12-1-1971

The Influence of Curiosity on Intentional and Incidental Learning

Richard L. Metzger

THE INFLUENCE OF CURIOSITY ON INTENTIONAL AND INCIDENTAL LEARNING

by

Richard L. Metzger

Bachelor of Science, Muskingum College, 1970

A Thesis

Submitted to the Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, North Dakota

December
1971

This thesis submitted by Richard L. Metzger in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

(Chairman)

Dean of the Graduate School

ACKNOWLEDGMENTS

I would like to thank Sister Geraldine, principal at St. Mary's School, Sister Mary James, principal at Holy Family School, and Mr. Ray Doucke, principal at Lincoln Elementary School, for their cooperation in this study. I would also like to thank the teachers at these schools for their cooperation in allowing class time for the conducting of this study.

I would like to extend thanks to Dr. Ralph Kolstoe and Dr. Michael Gatton for serving on the committee which directed this research. The third member of the committee was Dr. Hilda Wing who deserves special thanks for her tireless effort, extreme consideration and continued confidence, without which this thesis would not have come about. Special note also goes to Dr. David Skeen who supplied the original idea for this thesis, and continued encouragement for my graduate education.

I would finally like to thank Miss Anne Morgan who has provided support, confidence and encouragement throughout the course of this work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Previous research has indicated that the level of curiosity of an individual is related to the amount of information which that individual can acquire incidentally. The present study was conducted to test two hypotheses: (a) High curiosity children will learn more material incidentally than low curiosity children, and (b) the level of curiosity will effect intentional learning.

Twenty-eight fifth grade students (14 high curious, 14 low) were selected as subjects from a pool of 77 on the basis of scores attained on the Penney and McCann (1964) Children's Reactive Curiosity Scale. The intentional learning task was a paired-associate presentation of nine stimulus-response items using the anticipation method. The incidental cues were colored borders on the stimulus response cards of the intentional task. The intentional task was run to a criterion of two perfect recitations. When a subject reached criterion on the intentional task, he was asked to recall the incidental cues from each card.

No differences were found between groups on the intentional or the incidental learning tasks. The failure to find differences is explained in terms of Postman's (1964) Intrinsic-Extrinsic Stimulus Hypothesis.

CHAPTER I

THEORY AND EXPERIMENTATION

Melton (1950) suggests that motivation has three functions in learning: energizing the organism to begin some activity, directing the organism's activity, and evaluating the outcome of the activity. As a motivating factor, curiosity has been given increased experimental attention in recent years. The present study was conducted to investigate the effects of level of curiosity on learning in both intentional and incidental situations.

This chapter will present four theories of curiosity along with some of the research which has supported them. A discussion of the theory related to incidental learning will also be presented.

Berlyne's Theory

Berlyne (1960, 1954a, 1950) was the first to propose a comprehensive theory of curiosity. His basic postulates are:

1. When a novel stimulus affects an organism's receptors, there will occur a drive-stimulus producing response called curiosity.
2. As a curiosity arousing stimulus continues to effect an organism's receptors, curiosity will diminish (1950, p. 78).

Curiosity arousing stimuli have characteristic properties termed "collative variables," which include novelty, complexity, surprise, and incongruity. Berlyne (1954a) divides curiosity into two categories: perceptual and epistemic. Perceptual curiosity is characterized by the approaching of novel stimuli and is associated primarily with lower animals. Epistemic curiosity is predominantly human and is seen as resulting from a lack of knowledge. In other words, epistemic curiosity is aroused by a question and is reduced by discovering and rehearsing the answer until it becomes part of the individual's knowledge.

Berlyne (1960) states that conflict is the energizing factor in curiosity and is the result of the incompatability of present information with past experience. Epistemic curiosity may be energized by two forms of such incompatability. Information which is contrary to previously acquired knowledge produces "contradictory" incompatability. "Irrelevant" incompatability is a function of social conditioning. Society conditions the individual to respond "relevantly" when he is asked a question and incompatable information creates the possibility of making an irrelevant response. Irrelevance might be created when an individual is asked a question about an area with which he is only slightly familiar such that conflict is aroused by the individual's fear of making an irrelevant response. In both irrelevance and contradiction, the conflict is between a current novel information component and information in the individual's past experience.

Various aspects of Berlyne's theory have received intensive experimental evaluation. Studied aspects have been the concept of epistemic curiosity (Berlyne, 1954b), the collative variables (Berlyne, 1957; Berlyne & Frommer, 1966; Charlesworth, 1964) and the effects of curiosity arousal on learning (Mittman & Terrell, 1964; Paradowski, 1967).

To validate the concept of epistemic curiosity, Berlyne (1954b) presented the experimental group with, in succession, a pre-questionnaire about invertebrate animals, phrases describing these animals, and a post-questionnaire made up of the pre-questionnaire items arranged in a different order. The control group received only the phrases and the post-questionnaire. The number of correct responses on the post-questionnaire was defined as curiosity. Berlyne found that Ss in the experimental group answered more questions correctly than those in the control group. He explained that the conflict was created by the pre-questionnaire, thus supporting the concept of epistemic curiosity.

In a study of the importance of collative variables, Berlyne (1957) presented Ss with slides which were designed to create incongruity, surprise, and uncertainty. Incongruity was produced by showing pictures of an animal or bird with a head that was not characteristic of the body (i.e., a lion's head on a camel's body or an owl's head on a dog's body). Surprise was created by changing the shape and color of a geometric design (i.e., red triangles to green circles), and uncertainty was created by the random display of geometric figures. Ss controlled the time of exposure to each stimulus by means of a hand-held button and the time of exposure for each slide was used as a measure of curiosity. The novel, uncertain, and surprising slides were viewed longer than were neutral slides which Berlyne interpreted as support for the importance of collative variables.

Charlesworth (1964) tested the relative effectiveness of two collative variables: novelty and surprise. Ss were required to drop colored marbles into the top of a box. E could control the return of the marbles, unknown to S, and novelty and surprise were created by altering the marbles returned. Surprise was defined as altering the number, color, and order of marbles returned, while novelty was defined as altering only the number and order. Curiosity was indexed as persistence in the task and it was found that Ss in the surprise condition persisted longer in the task than did those in the novel condition. Charlesworth concluded that surprise was a stronger collative variable than novelty and thus more curiosity arousing.

Berlyne *et al.* (1966) assessed the concept of collative variables by having *S*s in an experimental group read stories with either surprise endings, novel elements, or incongruous contents. The number of questions asked during the reading of the stories was taken as a measure of curiosity. The *S*s in the control group heard the same stories but without the novel, incongruous or surprising elements, and it was found that significantly fewer questions were asked. The authors concluded that collative variables do effect curiosity arousal.

The effect of curiosity arousal on discrimination learning was investigated by Mittman & Terrell (1964). The discrimination involved distinguishing between size and form of three-dimensional objects. Curiosity was aroused by allowing the *S*s to complete a dot-to-dot puzzle. It was predetermined that 30 dot-to-dot completions were required to recognize the drawing and *S*s were allowed to complete one line of the puzzle following each correct discrimination. Curiosity was manipulated by exposing the completed drawing at different stages in the discrimination task. The low curiosity group was shown the entire drawing after the first correct discrimination, the medium group after the eighth, and the high curiosity group after the thirtieth, with all *S*s continuing the task to total acquisition. Mittman *et al.* found that the high curiosity group learned the task significantly faster than the low curiosity group and concluded that lack of knowledge of the completed dot-to-dot drawing increased conflict which resulted in more efficient learning.

Paradowski (1967) found that curiosity arousal increased the amount of material learned incidentally. He found that Ss presented with information about common and novel animals learned more intentionally about the novel animals. The incidental material associated with the novel animals was also recalled better. Paradowski (1967) concluded that curiosity arousal facilitated learning in both incidental and intentional situations.

Dember & Earl's Theory

Dember and Earl (1957) place curiosity into the general class of behavior known as "attention." Attention is defined as "any behavior, motor or perceptual, which has as its end-state contact between the organism and certain parts of its environment" (p. 91). The arousal of attention occurs when a discrepancy between the expected and actual values of a stimulus is observed.

A stimulus (j) is seen as having some actual value, Q_{hij}, for an individual (i) at a particular moment (h). The expected value which is ascribed to the stimulus by the individual is designated C_{hij}. P_{hij}, the novelty of a stimulus, is then defined as:

$$P_{hij} = \left| C_{hij} - Q_{hij} \right|$$

Novelty is thus conceived as the discrepancy between the value of a stimulus for an individual and the actual value of the stimulus. For example, if S scans a striped field, he gains more knowledge of the field on each scan and thus increases his C_{hij} value of the stimulus. As the C_{hij} value more closely approximates the Q_{hij} value of the stimulus, P_{hij} decreases and the stimulus becomes more redundant. less variability is noted and less information is obtained. Dember et al. suggest that this interpretation allows P_{hij} to be considered as a measure of complexity (amount of information) and of response variability.

The system can be generalized to consider all of the attributes of a stimulus. If each stimulus is conceived as a group of stimulus attributes, then each stimulus can be assigned a complexity value relative to the individual:

$$Q_{hij} = f(P_1, P_2, \ldots, P_n)$$

Analogously , the individual may be given a complexity value of each stimulus, C'_{hij}, which is based on his ability to deal with the information contained. C'_{hij} is a linear monotonic function in that the individual's ability can only increase with any one stimulus. Therefore, the only stimulus which can alter C'_{hij} are those with a sufficiently high Q_{hij}. These stimuli are then functioning as "pacers."

It is reasonable to assume that "pacer" stimuli cannot exceed some Q_{hij} value acting as an upper limit to the individual's ability to respond (Dember et al., 1957). This pacer sets the range of stimulation which will be effective in providing sufficient information to the individual. From this assumption, Dember et al. postulate the operation of pacers.

> Under [the condition of a set of stimuli which contains a pacer] the individual will apportion his attention among the stimuli in the set in proportion to their similarity to the pacer, with the modal amount of attention applied to the pacer (p. 94).

Two experiments reported by Munsinger and Kessen (1964) offer support for the Dember et al. model. The stimuli in both studies were random figures constructed by the Attneave & Arnoult (1956) technique. In the first study Ss were asked to make paired-comparison preference judgments of the stimuli. It was found that preference formed a W function, with the most preferred stimuli of a moderate level of complexity as well as very low and very high complexity levels. If it is assumed that the level of preference is the value that the individual ascribes to the stimulus, then the level of preference can be assigned the value C'_{hij}.

In the second experiment *Ss* made paired-comparison judgments of the same stimuli but in terms of meaningfulness. The judged meaningfulness was found to approximate a linear monotonic function of the level of complexity. If it is assumed that meaningfulness is an indication of the arousal value of the stimulus, which would also increase in a linear monotonic fashion, then meaningfulness can be assigned the value Q'_{hij}, and the observed monotonic trend would be predicted.

If the results of both studies are compared, the Dember *et al.* model is fulfilled. By finding the difference between the individual's C'_{hij} and the stimulus Q'_{hij}, the complexity value, P, is derived. The distribution of P values would then tend to form an inverted-U function around the modal or pacer value and this is what Munsinger and Kessen found when they considered the interaction of preference and meaningfulness.

The Dember *et al.* model resembles the Berlyne model in its emphasis on curiosity arousal as a result of a discrepancy between past experience and current information. They differ in that Berlyne theorizes that this discrepancy arouses conflict which the individual reduces by displaying curiosity, while Dember *et al.* merely define the difference as novelty or complexity.

Glanzer's Theory

Glanzer proposes a system of curiosity which is distinguished from Berlynian systems by its emphasis on the organism as an information processing system. The organism requires certain amounts of information over time and actively seeks stimulation if sufficient information is not present or actively avoids stimulation if too much information is present.

The amount of information is a function of past experience of the organism.

> The organism's requirements are set by past experience. An organism that has had a high information flow in the past would have a higher requirement or standard. An organism that has lived in an impoverished environment would have a lower information requirement or standard. The organism will respond in terms of the difference between its individual standard and the amount of information furnished by the situation (1958, p. 312).

The Glanzer hypothesis is represented by the differential equation:

$$\frac{dA}{dt} = f\left(\frac{I}{t} - \frac{dI}{dt}\right)$$

where A = activity, I = amount of information (historically), and t = time measured since the organism's birth. Thus, the change in activity (dA) over some period of time (dt) is a function of the difference between the amount of information in the organism's experience (I/t) and the change in information over some period of time (dI/dt). Glanzer contends that if the various quantities of the equation could be scaled, an accurate prediction of curiosity behavior could be made.

Glanzer's system implies a differential effect of early and late experience. The greater the amount of early experience the less is the effect of later experience. This interpretation mathematically accounts for the effects of aging on information processing by considering the value of new information in terms of that present at some age.

The Glanzer system has received little systematic verification, but research by Unikel (1971) offers support for the effects of experience on information preference. Unikel (1971) exposed Ss to a set of light displays of varying complexity. After this familiarization sequence Ss were allowed to choose between the familiar display or a new pattern. Unikel found that Ss preferred the more complex patterns initially and preferred the more complex stimuli from the new group. This suggests that as S had more experience with the complex stimuli more and more complex stimuli were preferred.

This system also hypothesizes discrepancy between past experience and current information. Unlike Dember *et al.*, Glanzer emphasizes only the role of the individual's information input in a particular situation with no consideration of the amount of information contained in the stimulus. Also notable is the absence of a conflict arousal hypothesis.

Livson's Theory

Starting from Berlyne's epistemic curiosity, Livson (1967) has proposed an alternate definition of curiosity:

> Curiosity is the tendency, or motive, to acquire or transform information under circumstances that offer no immediate adaptive value for such activity (p. 76).

He explains that "activity" is used instead of behavior in order to include phenomena which cannot be directly observed, such as thinking. "No adaptive value" is used in the Lewinian sense, that is, activity cannot be inferred from any biological drive in the life-space of the individual. "Acquires information" has purposely been left neutral with regard to intent, or the lack of it, which allows for the explanation of incidental learning. "Information" is defined by the complexity level (CL) of the environmental situation. Novelty, therefore, is determined by the discrepancy between CL of the contemporary situation and knowledge previously possessed by the individual. An optimal CL seems to exist at some intermediate value within the range of stimulation and this value is affected by the individual's familiarity and ability with the stimulus.

Livson offers a set of categories to divide curiosity behavior into "meaningful units." These categories are based on the concept of experienced complexity (EC), which is the difference between the CL of the stimulus and the individual's previous knowledge.

"Seeking" curiosity is the level of EC at which the individual will alter his environment in order to modify the information input. This modification may be either to increase or decrease EC and is probably not determined by a point but rather by a range of stimulation in which such alterations occurs. The level of EC at which a person's attention is attracted is the "noticing" curiosity. Like seeking curiosity, noticing curiosity is seen as a range of stimulation, thus a stimulus may not be complex enough to attract attention or it may be too complex and is overlooked. "Examining" curiosity is the level of EC required to maintain an individual's attention to a stimulus, in that an individual may require less complexity to maintain interest than he requires to notice a stimulus.

To date, no research has been reported which directly tests the Livson approach, although research in the area of sensory deprivation seems to offer support for his concept of seeking curiosity. The paucity of studies can probably be [understood in terms of] the relative recency of its proposal. Jones, Wilkerson, & Braden (1961) hypothesized that Ss in a deprivation condition would acquire and maintain an instrumental response which results in the presentation of visual stimulation. S was placed in a totally dark, soundproof room and was required to lie on a bed with a minimum of motion. S had access to a push button which activated a series of dim lights located in the ceiling at the foot of the bed. Each button push resulted in the displaying of 24 light flashes at 1-sec. intervals with uncertainty being created by alternating the color of the light flashes randomly between red and green. Four levels of uncertainty were used ranging from maximum uncertainty (a totally random presentation) to total certainty (continual presentation of one color). It was found that button pushing could be established as an operant under deprivation conditions and that responding was a function of the level of uncertainty (interpreted by the authors as a measure of information). These findings support Livson's contention that an individual will alter his environment in order to increase the information input. The linear function between level of uncertainty and rate of responding suggests that the probability of response is directly related to the level of uncertainty.

Livson's theory is in essence a combination of the three theories presented thus far. All of the theories emphasize curiosity as the difference between current stimulation and past experience. Livson refers to this difference as EC, Berlyne as incompatability, Glanzer as change in activity over time, and Dember _et al._ as P value.

All of the theories predict the existence of a peak stimulation value in the central range of stimulation. This function has been found in a number of studies, using random figures (Munsinger _et al._, 1964), auditory stimuli (Vitz, 1966) and random matrices (Dorfman _et al._, 1966), although several studies have failed to find such a relationship, using random matrices (Gunn, 1969) and using random figures (Cantor, Cantor, and Ditrichs, 1963). Such failure has usually been attributed to a truncated range of stimuli rather than to a negation of the relationship.

Incidental Learning

Incidental learning (INC) has been defined as the acquisition of material without motive or instruction (McGeoch & Irion, 1952). INC is characterized by an individual's retaining material which is irrelevant to the task as opposed to intentional learning (INT) where the individual retains relevant material. Postman (1964) suggests that the distinction between INC and INT is best considered in terms of instructional stimuli.

> Operationally incidental and intentional learning are distinguished by the use of different classes of instructional stimuli--those which do and those which do not prepare the S for a test of retention (p. 185).

It must be emphasized that this definition does not exclude the possible existence of an implicit set or motive to learn but merely recognizes that such implicit variables cannot be operationalized.

Two types of experimental approaches have been used to study INC (Kausler & Trapp, 1960; Postman, 1964). In the Type I approach S is unexpectedly asked to recall the material. McLaughlin (1965) indicates that this type of experiment is the "classical" form of investigation used in the study of INC. Type II experiment requires S to perform some specific learning task and the INC material is exposed simultaneously. Postman (1964) subdivides the stimulus materials into two classes--intrinsic and extrinsic components. Intrinsic components are those which, while irrelevant to the INT task, are in some way related to the INT material, for example, words or geometric figures to be learned are drawn in different colors. Extrinsic components are irrelevant material which are not related or connected to the INT materials, for example, digits presented in conjunction with a list of words to be learned.

While both Type I and Type II approaches are INC situations, an important difference is the inclusion of instructions to learn in Type II (Postman, 1964). That any type of instructions is given may predispose the individual to a learning set. Both methods have been found to result in INC, but Postman suggests that Type I is best for studies of associational processes and Type II is best for studies of motivational influences.

Several investigations of the effect of anxiety level of INC are of particular relevance to the present study, as both used an intrinsic measure of anxiety which was considered an indication of level of motivation.

Speilberger, Goodstein & Dahlstrom (1958) investigated the relationship between level of anxiety and task difficulty in an INC task. _S_s were asked to replicate the designs from the Bender-Gestalt Test while being shown the plates. They were then asked to replicate the figures from memory and it was found that high anxiety _S_s did better on the easy plates while low anxiety _S_s did better on the difficult plates.

Miller and Dost (1964) used a task of sorting thirty words alphabetically. An INT group composed of high and low anxiety _S_s were given instructions to sort the cards and to learn the words while two INC groups who were told to merely sort the cards. Miller _et al_. found that high anxiety _S_s performed the sorting task more rapidly but that low anxiety _S_s showed greater INC. Both experiments support the contention by Easterbrook (1959) that increased drive level is disruptive to the learning of material incidentally. He contends that the activation of drive forces _S_ to concentrate on the task or relevant cues, thus reducing the potential for learning INC cues.

A great deal of research has been conducted on INC and the reader interested in a comprehensive review is directed to Kausler _et al_. (1960) and McLaughlin (1965).

CHAPTER II

CURIOSITY AND INCIDENTAL LEARNING

Curiosity has been defined as the number of correct responses on a postquestionnaire (Berlyne, 1954), number of questions asked about a story (Berlyne *et al.*, 1966), total time attending to slides (Berlyne, 1957), number of button presses (Jones *et al.*, 1961) and attention to stimuli (Dember *et al.*, 1964). The arousal approach, while contributing greatly to curiosity research, is not the only alternative. Recently several paper and pencil scales which assess "stimulus variation seeking" (Penney, 1966) and "sensation seeking" (Zuckerman *et al.*, 1964) have been developed for adults. Several evaluation procedures have also been developed for children (Maw & Maw, 1961; Penney & McCann, 1964) and these are of particular relevance to the present study.

Maw *et al.* (1961) proposed a curiosity measurement system for use with children based on a triple rating procedure. It is designed for use in a classroom setting and *Ss* receive curiosity ratings from their teacher, their classmates, and themselves. The teachers' ratings are obtained by having the teacher rank the students starting with the child showing the highest curiosity and then the lowest and so on until all of the students have been ranked. The classmate ratings are obtained by using the Who-Should-Play the Role-test, in which the class is read descriptions of eight parts for plays. Four of the parts exhibit high curiosity traits and four exhibit low curiosity. Ratings are obtained by having the students specify who should play each role. The self-evaluation is obtained by having Ss answer a forty one item true-false questionnaire. The three ratings have been found to be positively related. They are also related to intelligence, more for teacher ratings than for student ratings, but are not related to sex, race, or popularity.

Penney et al. (1964) developed a paper and pencil scale for measuring "reactive" curiosity in fourth, fifth, and sixth grade students. The Children's Reactive Curiosity Scale (CRC) defines curiosity as the:

1. tendency to approach and explore relatively new stimulus situations,
2. tendency to approach and explore incongruous, complex stimuli,
3. tendency to vary stimulation in the presence of frequently experienced stimulation (p. 323).

The instrument is a 90 item true-false inventory with 10 additional lie items. The CRC has been found to be related to sex (Penney et al., 1964), with girls scoring higher than boys, and also highly related to the Guilford Unusual Uses Test (Penney et al., 1964). Penney et al. (1964) and Wunderly (1969) have found the CRC is related to the California Test of Mental Maturity, and Metzger (1970) found the CRC unrelated to the Children's Intellectual Achievement Questionnaire. Penney et al. (1964) indicate that the test-retest reliability was found to be 0.70 for males and 0.65 for females at the fifth grade level. Metzger (1970) divided the CRC into two split-halves and found that the reliability determined by a split-half composed of those items scored as true versus those items scored as false was -0.178, while the odd-even split-half yielded a 0.285 reliability.

The CRC will be used to measure curiosity in the present study despite the low reliability. It was selected because of its availability and because it was found that teachers were unwilling to devote the time required by the Maw et al. (1961) method. The CRC is also desirable because of its apparent lack of relationship with I.Q.

Paradowski (1967), as has been previously noted, studied the relationship between curiosity and INC. He presented _S_s with booklets which contained pictures and paragraphs concerning five novel and five common animals. It is important to note that this study used an arousal technique similar to that used by Berlyne (1954). Each picture was mounted on one of five backgrounds (desert, forest, field, swamp and jungle) and was framed by one of five colors. The intentional task was conducted by presenting the picture for ten sec and then exposing the paragraph for twenty sec. INT was measured by having college student _S_s answer completion and multiple-choice items on the pictures and paragraphs. When _S_ had completed the INT task, he was shown the pictures without the INC cues (backgrounds and borders) and asked to recall the color of the border and the type of background. INC was measured by the number of correct INC cues recalled. The novel material was learned more rapidly in both the INT and INC tasks. Paradowski suggests that curiosity arousal heightened attention to all aspects of the stimulus.

Wunderly (1969) used the CRC (Penney _et al._, 1964) to distinguish between high and low curiosity fourth, fifth, and sixth grade students. _S_s learned a seven item list of nouns, using a paired-associate task (anticipation method). The INC cues were colored underlinings of the response word, and _S_s were run to a criterion of two perfect recitations of the INT list. Then, _S_ was shown the stimulus-response pairs without the underlinings and asked to recall the color. Wunderly found that no difference existed between groups on the INT task, but high curiosity _S_s recalled significantly more INC cues than the low curiosity _S_s. No sex difference was found on either the INT or INC tasks.

Metzger attempted to replicate Wunderly's results using the same procedure and INT stimuli, but with the INC cues changed to presenting the response words in color. He found that the low curiosity group learned the INT task faster than the high curiosity group, but no differences existed on the INC task. The failure to find a difference in INC was explained as a shift of the INC cues from extrinsic to intrinsic.

Purpose

The purpose of the present research is to investigate the relationship between curiosity and INC. Paradowski (1967) and Wunderly (1969) suggest that, when extrinsic cues are used, INC is influenced by level of curiosity. Metzger found no difference on a similar task when intrinsic cues were used. Since the effect of curiosity on INT is confused, this will also be investigated, with the hope of arriving at a clearer view of the effect of differing levels of motivation on learning.

Hypothesis 1:

High curiosity Ss will learn more material incidentally than low curiosity Ss.

Hypothesis 2:

Level of curiosity will effect INT (no direction is predicted).

CHAPTER III

METHOD

Subjects

The Ss were twenty eight fifth grade students, five from Holy Family School, Grand Forks, North Dakota, five from St. Mary's School, Grand Forks, North Dakota, and eighteen from Lincoln Elementary School, Crookston, Minnesota. The seventeen females and eleven males were selected from an original pool of seventy seven children from these schools, who ranged in age from ten to twelve years.

Materials

The Children's Reactive Curiosity Scale (Penney et al., 1964) was used to measure curiosity. The words used as stimulus and response items were selected from Palermo and Jenkins (1964) and were four letter monosyllabic nouns having no associations with themselves or with the colors and forms used as INC cues. A pool of eighteen words was selected, split into two groups, and words in each were assigned a number from one to nine. The words were then randomly paired across groups and their position as either stimulus or response item was randomly determined. Each pair was then randomly assigned a combination of color and form cues which were either red, blue, or brown, and horizontal, vertical, or vertical and horizontal (total) borders. This procedure was used to construct two lists of nine stimulus-response items. (The items used may be found in Appendix C.)

Three decks of display cards were made for each list to present the INT and INC tasks. Deck A contained the stimulus-response pairs without INC cues, Deck B contained only the stimulus words, while Deck C contained the stimulus-response pairs with the INC cues. The cards were 4 x 6 in. white index cards and the lettering was twenty four point, folio medium extended Para-type (Para tone #11438).

Procedure

Seventy-seven fifth grade students were administered the CRC. Seven students were excluded because of lie scores higher than six. Those scoring in the upper quartile (N = 14) were designated high curiosity (HC) and those in the lower quartile (N = 14) were designated low curiosity (LC).

The learning task was conducted during school hours and Ss were called from their classrooms one at a time. They were told that they had been selected to participate in an experiment and were given the instructions for the learning task (Appendix A). S was shown Deck A and asked to say each of the pairs of words aloud. This procedure provided an approximate exposure time of two seconds per card. The INT task was then begun with E showing the stimulus card from Deck B, followed by five seconds during which S read the word aloud and made a response. After S responded he was shown the correct stimulus-response pair from Deck C and asked to read the pair aloud. This procedure was continued until the criterion of either two perfect recitations of the list or twelve trials was reached. Upon completion of the INT task, S was shown each card from Deck A and asked to recall the color and form cues contained furing the INT task. S was then dismissed and asked not to discuss the study with any classmates until E came and explained the experiment to the class (Appendix B).

CHAPTER IV

RESULTS

The obtained distribution of CRC scores was compared to a normal curve using the χ^2 method (McNemar, 1969, p. 267). The obtained distribution was significantly different from a normal function ($\chi^2 = 22.51$, $df = 3$, $p < .001$). The CRC was then compared with those data obtained by Penney *et al.* (1964). Figure 1 shows the curves obtained by plotting the cumulative frequencies for each score. The means differ significantly with the Penney *et al.* groups scoring higher than the present group.

Table 1 gives the means and standard deviations of curiosity, INT and INC learning. To test the hypothesis that curiosity level will influence INT, a simple analysis of variance was performed. No difference ($F = 0.04$) was found between high curiosity (HC) and low curiosity (LC) groups on the INT task.

A three-way analysis of variance with repeated measures (Winer, 1962, p. 337) tested the effects of level of curiosity, the two lists used, and the type of INC cues on INC learning. The results of analysis of variance are presented in Table 2, and the means and standard deviations as a function of curiosity and list used may be found in Table 3. As can be seen, the hypothesized effect of curiosity on the recall of INC cues was not found. It should also be noted that no difference existed as a function of the lists used.

To find out whether the different color and form cues may have had

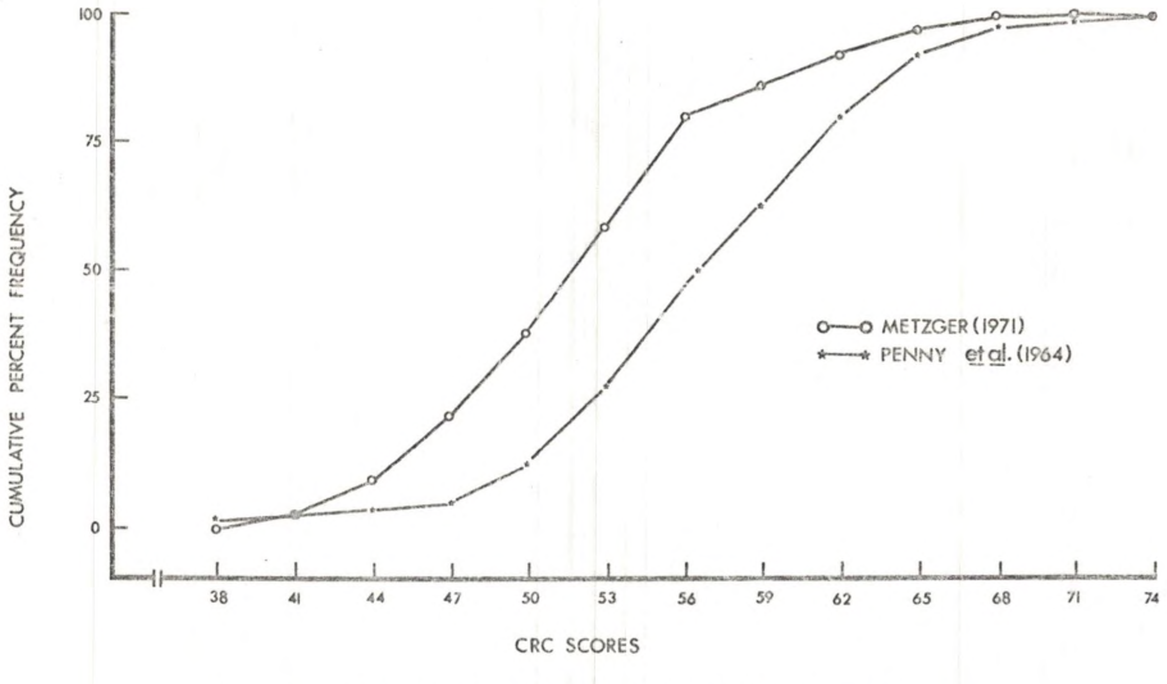

Fig. 1.--Cumulative Frequency of CRC Scores

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR CURIOSITY, INT AND INC LEARNING

	CRC Scores	INT	INC		
			Form	Color	Total
Low Curiosity					
Mean	44.50	7.43	3.00	3.14	6.14
S.D.	2.38	2.74	1.36	1.69	2.68
High Curiosity					
Mean	62.23	7.69	2.69	3.15	5.85
S.D.	3.06	2.52	1.38	1.36	1.91

TABLE 2

SUMMARY TABLE OF THREE-WAY ANALYSIS OF VARIANCE OF THE EFFECTS OF CURIOSITY BY LISTS BY TYPE OF INC CUE

Source				
Between	97.50	27		
A (Curiosity)	0.28	1	0.28	0.09
B (Lists)	8.64	1	8.64	2.79
AxB	12.00	1	12.00	3.87
Error between	76.50	24	3.10	
Within				
C (Cues)	1.79	1	1.79	0.68
AxC	1.79	1	1.79	0.68
BxC	1.14	1	1.14	0.68
AxBxC	0.28	1	0.28	0.11
Error within	63.50	24	2.64	

[1]All F's were nonsignificant at P = .05.

TABLE 3

MEANS AND STANDARD DEVIATIONS OF INCIDENTAL LEARNING AS A FUNCTION OF LEVEL OF CURIOSITY, LIST USED, AND TYPE OF CUE

	Mean	Standard Deviation
High Curiosity		
List A		
Form Cues	3.00	1.51
Color Cues	3.28	1.17
List B		
Form Cues	2.43	1.05
Color Cues	3.28	2.44
Low Curiosity		
List A		
Form Cues	2.28	1.49
Color Cues	2.14	1.25
List B		
Form Cues	3.71	0.73
Color Cues	4.14	1.47

a differential effect on INC recall χ^2 was computed for the recall of the three colors (red, blue, and brown) as a function of level of curiosity. Table 4 shows the number of INC color cues recalled as a function of level of curiosity and Table 5 shows the number of INC cues recalled for form. No differences were found (see Table 4: $\chi^2 = .0036$, $df = 2$, $p > .05$).

TABLE 4

INCIDENTAL COLOR CUES AS A FUNCTION OF LEVEL OF CURIOSITY

	Color			
	Red	Blue	Brown	Total
High Curiosity	16	21	9	46
Low Curiosity	17	19	9	45
Total	33	40	18	91

The colors were recalled differentially across all Ss (See Table 4: $\chi^2 = 8.34$, df = 1, $p < .02$), with blue recalled more frequently than red and red more than brown.

TABLE 5

INCIDENTAL FORM CUES RECALLED AS A FUNCTION OF LEVEL OF CURIOSITY

	Horizontal	Vertical	Complete	Total
High Curiosity	10	10	19	39
Low Curiosity	9	16	18	43
Total	19	26	37	82

For the form cues, no difference was found as a function of curiosity (see Table 5: $\chi^2 = 1.23$, df = 2, $p > .05$) but a differential effect of type of cue was evidenced (see Table 5: $\chi^2 = 6.03$, df = 1, $p < .01$). The complete border was recalled most frequently, then the horizontal, and finally the vertical.

Table 6 shows the means and standard deviations of curiosity, INC, and INT as a function of sex. In the total group females scored higher on the CRC than did males ($t = 2.964$, df = 75, $p < .01$) but no sex differences existed in INT ($\chi^2 = 0.48$, df = 1, $p > .05$) or INC ($\chi^2 = 0.31$, df = 1, $p > .05$) task (see Table 6).

TABLE 6

MEANS AND STANDARD DEVIATIONS OF CURIOSITY, INTENTIONAL LEARNING, AND INCIDENTAL LEARNING AS A FUNCTION OF SEX

	Males (N = 17)		Females (N = 11)	
	Mean	Standard Deviation	Mean	Standard Deviation
Curiosity (CRC)	50.82	9.72	56.91	6.70
Intentional Learning	7.41	2.83	7.64	2.29
Incidental Learning	5.82	1.84	6.45	3.27

CHAPTER IV

DISCUSSION

The failure to find any difference between HC and LC Ss on the INT task was not totally unexpected as Wunderly (1969) also failed to find such a differential effect of level of curiosity.

The failure to find the hypothesized difference between HC and LC on the INT task is amenable to several other explanations. It is possible that no real difference exists, i.e., the null hypothesis is justified. This possibility was rejected, however, on the basis of research which seems to support some alternatives. The most obvious alternate explanation is the discrepency between the obtained CRC scores and those reported by Penney et al. (1964) in the development of the scale. CRC scores for the present group were significantly lower than those reported earlier. It is difficult to explain the difference between the two sets of CRC scores. The Penney et al. data was collected on a wide range of students and it may be that the Grand Forks-Crookston sample was not as heterogeneous.

A second explanation is that the INC cues were irrelevant to the INT as they were out of the visual range of most Ss. Postman's (1964) concept of intrinsic-extrinsic cues may be relevant here. The cues in the present study were extrinsic, in that they were not physically part of the INT materials, and thus required an additional orienting task to that required by the INT material. This is to say, once S has been given the instructions for the INT task, he had also to orient the INC cues located independently from the INT material. Wunderly used cues which were physically within the range of the initial orienting task and thus the INC cues may have had a greater probability of being attended to. Metzger (1970) embedded the INC cues in the INT material but these cues were not picked up. The ability to recognize INC cues may be a non-monotonic function of their physical proximity to the INT material with the greatest INC learning occuring when the INC cues are close to but not functionally part of the INT task. The possibility thus arises that the intrinsic-extrinsic variable may be continuous, but non-monotonic having a modal value at which INC cues will be best recalled.

The relative effectiveness of the various cues is puzzling. It was initially suspected that red and blue would be more effective than brown, but it is unclear why blue was recalled more often than red. The finding that total borders were more effective than horizontal or vertical borders was also anticipated. Postman (1964) states that research on the short-term memory of form indicates that incomplete forms tend to be completed in accordance with Gestalt principles. Therefore, in the present study when Ss were presented with the horizontal or vertical borders, they tend to remember them as completed forms. This tendency to remember total borders increased the probability of that response being given and thus increased the probability of correct response when "total" was correct and reduced the probability of responding correctly to the other types of forms.

A final explanation to find significant results may lie in the CRC. The reliability coefficient reported by Metzger (1970) is low (r = 0.23). Unfortunately no alternative scale is available for easily assessing curiosity in children.

CHAPTER V

SUMMARY AND CONCLUSIONS

Curiosity as a personality variable affecting learning has recently been studied by several psychologists. Paradowski (1967) found that high curiosity Ss learned material, both intentional (INT) and incidental (INC) at a higher rate than low curiosity Ss. The INT materials were pictures of novel animals and the INC materials were borders on the display cards.

Wunderly (1969), using pairs of nouns as the INT material and colored underlining of the response word as the INC material, found that high curiosity Ss retained more INC material than low curiosity Ss. No differences were found on the INT material.

Metzger (1970) failed to replicate Wunderly's findings using identical INT lists but with the response word written in a color as the INC cue. As with the Wunderly study, no differences were found on the INT task.

The present study was designed to investigate the relationship between curiosity and INC. The Children's Reactive Curiosity Scale (Penney *et al.*, 1964) was used to measure curiosity, and to select high and low curiosity Ss. The INT materials were nine pairs of nouns presented in a paired-associate task. The INC cues were colored (red, blue, or brown) borders on either the top and bottom (horizontal), left and right (vertical), or both (total).

No differences were found on either the INT or INC tasks between high and low curiosity Ss. Differences were found on the INC task as a function of cues. The color of the border was found to have an effect with blue being recalled most frequently, then red, and finally brown. The type of the border was also found to have an effect with the total border condition being recalled most frequently, then horizontal, and finally vertical.

The results were explained in terms of Postman's (1964) concept of intrinsic and extrinsic cues. Cues which are not physically a part of INT material are extrinsic, such as those in the present study. Such cues require a greater amount of attention in order to be observed by the S. It was concluded that the INC cues in the present study were outside of the range of attention-attracting stimuli and were thus not relevant.

APPENDIX A

INSTRUCTIONS

I would like you to help me with an experiment. I am going to show you some pairs of words, and I want you to try to remember which words go together. After I have shown you all of the pairs of words and I want you to tell me which word goes with it. Do you have any questions? Okay, now I am going to show you the pairs of words and I want you to say them outloud. Remember, you are to try to learn which words go together. (S was then shown Deck A.)

Now I am going to show you one word from each pair and I want you to tell me which word goes with it. Try to answer as quickly as possible. After you have answered, I will show you the pair of words again and I want you to say them outloud. Do you understand? Okay, let's start. (S was given the INT task until he reached criterion.)

You may have noticed when I showed you the pairs of words the cards had borders on them. There were several types of borders, and they were in several different colors. (If the S asked about the types of borders he was told, "Some went up and down on the sides, some went across the top and the bottom, and some went all the way around the card." The S was never given any information about the colors.) I am going to show you these cards again but without the borders, and I want you to try to remember what color the border was and whay type it was. Do you understand? (S was then shown Deck A.)

APPENDIX B

DATA

Subject Number	Sex	CRC	Intentional (trials to criterion)	List	Incidental Form	Incidental Color	Total
Low curiosity							
104	M	47	4	B	4	3	7
119	M	42	4	A	2	2	4
120	M	43	6	B	5	3	8
123	F	45	9	A	0	1	1
124	M	45	4	A	2	1	3
125	M	40	7	A	3	1	4
135	M	47	11	A	1	2	3
136	F	47	8	B	4	6	1
138	F	47	10	B	3	6	9
157	M	43	11	B	3	5	8
161	M	41	8	B	4	4	8
168	M	46	5	A	3	4	7
169	M	43	12	B	3	2	5
175	M	47	5	A	5	4	9
High Curiosity							
102	M	64	9	A	2	3	5
112	F	63	8	A	4	3	7
114	M	69	11	B	3	3	6
115	M	61	11	B	3	3	6
148	F	63	4	A	4	3	7
165	M	67	5	B	2	2	4
173	F	62	6	B	3	1	4
181	M	61	7	A	5	2	7
184	F	60	9	A	4	5	9
185	F	59	7	A	1	2	3
194	F	63	4	A	1	5	6
195	F	58	12	B	3	6	9
196	F	59	7	B	0	3	3

APPENDIX C

Stimulus	Response	Color Cue	Form Cue
List A			
King	Note	Blue	Horizontal
Foot	Goat	Brown	Vertical
Shoe	Desk	Brown	Horizontal
Salt	Pill	Red	Vertical
Pear	Nail	Brown	Total
Wall	Dirt	Red	Total
Hand	Food	Red	Horizontal
Book	Lace	Blue	Total
Coat	Ring	Blue	Vertical
List B			
Book	Dirt	Blue	Horizontal
Note	Wall	Brown	Total
Shoe	Ring	Brown	Vertical
Pill	Hand	Red	Vertical
Foot	Lace	Blue	Total
Desk	Coat	Red	Horizontal
Goat	Pear	Blue	Vertical
Salt	Ball	Red	Total
King	Nail	Brown	Horizontal

REFERENCES

Attneave, F. & Arnoult, M. D. The quantitative study of shape and pattern perception. Psychological Bulletin, 1956, 53, 452-471.

Berlyne, D. E. Novelty and curiosity as determinants of exploratory behaviour. British Journal of Psychology, 1950, 41, 68-80.

Berlyne, D. E. A theory of human curiosity. British Journal of Psychology, 1954(a), 45, 180-191.

Berlyne, D. E. An experimental study of human curiosity. British Journal of Psychology, 1954(b), 45, 256-265.

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

Berlyne, D. E. Conflict, Arousal and Curiosity. New York: McGraw-Hill, 1960.

Berlyne, D. E. and Frommer, F. D. Some determinants and content of children's questions. Child Development, 1966, 37, 177-189.

Cantor, G. N., Cantor, J. H., and Ditrichs, R. Observing behavior in preschool children as a function of stimulus complexity. Child Development, 1963, 34, 683-689.

Charlesworth, W. R. Instigation and maintenance of curiosity behavior as a function of surprise versus novel and familiar stimuli. Child Development, 1964, 35, 1169-1186.

Dember, M. N. and Earl, R. W. Analysis of exploratory, manipulatory and curiosity behavior. Psychological Review, 1957, 64, 91-96.

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

Glanzer, M. Curiosity, exploratory drive and stimulus satiation. Psychological Bulletin, 1958, 55, 302-315.

Gunn, S. R. Preference for complexity in various age groups. Unpublished Master's thesis, Department of Psychology, Brigham Young University, 1968.

Jones, A., Wilkinson, H. J., and Braden, I. Information deprivation as a motivational variable. Journal of Experimental Psychology, 1961, 62, 126-137.

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

Livson, N. Toward a differential contruct of curiosity. Journal of Genetic Psychology, 1967, 111, 73-84.

McGeoch, J. A. and Irion, A. L. The Psychology of Human Learning. New York: Longman's, Green, 1952.

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

McNemar, Q. Psychological Statistics. New York: John Wiley and Sons, 1969.

Maw, W. H. and Maw, E. W. Establishing criteria for evaluating measures of curiosity. Journal of Experimental Education, 1961, 29, 299-306.

Melton, A. W. Motivation and learning. In W. S. Monroe (Ed.), Encyclopedia of Educational Research, New York: MacMillan, 1950.

Metzger, R. L. Curiosity and incidental learning. Unpublished undergraduate thesis, Muskingum College, Department of Psychology, 1970.

Mittman, L. R. and Terrell, G. An experimental study of curiosity in children. Child Development, 1964, 35, 851-855.

Miller, M. E. and Dost, J. A. Stimulus vividness and anxiety level in intentional-incidental learning. Psychological Reports, 1964, 14, 819-825.

Munsinger, H. and Kessen, W. Uncertainty, structure, and preference. Psychological Monographs, 1964, 78, (Whole No. 586).

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

Penney, R. K. and McCann, B. The children's reactive curiosity scale. Psychological Reports, 1964, 15, 323-334.

Penney, R. K. and Reinehr, R. C. Development of a stimulus-variation seeking scale for adults. Psychological Reports, 1966, 18, 631-638.

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

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

Unikel, P. Effects of changes in stimulation upon preference for complexity. Journal of Experimental Psychology, 1971, 88, 246-250.

Vitz, P. C. Affect as a function of stimulus variation. Journal of Experimental Psychology, 1960, 71, 74-79.

Wunderly, D. Curiosity and incidental learning. Unpublished undergraduate thesis, Muskingum College, Department of Psychology, 1969.

Zuckerman, M., Kolin, E. A., Price, L., Zoob, I. Development of a sensation seeking scale. Journal of Consulting Psychology, 1964, 28, 477-482.