LEARNING AS A FUNCTION OF MOLAR ENVIRONMENTAL COMPLEXITY

by

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ABSTRACT

The investigation was designed to determine the relationship between molar environmental complexity and learning. According to Trabasso's speculations, learning should be a decreasing linear function of increasing environmental complexity. Molar environmental complexity was defined and three complexity levels, high (HC), medium (MC), and low (LC), were designed. The levels of complexity were designated according to quantitative room content in terms of decor.

Two separate experiments were conducted. The first, using 18 adults and 18 children, was designed to assess the three levels of environmental complexity in terms of the subject's conception of, preference for, and retention of information about the rooms and their contents. Questionnaire results for both adults and children indicated that the rooms differed reliably while the rating scales were reliable only in the case of the children. However, the results were sufficiently sound to permit the retention of these levels for the second experiment.

The latter was designed to assess the functional relationship between environmental variables and learning. Thirty third grade and 30 fifth grade children were compared on an identical learning task over 6 training and 6 test trials. The results indicated that

children at both age levels perform better in a less complex environment; the predicted linear trend (after Trabasso) was confirmed. Although the result was statistically reliable, the environmental complexity effect accounted for only a small proportion of the variance. A predicted grade-performance difference was confirmed. 'Looking behaviour' was assessed, but proved to be statistically unreliable; there appeared to be no relationship between proportion learned and amount of time spent in looking at or attending to the environment.

The study is regarded primarily as an exploratory investigation. Before any sound conclusion can be drawn, further investigation should be undertaken, preferably within the classroom environment.

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Chapter I

INTRODUCTION

The Importance of Environmental Variables

The effects of the physical environment upon behaviour have not, until recently, been empirically investigated. The study of environmental variables in psychology has undergone a radical change in recent years with the term 'environment' acquiring a more versatile meaning. 'Environment' as used in environmental psychology refers to the gross physical environment whether natural or built (Craik, 1970) with the built ranging from a room to a city. In this newly emergent field, environmental variables, and specifically the man-environment relationship, are of primary interest.

'Environment', in psychology, has either referred to the immediate surroundings of the organism or to home background. The term is a global one and may be applied to the external sensory environment, the social environment, home background, or to the general milieu of the organism. Drever (1964) defined 'environmental factors' as "all conditions and factors affecting an organism from without" and Craik (1970) stated: "The unmodified term 'environment' broadly signifies any condition or influence outside the organism, group, system, or whatever entity is being studied" (p. 13).

The importance of environmental variables has long been recognised in experimental and developmental psychology. However, direct manipulation of environmental variables has been limited. Craik noted that

"While the terms 'environment' and 'environmental' are frequently encountered in the psychological literature, the specifically physical environment has been granted little systematic attention" (p. 13). He argued that "Strategic assumptions and methodological obstacles partially explain the neglect of physical environmental variables in psychological research" (p. 14). Wohlwill (1966) in a somewhat similar vein stated:

> "As a psychologist this writer has been struck by a curious paradox. Psychologists never tire to point out the importance of stimulus factors as a determinant of behavior, and of the role of environmental influences in behavior. Yet, as a group they have had relatively little to say on the important problems relating man's response to his physical environment" (p. 29).

Environmental variables (that is, physical background variables both natural and man-made) have, on the whole, either been kept constant (especially in animal research) or ignored (as in a large number of human studies). Nevertheless, prior to the emergence of environmental psychology, a number of psychologists pointed to the importance of gross or molar environmental variables. For example, Stevenson and Wright (1966) made the following recommendation:

> "It is especially important in work with children that the experimental rooms be free of distracting stimuli and of stimuli associated with other experiences of the child, such as physical exams and mental testing" (p. 581).

Statements such as that made by Stevenson and Wright have not, until recently, been examined empirically. However, Craik pointed out that "...beyond the traditional research in human engineering, remarkably few environment-behavior linkages have been identified and reliably demonstrated" (p. 38). Rosenthal (1966) noted that Riecken, in 1962, pointed out how little is known about the effects of the physical scene on the experimental process. Rosenthal wrote: "We know little enough about how the scene affects the subject's response; we know still less about how the particular laboratory setting affects the experimenter" (p. 99).

Rosenthal cited an early study by Maslow and Mintz (1956) who found that subjects' responses may be affected by the laboratory's characteristics. They found that negative photographs of faces were judged differently on both a fatigue/energy scale and on a displeasure/well-being scale in three rooms designated as beautiful, average, and ugly. The faces were judged most pleasant and energetic in the 'beautiful' room and were judged least pleasant and most fatigued in the 'ugly' room. The average room resulted in average ratings of the faces. In discussion, Maslow and Mintz mentioned the possibility that the effects may have been obtained by the rooms' affecting the subject-examiner relationship, even when the examiner was as naive as the subject. Rosenthal wrote:

> "It seems, then, that the physical scene in which the subject interacts with his experimenter may affect the subject's response in two ways. First, the scene may affect directly the subject's response by making him feel differently. Secondly, the scene may affect the experimenter's behavior, which in turn affects the subject's responses to the experimental task" (p. 101).

He suggests that so little knowledge is available on this topic that further research should be undertaken. Craik also concluded, on the basis of recent findings which were not entirely consistent with the results from the Maslow and Mintz study, that further research on the environment-behaviour problem was needed.

Helson (1959), in his theory of Adaptation Level, also regarded background or contextual variables to be part of the adaptation level. He wrote:

> "It is convenient to distinguish three broad classes of stimuli operative in all behavior: 1) the stimuli being responded to and in the immediate focus of attention; 2) all other stimuli immediately present and forming a background or context for foveal stimuli and often affecting them profoundly; and 3) all determinants of behavior having their locus within the organism such as effects of past experience and constitutional and organic factors which interact with present stimulation and are treated as residuals since they are not ordinarily under experimental control. These three classes of stimuli pool to form a single level to which all responses are referable" (p. 567).

Helson calls this the adaptation level because it represents the adaptation of the organism to given conditions of stimulation. In other words, Helson is proposing that adaptation level is equivalent to focal stimulation, background or contextual variables, and long-term experience. By contextual variables he originally referred to perceptual variables in the Gestalt tradition but he advocated that his theory be applied to many other fields of psychology. His theory is particularly pertinent to the work by Maslow and Mintz and to the report by Rosenthal.

Barker (1963) has displayed a more direct research interest in the 'ecological environment' although his studies have focussed on social variables rather than cognitive. He regards behaviour settings ("an ecological unit consisting of interdependent behavior and environment systems"; Craik, p. 23), as he terms ecological or environmental niches, much as the role-theorist regards role. He noted that,

> "It is a common observation that the same people and objects are transformed into different patterns as they pass from one variety of setting to another. ...different sets of people and objects exhibit the same pattern within the same variety of behavior setting" (p. 28).

Proshansky, Ittelson, and Rivlin (1970) studied a rather different population (i.e. psychiatric patients, whereas Barker's work (1964) has been primarily with children) but reached the same conclusion that "space utilization patterns persisted regardless of the patients involved" (Proshansky et al., p. 29). Using a less strict observational technique than in the work cited above, Richardson (1970) found that classroom environments were crucial in teacher-student interaction and in the subsequent performance of the students.

As pointed out above, the importance of environmental variables has been noted by psychologists, especially in the context of the nature-nurture controversy. Here home background experience was considered important and a plethora of studies were undertaken to examine the relative importance of 'environmental' versus genetic variables (Hunt, 1969). Craik pointed out that "In the heredity-environment controversy...the environmentalists countered genetic variables not only with physical environmental variables, but all variables outside the organism that influence its development" (p. 13). Research on humans was primarily of a correlational nature while more carefully controlled work was undertaken by the animal researchers. Two examples serve to illustrate the animal findings.

Rosenzweig (1966), in collaboration with Bennett and Krech, examined anatomical and chemical as well as behavioural reactions to differing amounts of environmental complexity in a series of studies. They found consistently that rats raised in enriched environments (this includes sensory and social environments as well as training) were superior both in cerebral cortex weight and on behavioural tests to those rats raised in less complex environments. Their work is substantial insofar as they varied complexity at four different levels and they tested rats who had been taken from the home cage at different ages. Moreover, they found that the same conclusions could be made about adult rats introduced into such environments. The results are, however, somewhat confusing because the effects of training, sensory, and social environmental manipulations were confounded. Experiments were carried out to clarify this issue and it was concluded that sensory or perceptual environmental complexity was the important variable.

Thompson and Heron (1954) found that dogs placed in a restricted environment did not have the same ability to solve problems as dogs raised in an enriched environment; the enriched group were superior. The authors claimed that perceptual deprivation rather than emotional or motivational variables affected problem-solving ability. They pointed out that the human data on this type of problem are inconclusive and often contradictory.

Studies such as that of Thompson and Heron cannot, for moral reasons, be undertaken on the human infant. Consequently, the studies of human behaviour have either been correlational at the human infant level or straightforward manipulations of sensory input at the adult stage. A series of studies of the effects of sensory deprivation on the human adult were undertaken in the 1950's. The results culminated in a symposium edited by Solomon et al. (1961).

Essentially, in these studies human adult subjects were placed in environments which were kept as constant as possible and a number of behavioural and physiological measures were taken before, during, and after the deprivation period. It was shown clearly that deprivation at such a sensory level (in these experiments too, social deprivation was a necessary artifact) had a marked effect on behaviour, notably disorientation in the subjects. Bexton, Heron, and Scott (1954), in one of the classic studies, concluded:

> "both the changes in intelligence test performance and the hallucinatory activity, induced merely by limiting the variability of sensory input, provide direct evidence of a kind of dependence on the environment that has not been previously recognised" (p. 76).

Such studies, however, examined only one end of the sensory continuum, and there has been a marked neglect of the opposite end i.e. sensory overload. Wohlwill (1970) regards this as misplaced emphasis and believes sensory overload to be a more relevant topic for study. A study comparing various levels of environmental stimulation has not been undertaken in a satisfactorily controlled manner for human subjects. The studies have primarily examined only one portion of the sensory continuum.

The Optimal Environment

Wohlwill (1966) pointed to developments in the experimental psychology of motivation "which appear to have interesting implications for the study of the impact of the physical environment on behavior and for approaches to environmental design" (p. 29). The concept of an optimal level of stimulation is one of the contributions Wohlwill sees as being particularly useful. He argues that there is a substantial body of recent research that is relevant to the study of environmental variables. This work, in Wohlwill's terms, deals "with the stimulus correlates of the arousal of human attention and with human activity involving the seeking out of stimulation" (1966, p. 31).

The key concept which is applicable to environmental studies is the concept of optimal stimulation which has been proposed by a number of psychologists (Hebb, 1955; Leuba, 1955; Berlyne, 1960; 1967). Berlyne (1967) wrote:

> "One hypothesis that obtrudes itself is that the degree of arousal increase is crucial - that moderate increases are rewarding, whereas extreme increases are aversive. This hypothesis implies that there is an intermediate, optimal degree of arousal increase for learning" (p. 51).

Thus an inverted U-relationship is postulated between magnitude of stimulation and subsequent behavioural measures. The notion of optimal stimulation stems directly from the concept of arousal level which is an outgrowth of several developments in neurophysiology and psychology (Hebb, 1955). According to Berlyne (1966) "...it connotes a psychophysiological dimension, indicative of how 'wide awake', 'alert', or 'excited' an organism is at a particular time" (p. 31). The optimal level of stimulation hypothesis relates directly to Helson's adaptation level theory where "deviations from the AL in either direction are evaluated positively within a certain range, while beyond these boundaries they are experienced as unpleasant" (Wohlwill, 1966, p. 34).

It was stated by Berlyne (1967) that the assessment of the hypothesis of optimal stimulation would have to be indirect i.e. "we shall have to fall back on findings about choice, verbally expressed preference, and other indirect indices of reward value" (p. 51). Rapaport and Kantor (1967) pointed out that an increasing body of research, such as that Berlyne indicated above, has suggested that humans prefer complex visual environments over simpler ones. They do modify this statement by pointing out that Munsinger and Kessen (1964) found that more complex environments were not preferred when they became "chaotic" (Rapaport and Kantor, p. 211). A series of studies (Munsinger and Kessen, 1964; Berlyne, 1963; 1966; Dorfman, 1965; Vitz, 1966) have shown that preference for visual stimuli (usually in the form of random patterns) results in the inverted U-relationship hypothesized by the 'optimal stimulation' or 'arousal hypothesis' advocates. Craik pointed out that the research findings on the simplicity-complexity dimension,

> "indicates that preference is related to an intermediate amount of stimulus complexity, whereas exploration (viewing time, voluntary exploration) is positively related to increasing complexity" (p. 78).

Berlyne has been the most productive worker in the field and has documented a large amount of evidence for the inverted U-relationship between his 'collative' variables and performance measures (1967). However, he (1963) did point out that preference, or whatever behavioural measure is taken, will be dependent on exposure time to the stimulus.

He found that when stimuli were presented tachistoscopically at 0.5 and 1 second exposures subjects preferred more irregular patterns and when shown stimuli at 3 and 4 second exposures the less irregular patterns were preferred. He argued that the former was due to the subjects not being satiated by the stimulus whereas the latter result was due to some more 'aesthetic' principle at work. He also pointed out (1966) that the extent to which a stimulus raises arousal increases with its novelty and with the subject's initial arousal level.

Wohlwill (1968) found the same inverted U-relationship even when the stimuli were not so easy to quantify. Most studies prior to Wohlwill's used random patterns. He chose to use 'real-life' slides of the natural physical environment and of modern art work. He found the predicted inverted U-relationship between complexity of the slides, which were independently rated, and preference (evaluative rating on a 7-point scale). Exploratory behaviour (number of times S chose to expose each slide briefly), on the other hand, was a linear function of complexity. Leckart and Bakan (1965) found that mean looking-times increased with complexity of real-life slides. The slides had been rated for complexity by an independent group of subjects.

However, Kaplan and Wendt (1972), using slides of natural physical environments and of man-made environments found a linear relationship between preference (likeability) and complexity. They also found consistently that natural environments were preferred over the built environments, regardless of complexity. Kaplan and Wendt criticised Wohlwill's work severely; they wrote: "it is questionable both whether the slides were truly representative of environmental settings of those complexity levels and whether complexity actually accounted for the preference values" (p. 6-8-3).

The linear function between complexity and preference reported by Kaplan and Wendt is not a serious point of dispute because the stimulus materials were different from those used by Wohlwill. As Berlyne (1967) pointed out, such a discrepancy could simply be a matter of sampling. That is, the portion of stimuli selected could be representative of a linear portion of the quadratic curve. Berlyne (1967) added:

> "It is worth noting that if an inverted U-function exists, one would expect only the increasing or only the decreasing part of the curve to appear under some experimental conditions, depending on the population of the stimulus patterns, the population of subjects, and other factors" (p. 61).

However, Kaplan and Wendt concluded that

> "Using a substantially more adequate sample of slides we find neither the inverted-U relation assumed to obtain between preference and complexity nor any indication that complexity operates in a systematic fashion across environmental domains" (p. 6-8-3).

Rating of complexity could be a questionable technique for designating complexity levels for stimuli but on the basis of a number of studies (cited above) there appears to be a high correlation between rating and performance. Leckart and Bakan are of the opinion that "phenomenological reports in the form of judgments can be utilised for the quantification of stimuli where more objective methods such as those based on information theory are not applicable" (p. 17).

The Classroom Environment

If the inverted U-relationship between environmental complexity and behavioural variables were to be generalised, the prediction could perhaps be made that there is some 'optimal' level of environmental complexity for learning. As Wohlwill (1966) pointed out: "Where attempts have been made to enhance the behavioral effectiveness of animals...the research has typically started from a straight-forward 'the more, the better' assumption" (p. 30). He cited an example of where the assumption is not applicable i.e. the "typical 'culturally deprived' child from the slums, who is apt to grow up under just such conditions of overstimulation, without greater profit to his general intellectual development or emotional well-being" (p. 31).

Berlyne's (1960, 1967) work and Wohlwill's (1966) argument suggest some optimal level of stimulation for learning. Once the environment is too enriched, as in the case of Wohlwill's "culturally deprived child", learning is hindered. In other words, 'too much' stimulation produces deleterious effects. The opposite end of the sensory continuum, i.e. sensory impoverishment, has been examined more empirically but the results are somewhat inconclusive. Kubzansky and Leiderman (1961) wrote, with reference to sensory deprivation studies:

> "on the cognitive level the data have been less abundant and the findings more uneven. A number of investigators have reported deterioration in learning ability, while others have shown no change or improvement" (p. 229).

Bexton et al. (1954), as reported above, found inferior performance on cognitive tasks. In contrast, Vernon and Hoffman (1956) found that subjects' ability to learn adjective lists improved with continuous sensory deprivation in comparison to a control group. It must be noted, however, as Vernon et al. point out, that the sensory deprivation conditions were not so severe as in the Bexton et al. study. In a replication study, Vernon and McGill (1957) found that the sensorily deprived groups when tested prior-, during-, and post-deprivation did not perform differently overall from the control group except "on the deprivation tests (where) the experimental group made significantly fewer overt errors" (p. 639).

It is notable that educators and architects have experienced conflict over the level of optimal stimulation in the issue of windowless classrooms. The basic argument is whether the windowless classrooms are detrimental to or facilitative of learning (Frye and Stanhardt, 1961; Arnold, 1961). These papers were primarily subjectively oriented and empirical research appears to be lacking. Wools (1969) noted: "Several studies have concerned themselves with windowless environments. It has been shown that there is no significant difference in learning rate if the windows were replaced by solid walls" (p. 52). A number of studies have shown that adults prefer to have windows in their workrooms. Ruys (1971), for example, on interviewing office workers, found that only eight percent (11/139 respondents) thought that not having windows might be less distracting. Sommer (1969) noted that windowless classrooms appear to be superior physically and that the present controversy is a matter of putting the technical advantages of windowless schools against the 'soft' social-psychological variables.

Fitch's (1970) observations on optimal learning environments are pertinent. From an architectural viewpoint he asked how we may manipulate the child's "external environment so that his learning advances with optimum speed and minimum stress?" (p. 82). He suggested that the only method of deriving any answers is to study the child in the learning environment.

Skinner (1968) made a relevant point when he stated that architectural variables, if attractive, may influence a child's attitude toward school but such variables will "provide merely the setting" (p. 105) for instruction and not the instruction itself. However, to the educator, attitude may be of extreme importance in eliciting the child's attention.

With regard to the optimal environment that so many educators (e.g. B.C. Programme for Intermediate Grades, p. 13-14) and psychologists have discussed, where a more enriched environment has been thought to be more conducive to learning, recent statements by Trabasso (1968) must be considered. It has been argued, in the area of discrimination learning, that the acquisition of a task is dependent on attention to the relevant dimension of the task and that learning will not materialise until the relevant cue is located. However, the notion of relevance has been applied primarily to the task rather than to the gross physical environment, which has not been considered as a major distractor in the classroom learning process. The two-stage models of discrimination learning (e.g. Zeaman and House, 1963) describe an attention phase and an association phase in the learning process. Perhaps a further stage, that is a focussing stage, should be added; before the relevant dimension of the task can be attended to, the task itself has to be distinguished from the gross environment. As Wyckoff (1952) pointed out "In many discrimination learning situations some response, such as an orienting response, will be required of S before he is exposed to the discriminative stimuli. We call these responses 'observing responses'" (p. 441).

Trabasso (1968) argued that the child has to combat irrelevant stimulus features of the environment all the time. This may be interpreted as stimulus features of the task or of the molar environment. He argued:

> "...there is some danger in enriching a learning environment - perhaps we might do better as teachers to impoverish the environment by displaying only those objects, words, or relationships that are to be learned" (p. 31).

He supplemented this statement with the following:

> "Thus it appears that more efficient engineering of the learning environment will require the seemingly paradoxical effort to impoverish the environment by eliminating potentially distracting and irrelevant material, while at the same time enriching it by using attention-getting cues having maximum vividness and interest" (p. 36).

If this argument were carried to its logical conclusion then the tasks a child would have to learn would be highly stimulating while background stimuli of both the task and the built environment would have to be reduced to a minimum. The task would be "attention-getting" while the environment would be so dull it would not distract the child and would, in fact, encourage him to be more task-oriented. Trabasso stated that brain-injured children learn more and learn faster "when, for instance, the windows of their rooms are covered, and when the children sit before a blank wall and are exposed to a small portion of reading material through a small opening in a screen" (p. 36). One is inclined to agree with Trabasso when he regards this type of learning environment as a "poverty of stimuli with almost a vengeance" (p. 36). In contrast to the arousal hypothesis argument for optimum stimulation, the recommendations for classroom environments above appear severe. It is on this issue that the present investigation was undertaken.

One other study by Busse, Ree, Gutride, Alexander and Powell (1972) reflects on the issue described above. Busse et al. found, much to their consternation, that preschool childrens' performance on a number of measures (Binet I.Q., the Wechsler Preschool and Primary Scale of Intelligence Performance I.Q., and four subtests of the Illinois Test for Psycho-linguistic Abilities) were not significantly enhanced when the classroom environments were enriched over a long period (i.e. one school year). In fact, on a number of the performance measures the control groups of children surpassed the 'enrichment' groups' performance. This result was not due to the enriched groups' failure to use the materials provided nor to teacher attitude and behaviour. Both teacher attitude and behaviour were rated and the usage of the 'enriched' materials by the children was rated. Teacher ratings did not differ for control and experimental groups; the enriched groups of children did use the materials. The observational ratings do not enlighten the results. The conclusion Busse et al. reached is somewhat weak and expresses their confusion with the findings. They wrote: "It seems that the most probable reason for the findings concerning cognitive and perceptual development remains with the play materials themselves. There can be too much of a good thing" (p. 21).

Two explanations may be offered for the results found by Busse et al. They may have experienced the phenomenon Trabasso is discussing, that is, the enrichment program probably interfered with or distracted the children from the more formal training which the performance tests assessed. The alternative explanation would be couched in arousal terms, somewhat like Wohlwill's statement about culturally deprived children. All the children under observation were from a low socio-economic class and were therefore placed in a Head Start program. The enriched environment did not compensate for the poor home background but perhaps, as Wohlwill pointed out, these children were sensorily overloaded and the addition of further complexity may have been a hindrance rather than a help.

Purpose of the Investigation

The present investigation was undertaken to determine the type of relationship that exists between environmental complexity variables and learning. Environment is defined in the present context (in visual sensory terms) as the immediate physical man-made surround; that is, the experimental room and its contents. Complexity is defined in Berlyne's (1960, p. 38-44) terms or in information theory terms where the number of environmental elements or stimulus objects are taken as being indicative of complexity. Dember, Earl and Paradise (1957) used the same type of concept of complexity i.e. "...by generalizing on some data by Attneave, we have assumed that number of elements, in a physical sense, can in some instances generate stimulus complexity" (p. 514).

Berlyne (1960) defined complexity in the following terms:

> a) "Complexity increases with the number of distinguishable elements"; b) "Complexity increases with dissimilarity between elements"; and c) "Complexity varies with the degree to which several elements are responded to as a unit" (p. 38-39).

The elements in the present investigation were highly distinguishable but no assessment as to each individual element's complexity merit was made. Rather, the environments were assessed *in toto*.

On the basis of Trabasso's statements a linear relationship was predicted between environmental complexity and learning. In other words, as environmental complexity increases, learning performance should decrease. However, before any conclusions could be drawn about the nature of the relationship between environmental complexity and learning, the levels of environmental complexity had to be empirically assessed. Consequently, Experiment I was designed to assess whether the three levels of environmental complexity differed and how much they differed.

Three levels of environmental complexity (i.e. low, medium, and high) had been determined originally on an intuitive basis with neither the extremes of sensory impoverishment nor sensory overload being represented. The medium complexity condition was not given mid-line values, however, because a clear distinction was required between high and medium complexity.

Experiment II was designed to assess the effect of the three levels of environmental complexity on paired-associate learning in children.

Chapter II

EXPERIMENT I: METHOD

Subjects

The treatment conditions included 18 adult volunteers (13 male and 5 female) whose ages ranged from 21 yrs. to 43 yrs. with a mean age of 24 yrs. 4 mos. These subjects were either fourth year undergraduates, graduates or young assistant professors. Eighteen fourth grade children (9 boys and 9 girls), from a local elementary public school, whose ages ranged from 9 yrs. to 9 yrs. 10 mos. with a mean age of 9 yrs. 4 mos., also participated. Those children whose parents objected to their taking part in the study (2/31) were excluded from the study and the 18 children were randomly (in this paper the term 'random' refers to items selected with the aid of a table of random numbers) selected from the remainder.

Equipment

A mobile laboratory shown in Figure 1 was used throughout all the experiments. The mobile laboratory, a 26 foot (7.92 metres) long trailer especially designed for psychological research, contained three rooms, two of which were experimental rooms, the third being an observation room. The mobile laboratory was constructed so that the experimental rooms were at each end of the trailer while the observation room was located in the centre between the two experimental rooms. There was a slight structural difference between the two experimental

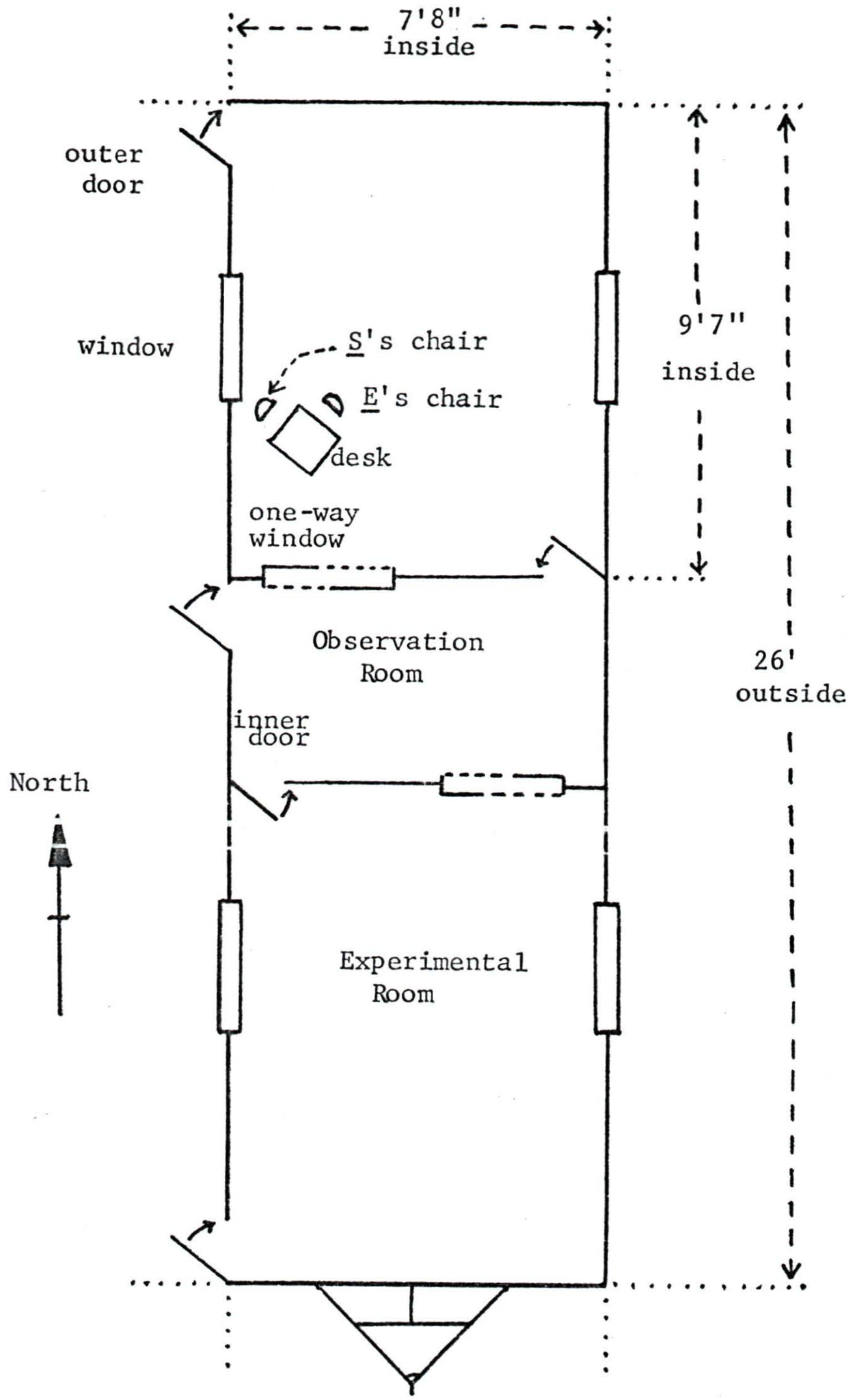

Fig. 1. Diagram of the Mobile Laboratory.

rooms. This was not crucial because in the major part of the study (i.e. Experiment II) only one of the rooms was used.

Stimulus Materials

The environmental complexity conditions contained visual stimulus materials only. The materials were twelve posters (approximately 24" by 36" or 60 cm. by 90 cm.), four mobiles, four 18" by 27" (45 cm. by 75 cm.) rugs, Mattex and two sets of drapes. Posters and mobiles depicted patterns, landscapes, animals and childrens' fantasy characters (e.g. Winnie the Pooh and Snoopy). The rugs were unpatterned and each was of a different colour (i.e. gold, blue, green and orange). The window-panes, at all levels of complexity, were covered by Mattex, a translucent material which allowed light to enter the room but prevented the Ss from receiving patterned visual stimulation from outside the trailer. The two sets of drapes were a) plain and off-white and b) patterned and multi-coloured.

All materials were selected so that they were suitable for children. Here advice was obtained from teachers and mothers and extensive unstructured research was conducted in stores selling such materials.

Levels of Environmental Complexity

Three levels of environmental or background complexity were created in terms of internal decor. Complexity was defined in the present context in Berlyne's terms (Berlyne, Ogilvie and Parham, 1968) where the primary stimulus attribute of interest is the "number of distinguishable elements" (p. 377). That is, the three environmental levels differed according to the number of elements in the environment or stimulus situation. The three environmental levels differed along four dimensions: wall decor, window decor, ceiling decor and floor decor. All experimental conditions contained the same furniture which consisted of two chairs and a small table. The three conditions described below are shown in Figures 2, 3, 4, and 5.

Low complexity was defined as the bare experimental room where walls, ceiling, and floor remained unchanged and the windows uncurtained; in this condition the role of the Mattex was crucial. The overall appearance resembled a standard experimental room.

Medium complexity was defined as a condition in which four posters were hung on the walls, the windows were dressed with plain, off-white drapes, the ceiling had one mobile suspended from it, while the floor had one rug on it.

High complexity was defined as a condition in which twelve posters were hung on the walls, the windows were dressed with patterned, multi-coloured drapes, the ceiling had four different mobiles hanging from it and the floor was partially covered by four rugs.

Materials for the medium condition were selected randomly from the high condition and duplicates were then obtained. Each of the three environments, thus, contained different quantities of stimulus materials or elements. The low complexity condition (LC) contained 0 elements; the medium complexity condition (MC) contained 7 elements (four posters, one mobile, one rug and plain drapes); the high complexity

Plate 1a. Low Complexity Condition

Plate 2a. Medium Complexity Condition

Plate 3a. High Complexity Condition

Fig. 2. North wall of experimental room.

Plate 1b. Low Complexity Condition

Plate 2b. Medium Complexity Condition

Plate 3b. High Complexity Condition

Fig, 3. South wall of experimental room.

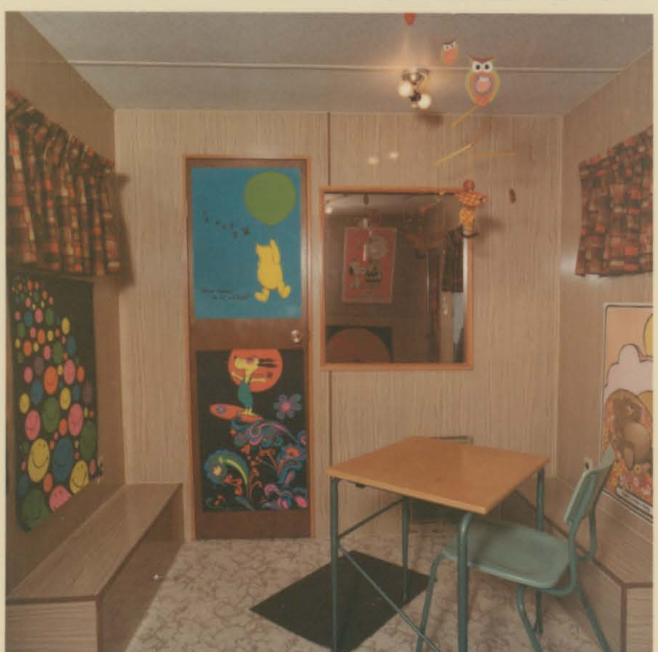

Plate 1c. Low Complexity Condition

Plate 2c. Medium Complexity Condition

Plate 3c. High Complexity Condition

Fig. 4. West wall of experimental room.

Plate 1d. Low Complexity Condition

Plate 2d. Medium Complexity Condition

Plate 3d. High Complexity Condition

Fig. 5. East wall of experimental room.

condition (HC) contained 22 elements (twelve posters, four mobiles, four rugs and patterned drapes). The drapes were assigned the following values: the plain drapes were given a 1 while the patterned drapes were given a 2.

Scaling Materials

1. The Semantic Differential. In the case of the adults, the rating scale contained 20 items which were divided into 5 separate scales or dimensions. All items had a 7-point scale. Nine of the 20 items were taken from Osgood's (Osgood, Suci, and Tannenbaum, 1957) original scales for quality, activity and potency. The quality items were: pleasant-unpleasant, beautiful-ugly, and good-bad. The activity items were: fast-slow, active-passive, and sharp-dull. The potency items were: heavy-light, strong-weak, and large-small. Nunnally's understandability dimension (Kerlinger, 1964, p. 569) was also assessed with 3 items: strange-familiar, complex-simple, disorganised-systematic. The remaining 8 items came from a scale devised by Kasmar (1970) for rating environments. The 8 items were: cheerful-gloomy, full-empty, comfortable-uncomfortable, ornate-plain, inviting-repelling, untidy-tidy, attractive-unattractive, and cluttered-uncluttered.

In the case of the child Ss, the rating scale was reduced to 9 items which resulted in 4 separate scales or dimensions. All items had a 5-point scale. The rating scale included Osgood's items for quality (beautiful-ugly and good-bad), activity (bright-dull) and potency (large-small). In the case of the activity item, the word 'bright' replaced the word 'sharp' because it was thought that this relationship would be more easily understood by children. The other 5 items were taken from Kasmar's environmental-specific items i.e. cheerful-gloomy, full-empty, comfortable-uncomfortable, untidy-tidy, and fancy-plain. In the last item 'fancy' was substituted for 'ornate' because it was thought that children of this age would not be able to understand the word 'ornate'. Nunnally's understandability item was completely excluded. On the final rating sheet, items from the different scales were randomly distributed and the positive and negative ends of the items were randomly reversed. The latter measure was taken to ensure that the Ss did not develop a set. Appendix A contains examples of both adult and child rating scales.

2. The Questionnaire. A questionnaire was devised to assess: a) whether the rooms differed, b) how much the rooms differed, c) how much and what the Ss retained about the rooms, and d) Ss' preferences for the rooms. The questionnaire was identical for both adults and children except that the rating scales were reduced from 7-points to 3-points for the children on questions 2 and 5. The children also received two extra preference questions (8 and 9) whereas the adults received a further rating scale. This rating scale was taken directly from the Berlyne et al. study (1968) of similarity/difference judgements of visual stimuli according to their complexity, interestingness and pleasingness. Appendix B contains copies of both adult and child questionnaires.

Experimental Design

One practical aspect of having only two rooms meant that the three environments could be assessed most easily by conducting paired-comparisons on the three environmental conditions. Thus, the Ss were shown only two of the three environments i.e. they were shown either HC and LC or HC and MC or MC and LC. Adults and children scaled the environments separately with the adults scaling first. There was a lapse of 3 days between the adult scaling procedure and the childrens'. Consequently, the order of presentation of the environments was as follows: 6 successive Ss saw the HC and LC, 6 successive Ss saw the HC and the MC, and 6 successive Ss saw the MC and the LC. Order of presentation of the rooms (e.g. HC presented first and MC presented second) was reversed (i.e. to MC and HC) for half of the Ss. The children scaled the environments in the same type of design.

As a result of the above design, each S rated two environments on the semantic differential which produced a confounded effect between subjects and treatments. That is, the result was a nested repeated measures design. Consequently, a difference score was obtained between the two ratings for each S. In all cases the lower complexity room rating was subtracted from the higher complexity room rating (i.e. the MC rating was subtracted from the HC rating while the LC and MC ratings were subtracted from the HC ratings). In the final analysis a constant of 3 was added to all scores to rid the analysis of any minus scores obtained.

This difference score was used in the case of the semantic differential analysis only. It is important to note that a difference score was obtained simply because of the paired-comparison nature of the design. Although the Ss were asked to rate the rooms shown to them independently, nevertheless for the purposes of the analysis, these ratings were combined in the manner described above to produce a difference score. It must be noted that on the questionnaire ratings, especially questions 2, 2a, 2b, 2c, and 5, the Ss were rating the rooms on a comparison basis and not on the independent basis used in the semantic differential scaling.

For the purposes of analysis the theoretical function to be utilised must be explained. According to one of the definitions of complexity Berlyne proposes, the number of distinguishable elements is a crucial variable. On this basis a theoretical function may be derived simply by counting the number of elements in each environmental complexity condition and averaging the two numbers of elements for each paired-comparison condition. As pointed out above the LC contained 0 elements, the MC contained 7 elements and the HC contained 22 elements. When the three sets of paired-comparisons were calculated the LC and MC $\frac{(0 + 7)}{2}$ averaged to 3.5 elements, the LC and HC $\frac{(0 + 22)}{2}$ averaged to 11 elements and the MC and HC $\frac{(7 + 22)}{2}$ averaged to 14.5 elements.

On the ordinate, the number of elements difference between the two environments in each paired-comparison condition may be noted i.e. MC and LC (7 - 0) had a 7 element difference, HC and LC (22 - 0) had a 22 element difference and HC and MC (22 - 7) had a 15 element difference. This relationship is plotted in Figure 6.

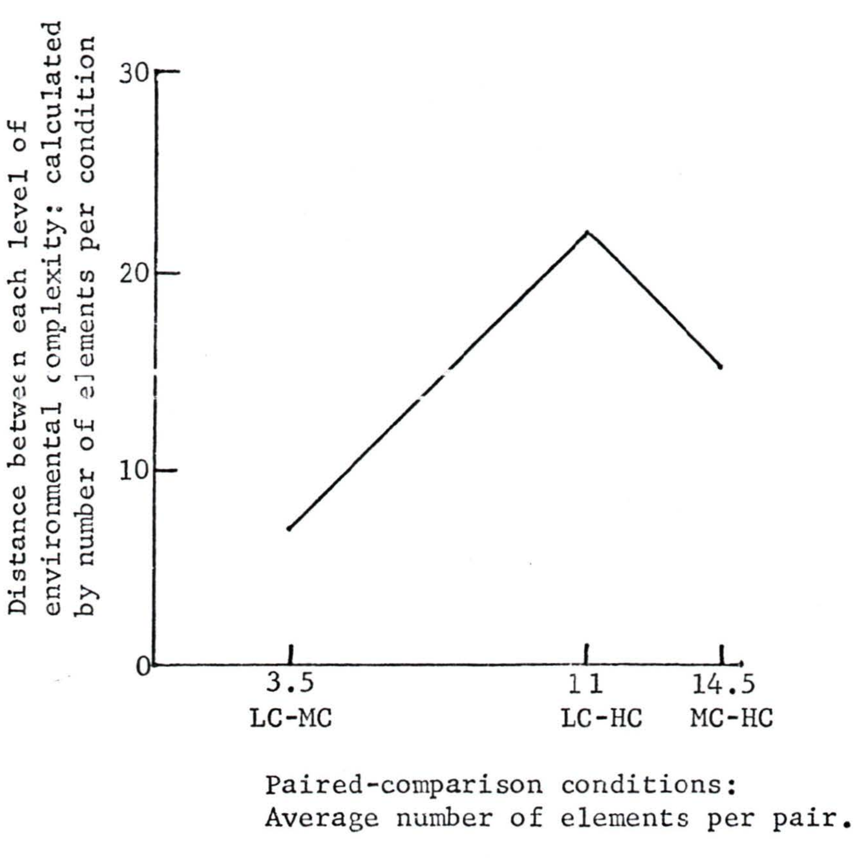

Fig. 6. Theoretical functional relationship based on Berlyne's definition of complexity.

Procedure

All Ss were randomly assigned to one of the paired-comparison conditions and each S was tested individually. The Ss were informed that they would have to accompany the E to the mobile laboratory. The only information they were given before being taken to the mobile laboratory was : "All I would like you to do is help me decide about some rooms. This was again reiterated at the mobile laboratory. The Ss were then given the following instructions:

> There are two rooms that I am going to show you. I am going to put you in each room for a couple of minutes. I will show you one first and leave you alone in that room for 2 minutes and then I will show you a second room and leave you alone in there for 2 minutes. Afterwards all I want you to do is help me make some decisions about the two rooms that I showed you.

The adult Ss were also told: "In other words, all I want you to do is relax, have a good look around and 'absorb the atmosphere'. There are one-way windows in the rooms I will put you in but don't worry, I am not interested in observing your behaviour." The children were told simply to "relax and have a good look around"; they were not informed about the one-way windows. It was expected that adults would suspect or have knowledge of the one-way windows; it was assumed that the children were naive.

After the instructions had been made clear to the Ss, they were asked if they had any questions. They were then shown into one of the rooms. Ss were shown into the first room (in their particular paired-comparison condition) and left alone for 2 minutes. The E had meanwhile retired to the adjacent observation room. When the 2 minutes had elapsed, the E re-entered the room and took the S, via the outside of the trailer, to the second room which was located at the opposite end of the trailer. In the second room the same procedure was followed.

Each S was then taken to the observation room where the semantic differential scales and the questionnaire were administered. In all cases, the semantic differential was presented first. The Ss had to rate both rooms shown to them on the semantic differential. The Ss were told to rate the first room they saw and forget about the second room for awhile. When the semantic differential scale had been completed for the first room, the Ss had to rate the second room they had seen on a second semantic differential scale. They were instructed not to compare the rooms but only to rate the rooms on individual merit. The questionnaire was then administered.

Adult Ss completed the semantic differential scales according to the instructions but the children had to be instructed more clearly as to the meaning of the 5-point divisions. Pilot study children had shown some reticence at marking the rating sheets. Consequently, the pairs of adjectives were read out to the children and they had to indicate where they would place their mark on the scale. Three of the children experienced difficulty with the word 'gloomy' and its meaning was explained to them.

All Ss were de-briefed and, in the case of adults, were told briefly the aim of the study. When the scales and questionnaire had been completed (which took about 10-15 minutes), the Ss were then asked not to discuss the rooms nor the questionnaire and rating scales with other people on campus/in school until the project had been completed.

Hypotheses

Hypothesis 1.

Analysis of a) the difference scores obtained on the semantic differential scales and b) the comparison rating scores on the ratings of questions 2 and 5 for both adults and children and questions 2a, 2b, and 2c for the adults only (see Appendix B) should yield a reliable difference between the three paired-comparison groups (i.e. LC-MC, LC-HC, and MC-HC). In other words, the LC-MC paired-comparison group mean ratings should not equal the LC-HC group mean ratings which, in turn, should not equal the MC-HC group mean ratings.

Hypothesis 2.

Based on Berlyne's (1968) definition of complexity and the theoretical function described under the experimental design section above, both the difference scores on the semantic differential scales and the rating scores for questions 2, 2a, 2b, 2c, and 5 should yield a reliable quadratic function between the three paired-comparison groups where the means are ordered as follows: Group LC-MC < Group LC-HC > Group MC-HC.

Hypothesis 3.

Analysis of the SAME/DIFFERENT judgement (question 1) about the pairs of rooms should yield a reliable number of Ss reporting that the rooms differed.

Hypothesis 4.

Analysis of question 4, i.e. 'Which room did you think had the most 'things' in it?', should yield a reliable majority of Ss judging the 'more complex' room (as defined previously) as containing the most 'things' or objects i.e. the HC in the two groups HC-MC and HC-LC and the MC in the MC-LC group.

Hypothesis 5.

Analysis of the two preference questions 'Which room would you prefer to study in?' (question 8a for adults and question 10 for children) and 'Which room would you prefer to have a party in?' (question 8b for adults and question 11 for children) should yield a significant change in response where the majority of Ss choose the 'more complex' room shown to them to party in and the 'less complex' room shown to them to study in.

Hypothesis 6.

Analysis of the question 'Which room would you like to take another look at?' (question 9 for adults and question 12 for children) and analysis of question 8 for the children only i.e. 'Which room did you like the best?' should yield a reliable majority choosing the 'more complex' room shown to them.

In the case of question 9 on the childrens' questionnaire, no specific prediction was made about the childrens' preferences for a room at home. The question was included for exploratory purposes. Questions 3, 6 and 7 were included to assess the S's awareness of or memory for the environments in which he had been placed. No specific predictions were made.

EXPERIMENT I: RESULTS

Analysis

The analyses conducted on the data were primarily of three types: a) multivariate analysis of variance (MANOVA) of the ratings and b) trend analyses of the ratings (both semantic differential and questionnaire) and c) simple frequency counts of the Ss' responses on the preference questions, although in the case of a predicted cross-over of opinion on two of the preference questions, McNemar's test for the significance of changes was applied. Hartley's Fmax test (Kirk, 1969, p. 62) was used to test for homogeneity of variance. All sets of variances proved to be homogeneous.

Hypothesis 1.

Four MANOVAS were conducted on four sets of data to test for hypothesis 1. The MANOVAS tested: a) the 5 adult semantic differential scales; b) the 4 childrens' semantic differential scales; c) questions 2 and 5 for both children and adults; and d) Berlyne's scales of complexity, interestingness and pleasingness for adults. The semantic differential scales were analysed separately for the adults and children because of a) the difference in number of items on each semantic differential scale (20 items for the adults and 9 items for the children) and b) the adults had a 7-point scale whereas the children had a 5-point scale.

On the semantic differential difference scores the childrens' results generally supported the prediction that the three paired-comparison group means would differ while the adults' results were not so clear-cut. The means and standard deviations for the semantic differential ratings for both adults and children are shown in Table I.

1. The multivariate test of the adults' semantic differential difference scores was only marginally reliable (F = 1.99, df = 10,22, p < .085) while the univariate tests of the quality and Kasmar scales were reliable (F = 4.59, df = 2, 15, p < .028 and F = 4.05, df = 2, 15, p < .039 respectively). The quality dimension accounted for 38 percent of the variance while the Kasmar scale accounted for 35 percent of the variance. Table II contains the complete analysis results.

2. The multivariate test of the childrens' semantic differential difference scores (Table III) yielded a reliable effect (F = 2.37, df = 8, 24, p < .049). Three of the four scales proved to be reliable i.e. quality (F = 3.80, df = 2, 15, p < .046), activity (F = 4.00, df = 2, 15, p < .041) and Kasmar (F = 10.35, df = 2, 15, p < .001). The last scale accounted for a substantial proportion of the variance i.e. 58 percent while the quality scale accounted for 34 percent of the variance and the activity items accounted for 35 percent of the variance.

3. The predicted mean rating difference for a) the 'amount' the rooms differed (question 2) and b) the 'number of things' the rooms contained (question 5) between the three paired-comparison groups was not clearly confirmed. The means and standard deviations for both adults and children are shown in Table IV and Table V contains the results of the MANOVA analysis. The multivariate test was marginally reliable (F = 2.13, df = 4,58, p < .088). The univariate test of

TABLE I

MEANS AND STANDARD DEVIATIONS OF THE SEMANTIC DIFFERENTIAL RATINGS FOR BOTH ADULTS AND CHILDREN

Paired Comparison		Quality	Activity	Potency	Understandability	Kasmar
LC-MC						
Adults	Mean	13.50	10.17	4.67	6.00	24.50
	S.D.	5.47	6.68	3.78	3.16	7.82
Children	Mean	4.67	4.50	3.83	--	9.33
	S.D.	1.21	1.38	1.17	--	1.86
LC-HC						
Adults	Mean	13.83	15.00	7.17	5.83	37.33
	S.D.	2.79	5.48	3.55	3.97	8.80
Children	Mean	6.17	5.17	2.50	--	11.83
	S.D.	2.14	0.98	1.52	--	3.19
MC-HC						
Adults	Mean	6.83	11.00	7.00	8.50	24.83
	S.D.	4.83	5.40	3.10	3.62	9.95
Children	Mean	3.67	3.50	3.83	--	5.83
	S.D.	1.21	0.55	1.60	--	1.47

TABLE II

MANOVA AND TREND ANALYSIS OF THE MEAN ADULT DIFFERENCE RATINGS FOR THE THREE ENVIRONMENTAL COMPLEXITY PAIRED-COMPARISON CONDITIONS ON FIVE SEMANTIC DIFFERENTIAL SCALES

(MANOVA univariate df = 2, 15; multivariate df = 10, 22; Trend univariate df = 1, 15; trend multivariate df = 5, 11)

Dependent Measures	MS	F	P	eta^2
Quality	93.56	4.60	.028	.38
Linear	99.06	4.87	.043	.20
Quadratic	88.05	4.33	.055	.18
Activity	40.06	1.16	--	
Linear	9.53	< 1	--	
Quadratic	70.58	2.04	--	
Potency	11.72	< 1	--	
Linear	20.00	1.65	--	
Quadratic	3.44	< 1	--	
Understan-dability	13.39	1.03	--	
Linear	13.81	1.07	--	
Quadratic	12.96	1.01	--	
Kasmar	321.06	4.06	.039	.35
Linear	28.67	< 1	--	
Quadratic	613.44	7.75	.014	.34
Multivariate		1.10	.085	
Linear		2.17	.132	
Quadratic		1.84	.186	

TABLE III

MANOVA AND TREND ANALYSIS OF THE MEAN CHILD DIFFERENCE RATINGS FOR THE THREE ENVIRONMENTAL COMPLEXITY PAIRED-COMPARISON CONDITIONS ON FOUR SEMANTIC DIFFERENTIAL SCALES

(MANOVA univariate df = 2, 15; multivariate df = 8, 24; Trend univariate df = 1, 15; trend multivariate df = 4, 12)

Dependent Measures	MS	F	P	eta^2
Quality	4.50	3.80	.046	.34
Linear	0.89	< 1	--	
Quadratic	18.11	7.24	.017	.32
Activity	4.22	4.00	.041	.35
Linear	1.59	1.50	--	
Quadratic	6.86	6.50	.022	.28
Potency	3.56	1.71	--	
Linear	0.25	< 1	--	
Quadratic	6.86	3.30	.089	.18
Kasmar	54.50	10.35	.001	.58
Linear	18.89	3.59	.078	.10
Quadratic	90.11	17.11	.001	.48
Multivariate		2.37	.049	
Linear		0.79	--	
Quadratic		5.42	.010	

TABLE IV

MEANS AND STANDARD DEVIATIONS OF RATINGS ON

A) THE EXTENT TO WHICH THE ROOMS DIFFERED (Question 2) AND

B) THE CONTENT QUANTITY OF THE ROOMS (Question 5).

Paired Comparisons		Question 2	Question 5
LC-MC			
Adults	Mean	2.17	2.50
	S.D.	0.41	0.84
Children	Mean	2.33	1.50
	S.D.	0.52	0.55
LC-HC			
Adults	Mean	2.83	2.50
	S.D.	0.41	0.55
Children	Mean	2.50	2.67
	S.D.	0.55	0.52
MC-HC			
Adults	Mean	2.17	2.83
	S.D.	0.41	0.41
Children	Mean	2.17	1.67
	S.D.	0.75	0.82

TABLE V

MANOVA AND TREND ANALYSIS OF THE MEAN DIFFERENCE RATINGS (Question 2) AND OF THE MEAN CONTENT QUANTITY RATINGS (Question 5) FOR THE THREE ENVIRONMENTAL COMPLEXITY PAIRED-COMPARISON CONDITIONS FOR BOTH CHILDREN AND ADULTS

	Univariate Test of The Difference Rating (Question 2)					Univariate Test of the Content Quantity Rating (Question 5)					Multivariate Test		
Source	DF	MS	F	P	eta^2	DF	MS	F	P	eta^2	DF	F	P
Complexity													
Paired-Comparisons	2	0.86	3.16	.057	.19	2	1.03	2.57	.093	.10	4/58	2.13	.088
Linear	1	0.05	< 1	--		1	0.72	1.79	--		2/29	< 1	--
Quadratic	1	1.34	4.64	.039	.13	1	1.34	3.39	.077	.06	2/29	2.68	.086
Age	1	0.03	< 1	--		1	4.00	10.00	.004	.18	2/29	5.60	.009
Complexity x Age	2	0.19	< 1	--		2	1.58	3.96	.030	.15	4/58	3.33	.016
Error	30					30							

question 2 was reliable (*F* = 3.16, *df* = 2, 30, *p* < .057). Although there was no age difference nor interaction between age and experimental group, the adult *Ss* did rate the rooms slightly more in conformity with the prediction than did the children.

The univariate test of question 5 was not reliable. However, there was an age main effect (*F* = 10.00, *df* = 1, 30, *p* < .004) and a reliable interaction (*F* = 3.96, *df* = 2, 30, *p* < .030) between age and paired-comparison groups.

The reliable interaction permitted further investigation of the question 5 ratings. Simple main effects analysis (Kirk, 1969, p. 179-182) demonstrated (Table VI) that the adults' groups mean ratings did not differ reliably whereas the three group means for the children differed reliably (*F* = 7.12, *df* = 2, 30, *p* < .01) (see Figure 10). The results of the simple main effects accounted for the age main effect and the interaction effect that was found with the MANOVA.

4. The predicted difference of the mean ratings on the Berlyne scales for the three paired-comparison groups was not confirmed; the analysis did not yield statistically reliable results. However, the correlations between complexity, pleasingness and interestingness were substantial and are tabulated in Appendix C. Results from the questions asked just prior to the ratings were substantial e.g. 'Which room did you think the more complex?' (Appendix B). All 18 *Ss* reported that the physically 'more complex' room shown to them was, in fact, the more complex. Seventeen of the 18 *Ss* reported that the 'more complex' room shown to them was the more pleasing; the one *S* who

TABLE VI

SIMPLE MAIN EFFECTS ANALYSIS OF THE CONTENT QUANTITY RATINGS (Question 5). AGE (A) = 2 LEVELS i.e. CHILDREN = 1, AND ADULTS = 2. ENVIRONMENTAL COMPLEXITY (C) = 3 LEVELS i.e. LC-MC = 1, LC-HC = 2, MC-HC = 3.

Source	DF	SS	MS	F	P
A at C1	1	3.00	3.00	7.95	.01
A at C2	1	0.09	0.09	< 1	--
A at C3	1	4.09	4.09	18.48	.01
C at A1	2	5.37	2.68	7.12	.01
C at A2	2	0.55	0.28	< 1	--
Within Error	30	11.99	0.38		

deviated stated that the MC room was more pleasing than the HC room. Seventeen of the 18 Ss reported that the 'more complex' room shown to them was the more interesting; the deviating S stated that the LC room was more interesting than the MC because it was 'strange'.

Hypothesis 2.

Four separate multivariate trend analyses were conducted on a) the five semantic differential scales for the adults, b) the four semantic differential scales for the children, c) the ratings on questions 2 and 5 for adults and children, and d) Berlyne's scales of complexity, pleasingness, and interestingness for the adults.

1. The predicted quadratic trend for the semantic differential difference ratings was not clearly confirmed for the three paired-comparison groups of adults. The multivariate test was not reliable but the Kasmar scale and the quality scale yielded the predicted effect ($F = 7.75$, $df = 1, 15$, $p < .014$ and $F = 4.33$, $df = 1, 15$, $p < .055$ respectively). The multivariate test for a linear trend was not reliable although the quality scale yielded a reliable linear trend ($F = 4.87$, $df = 1, 15$, $p < .043$). Table II contains the analysis results and the means are plotted in Figure 7.

2. The childrens' results supported the prediction that the difference scores on the semantic differential would be a quadratic function of the three paired-comparison groups i.e. LC-MC < LC-HC > MC-HC. Table III contains the complete analysis and the means are plotted in Figure 8. The multivariate test was reliable ($F = 5.42$,

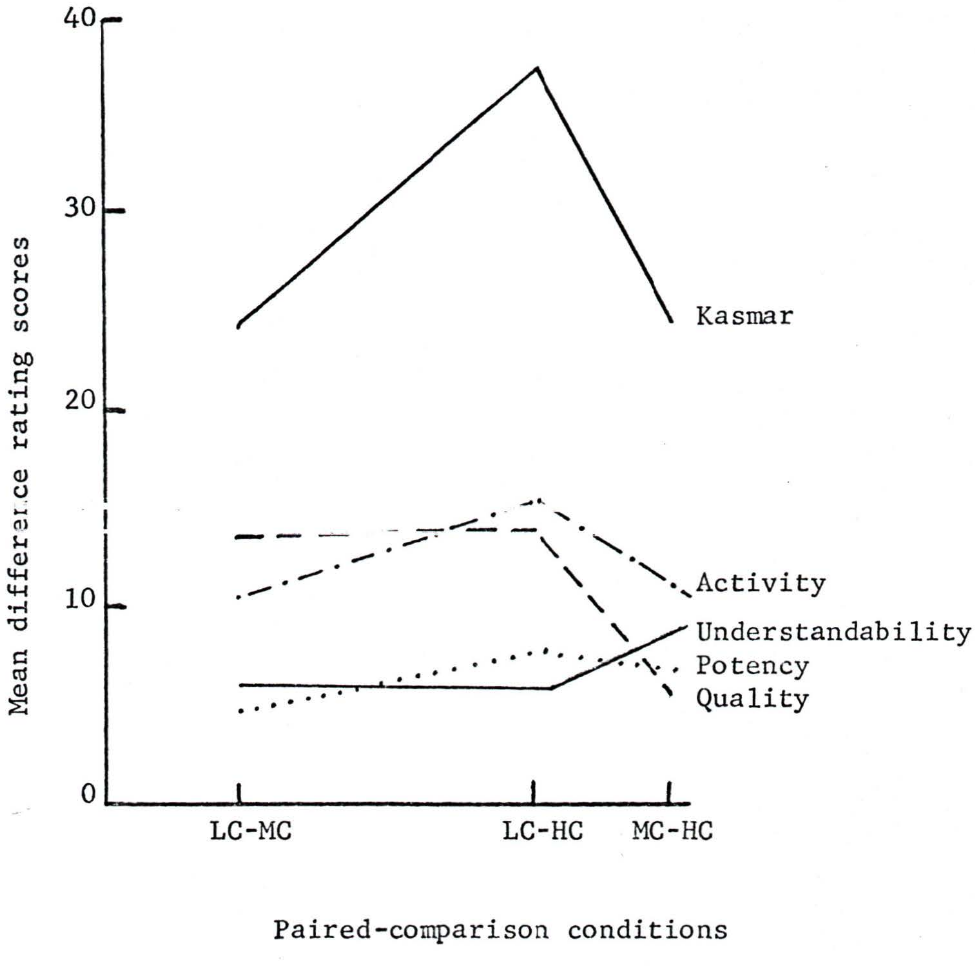

Fig. 7. Mean difference rating scores for adults on the five semantic differential scales over the three paired-comparison conditions.

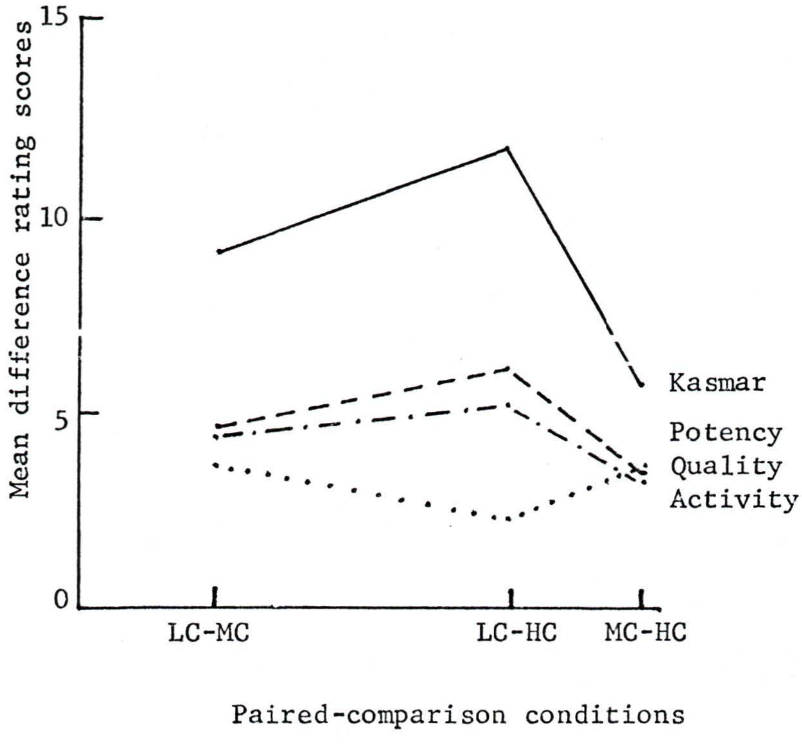

Fig. 8. Mean difference rating scores for children on the four semantic differential scales over the three paired-comparison conditions.

$df = 4, 12$, $p < .010$) and three of the univariate tests were reliable i.e. quality ($F = 7.24$, $df = 1, 15$, $p < .017$), activity ($F = 6.50$, $df = 1, 15$, $p < .022$) and Kasmar ($F = 17.11$, $df = 1, 15$, $p < .001$). The overall test for a linear trend was not reliable although the univariate test of Kasmar's items had $F = 3.59$, $df = 1, 15$, $p < .078$.

3. The predicted quadratic relationship between the three paired-comparison groups on a) the ratings for 'amount' the rooms differed (question 2) and b) the 'number of things' rating (question 5) was confirmed in the former but not in the latter. The latter result was due to an age by environmental complexity paired-comparison group interaction. The multivariate test was only marginally reliable ($F = 2.68$, $df = 2, 29$, $p < .086$). The complete analysis results are in Table V.

The univariate test for trend yielded a reliable quadratic relationship on question 2 ($F = 4.64$, $df = 1, 30$, $p < .039$) where both adults and children showed the same type of behavioural trend (Figure 9). However, the univariate test for a quadratic trend for question 5 resulted in $F = 3.35$, $df = 1, 30$, $p < .077$. The linear trend test was not significant. Examination of Figure 10 shows why the quadratic relationship was not clearly confirmed for question 5; only the children performed as predicted. Thus, the age discrepancy in the rating scores accounts for the low overall reliability.

4. The predicted quadratic relationship between the three paired-comparison groups on the Berlyne rating scales was not confirmed. The means for the ratings on complexity, pleasingness and interestingness,

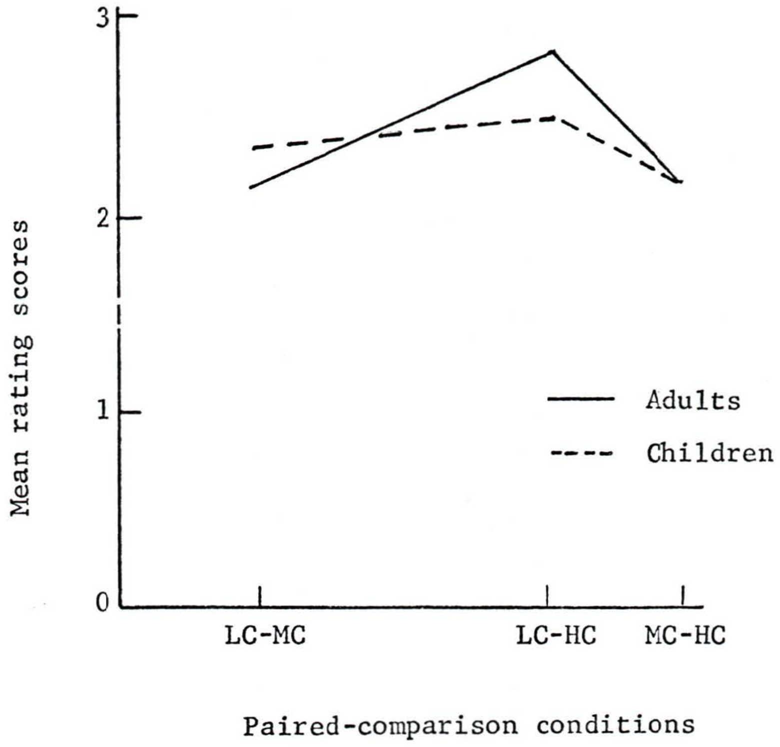

Fig. 9. Mean difference ratings (Question 2) of the three paired-comparison conditions for adults and children.

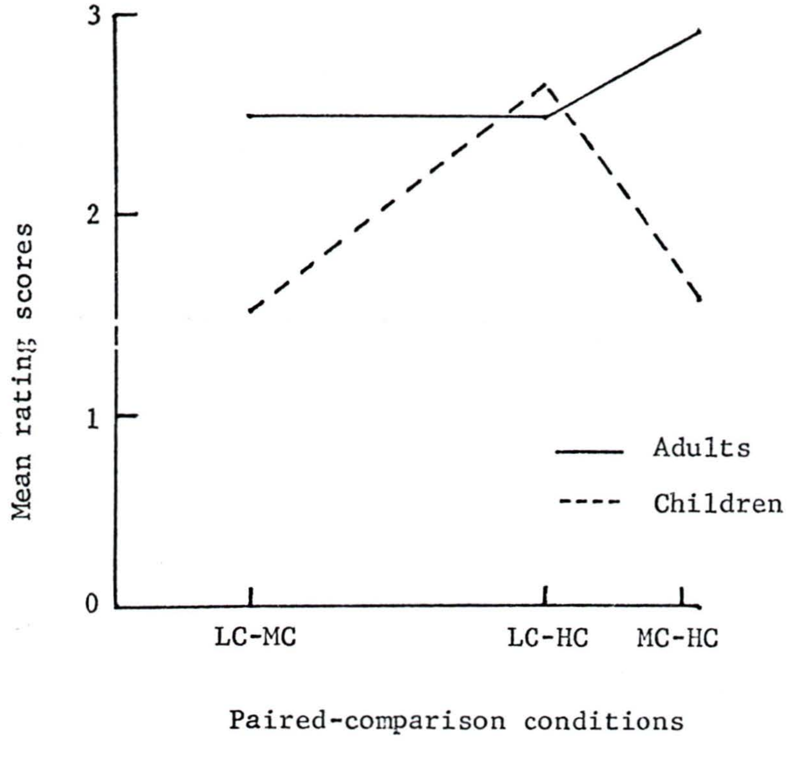

Fig. 10. Mean ratings of content quantity (Question 5) of the three paired-comparison conditions for adults and children.

however, were ordered as predicted, i.e. LC-MC < LC-HC > MC-HC; the means and standard deviations are tabulated in Appendix C.

Hypothesis 3.

The predicted 'difference' judgement for question 1 was confirmed: 36 Ss reported that the rooms differed according to decor. (Note: Six Ss mentioned the slight structural difference although the other 30 Ss did not recall the structural difference even when questioned about it).

Hypothesis 4.

All 36 Ss judged that the 'more complex' room contained the most 'things' or objects.

Hypothesis 5.

The predicted change in preference for room usage where the 'more complex' room was predicted to be preferred for parties while the 'less complex' room was predicted to be preferred as a study was confirmed. A McNemar's test for the significance of changes (Siegel, 1956, p. 63-67) was conducted on the data with the resultant X^2 value of 18.5 with 1 df. ($p < .001$). Thirty-five of the total 36 Ss chose to party in the 'more complex' room shown to them while 20 of those same 35 Ss chose to study in the 'less complex' room.

Hypothesis 6.

The predicted majority of Ss (i.e. 34/36) did choose the 'more complex' room shown to them when asked the question 'Which room would you like to take another look at?' All 18 children preferred or "liked best" the 'more complex' room shown to them.

In the case of question 9 where no specific prediction was made, 16 of the 18 children chose the 'more complex' room as the one they preferred to have as their "own room at home". In answer to the question 'What did you notice that was different about the rooms?', 32/36 _Ss_ mentioned that the rooms differed according to wall decor, 19/36 mentioned that the rooms differed according to ceiling decor while 11/36 noted the difference in window-dressing and 8/36 noted the rug difference. On review of questions 6 and 7, _Ss_ recalled the decor fairly accurately. In answer to the 'how many' questions, mean estimates and range estimates were obtained and are tabulated in Appendix D.

EXPERIMENT I: DISCUSSION

Hypotheses 1 and 2.

1. The results do not completely confirm the predictions that the three group means would differ and that the relationship between them would be quadratic. The lack of complete confirmation was due to the difference in rating performance of the adult and child Ss. The difference could be a function of age or of the fact that the children received a reduced version of the adults scales. The items selected out for the children may have been more sensitive to the problem to be rated or alternatively children may be more sensitive raters of the environments. However, the multivariate test for the adult semantic differential scores did show a trend in the predicted direction. Two of the univariate tests did prove reliable (i.e. quality and Kasmar) and accounted for a sizeable proportion of the variance.

The potency and understandability scales seem to be poor assessors of environmental variables, while the Kasmar items, as would be expected, appear to be the most sensitive. Kasmar's items are perhaps more applicable to and valid in the present experimental paradigm because they were tested out for applicability to the rating of environments.

Examination of Figures 7 and 8 demonstrate clearly that the Kasmar items produced the predicted quadratic relationship while quality and activity scales approximated to the predicted quadratic function. The reliable linear trend on the quality scale for adults may be seen where the LC-MC group and the LC-HC group means do not differ. The

Kasmar scale for the children gave evidence of a slight linear trend; this may be noted on examination of Figure 8 where the LC-MC and the LC-HC groups do not differ markedly.

The semantic differential as an environmental assessment device appears to be a reasonably sensitive technique if care is shown in item selection.

2. When asked to rate the pairs of rooms in question 2, both adults and children rated the rooms as being different; the ratings of the rooms in the three paired-comparison groups differed reliably. Examination of Figure 9 showed that, in accordance with the prediction, Ss rated the LC and HC rooms as more different than the LC and MC rooms and the MC and HC rooms with adults demonstrating this relationship more markedly than the children, although no reliable age difference was found.

When asked to rate the rooms on content quantity,the children rated in accordance with the predicted quadratic relationship (Figure 10) whereas adults did not. This age result is puzzling with the adults assessing the MC-HC rooms as being more different on object content than the LC-HC rooms which were rated the same as the LC-MC rooms.

3. The ratings on the Berlyne (1968) scales (for complexity, pleasingness, and interestingness) by adults did not confirm the predicted relationship between the three paired-comparison groups. However, on all three concepts, the adults rated the difference between the LC and HC rooms as more than that between the LC and MC rooms and the MC and HC rooms, which were approximately equivalent (Appendix C

contains the means). The relationship that Berlyne found between the three scaling items, although he used very different stimuli, held in the present experiment; complexity, pleasingness and interestingness were correlated (see Appendix C for the correlation matrix).

Hypotheses 3 and 4.

On a straight decision question rather than a rating, all 36 Ss confirmed the prediction that the rooms differed and all 36 Ss thought that the pairs of rooms shown to them differed on content quantity specifically. These results support the contention that the rooms differed and that they differed according to the 'number of distinguishable elements' in them. These questions (i.e. questions 1 and 4) supplied answers to whether the rooms differed but not to how much they differed.

Hypothesis 5.

The questions on room usage preferences were devised to test whether Ss would state that they preferred less complex environments for study purposes. In accordance with the prediction, Ss preferred the 'more complex' environment to party in or relax in and a 'less complex' environment for the purposes of studying. Both children and adults demonstrated the same preferences (i.e. 10/18 adults and 10/18 children preferred the 'less complex' room for studying purposes). When the children were questioned about these study preferences, many used the term 'distracting' in reference to the 'more complex' room and the phrase 'better to concentrate' in reference to the 'less complex' room.

Hypothesis 6.

In reply to the question: 'Which room would you like to take another look at?', 34/36 Ss selected the 'more complex' room shown to them. The two Ss who chose the 'less complex' room were adults comparing the MC and HC conditions. This result is of interest in light of Berlyne's (1966) comment: "He chooses the more complex pattern, presumably because that is the one about which he has more residual curiosity" (p. 32). It has been shown empirically that both animals (Butler, 1965) and humans (Jones, Wilkinson and Braden, 1961) will work for the reward of looking at the more complex of two stimuli. Presumably, the 34 Ss who chose to take another look at the 'more complex' room rather than the 'less complex', did so because their curiosity had not been satiated.

As predicted 18/18 children preferred or "liked best" the 'more complex' environment shown to them. This result is comparable to that of the adult Ss on the Berlyne scale where 17/18 Ss thought the 'more complex' room to be the more pleasing. The result is comparable with the findings of Kaplan and Wendt (1972).

Likeability or pleasingness is related to the concept of complexity; Berlyne (1968) has shown that pleasingness and complexity are correlated concepts. That is, Ss tend to find more complex environments more pleasing although when the environments become extremely complex the correlation should diminish. The preference questions for both adults and children confirm the relationship between complexity and preference because 35/36 Ss preferred the 'more complex' environment shown to them; this indicates that the HC room was not extremely complex.

The quality scale on the semantic differential is probably assessing the same dimension as that described above; people usually prefer or like beautiful over ugly, pleasant over unpleasant and good over bad.

The results from question 9 support the above comments further because 16/18 children preferred the 'more complex' room to the extent that they preferred to have it as their own room at home.

Questions 3, 6, and 7 affirmed that the Ss did notice the contents of the rooms and that they remembered the contents reasonably accurately. These results indicated which were the more noticeable items, i.e. posters and mobiles which are, in fact, often included in the classroom environment.

Summary

All of the above assessment techniques were devised to measure a) whether the three experimental treatments differed along a complexity continuum and b) whether they differed in accordance with the prediction that the LC-MC < LC-HC > MC-HC. None of the assessment techniques were perfect measures but the overall estimation of the results confirmed a) that the three environmental treatments differed and b) that they differed, for the children especially, in accordance with the predicted quadratic relationship. Thus, it was affirmed that the HC was, in fact, 'more complex' than the MC which, in turn, was 'more complex' than the LC.

It was decided on the basis of these results that the environments would be kept intact for the major part of the study (i.e. Experiment II) even though the rugs and curtains were not highly noticed.

EXPERIMENT II: METHOD

Subjects

All Ss for Experiment II came from the same local Elementary Public School as those children used in Experiment I. The treatment conditions included 30 third grade children (15 boys and 15 girls) whose ages ranged from 7 yrs. 9 mos. to 9 yrs. 5 mos. with a mean age of 8 yrs., and 30 fifth grade children (15 girls and 15 boys) whose ages ranged from 9 yrs. 11 mos. to 11 yrs. 7 mos. with a mean age of 10 yrs. 1 mo. In each grade there were several classes; from the two grades under study specific classes were randomly selected and Ss were, in turn, randomly selected from the classes. Exclusions consisted of those children whose parents objected to their taking part (approximately 10%) and the few children who spoke any French, Spanish, Portuguese or Italian. Those children who were rated by their class teachers as being below average or highly exceptional for their grade on reading and general abilities were also excluded from the study. Exclusions from the study for all of the above reasons totalled about 30% of the population of 130 children.

Room Complexity

Only one of the experimental rooms in the mobile laboratory (see Figure 1) was used thereby keeping the structural environment constant. The three environmental or experimental conditions (as explained in Experiment I - see plates for a visual description) were presented. In the HC placement of posters, mobiles, and rugs was randomized for each two successive Ss. That is, two Ss were tested separately but successively in this condition. In the MC the four posters, one mobile, and one rug were randomly selected from the same stimulus pool used in the HC and placement of these items within the room was randomized for each two successive Ss. The observation room was used to a) observe Ss behaviour during the learning period and b) interview the Ss at the end of the experimental period.

Training Cards

A verbal learning task was used to test for the effects of the environmental conditions on learning. The Ss had to learn 10 paired-associates which comprised one-syllable English animal names and their corresponding two-syllable Spanish animal names (e.g. CAT-GATO; see Appendix E for a complete list of the paired-associates). There were 6 training cards, each card having the same set of 10 paired-associates. However, word-order was randomized for each card; this was the only way in which the 6 training cards differed. The cards all measured 8.5 inches (21.8 cm.) by 3 inches (7.7 cm.). They were constructed in the following manner: the words were typed on white paper with a primary type-set, the paper then being backed with white cardboard and the whole card finally covered with Saranwrap.

Test Cards

Six test-cards were constructed on which the English words only were typed. They were the same size as the training cards and were constructed in the same manner. Again word-order was randomized for each card. Adjacent to each English word was a space where a Spanish name-card could be placed. Ten name cards 1.3 inches by .4 inch (3.3 cm. by 1 cm.) with one Spanish word per card were designed to fit the spaces on the test card (see Appendix F).

Observation recording sheets were designed so that Ss could be observed at 5 second intervals over the 2 minute trials (see Appendix G).

A questionnaire was designed to assess a) whether the Ss were aware of or had noticed the room and its contents, and b) their attitude toward both the task and the environment (see Appendix H for a copy of the questionnaire and the results).

Procedure

Each S was tested individually and in only one of the three possible environmental conditions. Each S was randomly assigned to an experimental condition and the task was constant throughout for all Ss except for order of presentation of both training cards and test-cards.

All the children were informed as to the identity of E. All Ss were informed in class that they would be taken to the trailer in the school grounds for about one half hour and that all children in the class would not necessarily participate. They were told that their names were picked out of a hat so that no favouritism was being shown. They were told that they were going to learn some new words and that these words would be Spanish words.

Each S was conducted from the classroom to the mobile laboratory by the E and was asked en route whether he/she had ever watched Sesame Street or Electric Company (note: all Ss used in the study had exposure to one or both of these programs). Each S was told again that he was to learn some new words and that they would be names of animals. The S was then shown into the experimental condition to which he or she had been randomly assigned. All Ss were asked to sit in the same chair at the table (in a position which could be easily observed from the one-way window), there being two chairs and a table in the room. The E sat in the chair next to the S and read the following instructions:

> I would like you to help me find out how easy it is to learn a new language. It shouldn't take long. Here is a list of animal names. Could you read the ones in English for me? (The S did so. Those Ss who had any severe reading problem were returned to the classroom i.e. 3 children). The words next to them mean the same but they are in Spanish. For example, rat is rata. (At this point the top three pairs were read out to the S so that he could grasp the nature of the task). Do you understand what you have to do? I am going to leave you in this room for a minute or so and you can learn the names. I will come back and see how many you can remember. Is that okay?

All Ss were asked if they knew what all the animals were; if they replied in the negative in any instance the nature of the animal was explained to them.

The S was then left alone to learn the 10 paired-associates. Each S was given a standard 2 minutes in which to learn the pairs. The E meanwhile observed and recorded Ss behaviour; that is, his attention or 'looking behaviour' to the room and its contents. The E returned to the experimental room and proceeded to give the child the following instructions:

1. (On entering the room). Turn your card over. (On reaching the table) Now I will take this card away and will give you a new list of the English animal names. Here is a little box full of cards. On the cards are all the Spanish words that you saw. I would like you to place the correct Spanish word next to the correct English word. Do you understand what you have to do?

2. This is a stop-watch (the stop-watch was shown to the child) which I am going to use to make sure that everyone gets the same amount of time to do this. Don't worry about it. I would rather that you got the words right than do them fast and make mistakes. Remember, everyone gets lots of goes and everyone gets the same amount of time. Okay, you can begin.

Part 2 of the instructions above were included after observation of pilot-study Ss who had shown an interest in the stop-watch. That is, they were curious or nervous about it. The rest of the instructions in Part 2 were included because a number of the pilot study children had asked questions about the number of opportunities they were to be given to learn the paired-associates and showed concern that everyone should be given the same amount of time to complete the task.

Each S was given the test-card and the Spanish name cards after the instructions had been given. They were given a standard 2 minutes in which to place the correct Spanish word next to the correct English word. The S was informed at the end of the trial which pairs were correct and which were incorrect.

The S was then left alone with a new training card which contained the same words as before, except that word-order was rearranged. Ss were told: Here is a new card. It has the same list of words except they are in a different order.

The procedure described above continued until the S had completed 6 successive trials. Order of presentation of both the 6 training cards and the 6 test cards was randomized for each S. However, after the initial instructions, Ss did not need to be given Part 2 of the instructions. Any questions as to number of trials etc. were answered in such a way that the questioning child did not gain more insight into the procedure than a child who did not ask questions. The mark sheet was designed so that the S was led to believe that he might have a maximum of 10 trials. Consequently, there was no anticipation of the final trials.

After the final trial the S was told:

> Well, I think that is enough for today. You did very well. What I would like you to do now, is to come into this other little room where I'd like to ask you some questions about what you think about what we just did.

The S was then taken into the adjacent observation room where the blinds had been lowered so that the S was not made aware of the one-way windows. The questionnaire (Appendix H) was administered. The S was asked not to discuss his experience with any of the other children nor to tell anyone any of the Spanish words. The S was then returned to the classroom.

Subjects were randomly assigned to conditions; all three conditions were run each day and presentation of the conditions was randomized. The resultant design was a 3x2x2 (Treatments of Environmental Complexity x Grade x Sex) complete factorial design with 20 Ss receiving each treatment and with 5 Ss per cell.

Hypotheses

Hypothesis 1.

Analysis of the verbal learning score for total number correct over all 6 trials should yield a reliable difference between the three environmental treatment groups and should yield a significant linear trend where the means are ordered as follows: LC > MC > HC.

Hypothesis 2.

Analysis of the verbal learning score for total number correct should yield a reliable difference between grades where Grade 5 children total a higher score than the Grade 3 children.

Hypothesis 3.

Analysis of the total attention or 'looking behaviour' score should yield a reliable difference between the groups in the three environmental conditions and should yield a reliable ordering of the means; that is, a significant linear trend should result where the means would be ordered as follows: LC < MC < HC.

Hypothesis 4.

Analysis of the total attention or 'looking behaviour' score should yield a reliable difference between Grade 5 Ss and Grade 3 Ss, where Grade 5 children would spend less time attending to the environment and more time attending to the task. It may be expected that Grade 5 children have been more influenced by societal expectations for achievement than Grade 3 children. Consequently, they should be more task-oriented than the younger children.

Hypothesis 5.

There should be an inverse relationship (i.e. a reliable negative correlation) between the total verbal learning score and the total 'looking behaviour' score.

EXPERIMENT II: RESULTS

Analysis

The analyses conducted on the data were essentially performed in four parts. A multivariate analysis of variance (MANOVA) was performed on the total learning score (i.e. number correct on the paired-associate task) and on the total 'looking behaviour' score (i.e. amount of time spent looking at the environment) for the 3 x 2 x 2 complete factorial design. This analysis tested for hypotheses 1, 2, 3, 4 and 5. A multivariate trend analysis was conducted on the same data to test for the latter parts of hypotheses 1 and 3. In addition, a repeated measures ANOVA was performed on the learning scores where trials was the within factor and a repeated measures ANOVA was also conducted on the 'looking behaviour' scores. The 6 trials were collapsed together in the following manner: trials 1+2, 3+4 and 5+6.

The verbal learning score was obtained by counting the number of paired-associates the S had recognised correctly on each trial. The attention score was obtained by counting each or part of each 5 second interval the S spent in looking at the environment as a score of 1. Thus, if the S spent the whole trial of 2 minutes looking at the environment, he would receive a score of 24 whereas the S who spent the same 2 minutes attending to the task would receive a score of zero.

Hartley's Fmax test was used to test for homogeneity of variance. Although within group variances were large for both dependent measures, i.e. verbal learning and looking behaviour, between group variances proved to be homogeneous.

Hypothesis 1.

The predicted effect of environmental complexity on verbal learning was found to be reliable with the means ordered as predicted: LC > MC > HC. The means for the verbal learning score for all 12 cells are in Table VII (note: see Appendix I for the raw scores). The multivariate test (Table VIII) for paired-associate learning and looking behaviour was reliable ($F = 3.09$, $df = 4, 94$, $p < .019$). The univariate test of the total number of paired-associates correct over the three environmental complexity conditions was reliable ($F = 4.07$, $df = 2, 48$, $p < .023$) although the effect accounted for only 9.5 percent of the variance.

The predicted linear relationship between environmental treatment and verbal learning performance was confirmed i.e. LC > MC > HC. The relationship is plotted in Figure 11 where the means are representative of the 20 Ss per treatment. The multivariate test for a quadratic trend was not significant and neither was the univariate test for quadratic trend for the verbal learning scores. However, the multivariate test for a linear trend was reliable ($F = 6.46$, $df = 2, 47$, $p < .003$). The predicted linear function was confirmed at the univariate level for learning performance ($F = 8.11$, $df = 1, 48$, $p < .006$); the effect accounted for 9.5 percent of the variance (Table VIII).

Hypothesis 2.

The predicted main effect of grade was confirmed. The older Ss

TABLE VII

MEANS AND STANDARD DEVIATIONS OF THE TOTAL NUMBER CORRECT ON THE PAIRED-ASSOCIATE TASK

Grade	Sex		LC	MC	HC
3	F	Mean	40.40	38.00	30.20
		S.D.	8.47	3.61	4.44
3	M	Mean	39.80	41.00	35.40
		S.D.	8.50	8.28	10.92
5	F	Mean	47.80	46.00	44.60
		S.D.	6.38	5.39	7.54
5	M	Mean	50.80	47.20	44.00
		S.D.	5.07	6.72	5.92
3+5	F+M	Mean	44.70	43.50	38.55

TABLE VIII

MANOVA AND TREND ANALYSIS OF THE MEAN EFFECTS OF ENVIRONMENTAL COMPLEXITY, GRADE, AND SEX ON THE NUMBER OF CORRECTLY RECOGNISED PAIRED-ASSOCIATES ON THE VERBAL LEARNING TASK AND ON THE NUMBER OF 'TICKS' SPENT IN ATTENDING TO THE ENVIRONMENT.

		Total paired-associate score over 6 trials				Total looking behaviour score over 6 trials				Multivariate test		
Source	DF	MS	F	P	eta^2	MS	F	P	eta^2	DF	F	P
Complexity(C)	2	202.65	4.07	.023	.095	880.72	1.86	.166	.06	4/94	3.09	.019
Linear	1	403.25	8.11	.006	.095	1674.52	3.55	.066	.06	2/47	6.46	.003
Quadratic	1	2.06	< 1	--		86.91	< 1	--		2/47	< 1	--
Grade(G)	1	1288.06	25.90	.001	.30	714.15	1.51	--		2/47	14.41	.001
Sex(S)	1	52.27	1.05	--		16.02	< 1	--		2/47	< 1	--
C x G	2	24.22	< 1	--		105.35	< 1	--		4/94	< 1	--
C x S	2	1.72	< 1	--		402.82	< 1	--		4/94	< 1	--
G x S	1	6.67	< 1	--		934.15	2.08	--		2/47	1.04	--
C x G x S	2	.82	< 1	--		120.05	< 1	--		4/94	< 1	
Error	48											

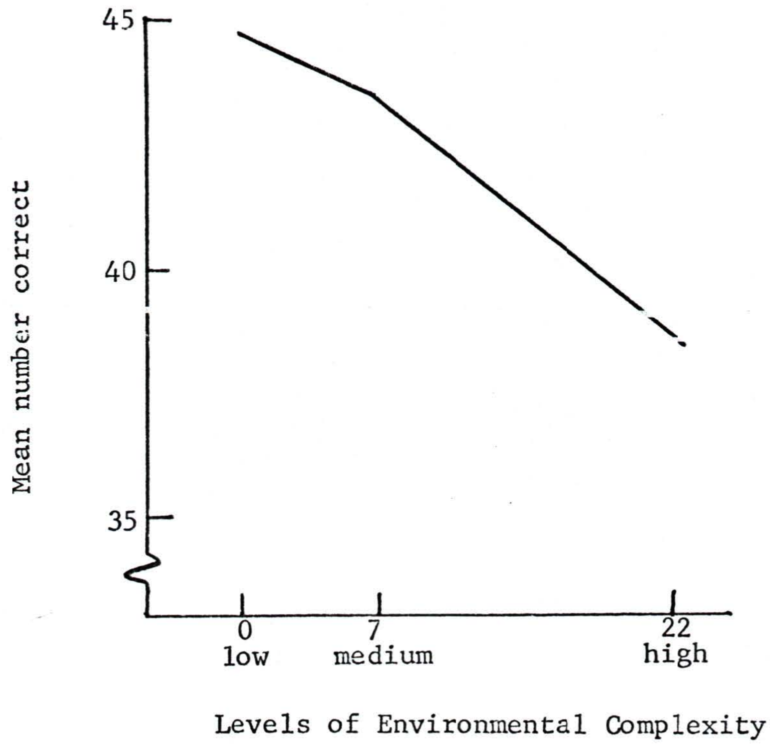

Fig. 11. Mean number of paired-associates correct on the verbal learning task over the three environmental complexity treatments with n = 20.

(Grade 5) obtained significantly higher learning scores than the Grade 3 Ss. The means for the two groups may be compared in Table VII. Figure 12 illustrates the relationship between the two groups. The multivariate F test was reliable (F = 14.41, df = 2, 47, $p < .001$) and the univariate F test was significant (F = 25.90, df = 1, 48, $p < .001$). This effect accounted for 30 percent of the variance.

Hypothesis 3.

The predicted effect of environmental treatment on looking behaviour was not confirmed. The means for the looking behaviour score for all 12 cells may be seen in Table IX (note: the raw scores are in Appendix J). Although the multivariate F test was reliable, the univariate F test was not (F = 1.86, df = 2, 48, $p < .166$), the effect accounting for a mere 6 percent of the variance.

The predicted relationship between environmental treatment and looking behaviour performance was not clearly confirmed i.e. HC > MC > LC. Although the multivariate F was reliable, the univariate test for a linear trend was only marginal (F = 3.55, df = 1, 48, $p < .066$). However, the result showed a tendency toward the predicted linear trend although the percentage of variance (i.e. 6 percent) associated with the effect was very low. There was no evidence of a quadratic trend in the data on attention performance (Figure 13).

Hypothesis 4.

The predicted grade effect with regard to looking behaviour performance was not confirmed. The Grade 5 Ss did not attend any less

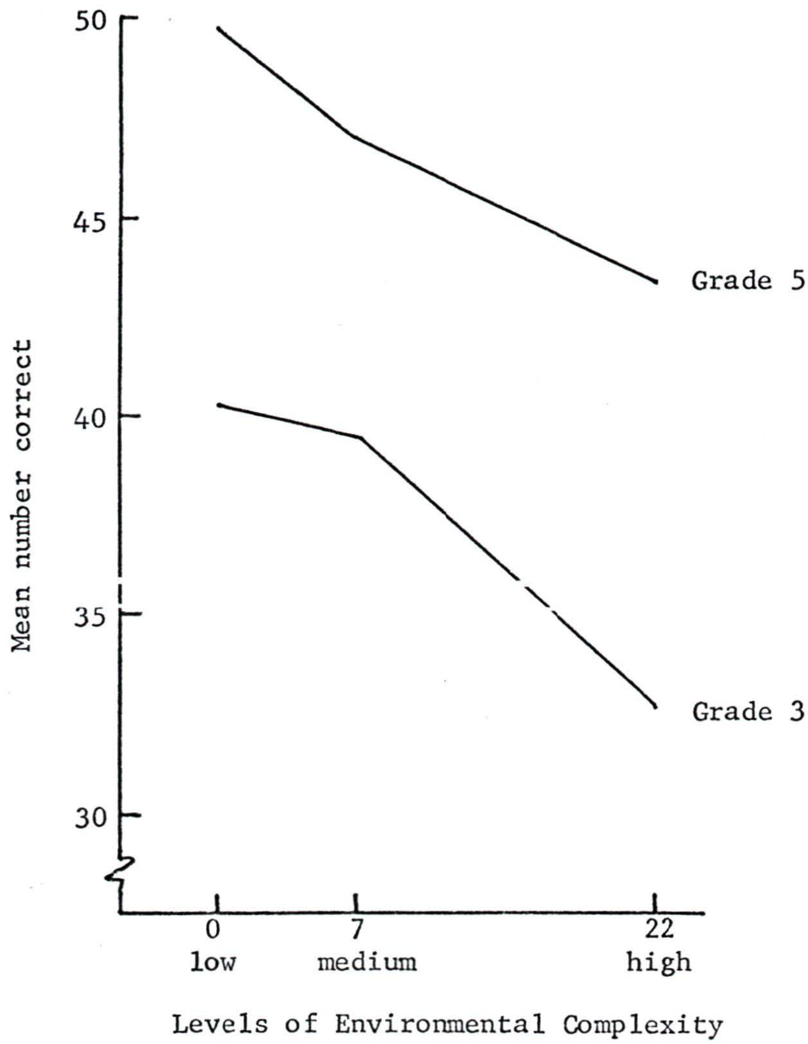

Fig. 12. Mean number of paired-associates correct on the verbal learning task over the three environmental complexity treatments for grade 3 and grade 5 subjects.

TABLE IX

MEANS AND STANDARD DEVIATIONS OF THE TOTAL 'LOOKING BEHAVIOUR' SCORE

Grade	Sex		LC	MC	HC
3	F	Mean	39.80	38.40	35.20
		S.D.	24.92	17.10	25.78
3	M	Mean	38.00	38.80	57.80
		S.D.	34.32	22.69	22.65
5	F	Mean	35.20	35.00	46.80
		S.D.	22.99	25.47	15.40
5	M	Mean	20.40	27.00	42.20
		S.D.	7.93	19.31	5.89
3+5	F+M	Mean	33.35	34.80	45.50

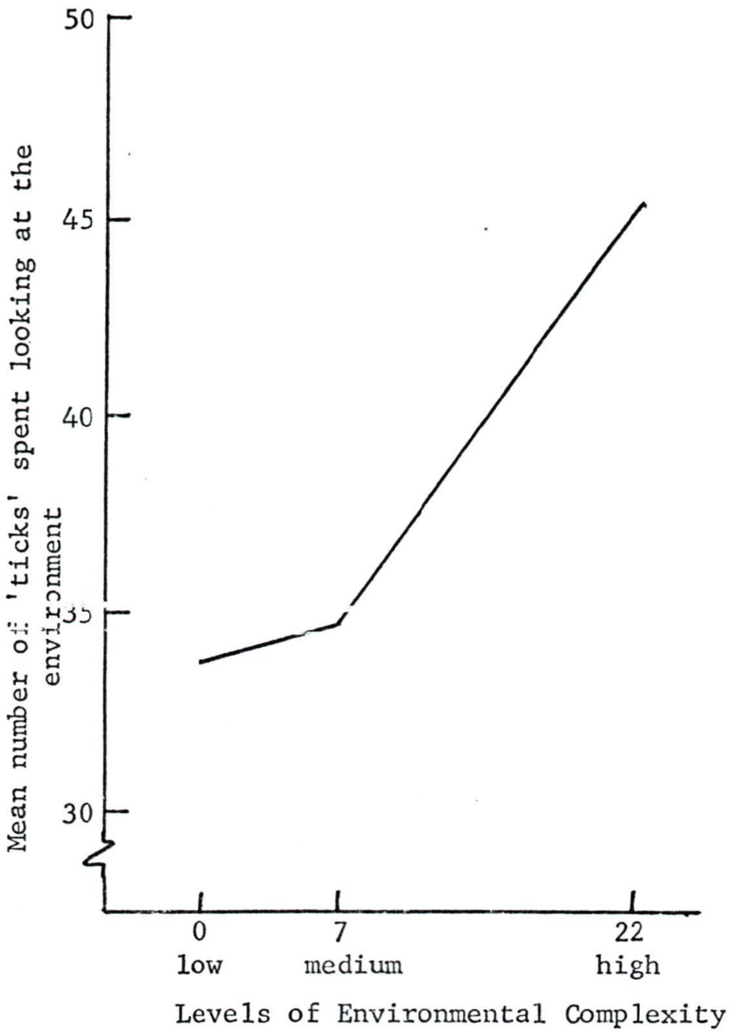

Fig. 13. Mean number of 'ticks' (approximation to time) spent in looking at the environment for each environmental complexity treatment with n = 20.

to the environment than the Grade 3 children although the means in Table IX show that the mean looking behaviour scores are generally lower for Grade 5 children. There was one exception in the HC where Grade 3 females had a lower mean looking behaviour score (35.2) than both Grade 5 females (46.8) and males (42.2). The means are plotted in Figure 14. Although the multivariate test for grade was reliable, the univariate test for grade on looking behaviour performance was not reliable.

Hypothesis 5.

The predicted inverse relationship between the two dependent measures (i.e..the total learning score and the total looking behaviour score) was not confirmed. The correlation between the two variables was, in fact, r = .125.

Repeated Measures ANOVA

Analysis (ANOVA for repeated measures) of paired-associate learning performance over trials showed that the means for the three sets of trials differed significantly (F = 153.58, df = 2, 96, $p < .001$). The means for each experimental condition over trials are in Table X and are plotted in Figure 15. The latter figure demonstrates, that in all cases, paired-associate learning performance increased over trials. No higher order interactions were significant except for the trials x complexity x grade x sex interaction which approached an acceptable level of reliability (F = 2.38, df = 4, 96, $p < .057$). The analysis is tabulated in Table XI. The means for the interaction are shown in

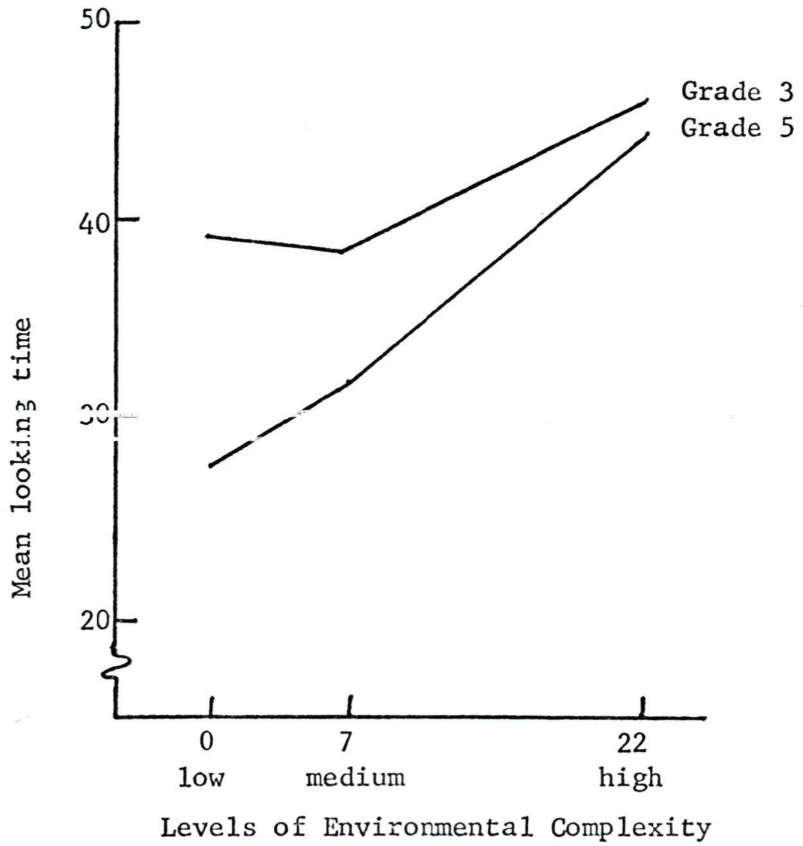

Fig. 14. Mean number of 'ticks' (time approximation) spent in looking at each environmental complexity treatment for each grade level.

TABLE X

MEANS FOR TRIALS 1+2, 3+4, 5+6, FOR COMPLEXITY-GRADE-SEX TREATMENTS FOR THE VERBAL LEARNING SCORE.

Complexity	Grade	Sex	Trials 1+2	Trials 3+4	Trials 5+6
Low	3	F	11.60	13.80	15.00
		M	9.00	15.00	15.80
	5	F	12.60	16.60	18.60
		M	13.40	18.20	19.20
Low	3+5	F+M	11.65	15.90	17.15
Medium	3	F	9.80	12.60	15.60
		M	9.40	15.20	16.40
	5	F	12.40	15.80	17.80
		M	11.80	16.60	18.80
Medium	3+5	F+M	10.85	15.05	17.15
High	3	F	5.40	10.40	14.40
		M	9.80	12.60	12.80
	5	F	11.20	15.60	17.80
		M	10.20	16.20	17.60
High	3+5	F+M	9.15	13.17	15.65

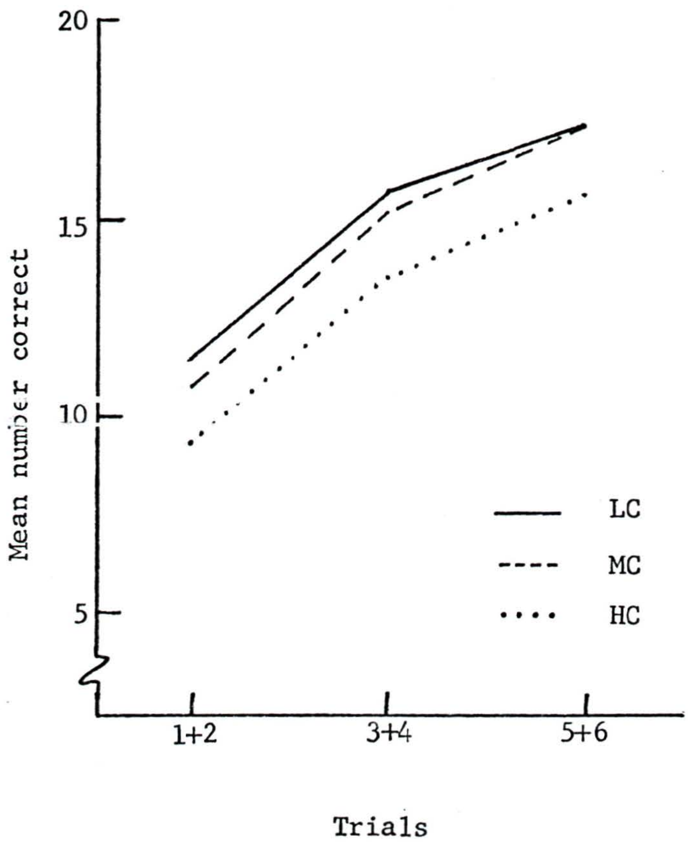

Fig. 15. Mean number of paired-associates correct on the verbal learning task over trials for the three environmental complexity treatments.

TABLE XI

REPEATED MEASURES ANALYSIS OF VARIANCE OF THE VERBAL LEARNING SCORE FOR COMPLEXITY-GRADE-SEX TREATMENTS FOR TRIALS 1+2, 3+4, AND 5+6.

Source	DF	SS	MS	F	P
Subjects	59	1422.19			
Complexity(C)	2	137.48	68.74	4.14	.022
Grade (G)	1	432.45	432.45	26.02	.000
C x G	2	16.90	8.45	< 1	--
Sex(S)	1	16.81	16.81	1.01	--
C x S	2	1.01	0.51	< 1	--
G x S	1	2.01	2.01	< 1	--
C x G x S	2	17.81	8.91	< 1	--
Error	48	797.73	16.62		
Trials (T)	2	1182.18	591.09	153.59	.000
T x C	4	6.96	1.74	< 1	--
T x G	2	2.53	1.27	< 1	--
T x C x G	4	3.87	0.97	< 1	--
T x S	2	17.91	8.96	2.33	--
T x C x S	4	28.62	7.16	1.90	--
T x G x S	2	4.58	2.29	< 1	--
T x C x G x S	4	36.56	9.14	2.38	.057
Error	96	369.47	3.85		

Table X and are plotted in Figure 16.

Analysis (ANOVA for repeated measures) of looking behaviour performance over trials showed that the means for the three sets of trials differed significantly ($\underline{F}$ = 7.43, $\underline{df}$ = 2, 96, $p < .001$). No other effect in this analysis was reliable. The means are shown in Table XII and are plotted in Figure 17.

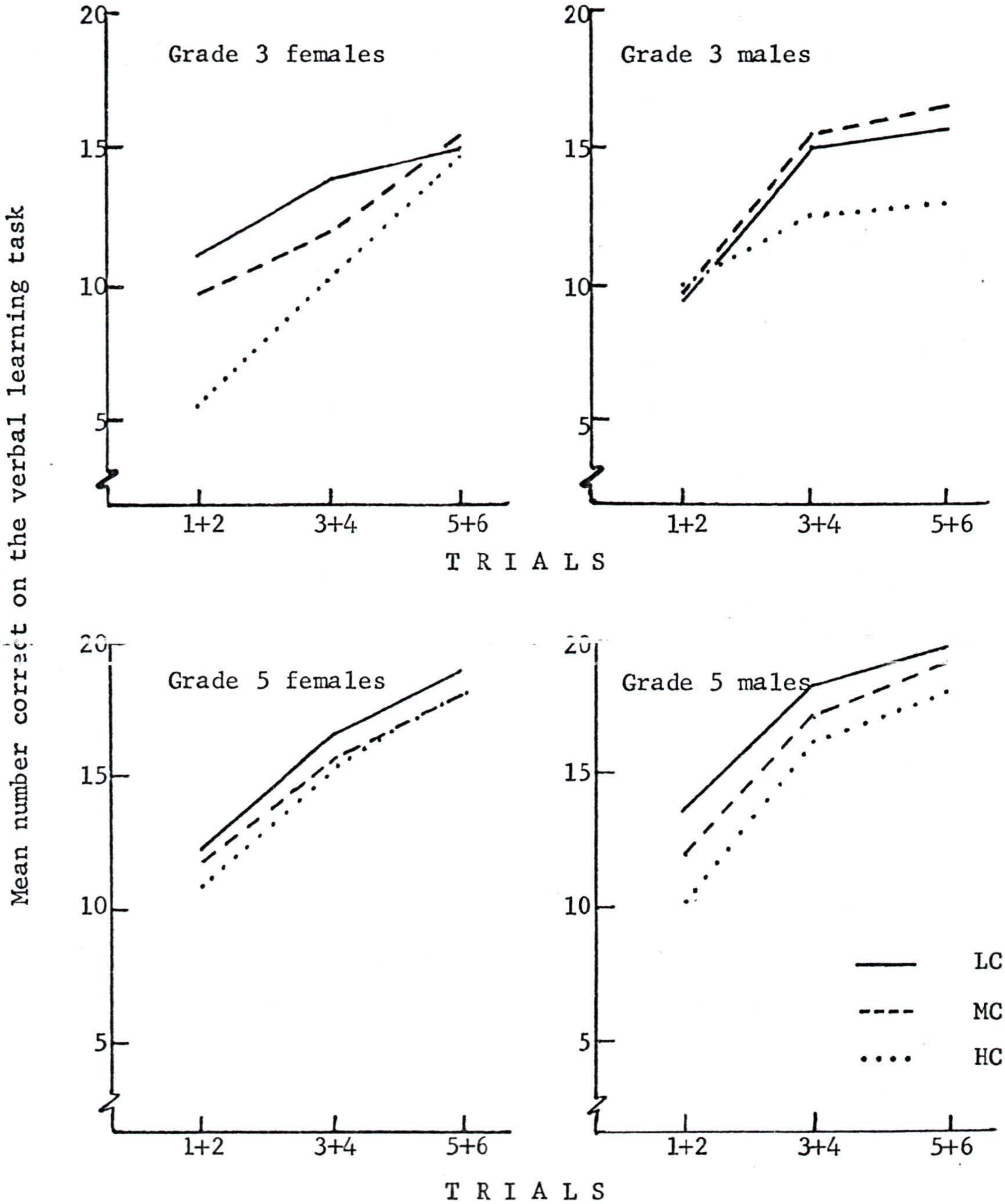

Fig. 16. The Trials x Complexity x Grade x Sex Interaction. Mean number correct on the verbal learning task over trials for the three environmental complexity treatments.

TABLE XII

MEANS FOR TRIALS 1+2, 3+4, 5+6, FOR COMPLEXITY-GRADE-SEX TREATMENTS FOR THE LOOKING BEHAVIOUR SCORE.

Complexity	Grade	Sex	Trials 1+2	Trials 3+4	Trials 5+6
Low	3	F	12.60	11.40	15.80
		M	6.00	14.20	17.80
	5	F	8.60	12.40	14.20
		M	8.40	5.60	6.40
Low	3+5	F+M	8.90	10.90	13.55
Medium	3	F	14.80	11.20	12.40
		M	11.00	14.80	13.00
	5	F	11.80	10.60	12.60
		M	8.60	9.20	9.20
Medium	3+5	F+M	11.55	11.45	11.80
High	3	F	10.20	9.40	15.60
		M	15.60	17.80	24.40
	5	F	17.00	10.80	19.00
		M	10.00	14.00	18.20
High	3+5	F+M	13.20	13.00	19.30

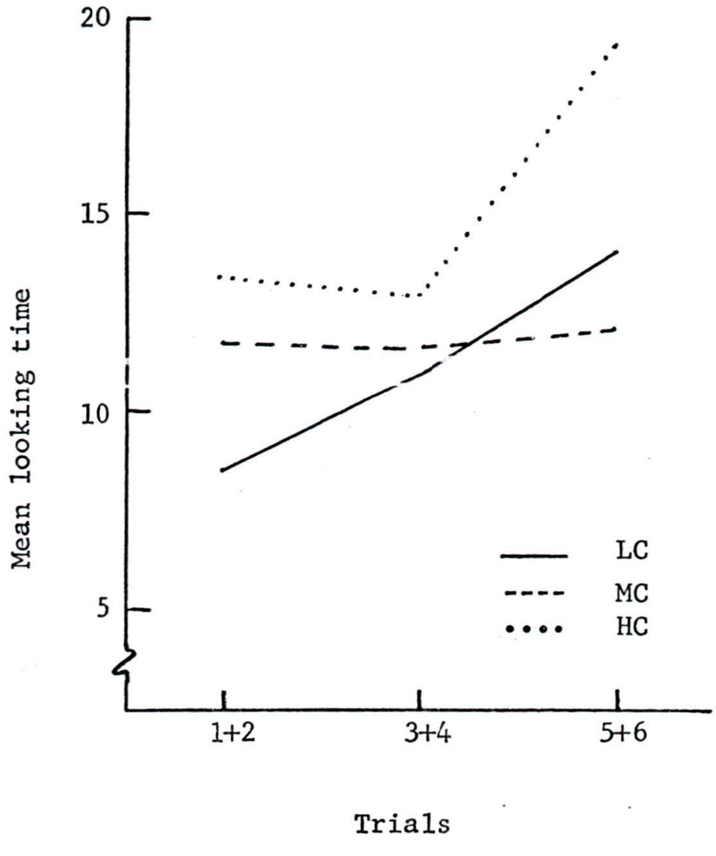

Fig. 17. Mean number of 'ticks' per pair of trials over the three environmental complexity treatments.

EXPERIMENT II: DISCUSSION

Hypothesis 1.

The predicted effect of environmental complexity on verbal learning performance was confirmed. Subjects in the LC performed better than Ss in the MC who, in turn, performed better than Ss in the HC. In other words, as environmental complexity increased, performance on the paired-associate task decreased. The trend was in accordance with the prediction that LC > MC > HC.

This result supports Trabasso's statements and indicates that physical environmental distractors function in a similar manner to task distractors. The implications of these findings for rote learning tasks is clear. Classroom environments could be manipulated to facilitate learning by reducing environmental complexity. Further studies should reveal a) the relationship between environmental complexity variables and other types of learning, b) the effects of social as well as physical environmental variables on the learning process and c) the long-term effects of physical environmental variables on learning.

The environmental complexity effect accounted for a small proportion of the variance in comparison to the grade effect which accounted for 30 percent of the variance. The fact that the experimental manipulations accounted for less than 50 percent of the variance indicates that some extraneous variables were entering into the experimental situation.

Hypothesis 2.

Grade 5 children did perform better than Grade 3 children. This result confirms a simple developmental hypothesis that older children will generally learn more material or information than younger children when given the same amount of study time. This superiority is probably a combination of the more task-oriented behaviour of the older child and his more developed cognitive abilities. Inspection of Figure 12 showed that Grade 5 Ss did not appear to be so strongly influenced by the HC as did the Grade 3 children.

Hypothesis 3.

The predicted relationship between 'looking behaviour' and experimental treatment was not confirmed although the trend analysis and Figure 13 demonstrate that the means are ordered in the predicted direction with the LC < MC < HC. However, the LC group and the MC group attended to the task for about the same amount of time while the HC group spent an average of approximately 50 seconds (10 ticks) more in looking at the room and its contents.

The 'looking behaviour' measure was statistically unreliable. This result could indicate that complexity did not affect 'looking behaviour' or alternatively it could indicate that the measure taken was inaccurate. The latter explanation could be offered for two reasons: firstly, the measure was only approximate (i.e. 1 tick = 1 to 5 seconds) and secondly, the children could have been rehearsing the paired-associates while looking about the room with the consequent effect that the measure was not clearly related to attention.

Hypothesis 4.

There was no reliable statistical difference between the 'looking behaviour' of the two grade groups. However, Grade 5 Ss' means were consistently below the means of Grade 3 Ss (see Figure 14). Attention performance differed more between the grades in the LC and in the MC but were almost identical in the HC. These results indicate that the novelty of the experimental situation was more important to the younger Ss.

Hypothesis 5.

The lack of relationship between 'looking behaviour' and learning is shown in the correlation coefficient $r = .125$. Thus, there appears to be no consistent pattern between learning performance and amount of time spent attending to the task. In other words, children who perform well on the paired-associate learning task do not necessarily attend less to the environment although Figures 11 and 13 show that the means are in the predicted order.

The findings are not detrimental to Trabasso's statements because stimulation from the contents of the room could have interfered with the learning process when the child was gazing about the room yet rehearsing the paired-associates. It could be postulated that in the LC room the learning process would not be so severely interfered with as compared to the HC room where the stimulus materials probably acted as distractors even when the child demonstrated the same amount of 'rehearsing/looking about the room behaviour' as the child in the LC room.

Repeated Measures ANOVA.

Paired-associate learning performance increased reliably over all three experimental conditions (Figure 15). The order LC > MC > HC held over trials although the LC group and the MC group were performing at the same level by the last two trials (5+6). This result could have occurred for one of three reasons: a) environmental complexity does not have a long-term effect on learning performance; b) the LC and the MC were not sufficiently different to produce long-lasting effects; and c) the task was too easy and therefore environmental variables were of little importance. The only solution to the problem would be to conduct a study where task difficulty was increased and the number of trials extended.

The trials x environmental treatments x grade x sex interaction was reliable. Inspection of Figure 16 showed that Grade 5 Ss generally performed better than Grade 3 Ss; there was little overlap between the two except in one instance where Grade 5 in the HC (both males and females) performed less well than Grade 3 females in the LC. Grade 5 performance demonstrated a consistent pattern while Grade 3 groups performed more diversely. This may indicate that the Grade 3 Ss were more affected by the environmental manipulation than were the Grade 5 Ss. This statement, however, has to be somewhat modified after close examination of Figure 16.

Grade 5 males in the MC performed as well as Grade 5 females in the LC, and Grade 5 females in the MC performed no better than the Grade 5 *S*s (both male and female) in the HC except on the initial trials. This indicates that the Grade 5 *S*s were generally less influenced by the levels of environmental complexity, especially after the initial trials. Figure 16 demonstrates the close relationship between the groups; Grade 5 males and females have the same performance pattern.

Grade 3 groups of *S*s performed more diversely. There was, in fact, a reversal in performance pattern between the males and females (see Figure 16). The males initially performed similarly in all three treatment conditions but performance diverged over trials; the reverse was true for the females where initial performance was divergent and converged over trials. The statement made earlier that Grade 3 *S*s were more influenced by environmental manipulations is true except the sex interaction confuses the conclusion because the male and female performance patterns are opposed. However, it must be noted that there is no main effect for sex nor is there any trials x sex interaction.

<u>Summary</u>

The main theme under investigation i.e. the relationship between environmental complexity and learning was, in general, confirmed. The result, although accounting for a small proportion of the variance, was statistically reliable. The repeated measures analysis showed that males and females (at least at Grade 3 level) were not affected by environmental complexity in the same fashion. Males and females, however, did not perform differently on the total learning score. The results do not supply an absolute confirmation for the major point at issue but supply indicators for further investigation of the hypothesis. The looking behaviour measure proved to be unreliable and was, perhaps, an inaccurate measure of attention. Unfortunately, assessment of overt behaviour does not necessarily estimate covert behaviour.

Chapter IV

GENERAL DISCUSSION

This discussion, structured for the sake of clarity in terms of the two experiments, deals with three major areas. These are: a) the relative merits of the experimental design, b) the application of the findings, and c) implications for future research. In view of their strong interrelationships, these areas are not discussed separately but in conjunction.

The results of Experiment I demonstrated that the physical built environment can be assessed in terms of complexity in the same manner as random patterns or slides of environments. To date, techniques of assessing visual complexity have been confined primarily to random pattern stimuli. Wohlwill (1968) and Kaplan and Wendt (1972) made the necessary link between complexity and 'real-life' stimuli. However, the present investigation extended the examination of visual complexity from the card or slide stimulus to the total built environment. Although not all results were statistically reliable, most of them indicated that the environments differed and that this difference was due to Berlyne's (1960) collative variable 'complexity'. The assessment technique had necessarily to be indirect, as Berlyne (1967) pointed out and as was mentioned in chapter I above.

On the basis of Berlyne's (1966) data it might be expected that the more complex environment would be the most preferred (so long as it was not overly complex) and, in semantic differential terms, the most evaluated, active, and potent. It could also be argued that a number of Kasmar's items assess a complexity-simplicity dimension, such as 'full-empty' and 'ornate-plain'.

In a future investigation of this nature it may be advisable to have each element (each poster, mobile, etc.) assessed as well as the assessment of the environments *in toto*. The contrast between the low complexity room and the high complexity room was clear insofar as the former contained no decorative elements while the latter contained many. The MC was a more difficult level to determine for a different combination of the stimulus materials might have induced a different rating. This problem, however, was overcome in Experiment II, where the elements for each two successive *S*s for the MC were randomly selected from all of the stimulus materials in the HC. Thus the results are more generalizable for the MC than if there had been only one group of stimuli. Furthermore, in future research it would be desirable for all environmental complexity levels to be judged by each subject rather than by the paired-comparison procedure used in the present study. The procedure used here was unfortunately necessitated by equipment constraints.

The selection of environmental complexity levels is arbitrary at this stage of investigation because a) there are no data of this nature on which to base any selection of environmental complexity levels, and b) the equipment restricted the amount of visual material that could be introduced into the rooms. Nevertheless, the environmental levels could be more diversified; stimulus materials representing other sensory modes, e.g. auditory, could be introduced into the paradigm. It was decided, because of the lack of data, that the investigation should be limited to the use of one sensory mode only. It is notable that visual materials are used widely in the classroom environment.

The selection of the MC level, as pointed out above, was somewhat arbitrary. The lack of guidelines and the desire to distinguish between the MC and the HC, induced the usage of an MC level which was not representative of the mid-line values between the LC and the HC. The MC was, in fact, closer to the LC so far as number of elements it contained although behavioural effects were unknown. It would be informative to conduct a rating study on a wide range of environmental levels. The results of Experiment II showed that the MC affected verbal learning more like the LC than the HC, which indicates that the psychological mid-line values were not, in fact, represented. It would have been valuable to have had a fourth level of environmental complexity (i.e. eight posters, three mobiles and three rugs).

However, the present investigation was not undertaken primarily to determine levels of environmental complexity but to assess the effects of such levels on cognitive performance. In these terms, Trabasso's statements have been substantiated, although before any sound conclusion could be drawn the result demonstrated in the present investigation would have to be replicated, preferably using more environmental treatment levels. The linear relationship between environmental complexity and learning is not necessarily contradictory to Berlyne's inverted U-function because the levels of complexity sampled could have been representative of only a portion of the inverted U curve. The results are contradictory to Berlyne's suppositions if the levels are construed as representative of the inverted U-function, because the children performed best in the LC. According to Berlyne they should perform best at some point between the LC and the HC. However, the children in the LC were far from sensorily deprived, the whole experiment lasting for a 30-40 minute period. This could be overcome, however, by manipulating exposure time to the environmental conditions or by some adaptation procedure which could be applied to assess the relative effects of environmental complexity.

Based on incidental observation, the one-way windows were a substantial source of stimulation in all conditions. The *S*s were stimulated by their own reflections. In future investigations the one-way windows could be wholly or partially covered so as to reduce the stimulation they provide.

An alternative argument may be proffered to that utilised above for the inverted U-function explanation. The experimental situation *per se* may have been so exciting and novel for the children that their level of arousal was already at an optimum for efficient learning in the LC. The addition of environmental complexity in the MC and especially in the HC may have combined with the already high arousal state to produce deleterious effects on learning.

The argument that children will adapt to their surroundings so well that environmental variables become unimportant has to be considered. To date, there is little empirical evidence to support or negate the argument. A long-term classroom investigation would be one alternative to considering the problem while adaptation studies should give insight into the effects of the experimental situation. Such studies could manipulate the length of time the child was exposed to the environment before the learning program had to take place or alternatively the child could be exposed to the mobile laboratory prior to the experiment so that the mystery and novelty of the total experimental situation would be reduced.

The results from Experiment II are not only applicable at the educational level but are of interest in light of Rosenthal's (1966) comments on the 'experimenter effect'. If environments do have a substantial effect on behaviour then a good proportion of published results would have to be restricted in their generality.

The children were aware of the rooms and their contents. The questionnaire results (Appendix H) demonstrated clearly that the children remembered the room's contents accurately. However, such awareness could have been induced by subject communication. Horka and Farrow (1970) demonstrated that children do communicate the details of experimental procedure. However, they used rewards in their experiment; this alone may have accounted for the type of results they found. Nevertheless, the possibility that the children communicated the procedure has to be entertained. Such communication was doubted because of the heavy emphasis which was placed on the learning task and observation of the children did not yield any child making a pointed memorization of the environmental elements. Each two successive subjects were shown different environments which would contribute a certain element of uncertainty about the environments even if communication between the subjects had occurred. The children appeared to be unaware that the room and its contents were part of the experimental manipulation.

The finding by Horka and Farrow could also be applied to the paired-associate learning aspect of the experiment. It is doubted that the Ss would retain much information after the experiment because children had to recognise rather than recall the task. Also children appeared to be remarkably honest; two children volunteered the information that they had been told one of the pairs. They were excluded from the study.

Based on Runquist's (1966) statements, the paired-associates used in the present study were far from perfect. It is likely that many of the Ss already knew 'BULL-TORO' and an obvious association could be made between 'RAT-RATA'. These objections are not serious in light of the fact that all Ss (reported in Experiment II: Method, above) had received some exposure to the Spanish language (in the form of Sesame Street) and that children in the normal classroom learning situation may make such associations and use any experience they may have previously acquired in the learning process. The quality and quantity of experience the S brings to the experimental situation cannot be completely controlled. However, two controls were imposed: the extremely bright and dull children were excluded from the study; and all the children with a speaking and reading knowledge of any romance language were excluded.

Two major criticisms of the present investigation are: a) that assessment of verbal learning was carried out once only, and b) that the environmental manipulation was artificial in comparison with the true classroom situation, where the child has to combat both sensory and social stimuli. With regard to the first criticism, studies by Kleinsmith and Kaplan (1963) and Kleinsmith, Kaplan, and Tarte (1963) indicate that the long-term effects of environmental complexity may need to be assessed. If it is assumed that complexity induces an arousal state, then the Kleinsmith et al. studies have to be taken into consideration. They found that paired-associates learned under low arousal exhibited high immediate recall and rapid forgetting, while paired-associates learned under low arousal exhibited low immediate recall and a high permanent memory. They argued that "the question arises as to the generality of the inverted U-relationship between arousal and learning" (p. 396).

However, the Kleinsmith et al. studies were not entirely reliable because arousal level was determined by the subject's skin conductance or GSR. Berlyne and Lewis (1963) noted: "Decreases in skin resistance are widely recognised as sensitive, but of course far from perfect, indices of rises in arousal" (p. 404). In other words, arousal was not manipulated in any way in the Kleinsmith et al. studies.

With regard to the second criticism, Sommer (1968) pointed out, "From a student's eye-level, the world is cluttered, disorganised, full of people's shoulders, heads and body movements" (p. 99). White (1966) also pointed out that "most learning does not take place in an environment free from distractions, without other people, with stimuli of standard design occurring at a fairly constant locus" (p. 95). White's comments suggest two further approaches to assessing environmental complexity in more 'real-life' terms. Firstly, more than one individual could be tested in an experimental design identical to the present one and secondly, complexity could be manipulated more dynamically i.e. a change in environmental complexity _per se_ could take place but using the same subjects.

However, Busse et al. in a live classroom situation found that enrichment of the environment in terms of play and instruction materials did not improve the perceptual and cognitive capacities of 'enriched' groups over non-enriched groups. It cannot be argued that the enriched group adapted because on a number of measures the control groups were superior.

In conclusion, the major recommendation resulting from the present study is that extensive research needs to be undertaken to determine the nature of the effects of the classroom environment on the cognitive performance of the child. There is a marked absence of any empirical data in this field and the present investigation is but a beginning.

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Appendix A

Semantic Differential scale for adults.

Pleasant	:	:	:	:	:	:	:	:	Unpleasant
Disorganised	:	:	:	:	:	:	:	:	Systematic
Empty	:	:	:	:	:	:	:	:	Full
Cheerful	:	:	:	:	:	:	:	:	Gloomy
Familiar	:	:	:	:	:	:	:	:	Strange
Ornate	:	:	:	:	:	:	:	:	Plain
Bad	:	:	:	:	:	:	:	:	Good
Strong	:	:	:	:	:	:	:	:	Weak
Uncluttered	:	:	:	:	:	:	:	:	Cluttered
Sharp	:	:	:	:	:	:	:	:	Dull
Large	:	:	:	:	:	:	:	:	Small
Repelling	:	:	:	:	:	:	:	:	Inviting
Heavy	:	:	:	:	:	:	:	:	Light
Passive	:	:	:	:	:	:	:	:	Active
Comfortable	:	:	:	:	:	:	:	:	Uncomfortable
Fast	:	:	:	:	:	:	:	:	Slow
Beautiful	:	:	;	:	:	:	:	:	Ugly
Untidy	:	:	:	:	:	:	:	:	Tidy
Simple	:	:	:	:	:	:	:	:	Complex
Unattractive	:	:	:	:	:	:	:	:	Attractive

Appendix A

Semantic Differential scale for children

Plain	:	:	:	:	:	:	Fancy
Empty	:	:	:	:	:	:	Full
Beautiful	:	:	:	:	:	:	Ugly
Large	:	:	:	:	:	:	Small
Untidy	:	:	:	:	:	:	Tidy
Good	:	:	:	:	:	:	Bad
Dull	:	:	:	:	:	:	Bright
Cheerful	:	:	:	:	:	:	Gloomy
Comfortable	:	:	:	:	:	:	Uncomfortable

Appendix B

Scaling questionnaire for adults

1. Did you think those two rooms I just showed you were the

SAME______ or DIFFERENT______

NOTE: If answer to 1. above is the SAME, then probe to see if they are referring to the decor or to the structure of the rooms. Inform them appropriately.

2. How much did the two rooms differ ? Could you rate the difference on a 7-point scale where 1 = 'not at all different' and 7 = 'very different'.

______

2a. I would like you to tell me which room you found the more complex.

FIRST______ SECOND______

Then give me a number from 0-9 indicating the difference in complexity between the two rooms i.e. if you find one much more complex than the other, you would give a number close to 9; if they are both complex or not very complex (i.e. not much difference between the two) then you would give it a low number. ______

2b. I would like you to tell me which room you found the more pleasing.

FIRST______ SECOND______

Then give me a number from 0-9 indicating the difference in pleasingness between the two rooms i.e. if you found one much more pleasing than the other, you would give a number close to 9; if they are both pleasing or not very pleasing (i.e. not much difference between the two) then you would give it a low number. ______

2c. I would like you to tell me which room you found the more interesting. FIRST______ SECOND______

Then give me a number from 0-9 indicating the difference in interestingness between the two rooms i.e. if you found one much more interesting than the other you would give a number close to 9; if they are both interesting or not very interesting (i.e. not much difference between the two) then you would give it a low number. ______

3. What did you notice that was different about the rooms ?

WALLS______ WINDOWS______ FLOOR______ CEILING______

4. Which room did you think had the most 'things' in it ?

FIRST______ SECOND______

5. How many more 'things' did that room have compared to the other ? Could you rate this on a 7-point scale where 1 = 'a very few' and 7 = ' many, many'. ______

6. Can you remember all the 'things' or objects in the first room that you were shown ? Do you remember if there were any posters or pictures on the walls ? YES______ or NO______. If so, then how many were there ? ______

Do you remember if there were any drapes or curtains at the windows ? YES______ or NO______. If so, then what were they like ? ______

Do you remember if there were any rugs on the floor ? YES_____ or NO_____. If so, then how many were there and what colour were they ? __________.

Do you remember if there were any mobiles hanging from the ceiling ? YES_____ or NO_____. If so, then how many were there ? _______.

7. Can you remember all the 'things' or objects in the second room that you were shown ? Do you remember if there were any posters or pictures on the walls ? YES_____ or NO_____. If so, then how many were there ? _______.

Do you remember if there were any drapes or curtains at the windows ? YES_____ or NO_____. If so, then what were they like ? ___________.

Do you remember if there were any rugs on the floor ? YES_____ or NO_____. If so, then how many were there and what colour were they ? __________.

Do you remember if there were any mobiles hanging from the ceiling ? YES_____ or NO_____. If so, then how many were there? _______.

8. Which room would you prefer to: a) study in ? FIRST_____ SECOND_____, b) have a party in ? FIRST_____ SECOND_____.

9. Which room would you like to take another look at ?

FIRST______ SECOND______

Appendix B

Scaling questionnaire for children.

1. Did you think those two rooms I just showed you were the

SAME______ or DIFFERENT______

2. Were the rooms
   1. very different ______
   2. a little bit different ______
   3. not different ______

3. What did you notice that was different about the rooms ?

WALLS______ WINDOWS______ FLOOR______ CEILING______

4. Which room did you think had the most 'things' in it ?

FIRST______ SECOND______

5. How many more 'things' did that room have compared to the other ?
   1. lots and lots ______
   2. many ______
   3. just a few ______

6. Can you remember all the 'things' or objects in the first room that you were shown ? Do you remember if there were any posters or pictures on the walls ? YES_____ or NO_____. If so, then how many were there ? _______.

Do you remember if there were any drapes or curtains at the windows ? YES_____ or NO_____. If so, then what were they like ? __________.

Do you remember if there were any rugs on the floor ? YES_____ or NO_____. If so, then how many were there and what colour were they ? __________.

Do you remember if there were any mobiles hanging from the ceiling ? YES_____ or NO_____. If so, then how many were there ? _______.

7. Can you remember all the 'things' or objects in the second room that you were shown ? Do you remember if there were any posters or pictures on the walls ? YES_____ or NO_____. If so, then how many were there ? _______.

Do you remember if there were any drapes or curtains at the windows ? YES_____ or NO_____. If so, then what were they like ? __________.

Do you remember if there were any rugs on the floor ? YES_____ or NO_____. If so, then how many were there and what colour were they ? __________.

Do you remember if there were any mobiles hanging from the ceiling ? YES_____ or NO_____. If so, then how many were there ? _______.

8. Which room did you like the best ? FIRST______ SECOND______

9. Which room would you like to have as your own room at home ?

FIRST______ SECOND______

10. Which room would you like to do your homework in ?

FIRST______ SECOND______

11. Which room would you like to have your birthday party in ?

FIRST______ SECOND______

12. Which room would you like to take another look at ?

FIRST______ SECOND______

Appendix C

a) Mean ratings of the paired-comparison conditionsby adults for complexity, pleasingness and interestingness.

	Complexity	Pleasingness	Interestingness
LC-MC	5.83	6.00	7.00
LC-HC	7.67	7.83	8.17
MC-HC	6.17	6.00	7.33

b) Correlations between the rated variables on Berlyne's scale.

	Complexity	Pleasingness	Interestingness
Complexity	--	.648*	.565*
Pleasingness	--	--	.538*
Interestingness	--	--	--

* = $p < .01$

Appendix D

Range and Mean Estimates of the Judgement Of the Number of Stimulus Materials

			Posters (0,4,12)	Curtains (0,1,2)	Rugs (0,1,4)	Mobiles (0,1,4)
LC -	Adult	- Range	0-0	0-0	0-0	0-0
		Mean	0	0	0	0
	Child	- Range	0-0	0-0	0-1	0-0
		Mean	0	0	0.08	0
MC -	Adult	- Range	3-5	0-2	0-1	0-2
		Mean	3.92	1	.08	1.08
	Child	- Range	3-10	0-1	0-1	0-2
		Mean	4.00	0.75	.42	1.00
HC -	Adult	- Range	6-12	0-2	0-4	2-4
		Mean	10.00	1.67	2.58	3.58
	Child	- Range	6-20	1-2	0-6	0-8
		Mean	9.66	1.42	1.50	3.17

Appendix E

Training card

WOLF	-	LOBO
CAT	-	GATO
BAT	-	PALO
COW	-	VACA
MULE	-	MULO
DUCK	-	PATO
RAT	-	RATA
BULL	-	TORO
MOLE	-	TOPO
APE	-	MONO

Appendix F

Test card

WOLF - _ _ _ _ _

RAT - _ _ _ _ _

MOLE - _ _ _ _ _

BULL - _ _ _ _ _

APE - _ _ _ _ _

CAT - _ _ _ _ _

DUCK - _ _ _ _ _

COW - _ _ _ _ _

MULE - _ _ _ _ _

BAT - _ _ _ _ _

Appendix G

Looking behaviour scoring sheet

T.1.	a)	---	---	---	---	---	---	---	---
	b)								
	c)								
	d)								
	e)								
T.2	a)								
	b)								
	c)								
	d)								
	e)								

etc. for 6 trials.

a = eyes staring away from task

b = eyes moving about the room

c = eyes and head moving

d = eyes, head and shoulders moving - moving in the seat

e = getting up out of the seat

NOTE: For the purposes of analysis these categories were collapsed together and each 'tick' or approximate 5 seconds not spent attending directly to the task (i.e. looking at the training card) was noted.

Appendix H

Questionnaire administered at the end of Experiment II.

I would like you to tell me what you thought about what we just did.

1. Did you enjoy learning those words ? YES_____ NO_____

2. Did you like the room you were in ? YES_____ NO_____

3. Did you like working in that room or would you have liked to have learned the words in a different kind of room ?
THIS ROOM_____ ANOTHER ROOM_____

4. If ANOTHER ROOM then: What kind of room do you like to work in best? FREE RESPONSE_______________

5. Do you remember if there were any other things in the room besides your desk and chair and my chair ?
Posters_____ IF SO, how many ? __________
Curtains_____ IF SO, how many ? __________
Rugs IF SO, how many ?
Mobiles_____ IF SO, how many ? __________

In MC and HC:

6. Do you think you would have learned better if you had not had pictures and things in the room ? YES_____ NO_____

7. Did all these things bother you while you were trying to learn ?
YES_____ NO_____

In LC:

8. Would you have liked it better if there had been pictures and things in the room ? YES_____ NO_____

Appendix H

Results of questionnaire administered at the end of Experiment II.

1. 59/60 replied YES

2. 59/60 replied YES

3. 52/60 replied THIS ROOM, 4/60 replied ANOTHER ROOM and 4/60 replied DON'T KNOW

4. DON'T KNOW

5. See Table H

6. 9/40 replied YES, 26/40 replied NO, and 5/40 replied DON'T KNOW

7. 5/40 replied YES, 35/40 replied NO

8. 7/20 replied YES, 12/20 replied NO and 1/20 replied DON'T KNOW

TABLE H

RANGE AND MEAN ESTIMATE OF THE JUDGEMENT OF ROOM CONTENT QUANTITY

i.e. NUMBER OF STIMULUS MATERIALS.

			Posters (0,4,12)	Curtains (0,1,2)	Rugs (0,1,4)	Mobiles (0,1,4)
LC	Grade 3	Range	0-0	0-0	0-0	0-0
		Mean	0	0	0	0
	Grade 5	Range	0-0	0-0	0-0	0-0
		Mean	0	0	0	0
MC	Grade 3	Range	2-4	0-1	0-2	1-1
		Mean	3.1	0.8	0.7	1
	Grade 5	Range	2-5	0-1	0-1	0-1
		Mean	3.0	0.8	0.1	0.7
HC	Grade 3	Range	6-20	2-2	0-5	0-4
		Mean	9.8	2	1.8	2.4
	Grade 5	Range	7-10	0-2	0-5	1-4
		Mean	8.6	1.8	2.1	2.4

Appendix I

Learning Scores (Number Correct) On Each Trial, and Trial Totals

Subject	Exptl. Condition	Grade	Sex	1	2	3	4	5	6	Total
1	LC	3	F	7	10	10	10	8	10	55
2	"	"	"	6	7	6	5	7	6	37
3	"	"	"	3	6	8	6	8	8	39
4	"	"	"	3	6	7	4	5	8	33
5	"	"	"	4	6	5	8	7	8	38
6	"	"	M	6	6	8	8	8	8	44
7	"	"	"	3	4	6	5	6	6	30
8	"	"	"	5	7	8	10	10	10	50
9	"	"	"	4	3	8	10	8	10	43
10	"	"	"	3	4	5	7	5	8	32
11	"	5	F	4	7	8	8	8	10	45
12	"	"	"	6	5	8	10	8	10	47
13	"	"	"	4	10	10	10	10	10	54
14	"	"	"	4	7	5	6	7	10	39
15	"	"	"	8	10	10	8	10	10	54
16	"	"	M	6	5	10	8	8	8	45
17	"	"	"	4	10	8	10	10	10	52
18	"	"	"	4	7	8	7	10	10	46
19	"	"	"	6	10	10	10	10	10	56
20	"	"	"	5	10	10	10	10	10	55
21	MC	3	F	3	7	5	8	7	8	38
22	"	"	"	1	7	5	6	6	8	33
23	"	"	"	7	4	6	8	6	8	39
24	"	"	"	6	7	6	7	7	10	43
25	"	"	"	3	4	6	6	8	10	37
26	"	"	M	5	7	8	8	8	10	46
27	"	"	"	4	7	6	8	8	10	43
28	"	"	"	6	5	10	10	10	10	51
29	"	"	"	2	4	6	7	7	7	33
30	"	"	"	5	2	6	7	8	4	32
31	"	5	F	6	10	8	8	7	8	47
32	"	"	"	7	7	10	10	10	10	54
33	"	"	"	6	6	4	7	10	8	41
34	"	"	"	5	8	6	10	10	8	47
35	"	"	"	3	4	8	8	10	8	41
36	"	"	M	8	10	10	10	10	10	58
37	"	"	"	5	5	6	10	10	10	46
38	"	"	"	4	6	10	8	10	10	48
39	"	"	"	5	8	6	7	10	8	44
40	"	"	"	4	4	6	10	8	8	40
41	HC	3	F	1	4	4	5	6	10	30
42	"	"	"	2	3	3	6	6	8	28
43	"	"	"	1	3	7	7	7	6	31
44	"	"	"	2	4	6	4	3	6	25
45	"	"	"	4	3	4	6	10	10	37
46	"	"	M	5	7	3	6	8	6	35

Appendix I (Continued)

Subject	Exptl. Condition	Grade	Sex	1	2	3	4	5	6	Total
47	HC	3	M	2	3	4	4	3	3	19
48	"	"	"	3	5	6	7	4	8	33
49	"	"	"	8	7	7	10	8	8	48
50	"	"	"	4	6	8	8	8	8	42
51	"	5	F	4	6	8	10	8	10	46
52	"	"	"	5	7	8	10	8	10	48
53	"	"	"	8	8	8	8	10	10	52
54	"	"	"	4	6	7	8	10	10	45
55	"	"	"	4	4	6	5	6	7	32
56	"	"	M	4	8	8	8	8	8	44
57	"	"	"	5	5	7	8	8	8	41
58	"	"	"	2	6	7	10	10	10	45
59	"	"	"	4	4	6	7	8	8	37
60	"	"	"	5	8	10	10	10	10	53

Appendix J

Attention Scores (Number of Ticks) on Each Trial, and Trial Totals

Subject	Exptl. Condition	Grade	Sex	1	2	3	4	5	6	Total
1	LC	3	F	11	5	7	13	17	21	74
2	"	"	"	11	10	11	8	12	6	58
3	"	"	"	1	2	3	4	2	8	20
4	"	"	"	8	4	1	2	1	2	18
5	"	"	"	6	5	3	5	6	4	29
6	"	"	M	8	11	11	16	18	23	87
7	"	"	"	0	1	2	6	2	6	17
8	"	"	"	1	2	18	10	17	13	61
9	"	"	"	2	1	2	3	5	4	17
10	"	"	"	1	3	3	0	0	1	8
11	"	5	F	5	6	3	8	6	5	33
12	"	"	"	1	2	0	0	3	0	6
13	"	"	"	0	2	5	15	12	10	44
14	"	"	"	15	7	14	11	10	11	68
15	"	"	"	3	2	3	3	8	6	25
16	"	"	M	11	5	4	0	0	9	29
17	"	"	"	11	2	1	2	0	5	21
18	"	"	"	4	3	4	2	1	5	19
19	"	"	"	1	1	6	8	6	3	25
20	"	"	"	3	1	0	1	2	1	8
21	MC	3	F	10	2	3	4	4	2	25
22	"	"	"	5	10	11	9	13	14	62
23	"	"	"	10	6	3	8	5	5	37
24	"	"	"	17	3	10	2	5	11	48
25	"	"	"	10	1	3	3	3	0	20
26	"	"	M	3	3	2	5	6	7	26
27	"	"	"	4	6	8	7	5	5	35
28	"	"	"	1	3	0	2	1	5	12
29	"	"	"	8	7	6	14	6	9	50
30	"	"	"	6	14	19	11	13	8	71
31	"	5	F	8	3	4	7	5	4	31
32	"	"	"	3	0	2	2	7	5	19
33	"	"	"	11	12	13	8	19	13	76
34	"	"	"	10	6	10	5	3	5	39
35	"	"	"	6	0	0	2	2	0	10
36	"	"	M	5	4	5	9	12	5	40
37	"	"	"	3	12	11	11	7	10	54
38	"	"	"	5	1	2	1	2	0	11
39	"	"	"	3	2	0	0	5	0	10
40	"	"	"	5	3	5	2	2	3	20
41	HC	3	F	1	1	1	0	1	4	8
42	"	"	"	11	1	5	7	6	3	33
43	"	"	"	6	1	2	9	16	12	46
44	"	"	"	5	2	1	1	2	5	16
45	"	"	"	13	10	7	14	16	13	73

Appendix J (Continued)

Subject	Exptl. Condition	Grade	Sex	1	2	3	4	5	6	Total
46	HC	3	M	1	2	1	6	3	9	22
47	"	"	"	1	9	10	15	14	19	68
48	"	"	"	12	14	4	5	14	13	62
49	"	"	"	8	6	12	9	8	11	54
50	"	"	"	15	10	13	14	17	14	83
51	"	5	F	7	8	1	7	7	7	37
52	"	"	"	5	1	8	5	13	7	39
53	"	"	"	7	5	6	18	18	18	72
54	"	"	"	17	10	6	2	7	9	51
55	"	"	"	18	7	1	0	5	4	35
56	"	"	M	3	4	1	13	13	13	47
57	"	"	"	0	12	3	8	2	12	37
58	"	"	"	10	3	5	7	14	9	48
59	"	"	"	7	3	8	10	8	8	44
60	"	"	"	2	6	6	9	4	8	35

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