and allows a greater degree of redundancy.

Action: When the game was first introduced the children built primarily in a linear fashion, i.e., slot-to-slot, and their constructions grew in a rather random, uncontrolled fashion. They were developing skills at connecting parts and this task demanded their entire attention. As they discovered and experimented with the results of these combinations, they developed a preference for certain relationships between planes which is reflected in the evolution of slot configurations in the vocabulary. The next step in the construction skill-building was
among the parts. The child is able to use a particular part several times and alter its potential by manipulating it in attitude and orientation. Through these manipulations he can discover relationships of left-right, side up-side down, horizontal-vertical, and so forth. The slot relationships in Stage III are illustrated in Figure 3.

the discovery of identical and contrasting slot positions when different planes were oriented in a particular way. This discovery of identity relationships between slots and a trial and error approach to interval allowed them to build horizontal surfaces at a particular level above ground and to connect two horizontal surfaces with a single vertical plane.

They also built corners and enclosures of different degrees and kinds and began to extend and relate them in space.
The parts therefore were no longer simple things which they could connect, but contained potentials for building particular kinds of spaces. Their efforts to develop those potentials were often frustrated because the supply of similar parts was relatively low. The vocabulary in Stage III eases this frustration and it allows them to discover other relationships of materials in space which are both more elaborate and more complex. When the children were introduced to the new vocabulary they made no preferential distinctions between the more familiar
With regard to combinations of two slots (Fig. 4) there are relationships of identity (a), inversion (b) and contrast (c) which the child discovers as the parts are manipulated in space. The small parts may be related by identity and contrast, and the intermediate parts may be related by identity, contrast, and inversion. There are correspondances as well between the slot configurations of intermediate and small parts. Other variables such as color (red/orange/yellow/green) and material (plywood/cardboard) are introduced into the high redundancy vocabulary rectangles and the new, more elaborate parts. They tried to use the parts together, and it soon became evident that the parts could produce some very complicated results. Two modes of working, therefore, began to emerge: at times they were interested in exploring by trial and error; at other times there was a particular task to perform, and they tried to find ways to accomplish it. The variety of structures that were produced along the way beggars description, but progressively they learned some effective and sophisticated ways to build spaces for themselves and to pursue
so that for a particular geometry a child may find relationships of identity and contrast in other terms. The high redundancy extension of earlier vocabularies comprises half the vocabulary in Stage III. The other half of the vocabulary is a low redundancy exploration of other properties of a plane that may operate as variables. These properties are shape, direction, and edge topography; and they are generated by properties implicit in the original rectangular plane (Fig. 5). The development of these properties is controlled by the set of slot relationships that developed new discoveries.
from Stages I and II. The variables in the vocabulary are nested in different relationships of dependency (Fig. 2) so that a child is able to identify, select, and control a wide variety of differentiations and similarities between parts.

The vocabulary in Stage III is not a complete elaboration of all the possible combinations.
of variables. Instead it is the germinal development of new choices which are related in different ways to different degrees. The subsequent development of these choices and their interrelationship is intended to proceed on-line with the responses and with the developing skills of the children.
Stage 4  The Large Additions
**Language:** The introduction of large parts represents a different mode of response in the evolution of the language. Previously ideas were introduced in general form where there were alternative combinations of variables (eg. rectangular/non-rectangular with/without curved edges). The intent of the general mode of response was to clarify the relevance of an idea over time through subsequent usage. The large parts project from past experience in a specific form where the relevance of an idea is elaborated through subsequent actions and responses.

**Action:** When the large parts were introduced, the response was immediate and direct. They were a novelty to be investigated and explored. The children made them stand vertically to see how tall they were. They climbed into the opening, straddled the part with their legs, and pushed it across the floor. This last procedure seemed to be a successful method for moving the part from one point to another. The first use of the large parts in a construction was similar to the use of the smaller parts: they were related in a linear fashion using alternate horizontal and vertical.

**Context:** In Stage I a change in the social context was initiated to permit a more concentrated study of a child's performance. Later, it became evident that a contextual shift was as important and valid a response in the dialogue as a change in the vocabulary, and that a contextual shift could be initiated by either party. The contexts of particular concern were those of social grouping, activity, and time. In the early stages of the dialogue, social grouping was the most important and frequent contextual shift. The dialogue proceeded on an irreversible day-
There are strong continuities between the large parts and the preceding vocabulary: the principal distinction is that alternatives are added in the same plane in large parts, whereas alternatives in the preceding vocabulary are added in three dimensions. The continuities are itemized in Fig. 6. The two primary directions of the plane are related at the corner; and these simple edges allow the part to be used in several attitudes. The size and slot intervals of small and intermediate parts are added to form the principal dimensions.

tical members. The rotation at the connections, however, was more pronounced because of the new size and weight of the large parts, and it was difficult for the children to make the large parts stable. It became necessary to show the children how to provide more stable configurations than those permitted in a linear building process. The first construction therefore, was not entirely executed by the children.

The vertical advantage of the large parts had considerable appeal. The children wanted to build places that were off the ground, and the by-day basis, and the central activity, apart from building the constructions, was play.
distribution of territories in space was vertical as well as horizontal. In subsequent sessions the large parts were used in alternative attitudes either separately or in combination. As the children's experience increased, the organizing value of the parts became clear. The parts were then used to localize a shared space in which more personal spaces could develop.
The interior edge of the part establishes diagonal directions, and it is manipulated to include space within the plane as well as to relate the material to the surrounding space.

The activity of the children with the large parts was recorded on video tape. The presence of this new machine-observer in the environment produced some interesting responses. The children had an understandable interest in seeing themselves on television and spent some time testing it out. Their first reactions were to stand in front of the monitor and stare at the image. Then they discovered that they could see themselves better if they stood in front of the camera. They waved their arms, walked toward the camera, and pressed their face against the lens.

The video tape recorder is used in the dialogue not simply as a recording device but as a means for shifting the time context and reversing time. An individual can review an experience at different time grains and observe it from a totally different and previously unavailable perspective. With the aid of video feedback he can perform for himself in the way
They were operating on the machine and it was visibly operating on them. These kinds of probes (i.e. person-to-machine) became less important and less frequent. The form of their responses to the machine began to change. They wanted it to see them in a special place or as they moved from one territory to the next. Direct feedback, the simultaneous experience of an event from two perspectives, stimulated their exploration and interaction in the built environment. Experimentation with delayed feedback was far less conclusive. In certain sessions the children were that he currently performs for a parent, teacher, or for his friends. He can evaluate his performance and learn from it. He can learn about his interactions with a group even when in real time his attention is diverted elsewhere.

This particular educational potential of television and its relation to a responsive environment is a subject that we shall continue to explore.
able to review the previous day before they began to build. After a very brief exposure their interest in the video declined. In other sessions they were able to review the activity of the same day. Then their interest was more sustained, but the effect of the review on the context of subsequent work was difficult to determine. The response of the children to the video machine however, demonstrated the importance of gestures made through the environment which make the commitment and interest of an individual explicit.
The pilot construction provides a relatively long-term built environment that can be modified according to different situations and needs. Its principal components are large parts which are related in a configuration developed earlier by the children, and it accommodates a large number of non-structural modifications. The parts used in the pilot construction are restricted to

Apart from our personal involvement in the classroom, our interest had been expressed primarily through changes in the vocabulary. These changes were technically directed and were related to patterns of consumption and to the exposition of material choices. There are, however, responses in the language which have extra-technical as well as technical importance. Many of these responses are made through small time grain changes in context: the physical remembering of places that have special meaning and importance recognizes the individual and his achievement and

The constructions of the children have a very short life span. Each day a construction is started and completed in one session and is used for free play. At the end of each session the construction is dismantled and individual parts are stored. Continuity from one session to the next resides in the similarity of initial choices.

The video tape stores the events of each day, but storage is in real time. The tape may reveal some coincidence with events and conditions of special importance but it does not reflect any intelligent, concentrated
those necessary for support and stability. The remaining parts provide a maximum opportunity for individual or cooperative changes or additions.

A parallel intent of the pilot construction is to initiate inquiry into the nature and value of long-term space organizing elements which possess a relatively greater resistance to change. Are these elements developed from structural considerations or from definitions of space which exhibited some long-standing value? What potentials for development are needed in elements that are less sensitive to change? What is a reason—allows time for further inquiry. Other responses of this kind are made through language: changes in the vocabulary related to built forms identify the individual's direct contribution to the language and build on his learning.

The introduction of the pilot construction in extra-technical terms was a first effort to communicate our interest through language and context. At first, the children did very little to change it and spent a great deal of time playing in and around it. A few simple modifications interest. A more useful kind of continuity may be achieved when the important events of one session continue into the next, and when the children are allowed to explore and elaborate the important discoveries of the previous day.
able life span for such elements.

were made later to develop the construction as play progressed. The construction was used for group activities as well as for relating individual places. Three or four children gathered around the opening of the horizontal part and carried on conversations. Other children observed them, perched on high places that they had made for themselves.

Later, the construction was simplified so that some structural additions were necessary. In response, the children began to make new elaborations. Some were additive. Others were made separate from the
pilot construction with pieces that had been left behind. After a few sessions, interest in the pilot construction declined as new constructions appeared and as new play situations were invented. The strategy of maintaining the pilot construction indefinitely was therefore changed to a strategy where the more intensively used places of a particular day's session became
a nucleus for the following day's activities. This second strategy presented some difficulty in cases where a child was unable to develop a construction from the previous day because it had been claimed by someone else. To alleviate this difficulty, the social group was reduced to six children.

The shift of the social context to a group of six children allows a closer correspondence between continuities in performance and continuities in the physical environment. A child is able to continue his performance from a previous day in a setting that is continuous with that previous day. The smaller group also provides an opportunity to study the working relationships between children that develop over time: the transition from individual activity and individual place to shared activity and shared place.
Stage 5  Three-dimensional Pieces
Language: The three-dimensional (3-D) parts are a response to several intentions of the children.

(1) In response to attempts to build a greater degree of enclosure, we supplied two large, already built corners. These pieces are intended to form the large scale nucleus for large group environments. These pieces, which

Action: The three-dimensional (3-D) pieces proved to be very important additions to the children's repertoire. The children soon found that they worked extremely well when used together as a foundation for later small scale additions. Yet, this does not mean that they were used in a similar orientation from day to day. Building successfully usually involved some exclusive effort with the 3-D pieces, during which they were pushed around and tried in various orientations. Once the big pieces were related in a satisfactory way, the other pieces were used to stabilize them

Context: The three-dimensional (3-D) parts were mainly tested by context shifts. Whereas previously the general context was free-play, the children were asked to construct an environment for the purpose of a specific classroom activity. This meant that they somehow had to abstract some qualities from that classroom activity, and try to provide them with very different elements. The insertion of structure into a previously unstructured activity undoubtedly caused the children to view the environment in a somewhat different way. It appeared as if the children had just
are incomplete in terms of any definite character, provide some different kinds of built space definers (closed corners and special access corners) that are not readily buildable with the existing system. This quality is an example of a macro or multiple-move piece.

(2) Because there was some difficulty in making a stiff structure, the introduction of some pieces which already had one stiff-moment resisting connection was helpful as a foundation for rigidity.

and to carve out individual domains around and within their periphery. Since the whole system produces interlocking spaces and not clearly separable spaces, communication from one domain to another was still very strong. This communication ability became a strong factor in the interaction of children who were within the construction. They were given both a frame never thought of doing classroom work in spaces of their own devising. When presented with that possibility, they were extremely anxious to continue the practice. Our intention was to show the children that they could build their environments to fit their needs in an organic manner by building particular spaces that seemed relevant to them. What proved most interesting, however, was that after the children realized the consequences of this context shift (i.e. that they could build their own places for work as well as play) they began to manipulate context. A mixture of free-
As the children begin to experiment with making constructions that related to classroom activity as well as free-play, the ability to build larger, uninterrupted surfaces becomes more important. These new pieces provide that, and, since they are plywood, could support considerable traffic.

It must be emphasized that these new large of reference, and a channel for interaction because of this quality.

Still, building a perimeter around one's territory was very important. These barriers were, however, always more complete on the outside edge of the construction than the inside, but always allowed for two entries: one on the outside and one on the inside. It is not until the 3-D parts were introduced that the construction began to have the qualities of inside and outside. Previously the constructions were used as if they were fat linear networks, not volumar constructions. Interestingly em-

play and classroom activity began to appear in the construction by their own choice. Here territoriality became a positive feature. One's "home" became not only his "castle" but his "classroom". This adaptation of existing territorial space for more than one activity was significant to the child's understanding of the spaces he built. When the spaces showed some
pieces are not a deterministic solution to the needs of the children. In designing them, certain questions are also being asked. These pieces are very large and heavy relative to the children's size. The pieces were one way of finding out whether these were the largest pieces they could handle. After one day of timidity, the children soon began to tumble them around in the same exploratory manner as the other, smaller pieces.

Another interesting question concerns the relationship between the large 3-D pieces and the large 2-D pieces. Even though these pieces are rough, the central or inside areas of the constructions were often the public or shared areas. These spaces, however, were not usually built by one child, but were side benefits derived from the scale qualities of the 3-D pieces.

It is also noteworthy that in the layered platforms that were built, the areas near the ground were claimed and very private while the upper relevance to the individual child (i.e. he understood them), he was able to use them for different activities and to explore the relationship of space and activity. Interestingly enough, this may mean that the requirements of a space are more closely linked to an understanding of the space by a user, than any specific or deterministic set of criteria that could be generated by others.
the same in size, the children apparently perceived and used them differently. The horizontal parts of the 3-D piece were used, and probably perceived, in analogous ways. However, the 3-D pieces did not seem to be perceived as having the same linear vertical properties as the 2-D. This may simply be a function of the relative portions of the pieces, or that the children recognized the essential cubic quality of the parts, i.e. that neither direction is dominant. It is important to note that the 3-D pieces are not cubic in the same way as a polyhedron but are essentially a

spaces were more for public use.

As the children's activities became more diverse, their abilities to pre-experience their efforts seemed to increase. Much more attention was made to specific kinds and qualities of space. One child worked on making a dark, womb-like space while another tried to build a desk and a chair. These efforts were probably in-
tended to produce a secure home base or to illustrate a competency, respectively. Yet, once something was built, the child ventured away and then returned with either a friend or a new activity with which to test his creation. The children were attempting to understand how different activities of people could adapt or work in their constructions. This seems to indicate that a child is not really willing to share his experience or to cooperate until he has a firm position in his own frame of reference, not simply a dictated place as a member of a group.
SUMMARY

Our attempts at developing a process that gives the environment the ability to respond to individual or group actions have caused us to examine critically certain aspects of both the physical and social environment. From the perspective of the dialog process, the search for meaning becomes both a relative and a personal act. In the light of this relativity, we shall consider three aspects of responsive processes:

(1) Responsive techniques
(2) Territoriality and the concept of self
(3) The politics of power.

1. Responsive Techniques

The responsive environment that we are describing is an environment that engages the user in a cooperative experience building process through which each learns about the other. This cooperative environment is contrasted with environments that are termed "responsive" by virtue of the range of experiences they provide. Such environments provide alternatives in advance and apart from any user involvement and are unaffected by any learning that ensues.

In cooperative activities that evolve in the school (e.g. story-building, construction, fantasy play) there are two pre-requisites which must be satisfied before any further action can take place. An individual must establish his identity and it must be generally recognized. Identity was established through the language by such diverse activities as building
an enclosure, claiming a large part and pushing it across a room, and installing a connector at a joint. The act of identification is the first act in experience-sharing with the environment.

There are two general categories of response (Fig. 7) and both were used in the course of the experiment. Hard responses are responses which have a particular systematic reference and priority and are only loosely related to the personal understanding that has developed during the dialogue. These kinds of responses prevailed during the early stages of the experiment and provided a spectrum of choices for manipulating the built environment. Hard responses were in the form of language and context as in the case of new planar parts and individual building activity.

Soft responses are responses that proceed from one's experience with the other individuals and from a desire to establish common under-
standing, as in the case of the pilot constructions, group activity and three-dimensional parts.

Soft responses are distinguished from hard responses by intent as well as by result: They are sustained by a continued interest and sense of commitment.

2. Territoriality and the Concept of Self

One of our stated primary aims in this project was a study of the various ways that individuals can relate to each other in an unstructured, free-choice situation. The intention was to promote and encourage co-operative effort, but without any formal institution for that cooperation. However, our attempts at fostering the sharing of spaces and pieces by encouragement were mainly ignored, undoubtedly because our suggestions did not have a personal meaning to the children. They could not relate to the concept of sharing in a context-free way (i.e. sharing for the sake of sharing). Still, sharing did occur. It occurred when there was a scarcity of parts toward the end of building a construction. Some bartering and trading of parts even occurred, especially when a particular part was needed. As the parts became larger, heavier, and built more roomy spaces, cooperative effort became more prevalent. This was evidently not simply from the manpower problem, but from the fact that the scale of the spaces was small group size. It seems that the children learn to differentiate this scale change through their operations on the environment and an image of the amount of space that they can personally manipulate and control. This concept of group scale is then understood as relative to
the individual's scale. At this point it can easily be shown that our initial assumptions were wrong: Territoriality, as a way of establishing the individual's bounds and extent, is absolutely necessary to the concept of cooperative effort. The child must carve out his own domain in order to understand the relationship of himself to the group, of his space to group space. He cannot proceed with only one side of the argument. In the same way, his territory acts as an established, secure reference point for his continual excursions into the outside environment. It is extremely interesting to watch the children build their own "nests" in the environment, and then leave them to test and explore both the relationships of their constructed qualities to the qualities of other spaces, and the responses of other children to their space. Thus, the environment really does become a medium for exploring the results of actions in a comparative way. And the concept of territoriality, because it does establish the reference of self, is extremely important to the development of cooperative effort.

This is why environments should become more responsive to an individual's particular needs, why spaces should be able to be made directly relevant to every user. It is through this relevance to self that the user's position is made stable, so that he is able to relate on a secure basis to other people in a cooperative manner.

3. The Politics of Power

Any discussion of user participation or advocacy stimulates an exploration into the distribution of power in the system. Power can be thought of as the relative control that one party has over the actions of
others. The development of responsive environments, therefore, involves not an exercise, but a sharing of power. In a sense, the designed physical environment is paternalistic or authoritarian in that it is pre-determined by others. It does not allow the sharing of power by individuals. Most of the small scale decisions are made by the persons other than the users, even though the intention of these persons is usually benevolent. The degree that an individual cannot freely operate on his environment to shape it, and claim it as his territory, is a measure of the impersonality of the environment. The user is, therefore, not easily able to establish a reference for his operations, except in a superficial way. In addition to that, the environment is not able to evolve in relation to the growth in understanding between the user and his context.

An argument might be made that in our situation the children really did not have much power since we initiated the dialog and were the only party that actually altered the construction system. In actuality this was not so. To begin with the children were not constrained in any way to play with the construction game. This free-choice situation meant that although they did not initiate the dialog, they thought it relevant to participate. The children were also free to operate on the construction in almost any way, to the extent that many pieces had to be retired because they were broken or damaged. In a different sense they were controlling us, because we were bending over backwards trying to understand what they were trying to make. They also did not hesitate to bring other objects and pieces of furniture (chairs, toys, stairs) into the environment. So
even though they did not actually produce any new parts, or alter the old parts, they did wield a considerable amount of power in terms of the ability to operate on their environment.

Perhaps the fundamental reason why the children shared our power was that we were willing to do just that. This attitude is crucial to all responsive techniques. The willingness to share power, to reach mutual accord, is one of the most significant contributions to any true dialog process.
NOTES

Portions of Parts I and II are taken from the first progress report produced at the end of the first half of work entitled also "Studies Toward a More Responsive Environment," by Robert W. Gobel and Richard W. Hessdorfer. Notes in Part I are taken from the above report as follows:

1) page 13
2) page 19
3) page 19
4) page 21

Notes in Part II from the above report as follows:

5) pages 23, 25
6) pages 25, 27
7) pages 27
8) pages 41, 42
9) page 42


Johnson, Avery. Class ("Intelligent, Self-Organizing Systems") and conversations.


Negroponte, Nicholas. Class and conversations.


