70-24,501

FENNELL, Geraldine, 1932-
SELECTIVE ATTENTION AND INCIDENTAL LEARNING.

The City University of New York, Ph.D., 1970
Psychology, experimental

University Microfilms, A XEROX Company, Ann Arbor, Michigan

SELECTIVE ATTENTION AND INCIDENTAL LEARNING

by

GERALDINE FENNELL

A dissertation submitted to the
Graduate Faculty in Psychology in
fulfillment of one of the require-
ments for the degree of Doctor of
Philosophy, The City University
of New York.

1970

This manuscript has been read and accepted for the Graduate Faculty in **Psychology** in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

date — Chairman of Examining Committee

date — Executive Officer

Prof. Gertrude Schmeidler

Prof. Phillip Liss

Prof. William F. Oakes

Supervisory Committee

The City University of New York

ACKNOWLEDGEMENTS

I acknowledge with gratitude the guidance of my adviser, Dr. Gertrude Schmeidler, and my committee members, Dr. Phillip Liss and Dr. William Oakes.

I should like to thank Dr. William Paradowski for lending his materials, and Dr. Louis Gerstman for helpful discussions on the dissertation and related topics.

To Dean Harold Proshansky and Dr. William Jenkins I express a special word of appreciation for invaluable encouragement and advice at the early stages of my studies, and I thank Dr. Walter Weiss for giving me the opportunity to take my first courses in psychology.

CONTENTS

		Page
Acknowledgements		i
List of Tables		iv
List of Charts		v
Chapter		
I.	INTRODUCTION	1
II.	EXPERIMENTAL EVIDENCE RELATING TO EASTERBROOK'S "EMPIRICAL GENERALISATION"	11
	A Framework for Review of Easterbrook Related Studies	11
	Task Relevance in the "Defining Experiments"	12
	A Relevance Ordering	16
	1. Task Relevant Cues	18
	a) Size of Visual Field	18
	b) Cue Selection	20
	c) Importance Ordering	21
	d) Discrimination among Cue Elements	22
	2. Cue Task Relevance Indeterminate	26
	3. Non Task Relevant Cues	30
	a) Comment and Studies by Kausler and Colleagues	30
	b) Other INC Learning Studies	42
	4. Miscellaneous Studies	49
	Summary	50
	Review of Easterbrook Related Studies within an Attentional Framework	54
III.	HYPOTHESES AND EXPERIMENTAL DESIGN	61
	Selection of Materials and Instructed Task	61
	Hypotheses	65
	Experimental Design	69
IV.	METHOD	70
V.	RESULTS	76
	1. Analysis of "See Again" and "Interesting" Ratings	76
	2. Analysis of INC Learning Data	82

VI. DISCUSSION 86

Appendices

I Instruction Booklets 92

II Presentation Order for Conditions and Stimuli 103

Bibliography 104

Autobiographical Statement 110

Abstract 112

LIST OF TABLES

Table		Page
1	Mean Ratings on "See Again" Scale for LI and MI Stimuli within Exposure Time	77
2	Mean Ratings on "Interesting" Scale for LI and MI Stimuli within Exposure Time	79
3	Differences in Mean Ratings of LI and MI Stimuli for Berlyne and Paradowski Materials within Exposure Time	81
4	Proportion of Correct Identifications for Six Border Colors	83
5	Analysis of Variance for Correct Border Color Identifications	85

LIST OF CHARTS

Chart		Page
I	Key Features of Kausler et al. and Related Studies	40
II	Effect of Arousal on Cue Use Range (INC Learning)	41

I. INTRODUCTION

In his commerce with the environment, an individual may come to know more about that environment than is essential for the task in hand. Tolman (1948) discussed this phenomenon in terms of broad and narrow cognitive maps, and suggested a number of variables which would be likely to contribute to map size:

> "...narrow strip maps rather than broad comprehensive maps seem to be induced: (1) by a damaged brain, (2) by an inadequate array of environmentally presented cues, (3) by an overdose of repetitions on the original trained-on path and (4) by the presence of too strongly motivational or of too strongly frustrating conditions." (p. 207)

A small change of emphasis in what Tolman was saying sees the organism, human or animal, moving in an environment filled with potential stimulation, responding to some stimuli and not responding to others, and further, as Tolman suggested, exhibiting different selection criteria with changing states and needs.

The problem to which this paper addresses itself is one of identifying some of the variables which may determine this informational interaction between organism and environment. On the one hand is an organism equipped with sensory apparatus and information processing mechanisms, equipment shared by other members of its species. But at the same time it carries with it its own particular residue of previous experience which makes it not entirely identical to its fellows. On the other side is an environment of potential stimuli, some of which are so forceful as to compel response, and some of which wait, as it were, to be noticed.

What, then, are the laws which regulate and bring order to this state of affairs? The problem as expressed here has not received systematic study to any extent, although there are interesting contributions to certain aspects of it in the psychological literature. In this paper it is proposed to trace theoretical comment and experimentation relating to one line of approach which may be said to originate in the paper of Tolman's (1948) quoted above. Even within this limited scope it will be seen that the problem has many ramifications, and an experiment relating to one small aspect will also be presented.

"Cognitive Maps", "Breadth of Learning" and "Range of Cue Utilisation"

The particular aspect of the question just posed which will be discussed here has received some theoretical treatment in four *Psychological Review* articles, spanning a period of twelve years. Bruner, Matter and Papanek (1955) enlarged upon the suggestions in Tolman's (1948) paper, marshalling experimental evidence in the literature and presenting findings of an experiment of their own. Where Tolman had spoken of wide or narrow cognitive maps formed during learning, Bruner et al. spoke of breadth of learning. Easterbrook (1959) encompassed Bruner et al.'s discussion and evidence along with that available in many other experimental contexts and, dropping the specific tie-in with learning, placed the emphasis on performance. His proposition regarding the "range of cue utilisation" also narrowed the scope of the discussion from the four variables proposed for consideration by Tolman to the single variable of arousal. Kausler and Trapp (1960) commenting on Easterbrook's paper pointed the need for a larger conceptual framework and introduced considerations of task and stimulus properties and nature of the population.

Easterbrook's paper serves as the focal point for the present discussion and review. By stating a functional relation between arousal and cue utilisation in an unequivocal manner he provided subsequent experimenters with an apparently simple and clear-cut idea which they could explore in experimental settings of their choice. These experiments will be reviewed in a later section, and the status of Easterbrook's proposition will be discussed in the light of this new evidence.

Easterbrook was concerned to state an empirically-derived relationship rather than to discuss underlying processes or mechanisms, but we can turn to Bruner et al.'s paper for a discussion of one mechanism which could underlie variations in breadth of learning with changes in arousal.

Bruner, Matter and Papanek (1955)

Writing in the context of continuity/discontinuity interpretations of discrimination learning, Bruner et al. (1955) brought together a fair amount of experimental evidence in support of the narrowing effect of two of the variables Tolman had mentioned -- high motivation, and overlearning. They presented findings of their own indicating that more hours of deprivation, and many trials beyond criterion on a black/white discrimination problem appeared to prevent the rats subjected to these conditions from picking up a single-alternation cue which was introduced towards the end of discrimination training. In a subsequent test with the brightness cue removed, the rats originally trained under moderate deprivation, and those with no trials beyond criterion exhibited greater savings in learning the single-alternation discrimination.

Bruner et al. argued for making breadth of learning a dependent variable, rejecting the "axiomatic position of continuity theory that all cues present when a response is reinforced are relevant" as well as the "axiomatic position of discontinuity theory that only the one cue toward which the organism has a hypothesis is relevant."(p. 8) Among their conclusions they state:

> "It is fruitless to take an axiomatic position about the range of cues that an organism will utilize in making a discrimination. The range of cues utilized, or attended to, or associated with a response, is a function of determinate processes and should

> be treated empirically as a dependent variable. We have called this variable <u>breadth of learning</u>.
>
> Conditions requiring increased speed and efficiency of goal attainment by an organism may have the effect of narrowing the range of environmental cues to which the organism responds. High motivation and intensive practice are known to increase the specific efficiency of learning. In short, the picture given by such traditional measures as latency, speed, and even errors fails to encompass a critical aspect of learning: how much about the environment is the organism picking up over and beyond what is required by the task at hand?" (p. 9)

In suggesting a possible mechanism for the effect of high motivation in reducing the breadth of learning Bruner et al. refer to the results of information analyses of recognition and identification phenomena which suggest that the larger the number of alternative cues for which the organism is set, the greater will be its difficulty in recognising any one cue. They point out that:

> "the more pressing the requirement that an organism reach a goal rapidly, the more hindering will be a set for considering many alternative cues. Thus to speed up goal attainment, an organism sacrifices breadth of attention and consequently breadth of learning." (p. 8)

They suggest further that strong motivation would entail the sort of "adjustive requirement that compels speed and efficiency with respect to minimal cues", and would have the effect of "speeding up learning at the cost of narrowing it." (p. 8)

It is interesting to consider the implications of the sequence of events which Bruner et al. appear to suggest. The narrower breadth of learning which the highly motivated rats in Bruner et al.'s experiment exhibited could have occurred in one of two ways. Motivation per se could have the effect of narrowing the range of attention so that from the beginning of discrimination training the rats in the severely deprived condition were responding to a narrower range of cues. Bruner et al. appear to suggest this sequence.

On the other hand, it appears likely that the effect could have been obtained as a result of the highly motivated rats starting out with a range of attention similar to that of the less deprived rats. Their range of attention may have become reduced in relation to that of the less deprived rats as a consequence of learning the discrimination more quickly. This second process would appear to be the more adaptive.

The point at issue is important, and it will recur at other stages of the discussion throughout this paper. Is the organism equipped with processes which come into effect automatically under certain circumstances, say for example, with changes in arousal level, and which depend, for their adjustive value, on a fortunate combination of events in the environment? In other words, if an inevitable concomitant of arousal is a reduction in the range of attention, then this mechanism will be adaptive only if a relevant goal object should by chance fall within the restricted range of the organism's attention.

Easterbrook (1959)

Aside from the papers of Tolman (1948) and Bruner et al. (1955) which are directly relevant to our topic, other trends in the 50s suggested the beginnings of a new perspective on some old problems. The "new look" in perception pointed at least to the empirical fact of perceptual selectivity. An information processing approach posed the question from a different viewpoint: man's capacity to deal with available stimuli is limited; to some degree at least the organism must be an active selector of the stimuli which influence its behavior. Side by side with the defense and value related selectivity explored in the early "new look" studies, a sprinkling of experimenters studied the adaptive nature of a variable attentional range; subjectively perceived goal relevance as a possible determiner of range began to be discussed (Bahrick, Fitts and Rankin, 1952; Bahrick, 1954; Kohn, 1954; Silverman, 1954).

Studies relevant to breadth of learning or range of attention had generally been conducted in one of two experimental situations -- perceptual-motor tasks, and incidental or latent learning. Easterbrook (1959) summarised the studies in each of these categories as follows:

> "The range of cue utilization is said to have shrunk when the use of peripheral (occasionally or partially relevant) cues has been reduced, although the use of central and immediately relevant cues has been maintained (Bahrick et al., 1952; Bursill, 1958; Davis, 1948; Easterbrook, 1953). Such a change is associated with improvement of central performance or with maintenance of proficiency under stress. The range of cue utilization is said to have fallen when the amount of incidental learning has been reduced although task learning has remained constant or been improved (Aborn, 1953; Bahrick, 1954; Bruner et al., 1955; Johnson, 1952; Kohn, 1954; Silverman, 1954; Silverman and Blitz, 1956). In general, the range of cue utilization is the total number of environmental cues in any situation that an organism observes, maintains an orientation towards, responds to, or associates with a response." (p. 183)

The studies mentioned above are referred to by Easterbrook as the "defining" experiments. He continues:

> "In each of the experiments alluded to in the preceding definition, shrinkage or reduction in the range of cue utilization was found to have been associated with an increase in drive. Accordingly, it is an empirically derived generalisation that, when the direction of behavior is constant, increase in drive is associated with a reduction in the range of cue use." (p. 183)

Easterbrook proposed that this generalisation could be used to reconcile conflicting evidence in the controversy concerning emotion and the organisation of behavior:

> "It is proposed that emotional arousal acts consistently to reduce the range of cues that an organism uses, and that the reduction in the range of cue utilization influences action in ways that are either organizing or disorganizing, depending on the behavior concerned." (p. 183)

Among the "defining" experiments and the others to which Easterbrook applied his generalisation, "range" of cue utilisation encompassed a wide variety of operations. Following are some examples:

off-center location (in tracking tasks, reaction time to peripheral lights, e.g. Bahrick et al., 1952; in incidental learning studies, recall or recognition of incidental material which is physically separated from the material to which S's attention is directed by E, e.g. Silverman and Blitz, 1956).

psychological periphery (in incidental learning studies, recall or recognition of incidental material which is intrinsic to the material to which S is instructed to attend, e.g. Bahrick, 1954; or where the incidental material is received through a different sensory mode from that used by S for the instructed task, e.g. Silverman, 1954).

visual periphery (Easterbrook mentions Granger's "nine clinical references to restriction of visual field in anxiety" (p. 189). These studies used a perimeter -- Granger, 1953 pp. 13-14).

discrimination among cue elements (number of correct identifications of incomplete circles in a series of circles some of which had a segment of arc removed, e.g. Basowitz, Persky, Korchin, and Grinker, 1958).

stimulus generalisation (number of responses to generalisation stimuli interspersed among presentations of a training stimulus, e.g. Eriksen, 1954).

integration of impoverished cues (identification threshold for pictures presented at very low illumination, e.g. Davis and Cullen, 1958).

Easterbrook suggests that the effect of arousal in all of the examples he cites was identical, and could be described as causing a reduction in information transfer. From Easterbrook's point of view the differences in experimental operations were of little importance. He was interested in synthesis rather than analysis:

> "The hypothetical identity of the events which have been discussed is somehow obscured by the diversity of terms. If 'shrinkage of perceptual field,' 'increase in stimulus generalisation,' and 'rise in duration threshold' can be described in common terms, as measures of reduction in total information transfer, their essential similarity may be more readily recognised and treated." (p. 195)

Easterbrook's interest in generalisation led him to propose an amalgam of two distinct aspects of attention namely, total information transfer (number of cues in use) and degree of concentration of attention (range of cue use). Easterbrook's generalisation is phrased in terms of "range of cue utilisation" and he uses this term frequently through his paper. However, "range of cue utilisation" is defined as "the total number of cues that are in fact used." (p. 193)

Variations in the degree of concentration of attention in respect of elements in the experimental situation (reduction in the range of cue use) seemed to be occurring as a function of arousal in Easterbrook's "defining experiments." When he went on to apply his generalisation to other studies -- in particular to perceptual tasks requiring fine discrimination among cue elements -- "range of cue use" may have appeared to be a less appropriate term, and Easterbrook speaks of "use of cues" in these cases. One may speculate whether the definition of "range of cue use" as "number of cues used" was not forced on Easterbrook so that these studies could be encompassed within his generalisation. It would, in fact, be hard to find evidence in the "defining experiments" regarding total information transfer (number of cues used) as a function of arousal.

Easterbrook was not interested in discussing explanatory mechanisms for the effect of arousal on cue use, or range of cue use, as were Bruner et al. (1955). However, he offers the following progression as an empirical description of what occurs:

> "Regard the curvilinear relation between drive and proficiency as the resultant of two functions: one in which proficiency is a function of the number of cues in use, and one in which the number of cues in use is negatively dependent upon drive level. Assume now (a) that simultaneous use of task-relevant and task-irrelevant cues reduces the effectiveness of response to some extent, and (b) that as the total number of cues in use is reduced, task-irrelevant cues are excluded before task-relevant cues. For any task, then, provided that initially a certain proportion of the cues in use are irrelevant cues (that the task demands something less than the total capacity of the organism), the reduction in range will reduce the proportion of irrelevant cues employed and so improve per-

> formance. When all irrelevant cues have been excluded, however, (so that now the task demands the total capacity of the subject), further reduction in the number of cues employed can only affect relevant cues, and proficiency will fall." (p. 193)

There are a number of ambiguities in the above excerpt but the point of interest here is Easterbrook's suggestion that the effect of arousal in reducing cue use range takes cue relevance into account up to a point (provided irrelevant cues were in use initially, they will be lost first as reduction proceeds). If this were an accurate description of what occurs it would suggest, contrary to the position of Bruner et al. (1955), that the cue reduction process is not entirely automatic, but that at least initially some selection in regard to which cues are lost is allowed the organism.

Easterbrook, however, gives no indication of how the cue reduction process would discriminate cue relevance. Moreover, elsewhere in his paper and in his initial statement of the generalisation he would appear to place main emphasis on the predictability of reduction in the range of cue use and the unpredictability of the outcome of this process:

> "...emotional arousal acts consistently to reduce the range of cues that an organism uses, and ... the reduction in range of cue utilisation influences action in ways that are either organizing or disorganizing, depending on the behavior concerned." (p. 183)

It was mentioned above that while Easterbrook's statement of the problem narrowed its formulation from the four independent variables considered by Tolman to the single one, arousal, he broadened its scope from that of learning to performance. Easterbrook intends, it would seem, to have the formulation consider one dependent variable only -- range of cue utilisation; his definition of range in terms of number of cues in fact implicates two dependent variables -- total information transfer, and degree of concentration of attention. The state of the art being what it is, the number of dependent variables used in the experiments to which Easterbrook applied his generalisation, and to which it has been applied in subsequent work, is legion. Only two of the studies which tested hypotheses based on Easterbrook's generalisation present an analysis in information terms (Pylyshyn and Agnew, 1962, and Agnew, Pyke and Pylyshyn, 1962). The others used experimental situations and behavioral measures for which an interpretation in terms of information transfer would be highly inferential. These studies will be reviewed in the next chapter.

II. EXPERIMENTAL EVIDENCE RELATING TO EASTERBROOK'S "EMPIRICAL GENERALISATION"

In a review of research and commentary relating to the Yerkes-Dodson law, de Bonis (1968) discusses Easterbrook's position briefly in the context of different approaches to the specification of task difficulty. De Bonis notes the frequency with which Easterbrook is cited in the literature, notwithstanding the fact that the explanatory power of the "range of cue utilisation" and its value as an operational criterion of task difficulty have not been subjected to experimental scrutiny (p. 137). De Bonis is correct in remarking on the frequency with which Easterbrook is cited in discussion of experimental findings. However, although Easterbrook himself does not appear to have published any research relating to his generalisation, hypotheses stemming from his proposed relationship between arousal and cue use have been tested in a wide variety of experimental situations. This experimental evidence will be reviewed below.

The criterion for inclusion in the group of studies to be discussed here was mention of Easterbrook (1959) in relation to the hypotheses being tested in the study. In most of these studies the hypotheses were formulated as tests of Easterbrook's position. Two closely relevant studies which made no mention of Easterbrook will also be included.

A Framework for Review of Easterbrook Related Studies

Experiments which tested hypotheses relating to Easterbrook's generalisation may be classified in many different ways. Each of the main elements in the generalisation -- cue utilisation, range, arousal -- has been subject to a wide variety of operational interpretations. An initial review of these studies indicates that the findings are not consistent -- a reduction in the range of cue utilisation, however defined, is not an inevitable consequence of arousal. Among 52 comparisons between groups distinguished in terms of arousal level which were published concurrently with or subsequent to Easterbrook's paper in 1959, 19 show "reduction" where reduction would be predicted, 30 do not and 3 are unclassifiable. Presumably some combinations of variables result in range of cue use reduction under arousal conditions, while other combinations do not.

Easterbrook's interest was in finding similarities rather than in looking for differences. And his success in finding the similarities he sought prevented the question of underlying differences in the experimental situations from coming to the fore, as it has now, in the wake of conflicting findings.

The virtual absence of an analytical framework in Easterbrook's paper leaves the way open to a reviewer of the subsequent work to select one of many which might be instructive. The basis for organising this material which will be adopted here is in terms of the task relevance of the cues in regard to which reduction in the range of cue utilisation is predicted. This approach would seem to have potential value as a first step in an analysis which may lead to clarification of the question raised with regard to Bruner et al.'s (1955) and Easterbrook's positioning of reduction in breadth of learning, or range of cue utilisation as a more or less automatic consequence of a rise in arousal. In considering this question it would be instructive to know whether whatever reduction in the range of cue use occurs with arousal, occurs in respect of cues which are or are not task relevant.

<u>Task Relevance in the "Defining Experiments"</u>

The studies which comprised Easterbrook's "defining" experiments provide some important points on this task relevance dimension. It will be recalled that Easterbrook made a two-way grouping of these experiments -- those in which some cues could be classed as peripheral (occasionally or partially relevant) as, for example, in the perceptual motor task used by Bahrick et al. (1952), and those in which measures of incidental learning had been obtained. The latter category included incidental learning experiments with human subjects (Bahrick, 1954; Silverman, 1954; Silverman and Blitz, 1956), a latent learning experiment with rats (Johnson, 1952), a discrimination experiment with rats (Bruner et al., 1955), and two further experiments with human subjects which do not fit the usual incidental learning pattern -- in Aborn (1953) the arousal manipulation was introduced at a stage when it could affect retention but not initial learning, and in Kohn (1954) the analytical distinction was between recall of essential and less essential elements in a text which the subjects read under relaxed or stress conditions. Kohn (1954) would probably have been more logically classified with the first category in which some of the cues may be regarded as less relevant than others, but all are task relevant.

<u>All Cues Task Relevant: Some Less, Some More So</u>

In this first category, for which the perceptual motor task is a good example, the subject is made aware of all elements on which his performance will be measured; in this sense all elements are task relevant. However, it might be expected as Bahrick et al. (1952) noted, that aspects of the assigned task would take on various degrees of importance to the subject. They suggested as one basis for such an ordering that events occurring less frequently than others would tend to be regarded as less important:

> "...a continuously changing aspect of a complex task will tend (other things being equal) to be interpreted by <u>S</u> as more important to success than an infrequently and intermittently changing aspect. It is also believed that a stimulus object

> in the peripheral visual field will tend (other things being equal) to be interpreted as less important than an object in the central part of the field. However, our concept of 'peripheral' stimuli also includes all aspects of the central task that S classifies as being relatively unimportant." (p. 401)

A first category of tasks, then, may be described as one in which all aspects are formally relevant, but within which factors operate which may order S's categorisation of relevance into more and less relevant.

Some Cues "Irrelevant"

In contrast, the incidental learning experiments (with humans) can be regarded as situations in which while it is clearly indicated to S which elements are task relevant, his performance is also measured on elements which are defined, by exclusion, as task irrelevant.

Although the latent and discrimination learning studies included by Easterbrook in the second category had "incidental learning" results which were similar to those obtained in the human incidental learning studies, it is questionable whether it is advisable to group together experiments using a discrimination learning task with those using incidental learning. (Since no latent learning experiments will be included in the review of experiments relating to Easterbrook's generalisation which follows, this category will not be included in the present discussion in order to simplify and expedite it).

It will be recalled that Bruner et al. (1955) produced evidence relative to Tolman's assertion that level of motivation and overtraining would affect breadth of learning: high motivation and many trials past criterion were both seen to lead to what could be interpreted as reduced breadth of learning. Mackintosh (1965) continuing the Bruner et al. discussion added two further variables -- ease of initial discrimination and method of introducing the incidental cues: easy initial discriminations and gradual introduction of incidental cues lead to reduced breadth of learning.

There is evidence in the incidental learning literature that the effect of at least two of these variables is different from that reported by Bruner et al. and by Mackintosh. Overtraining produced reduced breadth of learning in Bruner et al. (1955) but increased breadth of learning (greater incidental learning) in Bahrick (1957). Difficult initial tasks in discrimination learning facilitatesirrelevant cue learning (Mackintosh, 1965); there are many examples of incidental learning studies where incidental learning is reduced as a function of the difficulty of the E-assigned task, e.g. Silverman (1954) where a comparison is available for incidental learning along with an easy or hard visual discrimination task. The reduction in incidental learning which accompanies fast rates of presentation in the instructed learning task can also be interpreted in terms of task difficulty (e.g. Rosenberg, 1959; Kausler and Trapp, 1961; Fisher and Cook, 1962). As pointed out by Mechanic (1962, p. 597) unless specifically counteracted by the nature of the orienting task to the incidental materials, difficult instructed tasks in incidental learning experiments will reduce the amount of such learning. In contrast to the discrimination learning experiment, task difficulty in incidental learning experiments prevents, rather than facilitates exposure to irrelevant cues.

Overtraining and task difficulty, then, show contrasting effects on "breadth of learning" in discrimination tasks and in incidental learning tasks. The different outcomes may not be unexpected in view of the difference in task relevance of the "irrelevant cues" in each case. In the incidental learning experiment there is an initial clarification regarding the elements that are relevant to the E-assigned task; if S responds to the irrelevant material he is departing from the task assigned by E. The situation is different in discrimination learning, however, where there is no initial definition of relevance with regard to the cues which E presents. Relevance is eventually determined by discovering the stimulus-response combination which leads to reward or to the correct solution. In the former (incidental learning) tasks S has a basis for determining cue relevance (even though his definition and E's are different); in the latter (discrimination learning) tasks, where cue relevance must be learned, an initial determination of relevance by S is not possible; cue task relevance is indeterminate in these situations.

Because of these differences we will depart from Easterbrook's grouping. In the review of experiments below, tasks which involve learning a "correct" stimulus-response combination will be discussed in a "Cue task relevance indeterminate" category, and those which use an incidental learning procedure in a "Non task relevant cues" category.

A Relevance Ordering

Based on these distinctions variations in the range of cue use can be discussed in relation to situations in which:

Cues are task relevant

Cue task relevance is indeterminate

Cues are non task relevant

The bulk of the experiments fall into the first category, and it is proposed to group these in so far as possible in terms of similarity of operations for "range" of cue use. A first subcategory here includes experiments in which variations in the visual field were studied. Two studies which comprise a second subcategory have to do with cue selection; here the predicted reduction in cue use range should facilitate performance.

Two experiments will be discussed in a third subcategory which is distinguished from the others because the experimental arrangements may suggest an importance ordering of the task elements. One of the experiments to be discussed here uses a perceptual motor task similar to that used by Bahrick et al. (1952).

A fourth and large subcategory comprises studies in which efficient performance demands that S make appropriate, usually "fine", distinctions among cue elements. Included are form recognition tasks, perceptual motor tasks mainly of the pencil maze and pathways type, and a task involving conceptual discrimination.

Studies in which use of certain cues would lead to optimal performance, but S had to determine task relevance over the course of the experiment will be discussed in the second main category -- Cue task relevance indeterminate. Incidental learning experiments may be considered in the third category of Non task relevant cues.

In the pages which follow evidence concerning variations in the range of cue use as a function of arousal will be reviewed in situations where:

1. Cues are task relevant: Range of cue use measured in terms of --
    a) Size of visual field
    b) Inferred cue selection
    c) Response to cues which are less and more relevant (importance ordering)
    d) Discrimination among cue elements

2. Cue task relevance indeterminate

3. Cues are non task relevant

4. Miscellaneous studies

As already noted, the studies which will be reviewed here were conducted in widely different experimental contexts. In order to keep this review within reasonable dimensions, descriptions of the studies will concentrate on the operations for cue utilisation, range, and arousal.

1. Task Relevant Cues

a) Size of Visual Field

The four studies to be described here relate to the question whether constriction of visual fields occurs as a function of arousal. Two of these studies investigated the physiological limits of the visual field by introducing stimuli from the periphery. Analytical interest in the other two studies was directed to S's performance in relation to central or off-center elements in a visual display, as a function of arousal.

Eysenck and Gillan (1964a) found increased visual fields in a perimeter test for aroused (situation-induced) compared with nonaroused Ss. Schmidt (1964) investigated narrowing of the visual field with increase in distance between S and the fixation point. He found the expected narrowing with distance for aroused and nonaroused Ss (selected on the basis of Manifest Anxiety Scale (MAS) scores); aroused Ss consistently achieved a wider visual angle than nonaroused Ss at each of the three distances studied, but the difference between arousal groups was significant for the shortest distance only.

Rubin, Shantz and Smock (1962) used a very complex procedure to investigate the perceptual constriction hypothesis with children (9 to 12 years old). S was asked to look at a comparison form, then following projection on a screen of a four-item display which contained the form, S placed the comparison form on a model of the presentation to correspond with its position in the screen projection. Rubin et al. found decreased localisation accuracy for stimuli to the sides of the display, and increased accuracy at the center for aroused compared with nonaroused Ss. Arousal was manipulated by means of incentive (offer of preferred toy, candy bar, etc., for "doing well"). The authors interpret this finding as supportive of Easterbrook's position.

Solso, Johnson and Schatz (1962) interpreted Easterbrook as predicting a narrowing of the perceptual field under drive. They asked their Ss to write, following each exposure, the items presented in a series of multi-item test slides. The items (two-digit numbers, bigrams, trigrams) were arranged on the test slides within each of three imaginary concentric circles. They found no main effect for arousal (MAS scores), that is, number of correct responses was roughly equal for the two arousal groups. Separate analysis of the outer circle results showed that aroused Ss gave significantly more correct responses than nonaroused Ss at each of the two exposure times used. In interpreting their findings the authors urge a distinction between cue use and perception -- between the "utilitarian function of a cue and perception of cues."

To recapitulate the findings of these four studies: In Eysenck and Gillan (1964a) and in Schmidt (1964) S was required to look at a fixation point. The findings of both studies suggest that aroused Ss have wider visual fields than nonaroused Ss. In Solso et al. (1962) although S was required to fixate the center of the slide before exposure, there were no restrictions on his visual behavior during exposure of the test materials, and the durations were sufficiently long (.50 sec., .75 sec.) to permit scanning. In this study, then, it is not possible to say whether the enhanced performance of aroused Ss with regard to the outer circle of the display was due to their having wider visual fields, or to their having engaged in greater scanning.

There was only one study in this group (Rubin et al. 1962) which found impaired performance with respect to the sides of a visual display for aroused Ss. S's visual behavior was not controlled, and the exposure time (.20 sec.) was long enough to allow eye movement. Factors which make this study difficult to compare with the others are the nature of the population (children), the arousal manipulation (specific incentives), and the fact that the task involved not only locating the stimulus item in the display but placing the comparison form manually on a model of the display.

1. Task Relevant Cues (continued)

b) Inferred Cue Selection

In the two studies to be considered here the predicted reduction in range of cue use as a function of arousal should lead to enhanced performance on the experimental task for aroused compared with nonaroused Ss. This is because the experimental arrangements are such that potentially distracting cues are presented to S along with the cues necessary for the task.

Agnew and Agnew (1963) found a trend in accordance with prediction for aroused (threat of avoidable shock) Ss to show better Stroop performance (combined card II and III scores), compared with nonaroused Ss.

In a paired-associate learning task using a compound (two-element) stimulus term Solso (1968) inferred use of one or both stimulus elements from rate of learning. He found weak support for the prediction that aroused (MAS scores) Ss would select one rather than both cues. For learning to be aided by the selection of one rather than both cues in this situation, however, it was necessary that the color rather than the word cue in the compound stimulus be selected. No rationale was given why aroused Ss would select the color (which surrounded the word) cue in this situation.

These studies provide weak evidence, at best, in support of a reduction of cue use range with arousal. The findings in Agnew and Agnew (1963) did not reach a satisfactory level of significance. Failure to explain why a reduction in the range of cue use should favor a color over a word cue in Solso (1968) creates some ambiguity for the interpretation of this study in relation to Easterbrook's position.

1. Task Relevant Cues (continued)

c) Importance Ordering -- cues which are less and more relevant

Tecce and Tarnell's (1965) measure of narrowed attention is unique within the studies considered here in that it involves response time for return to resting position following an instructed response to stimulus onset. Aroused Ss (unavoidable shock) took longer to make this movement than nonaroused Ss. To the extent that this is an acceptable measure of narrowed attention the results suggest that narrowing occurred here with regard to a subjectively unimportant aspect of performance.

Wachtel's (1968) task was modelled on that used by Bahrick, Fitts and Rankin (1952). It will be recalled that Bahrick et al. (1952) was included among Easterbrook's defining experiments. Their task consisted of three elements: continuous tracking and intermittent response to lights and dials. Wachtel (1968) used a continuous tracking task and intermittent response to lights.

He compared Ss in each of two arousal (threat of performance-related avoidable shock, threat of performance-irrelevant unavoidable shock) conditions with nonaroused Ss. In the avoidable shock condition he found no effect for arousal on reaction time to peripheral lights in a tracking task, and in the nonavoidable shock condition he found slower reaction time to the peripheral lights. Wachtel assumed his Ss would regard the peripheral task as less relevant, in that these responses were required only infrequently. The finding of no difference in peripheral reaction time between the nonaroused and avoidable shock conditions was unexpected. No evidence is available on how Ss perceived the relevance of the peripheral task. Since performance of peripheral as well as central task aspects contributed to task score, and hence, in the avoidable shock condition, to shock avoidance, subjective relevance of the peripheral task may have been enhanced for Ss in the avoidable shock condition compared with those in the nonavoidable condition.

These two studies provide evidence of narrowed attention to task elements which may be regarded subjectively as less important than others. Failure to find a reduced range of attention in Wachtel's avoidable shock condition points to the arousal manipulation as a potential source of relevance additional to task relevance.

1. Task Relevant Cues (continued)

d) Discrimination among Cue Elements

Smock and Small (1962) found a curvilinear relation between arousal (induced muscle tension) and form recognition. Intermediate tension levels yielded better performance than high or low. A target form (12 or 16 point, randomly generated) was presented on a screen at an exposure duration of .02 sec.* The target form and three variations of it were mounted on a response board with size and viewing distance the same as in the target form projection. Following presentation of the target form on the screen S had to indicate the form shown, from among those

* This may be a misprint for .20 sec. Two other studies for which Smock was co-author used a .20 sec. exposure -- Shantz et al. (1962), discussed following Smock and Small, and Rubin et al. (1962) discussed under a) Size of Visual Field, above.

on the response board.

The authors point out that their finding of an inverted U relation between induced muscle tension and accuracy of form recognition is in line with previous studies which used different materials and different criteria of recognition (Shaw, 1956 who used digit span; Shore, 1958 with visual resolution targets). However, Smock and Small draw attention to their significant tension by trials interaction. Contary to what might have been expected performance did not improve as a linear function of trials, suggesting that the effect of tension level on perceptual performance depends upon the particular stage of perceptual learning.

Shantz, Rubin and Smock (1962) found better form recognition for aroused (incentive) than for nonaroused Ss (9 to 12 year olds). This finding was consistent for three levels of complexity (familiar forms, randomly generated 8 and 16 point), and a main effect for complexity was also found. Slides consisting of four stimuli from each complexity level were presented on a screen, for .20 sec. Prior to each exposure S was given a replica of one of the stimuli and asked to indicate its position (top, bottom, left, right) in the test slide.

These authors were interested in the quantitative aspects of cue use range reduction -- whether a unit increase in motivation would reduce the range by a specified amount, regardless of the number of cues (complexity) present, or whether it might result in a reduction which would be proportional to the number of cues. They conclude that the findings support a proportional change interpretation.

Eysenck and Willett (1962) found no performance effect for arousal (situation-induced) in a symbol substitution task; McNamara and Fisch (1964) also found no difference between nonaroused and aroused (threat of avoidable shock) groups on a digit-symbol test, but they found improved performance on this task when incentives were used as the arousal manipulation.

A study by Scofield and Rankin (1962) is relevant here, although Easterbrook was not cited. Aroused (MAS scores) Ss made more errors than nonaroused in an incomplete circle identification task. Similar findings were obtained under both dark and light conditions.

Eysenck and Willett (1966) found poorer performance for high drive (situation-induced) Ss on the Ammons pathways test compared with low drive. The authors believe the result is in accord with Easterbrook's position since the task involves utilising a wide range of cues. McNamara and Fisch (1964) found poorer performance for aroused (threat of unavoidable shock) Ss than for high incentive or nonaroused Ss on a (similar) pathways test.

Agnew and Agnew (1963) found poorer Porteus Maze performance for aroused (threat of avoidable shock) compared with nonaroused Ss. This was in accord with their prediction from Easterbrook.

Two studies by Eysenck and Gillan (1964b, c) were considered by their authors as relevant to Easterbrook's position. The tasks were, respectively, mirror drawing, and kinaesthetic size matching. High drive (situation-induced) Ss showed better accuracy scores on both tests, and slower speed on the mirror drawing. Sharpening of perceptual ability with high drive was predicted in the matching test, and slower speed for high drive on the mirror drawing test.

Berkowitz and Buck (1967) found weak support for the hypothesised better discrimination among aroused (epinephrine) than among nonaroused Ss. The task involved categorisation of words into a class. S was given to understand that another S was reading a list of words of varying degrees of relevance to the concept "farm." S was to teach the second S (E's confederate) the concept "farm" by giving him an electric shock when he said a word of high relevance to "farm." Berkowitz and Buck made the prediction of better performance under arousal here by suggesting that Easterbrook's reduced range of cue utilisation could lead to heightened responsivity to central aspects in a situation and reduced responsivity to less relevant or peripheral aspects. While it is true that the words which were read by E's confederate could be ordered in terms of relevance to the "farm" concept, so far as S was concerned all the words were task relevant. It would seem that an analysis in terms of assimilation/contrast effects could be appropriate here, in which case S's task was essentially one of discrimination.

In this connection it is interesting to note that Berkowitz (1961) cited Easterbrook in support of a finding of reduced discrimination among trait-descriptive words (i.e. assimilation to the standard) which was observed for prejudiced Ss under stress.

The operations in the two studies are remarkably similar, yet the prediction, based on Easterbrook in each case, appears to be different. In the Berkowitz and Buck study S has to decide which words among a list of 14 have the closest relationship to the concept "farm." The task presumably requires discrimination ability in the sense in which we have been using this terms i.e. making fine distinctions among stimuli. The prediction was that arousal would facilitate discrimination.

In Berkowitz (1961) S had to rate 11 adjectives (trait descriptions such as "adaptable," "ambitious," etc.) in terms of "goodness" and "badness," should such words be used in a letter of reference. The first seven of the adjectives read to S had previously been judged "good" by a sample drawn from the same population, and the last four had likewise been judged "neutral." (In another condition the first seven traits had been rated "bad," and the last four "neutral"). The measures of interest for the present discussion are the ratings of the neutral traits when preceded by good or bad traits. Ss who were high in prejudice, and had been subjected to stress showed less discrimination between the standard stimuli (good/bad traits) and the neutral stimuli compared with high prejudice Ss not subjected to stress. In other words stress apparently operated here to weaken the ability to make fine discriminations **among** stimuli. Referring to the Ss in the high prejudice, stress condition Berkowitz (1961) says:

> "Their behavior in the judgmental task then becomes a special instance of a more general phenomenon: a reduction in the range of cue utilisation (i.e. category broadening) under emotion-producing conditions resulting in less adequate discrimination among the stimulus objects confronting them." (p. 214)

The tasks in this final subcategory of the Task relevant cues section had in common the fact that efficient performance involved making fine discriminations among stimulus elements. Among the thirteen comparisons considered here seven showed no impairment and four showed impairment in discrimination ability with arousal. In one further study an inverted U relationship between arousal and performance was obtained, and yet another in which accuracy and speed measures were obtained, showed better discrimination ability, but slower speed as a function of arousal.

2. Cue Task Relevance Indeterminate

The studies to be reviewed in this section differ from those assigned to the preceding "Task relevant cues" section in that S is exposed to cues which are potentially relevant to his performance on the measured task, but he is not alerted to the task relevance of the cues in question. These studies are similar to those in the "Non task relevant cues" section (below) in that S's behavior in respect of elements in the experimental situation to which his attention is not drawn is of interest to E. However, they differ from studies in the "Non task relevant cues" section (mainly incidental learning experiments) in that there two measures of S's behavior are obtained -- one on an instructed and one on a noninstructed task, whereas here S's behavior is measured on the instructed task only, and his cue use is inferred from performance on that task.

Braley (1962) found no effect for arousal (MAS scores) in a concept learning experiment with human Ss modeled in part on the Bruner et al. (1955) simultaneous discrimination experiment with rats discussed above. In addition to there being no effect for arousal, Braley's results also differed from those of Bruner et al. in that exposure to the irrelevant cue impaired subsequent learning in which the irrelevant cue had become relevant, compared to a group with no previous exposure.

Cornsweet's (1968) study is relevant to those in an earlier category in which visual fields were investigated, but it is included here because the author did not alert her Ss to the possibility of relevant peripheral stimulation. Cornsweet discusses Easterbrook in the context of variations in the physical range of cue use. She is interested in exploring whether "funnelling" of attention would occur if peripheral cues were task relevant. She compared two groups of aroused (performance-related avoidable shock, performance-irrelevant unavoidable shock) Ss with a nonaroused group, and found quicker reaction time to a central light on trials when peripheral light onset preceded central light onset. Although Cornsweet does not discuss the possibility, it seems this study could be regarded as a case of simple conditioning; if so, it accords well with the usual finding of greater conditionability of high drive Ss.

Zaffy and Bruning (1966) and Bruning, Capage, Kozuh, Young and Young (1968) contribute an interesting series of experiments in which the same task was used, with minor variations, and different arousal operations. In Zaffy and Bruning (1966) Ss were selected on the basis of MAS scores; in Bruning et al. (1968) in which two experiments are reported, arousal was manipulated by means of presence of absence of an audience (E peering over S's shoulder, or located behind a screen) in the first experiment, and in the second by means of success or failure indications.

A serial learning task was used, and there were three task conditions. Two cue conditions differed from the no cue condition in that subscripts were added which were either potentially helpful (relevant cue condition) or potentially distracting (irrelevant cue condition), with regard to the learning task. S had to pick the correct item in a series of multiple-choice units, correctness being determined by the position of the item. In the relevant cue condition the position of the correct choice was indicated additionally by the use of a numerical subscript. In the irrelevant cue condition, numerical subscripts which bore no relation to item position were added.

A significant trials x cues x arousal effect was obtained in all three experiments, indicating that subscript relevance/irrelevance had little effect on learning for aroused Ss, and clearly differentiated rate of learning for nonaroused Ss. Nonaroused Ss showed greater improvement over trials in the relevant cue condition than aroused Ss and less improvement in the irrelevant cue condition.

The findings are interpreted as being in line with the prediction from Easterbrook that arousal reduces the range of cue use. Aroused Ss appeared to pay less attention to the subscripts, relevant or irrelevant, than nonaroused Ss.

The findings of these three experiments would support a strong version of Easterbrook's proposition namely, that arousal reduces the range of cue use regardless of cue relevance. In considering these findings in relation to others which have tested Easterbrook's generalisation it is necessary to consider separately the relevant and irrelevant cue conditions.

None of the other studies reviewed is comparable to the irrelevant cue condition in the present experiments. The two studies which come closest are those discussed above under "Inferred cue selection," where efficient performance required the use of one of two cues presented. In those studies, however, S was given more information about the cues than in the present experiments (on the Stroop card III, S was told to recite the colors in which the color names are printed (Agnew and Agnew, 1963), and in Solso's (1968) use of a compound stimulus term in paired-associate learning, S was told that the color and word pairings were invariable). Possibly the experimental evidence that is most relevant here is the conclusion that emerged from the review of studies, above, in which S was required to make fine distinctions among cue elements. There we saw that arousal can apparently impair S's ability to discriminate among cues, though this is not an invariable finding. In the present experiments aroused Ss may have regarded the multiple choice item and irrelevant subscript as one unit -- may not, in other words, have discriminated the subscripts -- thus avoiding the adverse effect on learning which the subscripts appeared to entail for the nonaroused Ss.

Aroused Ss' apparent failure to benefit from the relevant subscripts in the Zaffy and Bruning, and Bruning et al. experiments should be considered in the light of Cornsweet's finding that aroused Ss benefited from and used relevant peripheral cues to a greater extent than nonaroused Ss. These four experiments have in common that the role of the cues in question was not explained to S. A possible explanation of the different outcomes may again lie in the relative discriminability of the additional cues -- peripheral location in Cornsweet, and juxtaposition in the Zaffy and Bruning, and Bruning et al. experiments.

Finally, Wachtel's (1968) finding that aroused Ss (avoidable shock threat) did not show reduced use of off-center task relevant cues should be considered. Wachtel's procedure differs from that of Zaffy and Bruning, and Bruning et al. in that his Ss were told that they should respond to the off-center lights, which flashed intermittently. The question of discriminability did not arise for Wachtel's Ss, and in fact, they would have had a set to respond to the off-center cues.

While the Zaffy and Bruning, and Bruning et al. studies provide striking experimental evidence in support of Easterbrook's position, the other studies discussed here suggest some limitations on the operation of the proposed reduction in the range of cue use, and they suggest additional variables which may be involved.

3. Non Task Relevant Cues

Largely because of the interest of Kausler and his colleagues there are a number of interrelated incidental learning studies which are relevant to Easterbrook's generalisation. These will be discussed first, and will be followed by a discussion of three other incidental learning studies which are relevant to Easterbrook but not closely related to each other or to the Kausler studies.

a) Comment and Studies by Kausler and Colleagues

Kausler, Trapp and Brewer published a study in December, 1959 in which a finding of no difference in incidental learning as a function of arousal (MAS score selection of Ss) was reported. This study was a two-experiment replication of Bahrick (1954), using the same materials but changing the arousal manipulation; the lack of correspondence in the findings was discussed by Kausler et al. (1959) in terms of the different arousal operations.

The publication of Easterbrook's review (in May, 1959) a few months prior to the Kausler et al. study apparently alerted Kausler and his colleagues to the wider implications of the disparity between their findings and those of Bahrick (1954). If, as Easterbrook proposed, cue use range is invariably reduced under arousal conditions, Kausler et al.'s (1959) findings were not only in disagreement with those of Bahrick (1954) but also with a larger body of experimental evidence. The issue was taken up in a review by Kausler and Trapp (1960), and two further studies were published (Kausler and Trapp, 1962; Kausler, Laughlin and Trapp, 1963). Since the experiments of Kausler and his colleagues used the same materials and procedure as had been used in two of the incidental learning experiments cited by Easterbrook (Bahrick, 1954; Silverman and Blitz, 1956), these experiments, and another cited by Easterbrook (Silverman, 1954) to which Kausler makes reference, will be described briefly.

(Throughout this section the abbreviations adopted by McLaughlin (1965) for referring to incidental and intentional learning (INC, INT) will be used. His use of incidental (INC) to refer to learning when there are no instructions to learn the relevant material, and intentional (INT) to refer to learning when there are instructions to learn the relevant material is also followed (p. 361). The abbreviation INT will also be used to refer to the instructed task in the rare Type

II instances (e.g. Silverman, 1954) where the instructed task is not a learning task).

INC Learning Studies among Easterbrook's "Defining Experiments"

Bahrick's (1954) INT task involved serial anticipation learning of a list of 14 geometric forms (seven different forms, each appearing twice). The area of the forms was filled with one of seven colors. Thus, each of the seven forms had two different colors associated with it. The forms were exposed at a 3 sec. rate in a memory drum. A recognition test of the colors associated with each form in the list constituted the measure of INC learning.

Arousal was manipulated in this study by means of incentive; in the high incentive condition Ss were offered a bonus ranging from 10c to $1.50, the exact amount to depend on the number of trials needed before a criterion of one completely correct trial was reached; in the low incentive condition S was told that E was interested in finding out whether the task could be learned when S was not trying very hard. The INC test was presented immediately following S's reaching the learning criterion.

The findings were better INT and poorer INC learning for high compared with low incentive Ss.

Silverman's (1954) INT task was a visual discrimination test following a short training session. S was required to respond (lever press) when a line projected on a screen equalled a standard line in length. A new comparison stimulus appeared on the screen every 10" for a total of 36 trials. The INC stimuli were spondaic words (e.g. whitewash, railroad) spoken in a woman's voice at the intensity of "subdued conversational tone" during S's performance of the discrimination test. Recall and recognition scores for INC words were obtained immediately following the discrimination test.

Performance on the INT and INC tests in the shock threat condition was poorer than in the no threat condition.

Silverman and Blitz (1956) used serial anticipation learning of nonsense syllables as the INT task. Ten syllables were presented at a 2:2 sec.* rate in a memory drum. The INC material was two-digit numbers, 6cm removed from the INT material. INC learning was measured by a recognition test.

Ss were selected on the basis of MAS scores. Low and high MAS scorers showed comparable performance on the INT task; low MAS scorers showed better INC learning than high scorers.

So far as the INC results are concerned these three studies showed poorer performance with arousal, or in the terms used by Easterbrook, a reduced cue utilisation range. Kausler and Trapp's (1960) discussion of the lack of correspondence between Kausler et al.'s (1959) results and the three studies described above drew attention to the role of two variables -- nature of arousal and cue position.

Bahrick (1954) Replication: Nature of Arousal Operation

The kind of arousal used provided a possible explanation for the different outcomes in Bahrick (1954) and Kausler et al. (1959). In one of the experiments reported by Kausler et al. Ss were selected on the basis of MAS scores (experiment I); in experiment II ego-involving instructions were used (S was urged to retrieve the standing of students in his college who had previously performed below the national average on the experimental task). Bahrick (1954), it will be recalled,

*When presentation rates are specified in this way (i.e. 2:2 sec.) the memory drum was rotating at a two-second rate, but INT material was appearing only on alternate turns. INC material was appearing on every turn. Better INC learning is typically obtained for the "temporally isolated" material. None of the studies which used this procedure found an interaction between arousal level and temporal positioning of INC material.

manipulated arousal by means of monetary incentive. In other respects -- materials and procedure -- the studies were comparable.

In Kausler and Trapp's (1960) discussion of these divergent outcomes in the light of Easterbrook's "empirical generalisation," they refer to the Farber (1955) distinction between the properties of generalised drive and of incentives:

> "...(incentives) elicit particular responses that are goal directed but do not energise other responses that are irrelevant to the goal.
>
> Generalised D...serves an energising function in that its presence intensifies indiscriminately all reaction tendencies existing in a given situation, both relevant and irrelevant to the central task." (p. 375)

Thus Kausler et al.'s (1959) manipulation of arousal by means of generalised drive in a situation otherwise similar to Bahrick (1954) could have strengthened irrelevant (i.e. INC) responses, accounting for their finding no adverse effect of arousal on INC learning.

In the discussion of Easterbrook's paper above several instances of inattention to potentially crucial distinctions with regard to task and stimulus features were mentioned. A similar comment is in order here with regard to his treatment of arousal. He stated that he was using the term "drive" throughout his paper to refer to a:

> "dimension of emotional arousal or general covert excitement, the innate response to a state of biological deprivation or noxious stimulation, which underlies or occurs simultaneously with overt action and affects its strength and course. This emotional arousal is greater in neurotic than in normal subjects, greater than usual in subjects under stress or threat or in frustration, and in general greater in animals that have been "motivated" by any of the usual deprivations, noxious stimulations, or other incentives than it is in unmotivated or resting animals of the same species." (p. 184)

Easterbrook, then, is not concerned to make distinctions between the various forms of arousal. The "defining" experiments include some which manipulated arousal by means of incentives (e.g. Bahrick et al.

1952; Bahrick, 1954) and some where the arousal operation could be said to have tapped generalised drive (e.g. MAS score selection of Ss as in Silverman and Blitz, 1956; shock threat in Silverman, 1954).

Enough is not yet known about the implications of different arousal states for various forms of behavior to say with certainty that Kausler and Trapp's (1960) interpretation is completely accurate. The likelihood of there being systematic differences in the effects of different arousal states is sufficiently strong to warrant being alerted to this distinction.

Cue Position

Kausler and Trapp (1960) also drew attention to the possible importance of positioning or location of the INC material relative to the INT material. The finding of no difference in INC learning for aroused compared with nonaroused Ss in Kausler et al. (1959) was also in conflict with results obtained by Silverman (1954), and Silverman and Blitz (1956), where aroused Ss showed poor INC learning compared with nonaroused. Here the different outcomes could not easily be ascribed to a difference in the arousal operation. Silverman and Blitz (1956) selected Ss on the basis of MAS scores as did Kausler et al. (1959, experiment I); Silverman (1954) had used threat of shock, which Kausler and Trapp believed to be comparable to Kausler et al.'s (1959) ego-involving instructions (experiment II).

However, the Kausler studies differed from those of Silverman in the location of the INC material -- intrinsic in the Bahrick material Kausler et al. (1959) had used, and extrinsic in the Silverman studies (i.e. different sense modality from that used for the INT task in Silverman, 1954; spatially separated on the memory drum opening in Silverman and Blitz, 1956).

Kausler and Trapp's (1960) line of reasoning in discussing the different outcomes with regard to INC learning took the following form: lthough in these four experiments generalised drive was assumed, and hence strengthening of relevant and irrelevant response tendencies, in line with the restriction in perceptual range proposed by Easterbrook, the extrinsic INC material in the Silverman studies fell outside S's perceptual range and hence outside, also, the energising effect of generalised drive. Hence the finding of poorer INC learning in the studies which had used extrinsic INC material. Since the INC material was intrinsic to the INT material in the Kausler et al. (1959) experiments, it fell within S's perceptual range and the effect of generalised drive in strengthening irrelevant response tendencies could operate:

> "even though anxious Ss may have a restricted perceptual range, the irrelevant cues may well fall within that range." (p. 376)

Kausler and Trapp propose further that there may be an interaction between level of motivation and cue positioning:

> "In general, as the irrelevant cues are moved towards the periphery of the perceptual field, incidental learning will decrease, but the reduction will be greater for high motivational levels than for low." (pp. 376-377)

Task Difficulty

Kausler and Trapp (1960) also drew attention to the study of Spielberger, Goodstein and Dahlstrom (1958), which Easterbrook had not discussed.* Spielberger et al. found an interaction between arousal (MAS scores) and task difficulty: aroused Ss showed better INC learning of easy designs and poorer learning of difficult designs compared with nonaroused Ss. Designs were selected from the Bender-Gestalt test,

*Spielberger et al. (1958) was published in July, and Easterbrook's paper has a receipt date of October, 1958.

and difficulty consisted of a composite of serial position and complexity, such that the most complex designs were placed in the most difficult serial positions. S was instructed to copy the designs. The measure of INC learning was ability to draw the designs in response to an unexpected request to do so, following six minutes spent on an unrelated task.

Silverman and Blitz (1956) Replication: Arousal and Cue Position

Kausler and Trapp (1962) conducted a replication of Silverman and Blitz (1956), manipulating arousal by means of incentive, where Silverman and Blitz had used MAS score selection of Ss. Other variables manipulated in Kausler and Trapp (1962) were rate of presentation and cue position (juxtaposed, or placed peripherally with regard to the INT stimulus). The task was serial anticipation learning of nonsense syllables, and the INC material was two-digit numbers. There was no effect for arousal at the quicker (2:2 sec.) rate of presentation; at the slower (4:4 sec.) rate aroused Ss showed better INC learning of peripheral cues, and poorer INC learning of central (juxtaposed) cues than nonaroused Ss. Factors contributing to these outcomes could relate to the relative distinctiveness of the INC cues; separation aiding the distinctiveness of the peripheral, and hindering that of the centrally placed (juxtaposed) cues.

So far as materials are concerned the conditions in which cues were peripherally placed are comparable in Kausler and Trapp (1962) and Silverman and Blitz (1956). The INC learning findings are different in the two studies: Better INC learning for aroused compared with nonaroused Ss in Kausler and Trapp, and poorer INC learning in Silverman and Blitz. The diverging outcomes could be attributed to the different arousal operations, and Kausler and Trapp (1962) do so, though without suggesting why generalised arousal and incentives should act thus differently.

It may be noted that Kausler and Trapp's (1962) finding is also at variance with their prediction (1960) quoted above; it was, however, not entirely clear from the context whether they intended the 1960 prediction to apply to incentives as well as generalised arousal.

The juxtaposed INC cue condition in Kausler and Trapp (1962) could be regarded as comparable to Bahrick's (1954) intrinsic INC material, and the arousal manipulations are comparable in both studies. Both studies, then, can be said to have found poorer INC learning of intrinsic material as a function of arousal (incentives).

Bahrick (1954) Replication: Nature of Population

Kausler, Laughlin and Trapp (1963) replicated Bahrick (1954) using seventh and eighth grade children as Ss. The arousal manipulation (incentive) and materials were the same as Bahrick's, and the procedure differed only in that a 2 sec. presentation rate was used in place of Bahrick's 3 sec. rate. Rate of learning in the INT task was superior among high incentive Ss. Contrary to Bahrick's finding of poorer (intrinsic) INC learning in the high incentive condition, Kausler et al. (1963) found better (intrinsic) INC learning. A generalised set to learn, embracing relevant and irrelevant material, not apparently present in Bahrick's college students, was inferred for Kausler et al.'s (1963) children. The finding of poorer INC learning of intrinsic material, as a function of arousal by means of incentives (Bahrick, 1954; Kausler and Trapp, 1962) did not hold up in the present instance when children were used as Ss.

Bahrick (1954) Replication by Dornbush (1965): Cue Position

Dornbush (1965) reported the results of two studies conducted to test Kausler and Trapp's (1960) predicted interaction of motivation level and cue location. (Kausler and Trapp (1962) had found an interaction between arousal (incentive) and cue location -- INC learning of peripheral cues was better and INC learning of centrally placed cues poorer for high than for low incentive Ss. This study was not, however, cited by Dornbush, 1965).

Among the variables manipulated by Dornbush were cue location (intrinsic-within; intrinsic-juxtaposed; extrinsic) and incentive. The incentive manipulation was similar to Bahrick's (1954), and Bahrick's materials were used with appropriate modifications to correspond to Dornbush's three levels of cue location: in the intrinsic-within condition the materials were used as Bahrick had used them (geometric forms filled with color); in the intrinsic-juxtaposed condition the colors were placed outside the forms but adjacent to them (¼" separation); in the extrinsic condition the colors were separated from the forms by 1".

No differences as a function of arousal were found; a too-rapid presentation rate (2:2 sec.), which increased task difficulty, or as Dornbush suggests, possibly changed the arousal operation from the incentive to the emotional variety, was offered in explanation.

Summary Charts: Findings of Kausler et al. and Related Studies

Key features of the INC learning studies discussed so far are listed in Chart I, and a summary of the INC learning findings in relation to nature of arousal and cue position is presented in Chart II.

In the studies which used serial anticipation learning as the INT task (i.e. all in Chart I except Silverman, 1954, and Spielberger et al., 1958) speed of presentation appears to have some effect on the

Chart I

KEY FEATURES OF KAUSLER ET AL. AND RELATED STUDIES

AROUSAL	AUTHOR(S)	RATE (sec.)	CUE POSITION	INC LEARNING	INT LEARNING
Incentive	Bahrick (1954)	3	Intrinsic (within)	HA < LA	HA > LA
Incentive	Kausler & Trapp (1962)	4:4	Intrinsic (juxtaposed - 1cm)	HA < LA	HA > LA
Incentive	"	4:4	Extrinsic (6cm separation)	HA > LA	HA < LA
Incentive	"	2:2	Intrinsic (juxtaposed - 1cm)	HA = LA	HA > LA
Incentive	"	2:2	Extrinsic (6cm separation)	HA = LA	HA < LA
Incentive	Dornbush (1965 - I)	2:2	Intrinsic (within)	HA = LA	HA = LA
Incentive	"	2:2	Intrinsic (juxtaposed - ½")	HA = LA	HA = LA
Incentive	Dornbush (1965 - II)	2:2	Intrinsic (within)	HA = LA	HA > LA
Incentive	"	2:2	Extrinsic (1" separation)	HA = LA	HA > LA
Incentive	Kausler et al. (1963, with children as Ss)	2	Intrinsic (within)	HA > LA	HA > LA
Shock threat (unavoidable)	Silverman (1954)	10	Extrinsic (different sense modality from INT task)	HA < LA	HA < LA
MAS scores	Silverman & Blitz (1956)	2:2	Extrinsic (6cm separation)	HA < LA	HA = LA
MAS scores	Kausler et al. (1959)	3	Intrinsic (within)	HA = LA	HA > LA
Ego threat	"	3	Intrinsic (within)	HA = LA	HA > LA
MAS scores	Spielberger et al. (1958)	-	Intrinsic - easy	HA > LA	-
MAS scores	"	-	Intrinsic - moderate	HA = LA	-
MAS scores	"	-	Intrinsic - difficult	HA < LA	-

amount of INC learning. A fast rate (e.g. 2:2 sec.) tends to depress INC learning and is associated with no difference on this measure between arousal groups. This comment cannot be made without qualification, however, because Silverman and Blitz (1956) and Kausler et al. (1963) found a difference in INC learning as a function of arousal, even though the presentation rate was 2:2 sec.

It may be helpful to summarise the outcomes of these studies further, noting the effect of arousal on variations in the range of cue utilisation. This is done in Chart II where INC learning findings only are shown.

Chart II

EFFECT OF AROUSAL ON CUE USE RANGE (INC LEARNING)

AROUSAL	CUE POSITION	NUMBER OF COMPARISONS	Effect of Arousal on Cue Use Range: REDUCTION	NO EFFECT	EXPANSION
Incentive	Intrinsic	7	2	4	1
"	Extrinsic	3	-	2	1
Generalised	Intrinsic	5	1	3	1
"	Extrinsic	2	2	-	-

Out of a total of seventeen comparisons of INC learning results for aroused and nonaroused Ss, five showed a reduction in the range of cue use with arousal; nine showed no effect for arousal; three showed expanded range of cue use with arousal.

Differences neither in the nature of the arousal manipulation, nor in cue position are capable of accounting for the findings. In their various discussions Kausler and his co-workers drew attention to these two variables and to others:

Task difficulty
Nature of the population (children, college students)
Distinctiveness of cues (i.e. INC material)

Even if these variables accounted for the empirical relationships in a consistent manner, which they do not, it would seem that much work would remain to be done in order to elaborate a theoretical framework to explain the observed relationships.

b) Other INC Learning Studies

McNamara and Fisch (1964)

An incidental learning study by McNamara and Fisch (1964) is relevant to Easterbrook's position, although it is not directly comparable to the studies we have just been discussing. The nature of the materials used by these authors makes it difficult to know exactly where to place their findings on the above chart. Their INT task was serial anticipation learning of six words printed centrally on a 5" x 8" card in heavy block capitals and encircled. The INC material consisted of four three-letter words in lighter and smaller print placed in a random manner around the central INC word. A different set of INC words was used with each INT word. INC learning was measured in terms of free recall of the INC words.

INC learning was investigated under three arousal conditions -- low, high "relevant," and high "nonrelevant" motivation. The method of introducing the experiment to the low motivation group is not mentioned. High "relevant" motivation was similar to the incentive manipulations discussed above -- Ss were promised monetary bonuses for fast and accurate performance. High "nonrelevant" motivation was aroused by threat of unavoidable shock. To maintain comparability with the previous discussion "incentive" and "threat of unavoidable shock" will be used here to refer to "relevant" and "nonrelevant" motivation respectively.

INC learning was better in the low arousal than in the incentive condition, which in turn was better than the threat of unavoidable shock condition. The location of the INC words correctly recalled was roughly similar for the low arousal and incentive conditions. In these two conditions correctly recalled INC words were fairly evenly distributed with regard to location on the test materials. In the threat of unavoidable shock condition, however, the small number of INC words correctly recalled had been located near the central INT word on the test materials.

The different materials used make it hard to compare McNamara and Fisch's findings with those of the studies discussed above. In respect, first, to their findings for the threat of unavoidable shock condition, which may be regarded as comparable to the emotional arousal assumed for high MAS scorers, it will be recalled that Silverman and Blitz (1956) found impaired INC learning for peripherally placed cues; emotional arousal in McNamara and Fisch also led to reduced INC learning of peripherally placed cues.

Compared to the low arousal conditions in each case, Bahrick (1954) and Kausler and Trapp (1962, 4:4 sec.) found incentives reduced INC learning for centrally placed cues, and Kausler and Trapp (1962, 4:4 sec.) found incentives facilitated INC learning of peripherally placed cues. McNamara and Fisch's finding for incentive was that, in comparison with the low arousal condition, incentives reduced the level of INC learning, but without regard to location -- central or peripheral.

<u>Markowitz (1969)</u>

The next INC learning study to be discussed calls in question the generality of Easterbrook's proposition by demonstrating that variation (reduction, expansion) in the range of cue use under arousal is a function of habitual style of coping with anxiety.

Markowitz (1969) found better INC learning for sensitisers, and poorer for repressers as a function of arousal (ego threat). The INT task was to learn twelve trigrams (presented at 4 sec.) under distraction from a "familiar language" -- the INC material. This consisted of twelve English words presented one at a time along with each trigram. Depending on the condition to which S was assigned the INC words were of positive, neutral or negative affect value, as determined by semantic differential ratings in previous research. The prediction that repressers and sensitisers would show the greatest difference in INC learning with regard to the negative affect words (which were expected to call forth the differing defense mechanisms most strongly) was not borne out. It was suggested that a strong main effect for affect value, such that positive INC words were better recalled than negative, and negative better than neutral, may have obscured the interaction between affect value, and coping style. A second analysis excluding words with strongest affect value, as indicated by the semantic differential ratings, showed a result in accordance with prediction for repressers -- greatest decrement in INC learning for negative affect words; the behavior of sensitisers was opposite to prediction, however, with sensitisers showing the smallest increment in INC learning for negative affect words. It was suggested that sensitisers had engaged in projection.

Although the more detailed predictions of this study were not borne out the overall finding of a different effect for variation in the range of cue use under arousal, as a function of style of coping, points to a source of limitation on the generality of Easterbrook's proposition which is additional to those encountered so far in this review.

Paradowski (1967)

The final INC learning experiment to be discussed is one in which Paradowski (1967) found enhanced INT and INC learning as a function of arousal (curiosity). Curiosity was manipulated by means of animal pictures, high and low interest having been determined in preliminary research with a sample from the same population as that used in the experiment (Paradowski, 1964). The INT task was to "assist in evaluating materials for a forthcoming textbook for undergraduates," and the measure of INT learning was recall of elements in a textual commentary on each of the animals. Two measures of INC learning were obtained: recall of background settings in which the animals were placed, and of the border color which framed the picture.

Paradowski suggests that Easterbrook's generalisation may be limited in applicability by having failed to consider "nonaversive" drives such as curiosity which are characterised by "positive affect and approach behavior" (1967, p. 50). Using Woodworth's (1958) terminology Paradowski proposes a reformulation:

> "Arousal of need-primacy motives decreases incidental learning, whereas arousal of behavior-primacy motives facilitates incidental learning." (p. 55)

Paradowski's findings are at variance with Easterbrook's prediction, but his interpretation of these findings raises some interesting questions. In the first place, not all theorists who have been interested in curiosity arousal would agree that it is nonaversive. Berlyne, for example, holds that the arousal of perceptual curiosity is aversive:

> "The condition of discomfort, due to inadequacy of information that motivates specific exploration is what we call 'curiosity'." (1966, p. 26)

Secondly, findings of enhanced INC learning as a function of arousal have been obtained in other studies discussed above. The four such instances are as follows:

- Children in an incentive condition showed better INC learning of intrinsic material compared with a nonaroused group (Kausler et al., 1963)

- Adults in an incentive condition showed better INC learning of extrinsic material compared with a nonaroused group (Kausler and Trapp, 1962)
- Adult high MAS scorers showed better INC learning of "easy" designs compared with low MAS scorers (Spielberger et al., 1958)
- Sensitisers exposed to ego threat showed better INC learning of English words placed alongside trigrams as distraction in a learning task, compared with a group of sensitisers not exposed to ego threat (Markowitz, 1969).

For each of the three arousal operations used in these studies (incentives, MAS score selection of Ss, ego threat) other experiments using similar arousal operations have shown either no effect of arousal on the range of cue use, or reduced range of cue use (e.g. Dornbush, 1965, Kausler and Trapp, 1962; Spielberger et al., 1958; Kausler et al, 1959). Neither in the present "Non task relevant cues" section, nor in other sections of this review has it been possible to bring order to the findings for range of cue use, now available, by referring to the nature of the arousal operation.

Two comments on procedural aspects of Paradowski's experiment are relevant in attempting to relate this study to the others discussed above. The black and white drawing of an animal and its background setting within a colored border is difficult to compare, in terms of formal character, with material used in the bulk of the INC learning studies which are relevant to Easterbrook's proposition. Paradowski's INT and INC material formed a continuous visual unit, in which it is hard to classify the INC materials (backgrounds and borders) as intrinsic or extrinsic, as these variables have been used in previous research. Kausler and Trapp (1962) found an interaction between cue position (intrinsic, extrinsic) and arousal, suggesting the potential importance of a cue position variable. Aroused Ss showed poor INC learning of centrally placed (intrinsic) cues, and enhanced INC learning of extrinsic cues compared with the nonaroused groups.

The final point relates to the nature of Paradowski's instructions. Paradowski introduced the task to his Ss as one in which they were to "assist in evaluating materials from a forthcoming textbook." The global nature of these instructions raises the question whether S may not have regarded all the materials presented to him as relevant to his task. If this were the case one might consider this experiment along with those classified above under "Cues which are task relevant," and more specifically with the subcategory of studies in which S might be expected to order the stimulus items in terms of importance.

Wachtel (1968) conducted an experiment in which S was expected to order the elements in terms of importance. He found that whether "reduction in cue use" occurred with regard to the less important elements depended on the nature of the arousal: in an unavoidable shock threat condition reduction in cue use was observed; no reduction was found in the avoidable shock threat condition. One interpretation of these findings is that the relevance to shock avoidance of performance in respect of all elements in the experimental task -- important and less important -- prevented impairment in performance relative to the less important elements.

It seems plausible that an explanation of Paradowski's findings may lie not so much in the nature of the arousal manipulation (i.e. "aversive" versus "nonaversive") but in the effect of the arousal manipulation on the potential relevance of the INC material. Perhaps S's curiosity was aroused by the high interest animals and he attempted to reduce this curiosity by heightened attention to the surrounding material and to the textual commentary. Hence the finding of better INC and INT learning.

It will be recalled that two measures of INC learning were obtained: recall of background settings and recall of border colors. The above analysis provides a reasonable explanation for enhanced recall of background settings surrounding the high curiosity pictures. These may be seen as relevant to curiosity reduction. There is less reason to assume that the borders surrounding the pictures would be relevant to curiosity reduction. And in fact Paradowski interprets his results as indicating that curiosity arousal aided INC learning regardless of whether the cues are "relevant or irrelevant to the eliciting stimulus"(1967, p. 54). We must conclude, therefore, that curiosity arousal had the effect in this instance of facilitating INC learning of material irrespective of whether the material in question was relevant to curiosity reduction. This suggests the operation, in reverse, of a passive, or automatic process of variation in the "range of cue use" analogous to that which may be inferred from Easterbrook's paper. Where formerly drive arousal caused a restriction in the perceptual field, curiosity arousal is now said to give rise to an expansion in the perceptual field.

Considering the INC learning studies which are relevant to Easterbrook's generalisation, although there has been some attempt at systematic research in this area no clear patterns have emerged. This may simply be because the ratio of relevant variables to studies executed has been too high. Further, although Sidman (1960) has made an appealing case for systematic replication, its use in two instances by Kausler and his colleagues (i.e. the replication of Bahrick, 1954, and Silverman and Blitz, 1956, changing the nature of the arousal in each instance), and by Dornbush (1965 replication of Bahrick, 1954, changing presentation rate), raises the question whether systematic replication is an entirely satisfactory technique if the E variable changes also.

Nineteen of the comparisons included in this section are additional to those discussed by Easterbrook. Nine of these showed no effect for arousal, five showed "reduction" and five showed "expansion" in the range of cue use.

A large number of variables has been suggested, usually on an ad hoc basis, as relevant. But the findings of these studies do not point conclusively to the overriding importance of any particular variable or combination of variables.

The review of experiments in which cues were task relevant suggested a second source of relevance namely, relevance to the arousal state. A further example of this source of relevance (relevance to curiosity reduction in Paradowski, 1967) may be in evidence among the present experiments in which variation in cue use range has been studied with regard to cues which are non task relevant. A third source of relevance was identified among these INC learning studies -- relevance to habitual style of coping (Markowitz, 1969).

4. Miscellaneous Studies

A prediction based on Easterbrook was a minor part of a large and involved study by Rosenthal (1967). Rosenthal did not find the predicted generalisation of dependency behavior from mother to stranger for aroused (anxiety-provoking visual and sound effects) high-dependent children (3½ to 4½ years old).

The basis for the prediction here is similar to that underlying the studies in the "Discrimination among cue elements" category above. The range of cue use is said to be reduced if there is evidence for generalisation, or a failure of discrimination. Hence the prediction, in this case, that the proximity-seeking behavior which the high-dependent child normally exhibits in regard to its mother, would generalise to a stranger under anxiety-provoking conditions.

Agnew, Pyke and Pylyshyn (1962) and Pylyshyn and Agnew (1962) studied the same task using avoidable shock in Agnew et al. (1962) and MAS score selection of Ss in Pylyshyn and Agnew (1962). Absolute judgment of distance was the task, and the authors predicted greater improvement with longer time to make the judgment for aroused compared with nonaroused Ss. Analysis of the data in information terms was presented.

Neither study found a main effect for arousal, and nonaroused rather than aroused Ss showed improved performance at the longer exposure time, contrary to prediction in Pylyshyn and Agnew (1962).

Mendelsohn and Griswold (1967) found no difference between high and low anxious male Ss (MMPI A scale) although both performed better than Ss in the middle of the distribution, on the following task: prior to an anagrams test S had been incidentally exposed to some of the anagram solutions; the prior exposure consisted in the solution's having appeared (1) among a list of words which S had been required to learn or (2) among a list of words presented in the background, as interference during the learning phase. The authors' hypothesis, based on Easterbrook, that high anxious Ss would show reduced use of the incidental material, was not confirmed. Their suggested modification of Easterbrook's position in terms of the relevance of the incidental material is in line with the present interpretation of some of the evidence being reviewed. The complex nature of their procedure raises some problems for a definition of relevance.

Among female Ss in this study no difference in use of the incidental material as a function of arousal was found.

Experimental Evidence relating to Easterbrook's Generalisation: Summary

Easterbrook rendered a valuable service in deriving his generalisation and in illustrating a variety of situations in which it could be applied. By formulating a principle which could serve as a point of reference he drew attention to one possible consequence of arousal. He was suggesting, essentially, that the organism viewed as information processor acts differently when aroused than when not aroused.

The fact that the precise form of his generalisation may not be entirely consistent with reality is of minor importance. As an empirical generalisation it attempted to reflect the facts then available. More and different facts are available now and the interpretation of the entire body of experimental evidence in this area changes accordingly.

Exhaustive systematic exploration of a small and tightly defined area is, of course, the answer if we want to avoid propounding invalid laws. But such work must begin somewhere and it may as well begin with a rough approximation that bears a relationship to known facts. There is always the chance that the right combination of variables will be present in a small collection of empirical facts, and that the first approximation will therefore be essentially correct, when reviewed in the light of new applications and new facts.

The chance that such will be the case -- that the first approximation will also be the final form of the law -- may be expected to vary inversely with the complexity of the problem under study. And all psychological problems are complex in the extreme.

Easterbrook proposed that the range of cue use would be reduced with arousal -- that is, under arousal conditions fewer cues would be used than under nonaroused conditions. It should be noted that even though Easterbrook, attempting perhaps to add precision to the concept, defines "range of cue use" in terms of "number of cues in use," this latter concept is still an impressionistic one. Measuring devices which will tell us how many cues a person uses, at any time or from moment to moment have scarcely begun to be developed.

The situations in which predictions from Easterbrook have been tested can be regarded in one sense as attempts to give concrete expression to the idea of "range of cue use." The experimental operations have reflected one aspect or another of the situations which existed in the "defining" experiments, and in the others to which Easterbrook applied the generalisation. In many instances where predictions based on Easterbrook were not supported it was because the subsequent experiments did not contain the combination of elements which yielded the results available to Easterbrook.

Easterbrook's "defining" experiments included tasks in which reduced use of "peripheral" cues had been observed -- for example, cues with off-center location in a perceptual motor task, extrinsically located cues in incidental learning experiments. These facts in the defining experiments suggested the idea that cues located off-center in a task might be good candidates for exclusion under conditions of arousal. Later experimentation has not supported this interpretation of "range." In the light of this later experimentation it is evident that what yielded the results observed in the "defining" experiments was a combination of off-center location and reduced subjective importance. In fact it can be said now, off-center location alone is not sufficient to result in reduced use of the cues in question. Cue relevance must be taken into account, regardless of the location of the cues. Three contexts for relevance were identified in this group of experiments: task relevance, relevance to the arousal manipulation, and relevance for habitual study of coping.

Easterbrook also applied his generalisation to experimental tasks in which the idea of range was appropriate only when range was defined as number of cues used. In these tasks efficient performance requires that fine discriminations among cue elements must be made. Among the studies reviewed by Easterbrook it could be observed that performance on such tasks appeared to be impaired under arousal. This has also been observed in some of the later experiments, though again, not in all. In these tasks the cues which should be discriminated are task relevant. When they are not discriminated, as sometimes happens when the subject is aroused, we have then a situation in which the relevance variable is not primarily determining. This suggests that there may be certain processes required for this kind of task which are adversely affected by arousal.

At this level of analysis, then, in looking for guidelines for the operation of arousal on the range of cue use it seems that we cannot appeal exclusively either to relevance (i.e. adaptive processes), or to automatic processes as the main determiner of the relationship.

The classificatory scheme within which the Easterbrook related experiments have been reviewed here has succeeded only to a very small degree in bringing order to the experimental data, suggesting that further conceptual differentiation is called for. Recent discussions of psychologists interested in attentional processes indicate that a beginning has already been made in developing an analytical framework within which functionally distinct aspects of "cue utilisation" may be studied. In the final section of this chapter experiments which were conducted to test hypotheses based on Easterbrook's generalisation will be briefly discussed in the light of conceptual distinctions contained in reviews of Berlyne (1970) and Treisman (1969).

Review of Easterbrook related Studies within an Attentional Framework

Berlyne's (1970) analysis takes account first of all, of intensive and selective aspects of attention. Among intensive aspects he distinguishes "attentiveness" -- the amount of information transfer from the environment, and "concentration" -- fluctuations in the range of stimuli that play some part in determining motor responses.

Among selective aspects he distinguishes selection on the basis of receptors stimulated, or spatial location (Berlyne would restrict the term "attention" to this aspect), and abstraction, which is selection among characteristics of a stimulus, keeping spatial location constant. Berlyne further distinguishes exploratory behavior, or receptor-adjusting responses, from both attention (in his narrow sense) and abstraction. Exploratory behavior influences selection by determining which stimuli will excite receptors. Attention and abstraction occur with regard to stimuli which have already excited receptor cells through exploratory behavior.

Treisman (1969) is concerned with selective aspects of attention only. She distinguishes three strategies, or models, for perceptual attention -- input selection, analyser selection, and target selection. Input selection provides the sensory data which will be analysed, and it will be itself the result of earlier analysis. Analyser and target selection distinguish two kinds of analysis which may be made on sensory input. The first occurs when one or more dimensions is selected for analysis, and others are ignored, as in the Stroop test. Target selection occurs when the items to be selected are defined by one or a set of critical features, each of which would constitute one value on a dimension identified by an analyser, for example, a "red item," or a "large red H." Treisman's "input selection" is probably a parallel concept to Berlyne's "spatial location," and her "selection of analysers" and "selection of targets" may be regarded as two classes of what Berlyne calls "abstraction."

Input Selection

Experiments conducted to test hypotheses relating to Easterbrook's proposition were classified above in terms of the task relevance of the cues in regard to which reduction in the range of cue use was being studied. The three classifications may be discussed in the light of Treisman's concept of input analysis. In the case of Task relevant cues, the cues in question should form part of S's sensory input, if S is following the experimental instructions. In the case of Cue task relevance indeterminate, and Non task relevant cues, the cues in regard to which reduction in cue utilisation is being measured do not form part of S's sensory input as a direct consequence of experimental instructions. In the former category the arrangements are such that S may determine a relationship which in fact exists between the cues in question and performance on the experimental task; in the latter category there is no connection between the cues in question and the instructed task. Input selection may then be seen to be determined largely by different factors in each of the three cases -- by experimental instructions in the first, by S's discovering task relevance in the second (possibly through a reinforcement process), and by properties of the stimuli which may be classified as self-relevance, and impingingness, in the third.

Within the first category where input is determined by experimental instructions, four subcategories of tasks were distinguished. In the case of two of these -- Size of Visual Field, and Importance Ordering -- some further choice of input within the experimental task was left to S; these tasks provide an opportunity for studying range of attention (cf Berlyne's "concentration" of attention), and they will be discussed below under that head. The remaining two subcategories of tasks in which input selection was determined by experimental instructions -- those labelled Cue Selection, and Discrimination among Cue Elements -- appear to involve respectively, selection of analysers, and target selection. The latter category in particular includes a number of distinguishable subgroupings which suggest further variables which could be added to Treisman's analysis.

Range of Attention

Range of attention was the attentional variable which figured most prominently in Easterbrook's "defining" experiments. Those experiments provided evidence on variations in attentional range with regard to cues which were task relevant (as in the perceptual motor task of Bahrick et al. 1952), and with regard to cues which were non task relevant (as in the incidental learning experiments). The experiments reviewed here provide additional evidence on attentional range variation, as a function of arousal, in each of these contexts. It seems possible to formulate some conclusions with regard to this attentional variable in situations where the cues are task relevant. As noted in the concluding comments on the Non task relevant cues section above, data on range of attention with regard to non task relevant cues as a function of arousal are not easily coordinated within a conceptual framework.

a) Task Relevant Cues: Size of Visual Fields

Solso et al. (1962) presented their Ss with test slides containing a number of stimulus elements, and found no difference as a function of arousal in number of stimulus elements recorded, but did find that aroused Ss recorded more elements from the outer part of the display compared with nonaroused Ss. Range of attention in this instance was broader, in physical terms, for aroused than for nonaroused Ss. The perimeter test reported in the same section (Eysenck and Gillan, 1964a) suggests that in so far as range of attention is determined by S's potential for receiving stimulation, aroused Ss can be expected to possess a capacity for greater attentional range than nonaroused Ss, again in physical terms. Schmidt's (1964) findings point in the same direction as those of Eysenck and Gillan (1964a).

These results suggest that arousal per se does not operate to restrict the range of attention within a stimulus field, nor does it narrow the stimulus field from which S may receive stimulation.

b) Task Relevant Cues: Importance Ordering

Wachtel's (1967) experiment in which attention (reaction time) to off-center, and possibly less important subjectively, stimuli was studied provided evidence that arousal could produce reduced attention to the off-center stimuli, but only when the arousal (unavoidable shock threat) was unrelated to performance. The arousal condition in which S believed shock was contingent on performance yielded reaction time results to the off-center stimuli which were comparable to those in the nonaroused condition.

Tecce and Tarnell's (1965) results, for their somewhat equivocal measure of attention, suggest reduced attention to an unimportant element of a task, as a function of arousal.

In a presidential address to the British Psychological Society, Drew (1963) refers to the use of the term "tunnel vision" to describe the apparent restriction of visual fields which had been observed for performance on simulated flying instrument panels under stress conditions. He suggests that the impression that attention becomes restricted from peripheral to foveal areas under stress is an artifact of the experimental design, and he refers to experimental evidence (not cited) which indicates that attention becomes "restricted to that part of the field from which stimuli are expected, whether this be central or peripheral." If the location of the main task is changed, "restriction will occur to whatever part of the periphery is given the most frequent or most important signals." (pp. 5-6)

While experiments which manipulated position of central task elements have not been available for review here, the evidence which has been reviewed in regard to visual fields, and importance ordering, is in line with Drew's (1963) remarks.

In situations, then, in which S̲ is familiar with all elements in the task (i.e. where learning is not required in the experimental situation) predictions relating to restricted range of attention as a function of arousal should take account of inferred ordering of elements in terms of subjective importance.

Easterbrook has been interpreted as suggesting that the process of reduction in cue use range goes on inexorably, without regard to any controlling factors within the individual (Wachtel, 1968, p. 422). If this was Easterbrook's position, and it is an impression which may reasonably be gleaned from his paper, it is not substantiated by evidence such as the above. If the precise locus of attentional restriction is determined by a subjective ordering of elements in terms of importance, variations in the range of attention must then be seen to be determined not only by arousal level, but by arousal in interaction with other variables, such as subjective importance.

c) Non Task Relevant Cues

Considerations of task relevance which in the preceding category of experiments (Task relevant cues) might be expected to work towards keeping the range of attention wide, would in the case of the experiments in the Non task relevant cues category tend to restrict the range of attention. If attention is not found to narrow as a function of arousal in the INC learning situation one would have to look to sources of relevance other than task relevance, or to other variables for an explanation of the effect.

Where an expanded attentional range has been observed with regard to non task relevant cues a variety of explanations has been offered:

- Generalised set to learn (among children) in Kausler et al. (1963)
- Interaction between arousal and cue distinctiveness (Kausler and Trapp, 1962)
- Interaction between arousal and task difficulty (Spielberger et al., 1958)
- Interaction between arousal and style of coping (Markowitz, 1969)
- Positive nature of the drive (curiosity) in Paradowski (1967)

In the case of Paradowski's interpretation, the finding is ascribed to a characteristic of the arousal per se. The interest aroused in conjunction with curiosity was such that it facilitated response to elements which were irrelevant, as well as relevant to curiosity reduction. The evidence presented by Paradowski, and his analysis of it are reminiscent of the implications of Bruner et al.'s (1955) analysis of the effect of motivation on breadth of learning, and also of the tenor of much of Easterbrook's (1959) paper. Variation in the range of attention (expanded range for Paradowski, reduced range for Bruner et al. and Easterbrook) is proposed as a direct consequence of increase in arousal.

Among the INC learning studies in which Easterbrook's predicted narrowing of attentional range as a function of arousal had not been found, and in which instead an expansion of attentional range had been observed, Paradowski (1967) provided a particularly interesting case of what could be interpreted as a direct, and apparently automatic effect of arousal. If Paradowski's effect were reproducible it would provide further evidence that Easterbrook's generalisation was an oversimplification of the relationship between arousal and attentional range. But it would tend to support at the same time, the suggestion implicit in Bruner at al.'s (1955) analysis and in Easterbrook's discussion, of an effect for arousal which is not dependent on any process of control (e.g. gating, or direction derived from task instructions) which might be inferred for the subject in the particular stiuation.

As indicated above, two sources of relevance in Paradowski's experiment may have contributed to the effect he obtained -- arousal relevance, and task relevance. Further, the nature of Paradowski's materials made it difficult to know whether his INC material should be classified as intrinsic or extrinsic, and hence made his study difficult to compare with the immediately relevant INC learning literature.

It was decided to investigate Paradowski's basis hypothesis again, namely that curiosity arousal leads to an expansion of the attentional range irrespective of relevance considerations. In so doing it was proposed to control for the sources of relevance which seemed to have been involved in his study, and to effect changes in his design which would make the experiment more comparable with other immediately relevant INC learning experiments.

III. HYPOTHESES AND EXPERIMENTAL DESIGN

Selection of Materials and Instructed Task

Two considerations influenced the selection of materials for the experiment. To maintain as much comparability as possible with Paradowski's study it was decided to use his materials, with changes as indicated below on the aspects which appeared to be the source of ambiguity. As a check on the generality of whatever findings might be obtained for Paradowski's materials it was also decided to include materials which Berlyne has used repeatedly to demonstrate various behavioral measures of curiosity. The use of Berlyne materials provided a further advantage in that he had published data (1963) which indicated that exposure to his materials for short and longer durations could be interpreted as representing respectively, stages of curiosity arousal and curiosity reduction. It should be possible then, using these materials, to tie down the effect found by Paradowski to the stage or stages of curiosity induction with which it might be associated.

Two considerations also influenced the selection of S's instructed task. Since a crucial point in Paradowski's position was his assertion of an expanded attentional range as a function of curiosity arousal, irrespective of "relevance to the eliciting stimulus," it was important that curiosity should be aroused in the present instance in a manner which would not imbue the INC material with task or curiosity reduction relevance. At the same time it was important to obtain evidence, within the present experiment, that curiosity had in fact been aroused. The INT task was selected with this dual purpose in mind.

Paradowski Materials

Prior to discussing the changes made in Paradowski's materials it is necessary to describe his experiment in greater detail than has been done to this point:

> Paradowski's Ss (undergraduates) were asked to assist in evaluating materials for a forthcoming textbook for undergraduates. The test material, presented in book form, consisted of an illustration of an animal on the left-hand page with informational text on the right-hand page. The animal illustration was exposed for ten seconds; then the text was exposed for twenty seconds.
>
> Following each of the ten illustration-text exposures, Ss took a completion test on the text, and a multiple-choice test concerning the appearance of the animal.
>
> Following presentation of stimulus materials and tests, Ss were given an INC learning test. Each of ten pages carried a reduced illustration of one of the test animals and two multiple-choice questions, the first calling for selection of the background against which the animal had been depicted (desert, forest, jungle, swamp, mountain), the second requiring selection of the color used for the border of the illustration (five colors were used).
>
> Curiosity was assumed to have been aroused by five of the illustrations which depicted unfamiliar animals. A group of comparable Ss had given these illustrations top rankings on "interestingness" among a series of 24; the five animal illustrations receiving lowest rankings on interest value comprised the remaining test stimuli used by Paradowski. In a separate test fixation time had been found to be longer for the more than for the less interesting animals.

The black and white drawing of an animal and its background setting within a colored border surrounded by white page which Paradowski presented to his Ss is difficult to compare, in terms of formal character, with material used in previous research. Paradowski's INT and INC material formed a continuous visual unit, in which it is hard to classify the INC material (backgrounds and borders) as intrinsic or extrinsic, as these variables have been used in previous research. Accordingly Paradowski's animals were centered in a white field spatially separated from a colored border for use in the experiment to be described here.

S's Instructed Task

S's task was to rate each drawing in terms of desire to see it again, and interestingness, within the context of exploratory research into "people's reactions to pictures." The role of the particular ratings selected as S's task in establishing that curiosity was in fact aroused in this situation is explained more fully below in the Hypotheses section.

Berlyne Materials

Differential responding which can be interpreted as indicating arousal or nonarousal of curiosity has been shown by Berlyne in respect of stimulus materials which he has published. Some brief background on these materials follows.

Properties of stimuli which can be described by such terms as "irregularity" and "complexity" have been shown to prompt various kinds of exploratory behavior. Among the measures used are number of tachistoscopic exposures (Berlyne, 1957) and fixation time (Berlyne 1958a, 1958b).

Berlyne's stimuli (e.g. 1958b, 1963, 1966) consist of line drawings in pairs, one member in each pair being a "less irregular" (LI), and the other a "more irregular" (MI) pattern. The paired stimuli are grouped within nine categories of irregularity, and from two to four pairs have been published within each category. The categories are distinguished from each other in that the difference between LI and MI patterns may be one of:

irregularity of arrangement
irregularity of shape
amount of material
heterogeneity of elements
incongruity
incongruous juxtaposition
number of independent units
assymmetry
random redistribution

Spitz and Hoats (1961) used these materials to investigate exploratory choice. Subjects were shown the two patterns of each pair side by side for three seconds and were then allowed to see either one again for as long as they chose. Under these conditions the less irregular patterns were chosen, in general, in preference to the more irregular. Using a similar procedure, with the modification that the patterns in a pair were seen by S in turn, rather than simultaneously, Berlyne (1963) found a tendency to select more irregular patterns following short exposure intervals (½ sec., 1 sec.), and to select less irregular patterns following longer exposure intervals (3 sec., 4 sec.).

In interpreting these results Berlyne (1963) suggests that the choice of more irregular patterns following the short exposure indicated the presence of perceptual curiosity in S's motivational state. Following the longer exposure, however, S had been able to absorb sufficient information to reduce his perceptual curiosity. His behavior, under these conditions, is presumed to be no longer motivated by perceptual curiosity directed to a specific stimulus, but is now likely to be reinforced by stimulation with "optimal collative properties, regardless of source or content." (1963, p. 283)

Berlyne is here talking about two kinds of exploratory behavior distinguished in terms of their antecedent conditions and motivational bases:

- Specific exploratory behavior, preceded by receipt of partial information (as under the short exposure condition) and motivated by curiosity directed to supplying the information lack.

- Diversive exploratory behavior, not preceded by receipt of partial information, (or preceded by receipt of partial information, arousal and satisfaction of perceptual curiosity, as under the longer exposure condition) and motivated by the desire to secure an optimal level of arousal.

The crucial point, so far as the present experiment is concerned, is that the two different exposure times represent two different states:

curiosity arousal, and curiosity arousal and satisfaction.

The Berlyne materials were prepared in a form similar to that used for the Paradowski materials -- each pattern was centered in a white field, spatially separated from a colored border.

Hypotheses

The use of Berlyne's materials permitted making differential predictions for INC learning in terms of the stage of curiosity arousal in effect. Further, except for the addition of the colored borders, Berlyne's stimuli were being used in this experiment in a manner which was quite similar to his. This was not the case with Paradowski materials; removal of the background settings, change in instructions, and the use of a slide projector in place of Paradowski's portfolio could affect S's response in indeterminate ways. On the other hand it seemed reasonable to assume that his analysis of the effect of curiosity arousal on the perceptual range would not be specific to his materials only, but could be applied to curiosity aroused by means of other materials regarding which considerably more behavioral evidence for curiosity arousal was available. Consequently the main hypotheses of the experiment were stated with regard to Berlyne materials and to the exposure times appropriate to curiosity arousal (½"), and curiosity arousal and satisfaction (4").

Before testing the main hypotheses, however, it seemed desirable to obtain evidence that Berlyne's materials were being responded to within the context of this experimental situation substantially as they had been responded to in their author's experiments. This check was provided for in the form of supplementary hypotheses stated in regard to the outcome of the stimulus ratings which constituted S's INT task.

These same ratings obtained in respect of Paradowski materials provided an indication of how Paradowski stimuli were being responded to in the present experimental situation, and in the form in which they were used here. Should Ss' ratings of Paradowski materials conform with their ratings of Berlyne's it would seem possible to apply the main hypotheses with regard to INC learning which had been stated for Berlyne materials to Paradowski's. This check on the comparability of Berlyne and Paradowski materials was stated in the form of further supplementary hypotheses in regard to the outcome of S's INT task.

The hypotheses stated for the purpose of conducting these initial checks on the experimental procedures are listed first below, followed by a statement of the main hypotheses of the experiment, and some exploratory hypotheses.

Procedural Checks

As indicated above, on a number of occasions Berlyne has demonstrated behavioral differences in response to his materials which can be related systematically to characteristics of irregularity, or complexity. For the purpose of this experiment it was important to know whether Berlyne's "irregular" stimuli (MI) -- those which had produced exploratory behavior in previous experiments -- could be assumed to be curiosity arousing here. It was particularly important to have this information for the effect of the MI stimuli at the shortest (½") exposure time, since we would assume that whatever effect is present at ½" would also have occurred during the initial portion of the 4" exposure.

The INT tasks were selected for this purpose. S's task was to rate each test stimulus on:

- whether he would like to see it again, and
- how interesting he finds it.

Support for the following hypotheses would indicate that Berlyne's stimuli were operating in the present experiment substantially as they had in his research:

Hyp. Ia At ½" exposure mean value on the "see again" scale will not be lower for MI than for LI stimuli (MI $\geq$ LI).

Hyp. Ib Also at ½", mean value on the "interesting" scale will be higher for MI than for LI stimuli (MI > LI).

Hyp. II At 4" exposure mean value on the "see again" scale will not be higher for MI than for LI stimuli (MI $\leq$ LI).

With regard to the Paradowski materials, notwithstanding the formal changes which were described above, it would still be expected that his more interesting (MI) animals should receive higher ratings on an interestingness scale than his less interesting (LI) animals. Paradowski does not state whether his animal drawings were ranked in terms of interestingness under conditions of controlled exposure time. The hypothesis was, therefore, stated as follows:

Hyp. III Mean value on the "interesting" scale will be higher for MI than for LI animals at one of the exposure times -- ½", 4", 10" (MI > LI).

If response to the Paradowski materials on the "see again" and "interesting" scales were similar to that obtained for Berlyne materials it would be reasonable to test the INC learning hypotheses stated for Berlyne materials using INC learning data obtained with Paradowski stimuli:

Hyp. IV Mean difference between LI and MI ratings on "see again" and "interesting" scales for Berlyne material will not differ significantly from the comparable statistic for Paradowski material

a) at each exposure time (½", 4", 10")

b) at ½" and 4".

<u>Main Hypotheses</u>

Given the two stages of curiosity arousal and reduction provided by the use of Berlyne's stimuli, if a broadening of the perceptual field associated with curiosity were to be found, it would seem more likely to occur at the stage of curiosity reduction than concomitantly with the initial arousal of curiosity. In fact it seemed plausible that the greater interest value of Berlyne's more irregular (MI) stimuli as demonstrated in previous research, might reduce the level of INC learning compared with his less irregular (LI) stimuli, at the initial stage of curiosity arousal:

Hyp. V INC learning with MI will be less than with LI designs at ½" exposure for B material (MI < LI).

Hyp. VI INC learning with MI will be greater than with LI designs at 4" exposure for B material (MI > LI).

Contingent on confirmation of Hypothesis IV b, identical hypotheses were stated for INC learning with Paradowski material:

Hyp. VII INC learning with MI will be less than with LI designs at ½" exposure for P material (MI < LI).

Hyp. VIII INC learning with MI will be greater than with LI designs at 4" exposure for P material (MI > LI).

Exploratory Hypotheses

The use, in the experimental design, of Berlyne material at 10" was essentially exploratory, in that no firm information was available on the response to his stimuli at this exposure time. However, based on a trend noted in Spitz and Hoats (1961) for LI patterns to be chosen with decreasing frequency over successive trials it was hypothesised that:

Hyp. IX Mean values on the "see again" scale will not be lower for MI than for LI stimuli at 10" for B material (MI ≥ LI).

It was felt that if there was any reason to believe that S's wish to see MI designs again was enhanced relative to LI at 10", the implications for INC learning could be complex. On the one hand, diversive exploratory behavior motivated by boredom with the LI patterns could be inferred. This might be expected to lead to greater scanning of the total picture, and hence of the border, possibly facilitating INC learning. On the other hand, a trend towards greater choice of the MI designs compared with LI at the 10" exposure could suggest a cycle of arousal, satisfaction, and renewed arousal of perceptual curiosity with regard to these stimuli. Because the implications for INC learning of such a cycle were not at all clear, the hypothesis was stated to reflect the analysis in terms of greater scanning prompted by the arousal of diversive exploratory behavior in connection with the LI stimuli.

Hyp. X INC learning with LI will be greater than with MI designs at 10" for B material (LI > MI).

Hyp. XI INC learning with LI will be greater than with MI designs at 10" for P material (LI > MI).

Experimental Design

A 2 x 3 x 2 experimental design was used in which the independent variables were curiosity arousal (low and high), exposure time (Berlyne's ½" or short, his 4" or long exposure, and Paradowski's 10" exposure), and materials (Berlyne's and Paradowski's). Curiosity arousal and exposure time were repeated measures. Identification of the border color in a list of color names constituted the dependent variable (a measure of incidental learning.)

IV. METHOD

Subjects

Ss were City College undergraduates, ranging in age from 18 to 28 years; all were volunteers recruited from psychology classes. A total of 48 Ss was used, 24 (12 males, 12 females) in each of two materials conditions. Ss were run in groups of about four. A total of 16 Ss had to be discarded and were replaced. (See Reasons for Discarding Subjects, below).

Materials

The stimuli used in this experiment had been used in previous research by Berlyne (e.g. 1963) and Paradowski (1967).

Berlyne Materials

Stimuli for the experiment were selected from those categories of "irregularity" (shape and arrangement) which showed the most marked shift in choice of "more irregular" designs from short (½", 1") to longer (3", 4") exposure times (Berlyne, 1963). Three pairs of patterns were selected from each of these two categories. These six pairs constituted the twelve stimuli used in the present experiment; six were "less irregular" (LI) and six were "more irregular" (MI).

One additional LI pattern was selected from the irregularity of arrangement category to be used as a practice slide for Ss in the Berlyne material condition (See Procedure, below).

Paradowski Materials

Paradowski's (1967) test stimuli consisted of the five animals rated most, and the five rated least interesting from a series of 24, twelve of which had been selected on the basis of their novel, and twelve on the basis of their ordinary appearance. Since the present design called for six low and six high curiosity stimuli, two additional animal drawings were obtained from Paradowski. The animal ranked sixth most, and that ranked sixth least interesting were added to the ten used by Paradowski. This gave a total of twelve animal drawings, six of which were "less interesting" (LI), and six were "more interesting" (MI).

One additional drawing from Paradowski's set -- the animal which ranked seventh least interesting -- was used as the practice slide for Ss in the Paradowski material condition (see Procedure, below).

Each of the B and P stimuli was centered in a white field framed by a colored border. Six different colors were used; each color was used an equal number of times with the LI and MI stimuli (see Presentation Order, below). The B and P practice stimuli were prepared in the same way as the test stimuli, and were framed with a gray border, a color not included among those used for the test stimuli. Two sets of 35mm slides were made of the B and P stimuli, one in color and one in black and white.

Apparatus

The stimuli were projected on a screen by means of a Polymetric V1459 Tachisto-Projector with a programmed slide exposure and sequencing attachment.

Procedure

Identical procedures were used with the groups of Ss exposed to the B and to the P stimuli. A copy of S's answer booklet which also contains the instructions may be found in Appendix I.

Task

The experiment was introduced to S as the first phase of a research project in which people's reactions to drawings would be obtained. S was told that some or all of the slides which would be shown in this first phase would be used in later stages of the research. S was asked to rate the drawings in terms of whether "people like yourself" would want to look at the picture again, and how interesting they would find it. S was told that the drawings would appear on the screen for varying exposure periods, with a constant interstimulus interval; that he should look at the drawing while it was on the screen and use the interval of blank screen between exposures to record his ratings (on each of two seven-point scales); he was also told that a ready signal would be given one second before the appearance on the screen of each picture.

Practice Trials

An LI picture from the Berlyne and Paradowski materials was used solely for practice purposes in the B and P conditions respectively, to insure S's familiarity with the instructions and with the test procedures. S was shown this slide in turn at 10", 4" and ½", with an interstimulus interval of the same duration as that used during the presentation of the test stimuli (8").

INC Learning Test

Following presentation of the twelve test stimuli S was told that E was also interested in S's reaction to aspects of the picture which he may or may not have consciously attended to, in this case, the color of the border. The pictures were presented again at the same exposure times and interstimulus interval used during the first presentation, but this time the slides were in black and white. S was asked to check from a list of names of the six colors used, the color that framed the picture during the first presentation; he was also asked to indicate his degree of confidence (seven-point scale) in his recall.

Supplementary Information

S was taken through the black and white set of slides once again, this time being asked to indicate, in those cases where he felt confidence in his recall of the border color (i.e. had checked 5, 6 or 7 on the confidence scale) the reason he remembered the color. Exposure times and interval were the same as during the previous presentations.

Presentation Order

Presentation order for stimuli and conditions over the entire experiment is shown in Appendix II. In arriving at this order the following factors were taken into account:

Between Ss

The material conditions (B,P) were run in a balanced order (BPPBBP, etc.) and Ss were assigned to B or P conditions on the basis of their test appointment time.

Within Ss

Curiosity level -- LI and MI stimuli were presented in a random order, counterbalanced across Ss; there were, then, two orders of presentation for curiosity level.

Exposure Time -- Three exposure time orders were used. For any S the exposure times were balanced in four blocks. Counterbalancing ensured that each exposure time appeared once in each of the twelve possible positions. Over the three orders each exposure time followed each of the others an approximately equal number of times, and did not follow itself.

Individual Stimuli -- The B stimuli are published in LI/MI pairs. The P stimuli were paired with reference to the rankings on interestingness of these stimuli in Paradowski's original pilot work. The first LI/MI pair of P stimuli were those drawings which had been ranked 24 and 1 respectively; the second pair were those which had been ranked 23 and 2, and so on. For each S both stimuli of each B or P pair were presented at the same exposure time; across all Ss each stimulus pair was shown at each exposure time. Because of the similarity of structure between B pair members, pair members were separated from each other by three or more intervening stimuli.

Border Colors -- Each color was used once with an LI and once with an MI picture. As there were two presentation orders for curiosity level, there were also two orders for border color presentation.

Reasons for Discarding Subjects

It was mentioned under Subjects, above, that a total of 16 Ss were discarded and replaced. Complete data for a subject were discarded for the following reasons:

> S failed to record ratings of one or more test drawings, and it was not possible to say which drawing S had omitted to rate (3 in Berlyne and 3 in Paradowski materials conditions).
>
> S misunderstood the INC learning test instructions (there were two kinds of difficulty here: S thought the instructions referred to the backgrounds, rather than the borders of the slides; S thought he was to note border colors during the black and white presentation of the slides for the border recall test; 2 Ss in the Berlyne, and 6 in the Paradowski conditions were discarded for these reasons).
>
> S expected a recall test on the border colors (1 S each in the Berlyne and Paradowski conditions was discarded for this reason).

Method of Estimating Missing Observations

In a small number of cases S failed to record ratings of one test drawing and it was possible to identify the drawing which had been omitted (for example, E noted that S missed the first, or the last of the twelve drawings presented. and recorded this on S's answer booklet). Data for Ss were not discarded when this occurred. Instead, since two observations per cell, per S, were obtained, and averaged to give S's score in each cell, in cases where one observation was missing, the obtained observation was used to represent S's score in that cell. Six

Ss in the B materials condition omitted to rate one stimulus -- three of the omitted stimuli were LI and three were MI. Two of the LI stimuli had been presented at ½", and one at 4"; one of the MI had been presented at ½", and two at 4". Five Ss in the P materials condition omitted to rate one stimulus -- two were LI and three were MI. All omitted LI and MI stimuli had been presented at ½".

V. RESULTS

1. Analysis of "See Again" and "Interesting" Ratings

Hypotheses concerning mean ratings on the "see again" and "interesting" scales for Berlyne material, and on the "interesting" scale for Paradowski material were stated as a means of checking whether these materials were being responded to in the present experimental situation substantially as they had been in their authors'. In addition, for Berlyne materials at 10", where no firm information was available from previous research, prediction was based on a trend noted in Spitz and Hoats (1961), and was stated in the form of an exploratory hypothesis.

The results indicate confirmation of these hypotheses. The relevant data are shown in Table 1 ("see again" ratings) and Table 2 ("interesting" ratings). Hypotheses stated in regard to Berlyne materials will be discussed first, followed by those stated in regard to Paradowski materials, and to the comparison of Berlyne and Paradowski ratings on these two scales.

Berlyne Materials

Hyp. Ia — At ½" exposure mean value on the "see again" scale will not be lower for MI than for LI stimuli (MI $\geq$ LI).

The slight numerical advantage shown in Table 1 for MI compared with LI mean ratings (4.3 versus 3.5) was not large enough to produce a significant *T*. However, the results are in accordance with the hypothesis as stated.*

Hyp. II — At 4" exposure mean value on the "see again" scale will not be higher for MI than for LI stimuli (MI $\leq$ LI).

*Conservative hypotheses, allowing for a no difference outcome were stated with respect to "see again" mean ratings. This was because it was felt that monadic rating using a seven-point scale was likely to be less sensitive to differences between the stimuli than the forced choice method which Berlyne had used in his research.

Table 1

MEAN RATINGS ON "SEE AGAIN" SCALE FOR LI AND MI STIMULI* WITHIN EXPOSURE TIME

SOURCE OF STIMULUS MATERIALS	½" Exposure				4" Exposure				10" Exposure			
	LI	MI	MI-LI	WILCOXON T	LI	MI	MI-LI	WILCOXON T	LI	MI	MI-LI	WILCOXON T
Berlyne	3.5	4.3	0.8	NS	3.7	4.1	0.4	NS	3.4	4.4	1.0	37.0*
Paradowski	4.5	4.9	0.5	NS	4.7	5.1	0.4	NS	4.1	4.8	0.7	NS

Note: All tests are one-tail; *, $p < .005$

*As indicated in the text (see Method -- Materials, above) Berlyne distinguishes his stimuli in terms of "irregularity." LI stands for "less irregular," MI for "more irregular." Paradowski distinguishes his stimuli in terms of "interestingness." For Paradowski materials LI stands for "less interesting," and MI for "more interesting."

Table 1 shows that the small numerical difference (0.4) between MI and LI mean ratings is not significant, an outcome in accordance with Hypothesis II.*

Hyp. Ib At ½" exposure mean value on the "interesting" scale will be higher for MI than for LI stimuli (MI > LI).

"Interesting" scale results are shown in Table 2. Mean ratings for MI stimuli on the "interesting" scale (4.5) are significantly higher than those for LI stimuli (3.6). Wilcoxon's _T_ has a $p < .005$ value.

Confirmation of the above three hypotheses was stated as a prerequisite for assuming curiosity arousal to have occurred at ½" exposure and curiosity arousal and satisfaction to have occurred at 4". This outcome, then, permits testing the INC learning hypotheses stated with regard to Berlyne materials for ½" and 4" exposures (i.e. Hypotheses V and VI). The results of these tests are discussed in a later section.

Results relating to one of the exploratory hypotheses will be reported next since the hypothesis refers to data for Berlyne materials which are reported in Table 1.

Hyp. IX Mean values on the "see again" scale will not be lower for MI than for LI stimuli at 10" (MI $\geq$ LI).

In the absence of firm previous indications concerning the likely response to Berlyne's stimuli when exposed for 10" the prediction was stated in the form of an exploratory hypothesis. The data which are shown in Table 1 indicate relatively greater desire to see MI stimuli again, compared with LI ($p < .005$). The 10" exposure, in fact, is the only one, among the three included in this investigation, where the difference in mean ratings for MI and LI stimuli on the "see again" scale is significant. Examination of the absolute level of the ratings for less and more irregular stimuli across exposure times is, unfortun-

*See footnote on previous page.

Table 2

MEAN RATINGS ON "INTERESTING" SCALE FOR LI AND MI STIMULI* WITHIN EXPOSURE TIME

SOURCE OF STIMULUS MATERIALS	½" Exposure				4" Exposure				10" Exposure			
	LI	MI	MI-LI	WILCOXON T	LI	MI	MI-LI	WILCOXON T	LI	MI	MI-LI	WILCOXON T
Berlyne	3.6	4.5	0.9	53.5***	3.5	4.3	0.8	61.4*	3.5	4.9	1.4	10.5***
Paradowski	4.6	5.3	0.7	31.0**	4.6	5.8	1.2	28.0***	4.1	5.4	1.3	52.5***

Note: All tests are one-tail; *, $p < .025$; **, $p < .01$; ***, $p < .005$

*See footnote to Table 1.

ately, not very enlightening concerning the source of the difference at 10". For example, had the LI ratings differed substantially at 10" from their levels at the other exposure times it may have been possible to infer that the difference at 10" resulted from boredom with the LI stimuli. There is no indication that this was the case, and an examination of the ratings on the "interesting" scale for LI stimuli across exposure times (Table 2) yields no support to such an interpretation.

<u>Paradowski Materials</u>

Hyp. III   Mean value on the "interesting" scale will be higher for MI than for LI animals at one of the exposure times -- ½", 4", 10" (MI > LI).

The relevant data are shown in Table 2. This hypothesis was not tied to any one of the exposure times because it was not known whether Paradowski had obtained his rankings of "interesting" under controlled exposure conditions. Significant *T*s were obtained for mean ratings on the "interesting" scale for Paradowski material at each of the three exposure times ($p < .01$ at ½"; $p < .005$ at 4" and 10"). Confirmation of this hypothesis indicates that the differential interest value which Paradowski had found for his animals was not adversely affected by the changes in formal aspects or method of exposure made for this experiment.

<u>Berlyne and Paradowski Materials: Comparison of Ratings</u>

Hypotheses relating to one other preliminary check on the rating scale data remain to be considered. It was decided that if the results on the rating scales were comparable for Berlyne and Paradowski materials that the INC learning hypotheses stated for Berlyne materials would also be tested with Paradowski data.

Hyp. IV   Mean difference between LI and MI ratings on "see again" and "interesting" scales for Berlyne material will not differ significantly

Table 3

DIFFERENCES IN MEAN RATINGS OF LI AND MI STIMULI*
FOR BERLYNE AND PARADOWSKI MATERIALS WITHIN EXPOSURE TIME

	½" Exposure			4" Exposure			10" Exposure		
	MI - LI		MANN-WHITNEY	MI - LI		MANN-WHITNEY	MI - LI		MANN-WHITNEY
SCALES	BERLYNE	PARADOWSKI	U	BERLYNE	PARADOWSKI	U	BERLYNE	PARADOWSKI	U
See Again	0.8	0.5	NS	0.4	0.4	NS	1.0	0.7	NS
Interesting	0.9	0.7	NS	0.8	1.2	NS	1.4	1.3	NS

*See footnote to Table 1.

from the comparable statistic for Paradowski material

a) at each exposure time (½", 4", 10")

b) at ½" and 4".

Within each exposure time, differences in ratings of Berlyne's MI and LI stimuli were compared with differences in ratings of Paradowski's MI and LI stimuli by means of Mann-Whitney U tests. As may be seen in Table 3, none of the six Us obtained was significant (i.e. three on "see again" scale ratings; three on "interesting" ratings). This means that Hypothesis IV a was confirmed, and permits including the INC learning data for all exposure times, and for both sets of materials in the one analysis.

2. Analysis of INC Learning Data

Prior to the analysis of data classified as INC learning is the question whether INC learning occurred. The proportion of correct border color identification obtained overall, and within conditions, for Berlyne and for Paradowski materials is shown in Table 4. The level of correct border color identification expected by chance is 0.17. Correct identification obtained in conjunction with Berlyne materials equals the level expected by chance; that obtained in conjunction with Paradowski materials is significantly different from chance ($p = .006$).

The following hypotheses relating to INC learning results were stated:

Hyp. V INC learning with MI will be less than with LI designs at ½" exposure for B material (MI < LI).

Hyp. VII As above for P material.

Hyp. VI INC learning with MI will be greater than with LI designs at 4" exposure for B material (MI > LI).

Hyp. VIII As above for P material.

Table 4

PROPORTION OF CORRECT IDENTIFICATIONS FOR SIX BORDER COLORS*

SOURCE OF STIMULUS MATERIALS	ALL STIMULI	½" Exposure		4" Exposure		10" Exposure	
		LI	MI	LI	MI	LI	MI
Berlyne	0.17	0.15	0.15	0.21	0.15	0.21	0.17
Paradowski	0.23[a]	0.25	0.15	0.19	0.27[b]	0.29[c]	0.21

*The data on this table also state mean correct border color identification

[a] N = 288, p = .006
[b] N = 48, p = .06
[c] N = 48, p = .002

Hyp. X INC learning with LI will be greater than with MI designs at 10" exposure for B material (LI > MI).

Hyp. XI As above for P material.

These hypotheses were stated with the expectation that data obtained in conjunction with Berlyne and Paradowski materials would be analysed. Therefore, for whatever interest it may have, a 2 x 3 x 2 ANOVA with repeated measures on curiosity level and exposure time was carried out. The only test in the ANOVA (see Table 5) which approached significance was the main effect for materials ($F = 3.0$, df 1,46; $p < .10$).

The data in Table 4 also state mean correct border color identification. The MI/LI differences are very small and do not approach significance.

The main hypotheses of the experiment receive no confirmation from these data. While we can state that INC learning occurred in conjunction with Paradowski materials, the data do not support the assertion that INC learning is systematically related to curiosity arousal by means of interesting pictures.

Table 5

ANALYSIS OF VARIANCE FOR CORRECT BORDER COLOR IDENTIFICATIONS

SOURCE OF VARIATION	SUMS OF SQUARES	df	MEAN SQUARES	F	p
Between Ss					
A (Materials)	0.22	1	0.22	3.00	< .10
Ss within groups	3.41	46	0.07		
Within Ss					
B (Curiosity)	0.09	1	0.09	1.21	NS
AB (Materials x Curiosity)	0.00	1	0.00	< 1	
B x Ss within groups	3.33	46	0.07		
C (Exposure)	0.11	2	0.06	< 1	
AC (Materials x Exposure)	0.00	2	0.00	< 1	
C x Ss within groups	8.97	92	0.10		
BC (Curiosity x Exposure)	0.08	2	0.04	< 1	
ABC (Materials x Curiosity x Exposure)	0.20	2	0.10	1.06	NS
BC x Ss within groups	8.81	92	0.10		
Total	25.22	287			

VI. DISCUSSION

In this experiment stimulus materials were used which had been demonstrated in previous research to have behavioral effects which give evidence of curiosity arousal. Within the experimental situation reported here further evidence was obtained that curiosity was differentially aroused by the MI stimuli, in the confirmation of the hypotheses regarding the outcome of "see again" and "interesting" ratings. This held true both for Berlyne and Paradowski materials. So far as can be determined, however, the fact that curiosity was aroused by the MI stimuli had no effect on INC learning. The absence of a relationship between INC learning and curiosity arousal will be discussed in turn for the Berlyne and Paradowski materials.

The absolute amount of correct border color identification with the Berlyne materials equalled the level that might be expected on the basis of chance alone. This raises the question whether INC learning occurred in conjunction with these materials, and it suggests, minimally, that the measure used was not sensitive to any INC learning which may have occurred. Correct border color identification in conjunction with Berlyne materials does not, then, provide an adequate test of the hypotheses relating INC learning and curiosity arousal.

The test of INC learning used here required S to have made an association between the border color and the particular stimulus which it framed. Quite possibly the nonmeaningful nature of the Berlyne stimuli made the formation of such associations difficult.

On the other hand, the overall level of correct border color identification obtained in conjunction with Paradowski stimuli was reliably greater than chance. The differences in INC learning with the LI and with the MI stimuli were not significant, however.

This finding of no difference in INC learning as a function of an arousal manipulation is not unprecedented in the immediately relevant INC learning experiments. Such an outcome has been obtained when Ss were selected on the basis of MAS scores by Kausler et al. (1959). With arousal by means of incentives this was also the outcome in Dornbush (1965) and Kausler and Trapp (1962), in both cases when the rate of presentation in the serial INT learning task was 2". An interpretation in terms of INT task difficulty, at 2", is suggested in these experiments.

The possible relevance of INT task difficulty as an explanation of the no difference finding can be considered in the present case, although it would be hard to compare, for example, the relative difficulty of the stimulus rating task used here, and the serial learning task used in the studies mentioned above. On a purely intuitive basis it would not appear that the rating task was a very demanding one, particularly at the 4" and 10" exposures when S had ample time to view the stimulus. A main effect for exposure and a direct relation between the amount of INC learning and exposure duration would support such an interpretation, but this was not found. However, this could be because the exposure times sampled in this experiment did not cover a wide enough range. A consideration for future research would be to simplify the INT task perhaps by using one rating scale only, and longer exposures and interstimulus intervals.

The failure to find any facilitating effect on INC learning in any of the three exposure time conditions used in this study suggests that for none of the stages of curiosity arousal assumed to be in effect at these different exposure times is Paradowski's prediction of expanded attentional range, embracing irrelevant stimuli, confirmed. The findings of the present study fail to replicate this aspect of his experiment. In Paradowski's study INC learning with the LI drawings was not significantly different from chance, but it was above the chance level with his MI drawings, and the MI/LI difference was significant ($p < .05$).

An explanation for the different outcomes in the present, and in Paradowski's experiment may lie in the nature of the exploratory behavior S engaged in, in order to reduce curiosity. Paradowski's materials presented the unusual animals in a background setting, and provided in addition textual commentary on the animals. Following exposure to his practice illustration and text, Paradowski's Ss knew that information would be provided, and within the experimental situation, on the animals. In the present experiment Ss were given no expectation of learning anything about the animals during the course of the experiment. This difference in experimental procedures may have led to Paradowski's Ss' directing exploratory behavior prompted by curiosity arousal to an examination of the test materials. In contrast, in the present experiment with no expectation that curiosity would be reduced within the experimental situation, S's curiosity-reducing behaviors may have been restricted to the stimuli to be rated, and possibly to scanning whatever symbolic responses were aroused by the stimuli.

An explanation along these lines would suggest that if curiosity arousal is to be effective in promoting INC learning care should be taken to ensure that curiosity is aroused in such a way that whatever behaviors S engages in to reduce curiosity will facilitate exposure to the INC material.

One of the experiments reported by Berlyne, Carey, Lazare, Parlow and Tiberius (1968) may provide an analogous situation to the comparison of the present experiment and that of Paradowski (1967). In this series of experiments, Berlyne et al. investigated the facilitating effect on INC paired-associate learning of various curiosity arousing fore-conditions. The paired-associate terms were Turkish words and their English equivalents e.g. MESEB Oak. The declared purpose of the experiment was to measure S's pulse rate while he pronounced the paired-associate items. The independent variables were introduced in a variety of fore-conditions to which S was exposed prior to exposure to the paired-associate items. In two of the fore-conditions of relevance here a Turkish word and an English word indicating the category (e.g. tree, food, etc.) to which the Turkish word belonged were presented for 4 sec. in the memory drum window, e.g. MESEB (tree). S was instructed to voice a guess as to the meaning of the Turkish word. The next rotation of the memory drum exposed the paired-associate items also for 4 sec., and S was instructed to pronounce both words. In one of the fore-conditions (guess, relevant learning), the Turkish word was the same on both presentations; on first being exposed it was accompanied by the English category word (e.g. tree), and on being exposed for the second time it was accompanied by the English equivalent (e.g. Oak). In the second fore-condition (guess, irrelevant learning) the Turkish word and English category word were different from the paired-associate items.

In the third fore-condition (no guess, double presentation) the Turkish word and its English equivalent appeared twice, each time for 4 sec. S was instructed to pronounce both words both times. INC learning of the English equivalents of the Turkish words was superior in the guess, relevant learning condition compared with both the guess, irrelevant learning condition, and the no guess, double presentation conditions.

Berlyne et al. (1968) interpret their results as indicating that prior guessing (assumed to have aroused curiosity), followed by pronouncing the test words, enhances INC learning compared with a condition in which the test words are pronounced twice, but only when prior guessing is followed by curiosity reduction (i.e. by paired-associate items which contain the same Turkish word as in the fore-condition).

In Berlyne et al.'s prior guess (irrelevant learning) condition, as in the present experiment, and in contrast to Paradowski (1967), although curiosity was aroused, the experimental procedures provided S with no expectation that curiosity would be reduced within the experimental situation.

It would seem then, that in considering the possible facilitating effect of curiosity arousal on other behavior, in this case INC learning, it is necessary to ensure that the exploratory behavior in which S engages in order to reduce curiosity will include the material on which INC learning will be measured. In the prior guess (irrelevant learning) condition in Berlyne et al. the exploratory behavior, in which S might be presumed to have engaged in order to reduce curiosity aroused by guessing, may have been restricted to implicit symbolic responses. In the present experiment it may likewise have been restricted to implicit symbolic responses, and to observing the stimulus drawings. In Paradowski's experiment it may have included the backgrounds and the borders.

The above interpretation of the different outcomes in the present and in Paradowski's experiment may be summarised as follows: In order for curiosity arousal to facilitate INC learning, curiosity reduction must occur in such a manner that the INC material will be included in S's exploratory behavior. The present experimental procedures provided S with no expectation that curiosity would be reduced by examining the INC materials, and he used other means to reduce curiosity.

Other explanations may also be entertained. It may have been possible to ensure that S's exploratory behavior would include the INC material by retaining the intervening background material which Paradowski had included in his materials. If, for example, curiosity arousal promotes eye movement, the availability of intervening backgrounds might act to extend the increased eye movements, bringing the eye out to the borders, thus ensuring S's exposure to them. If enhanced INC learning associated with the more interesting drawings were obtained under these conditions then the facilitation of INC learning by curiosity arousal could be attributed to the effect of curiosity arousal on scanning behavior.

If enhanced border recall were obtained under these conditions an important theoretical question would remain to be solved. This would relate to the mechanism by which enhanced retention of essentially irrelevant material would be effected. It is not really sufficient to say that curiosity arousal might result in increased scanning, provided material were present to be scanned, and that this scanning behavior would result in S's exposure to the INC material. Exposure to stimuli does not necessarily ensure retention of the stimuli in question.

Neither the present experiment, nor the evidence reviewed above concerning Easterbrook's generalisation proves that Paradowski's or Easterbrook's respective positions are completely wrong. In both cases, however, putting their ideas to experimental test has suggested that the relationships are not as simple and straightforward as either author stated them.

APPENDIX I

Project #: 3a
G. Fennell/1969

Session #: _____

Please do not open this booklet until we are ready to begin. We will then read the instructions inside. Since we are doing this as a group it is important that everyone should do the same thing at the same time.

Please write in the date of your birthday:

Month: __________ Day: __________ Year: __________

Please circle whichever is appropriate:

Male

Female

What is your major field?

____

We're interested in people's reactions to drawings. This is the first part of a research project in which we will be using some or all of the drawings you will be seeing to-day. In this part of the research we are interested in getting information on two things:

Whether people like yourself would want to look at a particular drawing again.

How interesting they would find the particular drawing.

You will be shown twelve drawings on the screen. The drawings will be exposed for different lengths of time -- a short, a medium and a long exposure. The screen will be blank for eight seconds after each drawing is exposed. You should use that time to indicate on the rating scales whether people like yourself would want to look at the drawing again, and how interesting they would find it.

Your booklet contains a page for each of the twelve drawings with two rating scales on each page.

Let's turn to the next page and read the rating scales.

Would people want to look at this picture again?

7	6	5	4	3	2	1
Extremely likely	Somewhat likely	Slightly likely	Undecided	Slightly unlikely	Somewhat unlikely	Extremely unlikely

How interesting would people find this picture?

7	6	5	4	3	2	1
Extremely interest-ing	Somewhat interest-ing	Slightly interest-ing	Undecided	Slightly uninter-esting	Somewhat uninter-esting	Extremely uninter-esting

Please look at the screen when I say "Ready," and turn the page to be ready for the next drawing.

Don't feel forced to give the same or different ratings to any one drawing on each of the two scales. Whether a person wants to look at a particular drawing again, may or may not be determined by how interesting/uninteresting he or she finds it.

We will go through a short practice session before we start on the series of twelve.

The purpose of the practice session is to make you comfortable with the procedure -- to give you an idea of the length of time the drawing will be on the screen, and of the amount of time you have between drawings.

For the practice session you will be shown the same picture at each of the three different exposure times, and with a constant interval of blank screen between the slides. These will be the same exposure times and blank screen interval which will be used when I show you the series of twelve pictures.

(Of course, for the experiment proper -- when I show you the series of twelve pictures -- you will see a <u>different</u> picture each time, sometimes at a short, sometimes at a medium and sometimes at a longer exposure time.)

So, just for the practice session you will be shown the same picture at three different exposure times.

This is what you are to do:

> When the drawing is on the screen look at it. Then, when the screen goes blank, make a quick decision and circle the appropriate number on each of the two scales in turn. Look back at the screen when I say "Ready."

I shall say "Ready" one second before the next drawing appears on the screen.

You have eight seconds of blank screen to mark the rating scales and turn the page. You will find that will be plenty of time. So please wait until the screen goes blank to mark the scales.

Are there any questions?

You can use the next three pages in your answer book for the practice session.

Please turn to the next page, and look at the screen when I say "Ready."

RATING SCALES

FOR SERIES OF TWELVE DRAWINGS

Project #: 3b
G. Fennell/1969

Session #: _____

Please do not open this booklet until we are ready to begin. We will then read the instructions inside.

Please write in the date of your birthday:

Month: __________ Day: __________ Year: __________

Please circle whichever is appropriate:

Male

Female

What is your major field?

____

You remember that at the beginning it was mentioned that we're interested in finding out about people's reactions to pictures. One of the things that interests us is whether people are likely to remember parts of the pictures to which their attention was not drawn.

This second booklet asks about something which you may or may not have consciously noticed. You may or may not have a recollection of it. PLEASE make the best guess you can, in any case. You will be provided with a scale to indicate the degree of confidence you have in your answer.

You will be shown the entire series of twelve drawings again, at the same exposure time and blank interval used the first time. This time, during the interval between the slides please indicate in this answer book the color of the border that surrounded the drawing when it was shown the first time.

Everything will be the same this time around, except that the slides will now be shown in black and white.

Again you have one page for each of the twelve drawings. The names of the six border colors are listed on each page. When the picture goes off the screen please circle one of the six color names to indicate the border color that surrounded the drawing the first time it was shown. Then please use the seven-point scale to indicate how confident you are that the color you have circled is the correct one.

I'll give you a ready signal one second before the next slide appears.

Are there any questions?

Let's read the answer page before we begin. Please turn to the next page.

Please circle <u>one</u> of the color **names** below to indicate the color of the border that surrounded this picture. If you do not remember, GUESS! Then indicate your confidence or doubt on the scale below.

BLACK

BLUE

BROWN

GREEN

RED

YELLOW

How confident are you that the color you circled is correct?

7	6	5	4	3	2	1
Extremely confident	Somewhat confident	Slightly condident	Undecided	Slightly doubtful	Somewhat doubtful	Extremely doubtful

Please look at the screen when I say "Ready," and turn the page to be ready for the next drawing.

Project #: 3c
G. Fennell/1969

Session #: _____

Please do not open this booklet until we are ready to begin. We will then read the instructions inside.

Please write in the date of your birthday:

Month: __________ Day: __________ Year: __________

Please circle whichever is appropriate:

Male

Female

What is your major field?

____

This is the last time you're going to have to look at the slides!

This time we want you to take out your second booklet -- the one marked Project #: 3b in the upper right-hand corner. That is the booklet in which you checked your recall of the border colors. Please do not open this booklet yet.

What we want you to do is this: If you checked 5, 6 or 7 on the confidence scale, we should like to get some idea of how it was that you noted the color of the border.

Please write in the blank space at the bottom of the page why you think you remembered the border color for that particular drawing.

As you are doing this you will be shown the drawings again, as you saw them the last time around. You will have eight seconds between the slides to write your answer.

Are there any questions?

Do you all have the booklet marked Project #: 3b? Please turn to the third page in that booklet -- that is the page on which you marked the border color which surrounded the first drawing.

It is necessary to write an answer only for those slides where you circled 5, 6 or 7 on the confidence rating scale. When you have finished writing your answer turn to the next page, and look at the screen when I say "Ready."

Finally, a few general questions about this experiment.

Please think back to the first part of the experiment -- that is the part from the time you came in here to-day through to the end of the <u>first</u> time you were shown the series of twelve pictures:

Aside from what you were told about the experiment in the instructions what other thoughts or ideas concerning the experiment did you have?

____

____

____

____

____

____

As you were looking at the pictures for the first time did you think you would be asked to recall any of the material you were being shown?

___No -- none of the material

___Yes -- the drawings

___Yes -- the borders

___Yes -- the drawings and the borders

Did you try to remember the border colors?

___No

___Yes -- tried to remember the border colors that were used

___Yes -- tried to associate the border color with the drawing

Thank you for your participation in this experiment!

APPENDIX II

PRESENTATION ORDER FOR CONDITIONS AND STIMULI

Session	Stimulus Order											
	1	2	3	4	5	6	7	8	9	10	11	12
1	$10E_1$	$4D_2$	$\frac{1}{2}C_1$	$4G_1$	$\frac{1}{2}F_2$	$10H_1$	$\frac{1}{2}C_2$	$10E_2$	$4D_1$	$10H_2$	$\frac{1}{2}F_1$	$4G_2$
2	$10e_1$	$4d_2$	$\frac{1}{2}c_1$	$4g_1$	$\frac{1}{2}f_2$	$10h_1$	$\frac{1}{2}c_2$	$10e_2$	$4d_1$	$10h_2$	$\frac{1}{2}f_1$	$4g_2$
3	$10e_2$	$4d_1$	$\frac{1}{2}c_2$	$4g_2$	$\frac{1}{2}f_1$	$10h_2$	$\frac{1}{2}c_1$	$10e_1$	$4d_2$	$10h_1$	$\frac{1}{2}f_2$	$4g_1$
4	$10E_2$	$4D_1$	$\frac{1}{2}C_2$	$4G_2$	$\frac{1}{2}F_1$	$10H_2$	$\frac{1}{2}C_1$	$10E_1$	$4D_2$	$10H_1$	$\frac{1}{2}F_2$	$4G_1$
5	$4E_1$	$\frac{1}{2}D_2$	$10C_1$	$\frac{1}{2}G_1$	$10F_2$	$4H_1$	$10C_2$	$4E_2$	$\frac{1}{2}D_1$	$4H_2$	$10F_1$	$\frac{1}{2}G_2$
6	$4e_1$	$\frac{1}{2}d_2$	$10c_1$	$\frac{1}{2}g_1$	$10f_2$	$4h_1$	$10c_2$	$4e_2$	$\frac{1}{2}d_1$	$4h_2$	$10f_1$	$\frac{1}{2}g_2$
7	$4e_2$	$\frac{1}{2}d_1$	$10c_2$	$\frac{1}{2}g_2$	$10f_1$	$4h_2$	$10c_1$	$4e_1$	$\frac{1}{2}d_2$	$4h_1$	$10f_2$	$\frac{1}{2}g_1$
8	$4E_2$	$\frac{1}{2}D_1$	$10C_2$	$\frac{1}{2}G_2$	$10F_1$	$4H_2$	$10C_1$	$4E_1$	$\frac{1}{2}D_2$	$4H_1$	$10F_2$	$\frac{1}{2}G_1$
9	$\frac{1}{2}E_1$	$10D_2$	$4C_1$	$10G_1$	$4F_2$	$\frac{1}{2}H_1$	$4C_2$	$\frac{1}{2}E_2$	$10D_1$	$\frac{1}{2}H_2$	$4F_1$	$10G_2$
10	$\frac{1}{2}e_1$	$10d_2$	$4c_1$	$10g_1$	$4f_2$	$\frac{1}{2}h_1$	$4c_2$	$\frac{1}{2}e_2$	$10d_1$	$\frac{1}{2}h_2$	$4f_1$	$10g_2$
11	$\frac{1}{2}e_2$	$10d_1$	$4c_2$	$10g_2$	$4f_1$	$\frac{1}{2}h_2$	$4c_1$	$\frac{1}{2}e_1$	$10d_2$	$\frac{1}{2}h_1$	$4f_2$	$10g_1$
12	$\frac{1}{2}E_2$	$10D_1$	$4C_2$	$10G_2$	$4F_1$	$\frac{1}{2}H_2$	$4C_1$	$\frac{1}{2}E_1$	$10D_2$	$\frac{1}{2}H_1$	$4F_2$	$10G_1$

Between S Conditions

The two materials conditions are distinguished in the above table by the use of upper or lower case letters -- Berlyne materials are represented by upper case, and Paradowski materials by lower case letters.

Within S Conditions:

The exposure time in seconds at which each stimulus was shown is indicated by the numerals 10, 4, ½.

The two levels of curiosity are indicated by the use of subscripts -- 1: LI; 2: MI.

Border colors were paired with drawings as follows:

C_1 Red	E_1 Blue	G_1 Green	C_2 Blue	E_2 Brown	G_2 Yellow
D_1 Black	F_1 Brown	H_1 Yellow	D_2 Green	F_2 Black	H_2 Red

The actual sequence of colors for each of the two curiosity level presentation orders was as follows:
Brown Black Blue Yellow Brown Red Red Blue Green Yellow Black Green
Blue Green Red Green Black Yellow Blue Brown Black Red Brown Yellow

BIBLIOGRAPHY

BIBLIOGRAPHY

Aborn, M. The influence of experimentally induced failure on the retention of material acquired through set and incidental learning. Journal of Experimental Psychology, 1953, 45, 225-231.

Agnew, N. and Agnew, M. Drive level effects on tasks of narrow and broad attention. Quarterly Journal of Experimental Psychology, 1963, 15, 58-62.

Agnew, N., Pyke, S. and Pylyshyn, Z. Information transfer in absolute judgment as a function of noxious stimulation and exposure time. Perceptual and Motor Skills, 1962, 15, 779-782.

Bahrick, H. P. Incidental learning at five stages of intentional learning. Journal of Experimental Psychology, 1957, 54, 259-261.

Bahrick, H. P., Fitts, P. M. and Rankin, R. E. Effect of incentives upon reactions to peripheral stimuli. Journal of Experimental Psychology, 1952, 44, 400-406.

Basowitz, H., Persky, H., Korchin, S. J. and Grinker, R. R. Anxiety and stress. New York: McGraw-Hill, 1955.

Berkowitz, L. Anti-semitism, judgmental processes, and displacement of hostility. Journal of Abnormal and Social Psychology, 1961, 62, 210-215.

Berkowitz, L. and Buck, R. W. Impulsive agression: reactivity to aggressive cues under emotion arousal. Journal of Personality, 1967, 35, 415-424.

Berlyne, D. E. Attention as a problem in behavior theory. In D. Mostofsky (Ed.) Attention: contemporary theories and analyses. New York: Appleton-Century-Crofts, 1970.

Berlyne, D. E. Curiosity and exploration. Science, 1966, 153, 25-33.

Berlyne, D. E. Complexity and incongruity variables as determinants of exploratory choice and evaluative ratings. Canadian Journal of Psychology, 1963, 17, 274-290.

Berlyne, D. E. Supplementary report: complexity and orienting responses with longer exposures. Journal of Experimental Psychology, 1958, 56, 183. (a)

Berlyne, D. E. The influence of complexity and novelty in visual figures on orienting responses. Journal of Experimental Psychology, 1958, 55, 289-296. (b)

Berlyne, D. E. Conflict and information-theory variables as determinants of human perceptual curiosity. Journal of Experimental Psychology, 1957, 53, 399-404.

Berlyne, D. E., Carey, S. T., Lazare, S. A., Parlow, J. and Tiberius, R. Effects of prior guessing on intentional and incidental paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 750-759.

Braley, L. A. Some conditions influencing the acquisition and utilization of cues. Journal of Experimental Psychology. 1962, 64, 62-66.

Bruner, J. S., Matter, Jean and Papanek, Miriam L. Breadth of learning as a function of drive level and mechanization. Psychological Review, 1955, 62, 1-10.

Bruning, J. L., Capage, J. E., Kozuh, G. F., Young, P. F. and Young, W. L. Socially induced drive and range of cue utilization. Journal of Personality and Social Psychology, 1968, 9, 242-244.

Bursill, A. E. The restriction of peripheral vision during exposure to hot and humid conditions. Quarterly Journal of Experimental Psychology, 1958, 10, 113-129.

Callaway, E. and Stone, G. Reevaluating focus of attention. In L. Uhr and J. G. Miller (Eds.) Drugs and behavior. New York: John Wiley & Sons, 1960, 393-398.

Cornsweet, D. M. Use of cues in the visual periphery under conditions of arousal. Journal of Experimental Psychology, 1969, 80, 14-18.

Davis, D. R. Pilot error. Air Publication 3139A. London: H. M. Stationery Office, 1948.

Davis, D. R. and Cullen, J. H. Disorganization of perception in neurosis and psychosis. American Journal of Psychology, 1958, 71, 229-237.

De Bonis, Monique. La loi de Yerkes-Dodson: problèmes méthodologiques liés a sa vérification. Année Psychologique, 1968, 68, 121-141.

Dornbush, R. L. Motivation and positional cues in incidental learning. Perceptual and Motor Skills, 1965, 20, 709-714.

Drew, G. C. The study of accidents. Bulletin of the British Psychological Society, 1963, 16, 1-10.

Duffy, E. Leeper's "Motivational theory of emotion." Psychological Review, 1948, 55, 324-328.

Easterbrook, J. A. The effect of emotion on cue utilization and the organization of behavior. Psychological Review, 1959, 66, 183-201.

Eriksen, C. W. Some personality correlates of stimulus generalization under stress. Journal of Abnormal & Social Psychology, 1954, 49, 561-565.

Eysenck, H. J. and Gillan, P. W. The effects of drive on the visual field. In H. J. Eysenck (Ed.) Experiments in motivation. New York:

The Macmillan Company, 1964, 132-136. (a)

Eysenck, H. J. and Gillan, P. W. Speed and accuracy in mirror drawing as a function of drive. In H. J. Eysenck (Ed.) Experiments in motivation. New York; The Macmillan Company, 1964, 100-106. (b)

Eysenck, H. J. and Gillan, P. W. The accuracy of kinaesthetic judgments. In H. J. Eysenck (Ed.) Experiments in motivation. New York: The Macmillan Company, 1964, 142-146. (c)

Eysenck, H. J. and Willett, R. A. The effect of drive on performance and reminiscence in a complex tracing task. British Journal of Psychology, 1966, 57, 107-112

Eysenck, H. J. and Willett, R. A. Cue utilization as a function of drive: an experimental study. Perceptual and Motor Skills, 1962, 15, 229-230.

Farber, I. E. The role of motivation in verbal learning and performance. Psychological Bulletin, 1955, 52, 311-327.

Fischer, G. J. and Cook, M. B. Influence of distribution of practice and varying speeds of stimulus presentation on incidental learning. Psychological Reports, 1962, 10, 539-545.

Granger, G. W. Personality and visual perception: A revision. Journal of Mental Science, 1957, 103, 48-79.

Johnson, E. E. The role of motivational strength in latent learning. Journal of Comparative Physiological Psychology, 1952, 45, 526-530.

Kausler, D. H., Laughlin, P. R. and Trapp, E. P. The effects of incentive-set on relevant and irrelevant (incidental) learning in children. Child Development, 1963, 34, 195-199.

Kausler, D. H. and Trapp, E. P. Effects of incentive-set and task variables on relevant and irrelevant learning in serial verbal learning. Psychological Reports, 1962, 10, 451-457.

Kausler, D. H. and Trapp, E. P. The effects of position and exposure duration on irrelevant cue learning. Paper presented at the 1961 meeting of the Southwestern Psychological Association, Little Rock.

Kausler, D. H. and Trapp, E. P. Motivation and cue utilization in intentional and incidental learning. Psychological Review, 1960, 67, 373-379.

Kausler, D. H., Trapp, E. P. and Brewer, C. L. Intentional and incidental learning under high and low emotional drive levels. Journal of Experimental Psychology, 1959, 58, 452-455.

Kohn, H. Effects of variations of intensity of experimentally induced stress situations upon certain aspects of perception and performance. Journal of Genetic Psychology, 1954, 85, 289-304.

Mackintosh, N. J. Selective attention in animal discrimination learning. Psychological Bulletin, 1965, 64, 124-150.

Markowitz, A. Influence of the repression-sensitization dimension, affect value, and ego threat on incidental learning. Journal of Personality and Social Psychology, 1968, 11, 374-380.

McLaughlin, B. "Intentional" and "incidental" learning in human subjects: the role of instructions to learn and motivation. Psychological Bulletin, 1965, 63, 359-376.

McNamara, H. and Fisch, R. Effect of high and low motivation on two aspects of attention. Perceptual and Motor Skills, 1964, 19, 571-578.

Mechanic, A. The distribution of recalled items in a simultaneous intentional and incidental learning. Journal of Experimental Psychology, 1962, 63, 593-600.

Mendelsohn, G. A. and Griswold, B. B. Anxiety and repression as predictors of the use of incidental cues in problem solving. Journal of Personality and Social Psychology, 1967, 6, 353-359.

Paradowski, W. Effect of curiosity on incidental learning. Unpublished doctoral dissertation, Columbia University, 1964.

Paradowski, W. Effect of curiosity on incidental learning. Journal of Educational Psychology, 1967, 58, 50-55.

Postman, L. Short-term memory and incidental learning. In A. W. Melton (Ed.) Categories of human learning. New York: Academic Press, 1964.

Pylyshyn, Z. and Agnew, J. N. Absolute judgment of distance as a function of anxiety and exposure time. Perceptual and Motor Skills, 1962, 14, 411-418.

Rosenberg, S. Exposure interval in incidental learning. Psychological Reports, 1959, 5, 675.

Rosenthal, M. K. The generalization of dependency behavior from mother to stranger. Journal of Child Psychology and Psychiatry, 1967, 8, 117-133.

Rubin, B. M., Shantz, D. W. and Smock, C. D. Perceptual constriction as a function of incentive motivation. Perceptual and Motor Skills, 1962, 15, 90.

Schmidt, H-E. Relation of the narrowing of the visual field with an increase in distance to manifest anxiety. Journal of Experimental Psychology, 1964, 68, 334-336.

Scofield, R. W. and Rankin, R. J. Anxiety and visual acuity. Perceptual and Motor Skills, 1962, 14, 18.

Shaw, W. A. Facilitating effects of induced tension upon the perception span for digits. Journal of Experimental Psychology, 1956, 51, 113-117.

Shore, M. F. Perceptual efficiency as related to induced muscular effort and manifest anxiety. Journal of Experimental Psychology, 1958, 55, 179-183.

Sidman, M. Tactics of scientific research. New York: Basic Books Inc., 1960.

Silverman, R. E. Anxiety and the mode of response. Journal of Abnormal and Social Psychology, 1954, 49, 538-542.

Silverman, R. E. and Blitz, B. Learning and two kinds of anxiety. Journal of Abnormal and Social Psychology, 1956, 52, 301-303.

Smock, C. D. and Small, V. H. Efficiency of utilization of visual infomation as a function of induced muscular tension. Perceptual and Motor Skills, 1962, 14, 39-44.

Solley, C. M. and Murphy, G. Development of the perceptual world. New York: Basic Books, 1960.

Solso, R. L. The effect of anxiety on cue selection in the A-Br paradigm. Psychonomic Science, 1968, 13, 105-106.

Solso, R. L., Johnson, E. and Schatz, G. C. Perceptual perimeters and generalized drive. Psychonomic Science, 1968, 13, 71-72.

Spielberger, C. C., Goodstein, L. D. and Dahlstrom, W. G. Complex incidental learning as a function of anxiety and task difficulty. Journal of Experimental Psychology, 1958, 56, 58-61.

Spitz, H. H. and Hoats, D. L. Experiments on perceptual curiosity behavior in mental retardates. Final report on NIMH grant M-4533. Bordentown, N.J.: E. R. Johnstone Training and Research Center, 1961.

Tecce, J. J. and Tarnell, M. Focal and incidental movement time as a function of shock arousal in humans. The Journal of Psychology, 1965, 59, 155-158.

Tolman, E. C. Cognitive maps in rats and men. Psychological Review, 1948, 55, 189-208.

Treisman, A. M. Strategies and models of selective attention. Psychological Review, 1969, 76, 282-299.

Wachtel, P. L. Anxiety, attention and coping with threat. Journal of Abnormal Psychology, 1968, 73, 137-143.

Wachtel, P. L. Conceptions of broad and narrow attention. Psychological Bulletin, 1967, 68, 417-429.

Woodworth, R. S. Dynamics of behavior. New York: Holt, Rinehart and Winston, 1958.

Yerkes, R. M. and Dodson, J. D. The relation of strength of stimulus to rapidity of habit formation. Journal of Comparative Neurological Psychology, 1908, 18, 459-482.

Zaffy, D. J. and Bruning, J. L. Drive and the range of cue utilization. Journal of Experimental Psychology, 1966, 71, 383-384.

AUTOBIOGRAPHICAL STATEMENT

AUTOBIOGRAPHICAL STATEMENT

The author, Geraldine Fennell, was born in Cambridge, Mass., and was brought to Ireland by her parents before her first birthday. She was educated at Loreto College, Stephens Green, and at University College,Dublin (BA 1952, Economics, Politics, Jurisprudence, Roman Law; MA 1954, Economics).

In 1954 and 1955 she held the position of Assistant Curator at the National Museum of Ireland, where she worked on the collections of Irish silver, glass, watches and clocks. Her annotated list of more than a thousand watch and clock makers working in Ireland from the 17th through 19th centuries was published by the National Museum under the title: A List of Irish Watch and Clock Makers (Dublin, 1962).

From 1955 through 1957 she worked as a research economist at the Basle Centre for Economic and Financial Research, Basle, Switzerland. In the summer of 1957 she was a participant at the Salzburg Seminar in American Studies, Salzburg, Austria. In the same year she was awarded the Aurelia Henry Rheinhardt International Fellowship by the American Association for University Women, and spent 1957-1958 at Columbia University, New York doing research in economics.

From 1959 through early 1962 she held the position of Research Director at the Association of the Junior Leagues of America, where her work involved consultation with individual Junior Leagues on their community and in-League research projects, and design and supervision of research for the Association.

From 1962 through spring 1968 she worked in marketing research -- with J. Walter Thompson Company, New York (1962, 1964-1968) and with Irish International Airlines, Dublin (1963-1964).

Her interest in studying psychology was sparked through contact with associates in marketing research whose academic training had been in psychology. She began to take courses in psychology on a part-time basis in fall 1965, and in spring 1968 was admitted into the Ph.D. program at the City University of New York.

ABSTRACT

ABSTRACT

The literature relevant to Easterbrook's (1959) proposition regarding range of cue utilisation as a function of arousal is reviewed, and an attempt is made to coordinate this literature to recent analyses of attention by Berlyne and Treisman.

An experiment is presented which attempts to replicate Paradowski's finding of enhanced incidental learning of irrelevant material as a function of curiosity arousal. Two sets of materials were used for which Berlyne and Paradowski had obtained behavioral indices of curiosity arousal in previous research. The use of Berlyne materials provided additionally the opportunity of studying incidental learning as a function of each of two stages of curiosity: initial arousal, and arousal and satisfaction.

A 2 x 3 x 2 factorial design was used in which materials (Berlyne and Paradowski) was a between subjects variable, and exposure time (½", 4", 10"), and curiosity (low, high) were repeated measures. An identification test of the border colors which framed the materials constituted the measure of incidental learning. Subjects were 48 CCNY undergraduate volunteers.

Incidental learning with Berlyne materials equalled the level expected by chance; that with Paradowski materials was significantly greater than chance. The data do not support the hypothesis of enhanced incidental learning of irrelevant material as a function of curiosity arousal.

Discussion of the results emphasises the importance of considering the specific exploratory behavior in which the subject engages in predicting whether incidental learning will occur as a function of curiosity arousal.