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ABSTRACT

To discover children's knowledge about computer operation and programing characteristics and its effect on children's perceptions of computer expertise, pre- and posttests were administered to 292 children from 5th, 7th and 9th grades. Children were randomly assigned to see a factual film on computers or to a film on another subject. It was hypothesized that increased knowledge about computers would lower student perception of its expertise. Pretests indicated all children, regardless of age level or previous computer-assisted instruction (CAI) experience, held a high regard for computer expertise; posttest indicated that those who viewed the film changed in a direction supporting the hypothesis of the study. Older students perceived the computer as somewhat more expert than did younger ones, and CAI-experienced students more than non-CAI experienced students. It was concluded that social lessons as well as cognitive outcomes were taught by CAI programs. (SK)

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Technical Report No. 44

CHILDREN'S PERCEPTIONS OF THE COMPUTER AS AN EXPERT SOURCE OF INFORMATION

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Introductory Statement

The Center's mission is to improve teaching in American schools. Its work is carried out through five programs:

- Teaching Effectiveness
- The Environment for Teaching
- Teaching Students from Low-Income Areas
- Teaching and Linguistic Pluralism
- Exploratory and Related Studies

This study of children's attitudes toward the computer was conducted as part of the work of the program on Teaching Students from Low-Income Areas. A more detailed analysis may be found in the author's doctoral dissertation, which was submitted to the School of Education and the Department of Communication, Stanford University, 1972, under the title "An Attitude Change Study on Children's Perceptions of the Computer as an Expert Source of Information."

Abstract

This study examined the effect that knowledge about the operation and programming characteristics of the computer has on children's perceptions of computer expertise. It was hypothesized that perceptions of high expertise with regard to the computer are chiefly the result of a lack of knowledge about the computer's capabilities and limitations. Teaching children information about the computer, therefore, was expected to lower their perceptions of its expertise.

The study also sought to generate hypotheses that would explain children's beliefs about (a) the computer's overall informational output and (b) its specific areas of expertise--i.e., areas in which it is considered to be more expert than a human or printed source of information. Theories of "information dependence" (Jones & Gerard, 1967) and "source credibility" (Hovland, Janis, & Kelly, 1953) were used as an interpretive framework for investigating the origin and socializing effects of the imputation of high expertise to the computer.

A 3 x 2 x 2 factorial design with pretest and posttest measures was used. Six groups of children from three different grade levels (5th, 7th, and 9th grades), with and without previous CAI experience, were assigned randomly to either the experimental film treatment, where they were presented with factual information about the computer, or the control film treatment, a film on another subject; 292 children participated. Measures tapping the subjects' knowledge and attitudes about the computer, the college graduate, and the encyclopedia were administered immediately before and after the films were shown.

The results of the pretest indicated that all the children--irrespective of grade level or previous CAI experience--initially held a high regard for the computer's expertise. The attitudes of the subjects exposed to the experimental treatment changed in the direction supporting the hypothesis of the study, while the attitudes of the control subjects essentially remained unchanged. Differences between the groups, almost without exception, were in the direction favoring the experimental treatment and were significant.

Contrary to the pattern of developmental age differences that might have been expected, the older subjects perceived the computer as more expert than did the younger ones. Also, subjects with CAI experience perceived the computer as slightly more expert than did those without CAI experience. The type of CAI program (Math Logic or Math Drill and Practice) in which the experienced subjects had participated appeared to be related to these perceptions.

The interaction between children and CAI apparently results in social learning in addition to the intended cognitive learning outcomes of a specific CAI program.

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CHILDREN'S PERCEPTIONS OF THE COMPUTER AS AN EXPERT SOURCE OF INFORMATION

Henry T. Ingle

INTRODUCTION

Popularized perceptions of expertise and superhuman efficiency associated with the use of computers in modern-day society are examined in this study.

The specific subject of investigation concerns one area of the previous research by Hess, Tenezakis, Smith, Brod, Spellman, Ingle, and Oppman (1970), which discovered a tendency among the seventh- and eighth-grade Mexican-American students they studied to place more trust in the correctness of information received from a computer than in that from a human or printed source of information. These students, both with and without previous computer-assisted instruction (CAI) experience, perceived the computer as having unlimited information in many areas and as never making mistakes. In general, the students had a more favorable image of the computer than of the classroom teacher or the textbook.

Hess et al. (1970) concluded that this high regard which the students had for CAI and computers stemmed from their perception that the machine has greater expertise than most other sources in processing and transmitting information. Their research suggests the need for a more detailed examination of how children's perceptions and knowledge about information sources influence their attitudes about CAI and computers in general. This study is an attempt to explore this relationship. It also seeks to generate hypotheses which may be of use in other investigations into the affective consequences of technology for society.

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HYPOTHESIS AND ASSUMPTIONS

The principle objective of the study was to explore whether or not children's factual knowledge about the mechanical operation and functions of the computer influences their perceptions about its expertise and its credibility as a source of information. For this purpose, the following hyphothesis was formulated:

> Factual knowledge about the computer--that is, knowing how the computer obtains its information, how/it operates as a machine, and where in its programming errors can occur (independent variable)--will alter perceptions of high expertise that children associate with the computer (dependent variable).

The study also tested the following assumptions, which underlie the hypothesis:

1. The expertise phenomenon encountered by Hess et al. is generalizable to other children, irrespective of differences in age, sex, intelligence (IQ), socioeconomic status (SES), or CAI experience.

   This assumption is supported by the fact that the students in the research by Hess et al. who had no experience in CAI had levels of positive regard for the computer similar to those students with CAI experience, both male and female, of the same age, and of similar IQ level and SES backgrounds.

2. The tendency to associate high expertise with the computer is principally the result of ignorance, i.e. a lack of factual knowledge about the computer and its powers and limitations.

   This assumption is supported by the fact that the subjects studied by Hess et al. had vague knowledge of matters relating to where and how he computer obtained its information.

3. Because of the unique unctions that children impute to the computer--i.e., those of a dispenser and a processer of information--the computer can be thought of as an agent of socialization in the lives of children.

   This assumption is based on the conclusion by Hess et al. that the images students hold of the computer and of CAI apparently are drawn from a much more general image in the society, which depicts the machine in science fiction literature, in the mass media, and in the advertising field as an authority figure possessing powers of high expertise and superhuman efficiency.

CONCEPTUAL CONSIDERATIONS

The Computer as a Socializing Agent in the Lives of Children

The systematic development of a child's ability to relate to the society in which he lives is known as socialization (Parson, 1937; Davis, 1941; Sears, Maccoby & Levin, 1957; Bronfenbrenner, 1958; Brim & Wheeler, 1966; Sears, 1961; Clausen & Williams, 1963; Hess & Shipman, 1965; Zigler & Child, 1969). It involves the acquisition of patterns of behavior and attitudes shared and valued by the society into which the individual is being socialized. The acquisition process can develop in a number of different ways, and is mediated by the various sources of information to which an individual is exposed, e.g., parents, teachers, peers, the mass media, and other authoritative agents. As such, socialization is a two-way process of interaction between the provider and the receiver of information. Interaction for the purpose of exchanging information, therefore, can be said to be a principal aspect of the socialization process.

Jones and Gerard (1967, p. 714) placed this approach to socialization under the rubric of "information dependence"--that is, "a subcategory of social dependence in which one person relies on another for information about the environment, its meaning and the possibility for action in it." It is within this framework that the computer, which represents a combination of the mechanical properties of an electronic device and a logical, sequenced format for rapidly storing and retrieving bits of information, can be viewed as a socializing force in the lives of children.

The computer, as used for CAI, not only facilitates interaction but also displays aspects of what traditionally has been the role of a human teacher in the socializing of the young--namely the power to evoke and reinforce specified patterns of student responses (Brod, 1972). Most CAI programs are designed to give the learner immediate feedback about the accuracy of his responses to a given instructional sequence.

When programmed for instructional purposes, the computer can store and rapidly manipulate a virtual library of information with a level of accuracy that virtually no human teacher could ever hope to maintain in his everyday teaching practice. In the process, the computer does not accompany its messages with the type of evaluative cues, found to be present in almost any human interaction (Hovland, Janis, & Kelly, 1953; Kelman, 1961; Osgood, Suci, & Tannenbaum, 1957; Heider, 1958; Aronson & Golden, 1962; Watts & McGuire, 1964; Bauer, 1965), that help an individual to accept or to doubt the credibility of the information source and the correctness of the information being transmitted. These cues include such things as the communicator's physical appearance and manner of dress, voice inflection and intonation, and individual mannerisms--e.g., the blinking of an eye, a smile, a frown, a nervous twitch, or the nodding of the head.

From the computer, however, the student receives no cues that can be of assistance in judging the reliability and truthfulness of the information. The computer rapidly presents information which is so well sequenced and structured that it gives the appearance of being indisputably correct.

Hess et al. advanced the position that perhaps these characteristics of the computer, aided by the tendency of computer programmers to introduce humanizing statements, such as greetings and goodbyes, in CAI lessons accounted for children's perceptions of the computer as superhuman. Further, because of these characteristics, the computer may not be perceived by children as simply a medium or channel of information but may come to be perceived as having human properties. And to the degree that children are impressed with the overall interactive and informational capacities of the computer, as opposed to the capabilities of the human teacher or the textbook, the computer could well become a molder of attitudes and perceptions that are unrelated to the intended academic skills and cognitive objectives of a CAI program. As such, the computer could be perceived in the stereotyped fashion of "being smarter than humans" and "never making mistakes," as the investigations of Hess et al. suggest.

On the basis of this reasoning, the computer, as used in CAI programs, can be viewed as a potential socializing agent. Its nonacademic effects on children merit serious consideration.

The need for further cognitive studies on CAI is not denied. In fact, much research is still needed to tease out the critical variables of computer teaching-learning strategies. However, the implications of "information dependence" and socialization suggest the need for concomitant work in the affective domain.

To these reasons may be added the fact that technological changes, such as those wrought by the computer, are taking place so rapidly that in many instances social institutions such as the school and even the individual human psyche are unable to keep up and adjust (Morison, 1966; Oettinger & Marks, 1968; Baier & Rescher, 1969). There is a significant need, therefore, for teaching individuals how to deal with the paradoxes of technology, as well as to recognize and value its potential.

The Computer as an Effective Communicator

Inasmuch as the basic function of the computer in the school is to disseminate cognitive content, part of its effectiveness as a communicator is contingent upon the way it is perceived by the student receiving the cognitive content.

The role of communicator effectiveness has been investigated along three major dimensions, all of which are actually overlapping (Kelman, 1961; McGuire, 1969a & b): attractiveness, power or "means-control," and credibility.

Attractiveness as a component of communicator effectiveness rests on the assumption that the receiver is motivated to attain and/or maintain a gratifying self-concept while relating to the communicator. Communicator attractiveness has been investigated in terms of the receiver's perception of his similarity to, familiarity with, and liking for the communicator. The maintenance of beliefs acquired through this identification process depends upon the communicator's continued advocacy of them, and on the extent to which the role relationship established between the communicator and the receiver maintains its instrumentality and salience. This emphasis on identification may be relevant in a person-to-person interaction, but in its present form appears less applicable to man-machine interaction because the computer as a machine does not require that the student necessarily identify with it.

Likewise, the power or "means-control" component appears not to be related to man-machine interaction. The effectiveness of the power or means-control component of source valence rests on the assumption that the message receiver regulates his behavior toward the attainment of anticipated goals. To the extent that a communicator is perceived by the receiver as having the capability to influence (i.e., enhance or impede) his behavior toward attaining his goal, it will be able to obtain the receiver's compliance, i.e., his private acquiescence in the views advocated, with or without commitment to them.

Attitudes shaped in this fashion are expected to be maintained to the extent that the receiver continues to perceive the communicator as retaining control or sanctioning powers over him. Such appears not to be the case with present-day "drill and practice" CAI programs because the student is not evaluated, but only given a nonthreatening opportunity to practice on specified drills. For this reason, the power dimension also offers limited guidance in conceptualizing the variables relevant to the nonacademic or socioaffective effects of the computer on children.

However, viewing a communicator's effects in terms of credibility does offer some concrete possibilities for a conceptual research framework.

The Computer as a Credible and Expert Source of Information for Children

While children develop the ability between the ages of seven and eleven to deal with the world of concrete fact, their judgments tend to be absolute and they are unprepared to evaluate issues and decisions from the standpoint of relative benefit, as the adult does (Hyman, 1959; Piaget, 1963a, 1963b; Greenstein, 1965; Hess & Torney, 1968). The adult's world is not one of simple comprehension or presented facts, but rather one of acquiring specific information about a situation in order to evaluate facts. Under these circumstances the credibility accorded both the information source and the message assumes special importance.

The child, however, is unable to evaluate the facts himself; hence, the interpretation given the facts by the source is relatively more important for the child than for the adult. Therefore, it would be expected that of all the components of communicator effectiveness, the credibility dimension plays a central role with children, particularly with younger children, who tend to orient themselves toward the source to a greater extent than do older children or adults.

Roberts (1968) presented a persuasive appeal to individuals of varying ages containing information on the source (in this case, a teacher) in the form of slides accompanying a tape-recorded talk and also in the form of comments by the source about his background, interests, and preferences. Significant differences were found among fourth-, seventh-, and tenth-graders in their abilities to recall facts concerning the source of a message, as opposed to the content. He also found significant differences by age in readiness to answer questions on the two topics. Younger children more often checked "Don't know" for questions on the content and older children more often checked "Don't know" for questions on the source. These differences were further supported in terms of the percentage of the total questions answered for both source and content and in the evaluations of source as opposed to content, both indicating decreasing source orientation with increasing age. In view of the importance of source credibility, particularly for children, it is unfortunate that so little is actually known about what source credibility is and how it works for children.

The concept of credibility has figured prominently in the literature of attitude change (e.g., Hovland, Janis, & Kelly, 1953; Aronson & Golden, 1962; Aronson, Turner & Carlsmith, 1963; Watts & McGuire, 1964; Bochner & Insko, 1966). The credibility dimension rests on the assumption that the message receiver is motivated to attain an objectively verifiable "right" stand on a point at issue, as is the case in selecting the right answer in a "drill and practice" CAI program. Hence, the receiver's positive or negative evaluation of the communicator's message rests on the receiver's perception of the communicator's expertise (i.e., his perceived potential to know the right answer) or trustworthiness (i.e., his perceived motivation to communicate what he knows in an objective, unbiased way).

McGuire (1969a) reports considerable research showing that the amount of attitude change or influence produced by a given message can be varied by ascribing the message to sources that differ on such socially desirable dimensions as knowledge, education, intelligence, professional attainment, etc.--in essence, expertise.

Likewise, in the sample of children studied by Hess et al. (1970), the computer as an effective communicator repeatedly was described in terms of its expertise. For these reasons, expertise has been singled out as the relevant dependent variable for this study.

As viewed herein, expertise is not so much a characteristic of the information source as it is a perception that an individual holds about the information source. That is, expertise is viewed as a relational term, and not a property term. It is, therefore, a hypothetical concept--a characteristic consisting of what the recipients of a communication feel and think about the source. Attitudes about the computer's expertise will not be viewed so much as a reaction to what the computer is, but as a reaction to what it is perceived to be. The computer's expertise, therefore, is the extent to which the computer is perceived by children as a source of correct information.

DESIGN

A 3 (fifth- vs. seventh- vs. ninth-graders) x 2 (prior vs. no prior experience with computers) x 2 (factual knowledge about computers vs. no factual knowledge provided) factorial design was used with 292 students. The subjects were assigned randomly to either the experimental film treatment (factual information about computers) or the control film treatment (used to occupy the subjects in the control condition).

Attitudinal measures focusing on the expert qualities of the computer, a printed source (an encyclopedia), and a human source (a college graduate) were administered before and immediately after the films were shown. The mean pretest and posttest scores for each of the three information sources were analyzed. Attitudes about the computer were contrasted with attitudes about the college graduate and the encyclopedia in an attempt to specify how children orient themselves to other information sources in their school environment that might also be thought of in terms of high expertise.

The inclusion of children at three distinct grade levels was an important aspect of the design. If it were shown that the perceptions of high expertise associated with the computer tended to diminish with increasing age, as the literature suggests (see Ingle, 1972), then the phenomenon encountered by Hess et al. (1970) might well be related to the particular cognitive stage of development and maturation of the students in their sample. If differences in age failed to reflect differences in attitudes about the computer, a stronger case could be made for supporting the findings of Hess et al., and for the assumptions that underlie the research hypothesis of this study regarding the shaping and altering of children's attitudes about the computer.

Another important aspect of the design was the effect that previous CAI experience, or the lack of it, might have had in shaping children's attitudes about the computer's expertise. Participation in a CAI program represents firsthand experience with a source of information (the computer); the literature pinpoints such experience as particularly necessary for children if they are to be able to judge information sources as fallible.

Individual background factors such as differences in sex, IQ, race, SES, and the type of CAI program (Math Logic or Math Drill and Practice) in which the subjects had participated were considered as intervening variables that may have influenced their expectations about the computer's expertise.

SAMPLE

The study was conducted in six Bay Area schools with a sample of 292 students. Two schools were selected for each of the three grade levels: one where the students at the particular grade level in question were participating in or had previously participated in a CAI program; and another where the students at the same grade level had not participated in any CAI program. In each school the students were assigned randomly to either the experimental condition or the control condition. A breakdown of the sample by CAI experience and grade level is shown in Table 1.

TABLE 1

Students in the Sample
(N=292)

	CAI Experience		Non-CAI Experience	
Grade and School	Experimental	Control	Experimental	Control
Fifth-graders				
School 1	28	30	--	--
School 2	--	--	25	25
Seventh-graders				
School 3	17	21	--	--
School 4	--	--	20	18
Ninth-graders				
School 5	30	28	--	--
School 6	--	--	26	24
Totals	75	79	71	67

Randomization was accomplished by numbering the pretest questionnaires from 1 to 60, the maximum number of students who could participate in the experiment at any given school. Once the students finished answering the pretest questionnaires, the administrators of the experiment selected a table (integers of 50 or 60) from Moses and Oakford's Tables of Random Permutations (1963) that most closely corresponded to the number of students present. Half of the integers (either the bottom or top half) in the selected table were read aloud in the random order in which they appeared. Students whose questionnaire had a number corresponding to the random integers that were called out were asked to go to another classroom to view one of the films. These students formed either the control or the experimental group in each instance.

Out of each grade level in each school, therefore, approximately half of the students viewed the experimental film and the other half viewed the control film. All were told that they were viewing the same film, but that because of the small size of the available screen, they had to be divided into smaller groups.

The children who participated in the study came from heterogeneous backgrounds; they were from professional, white-collar, and working-class families and had measured intelligence quotients varying from below average to well above average. An approximately equivalent distribution by sex, social class, and age was obtained within each experimental and control condition at each grade level.

Of the 292 cases in the sample, 135 (46 percent) were females and 157 (54 percent) were males. The age span was 10 to 16 years. With the exception of the concentration of black students with CAI experience in the seventh-grade, the majority of the students in every grouping were of white Anglo-Saxon ethnic backgrounds. Among the 292 cases, 111 (38 percent) came from families for which the father's occupation was categorized as Professional, 95 (33 percent) were in the White Collar category, and 53 (18 percent) were in the Blue Collar or working class. Thirty-three (11 percent) of the cases (predominantly in the seventh-grade CAI sample, which was black) were in the category of Father Absent or Father's Occupation Unknown. Since the data on father's occupation were collected from each student's permanent file, there was no way of undertaking further inquiry into the question of occupation. Consequently, sections in the analysis which refer to social class (based on father's occupation) do not include these 33 students.

Data collected on intelligence measures from the students' school records were less than satisfactory for making comparisons between conditions and schools. The school record listed either an LTIT score or an SCAT score as an IQ measure, never both. Only SCAT scores were available for the fifth-graders with previous CAI experience; and only LTIT scores were available for fifth-graders without previous experience. For seventh-graders with previous CAI experience, only LTIT scores were available. The seventh-graders without previous CAI experience had only SCAT scores. The ninth-graders with CAI experience had only SCAT scores, and ninth-graders without CAI experience had only LTIT scores. Score-correspondence tables for the SCAT and LTIT tests were not available.

All the students with CAI experience had participated in the Stanford Math Drill and Practice CAI program for at least one year, except the fifth-graders with CAI experience, who had participated for a year in the Stanford Math Logic CAI program (both programs were developed by Patrick Suppes and Barbara Searle). The Logic program appears to require a somewhat higher level of ability than the Drill and Practice sequence, which has a remedial orientation. Sample student CAI lessons from each of these programs are included in Appendix A.

VARIABLES AND INSTRUMENTS

Dependent Variable: Attitudes about Computer Expertise

The dependent variable was defined as attitudes about computer expertise. Expertise, as measured by Hess et al. (1970), was based on responses to eight items that were constructed to measure the amount of "knowledge" the computer was perceived as having; the ability of the computer to answer various types of questions; and the degree of correctness of the computer's information.

The matrix of Pearson product moment correlations among these items showed that the proportion of significant coefficients was greater than chance for both the CAI and Non-CAI groups. Of a total of 28 coefficients for each group, 16 (57 percent) were significant for the CAI group (< .05), and eight (28 percent) for the Non-CAI group. The correlations suggest that the items do indeed convey a quality that can be labeled as expertise (see Hess et al., 1970).

The percentage distributions and means for CAI and Non-CAI groups on a series of items developed by Hess et al. to further elicit student attitudes about the expertise of the computer were calculated. Items that were significant on the two-tailed t-test, together with the significantly correlated items, formed the basis for selecting the dimensions used in this study as a measure of "expertise." The items were restructured into a series of five-point semantic differential scales (Osgood, Suci, & Tannenbaum, 1957) to ensure greater uniformity in format and simplicity in answering for both the older and the younger children in the experiment. The scales used to measure expertise perceptions for each source are presented in Table 2. A full set of experimental measures is in Appendix B.

TABLE 2

Semantic Differential Scales for Source Expertise

Smart	(1)(2)(3)(4)(5)	Dumb
Has very little information	(5)(4)(3)(2)(1)	Has very much information
Gives right answers	(1)(2)(3)(4)(5)	Gives wrong answers
Makes many mistakes	(5)(4)(3)(2)(1)	Makes few mistakes
Knows a lot	(1)(2)(3)(4)(5)	Does not know much
Answers only a few questions	(5)(4)(3)(2)(1)	Answers almost all questions
Agree with answers	(1)(2)(3)(4)(5)	Disagree with answers
Do not accept information	(5)(4)(3)(2)(1)	Accept information

The eight sets of bipolar adjectives listed in Table 2 form the basis for measuring perceptions of "expertise" for a comparable printed source (an encyclopedia) and a comparable human source (a college graduate).[1] Each of the scales has been scored from 1 to 5; the most favorable end of each of the eight scales is scored as 1 (that is, "high expertise" perceptions about the source--smart, has very much information, and so forth). The opposite end of each scale is labeled as "low expertise" perceptions about the source and is scored as 5 (dumb, has very little information, and so forth).

"High expertise" perceptions about a source are thus indicated by a total score of 8; "low expertise" perceptions are indicated by a total score of 40. Ratings of each source have a possible range from 8 to 40. Scores at the higher end of the range indicated negative attitudes about the source's expertise; scores at the lower end of the range indicated positive attitudes about the source's expertise.

Independent Variable: Knowledge about the Computer

The independent variable was defined as knowledge about the source and its characteristics as a disseminator of information, that is, how the computer operates, where it gets its information, and what its capabilities and limitations as an information source are. This variable was operationalized in a filmed presentation on computers (see Appendix D for transcription of the audio portion of the film's content).

On the basis of previous research (Cronbach, 1954) which indicates that films are capable of changing attitudes in a favorable or unfavorable direction according to the slant of the presentation, a commercially produced film on computers was located. The film was pilot-tested and found to be suitable in content and level of presentation to the understanding of both the youngest and the oldest children who would participate in the experiment.

[1]Originally, the human source to be used was "teacher," but school officials refused to permit the use of the term in the study. A compromise was reached with the term "college graduate." In administering the questionnaire, however, it was found that most students first thought of a college graduate as being the teacher.

The experimental treatment film is entitled "The Thinking??? Machines" and was produced for children at the upper elementary and junior high levels by the Bell Telephone Laboratories. It is part of an Aids to Science Education program on computers and other types of technology. The film provided the students assigned to the experimental treatment with straightforward, factual information about the computer. In a humorous and informative manner, the film describes what computers are, where they get their information, and what they can and cannot do. The film is in color and runs for about 16 minutes.

In order to maintain conditions similar to those in the experimental treatment, the subjects in the control condition were shown an entertaining and humorous 15-minute film (see Appendix D for transcription of the audio portion of the film's content) while the subjects in the experimental condition viewed the computer film. The control film ("Six Questions and Seven Answers about the ERIC Clearinghouse") was used as a placebo. It describes the ERIC Clearinghouse at Stanford University.

Eight multiple choice items (see Appendix B for the instrument) were used to ascertain the student's knowledge about the computer's information process before and after treatment. These items were used as a measure of the effectiveness of the experimental treatment. Correct responses were given a score of 1; incorrect responses were given a score of 0. Each subject was assigned a total score, which could range from 0 to 8. It was assumed that the higher the score--that is, the more items answered correctly--the more the subject knew about the computer. In fact, this assumption was not correct.

The manner in which items 2, 3, 6, 7, and 8 were answered largely depended on the level of abstraction of the students' knowledge about the computer. Only items 1, 4, and 5 proved to be good discriminators, statistically, of an individual's knowledge about computers, and for this reason the "knowledge index" was limited to these three items. A factor analysis of the eight items further substantiated this decision (see Table 3).

TABLE 3

Factor Loadings for Knowledge about the Computer Items

Items	Pretest h^{2*}	Pretest i^{2**}	Posttest h^2	Posttest i^2
1. A computer can answer:				
a. Almost any and all questions because it has very much information.	.24	.20	.34	.30
b. Only questions for which it has been programmed for information.				
2. A computer can use:				
a. Numbers but not letters.	.05	.01	.04	.00
b. Both numbers and letters.				
3. Computers are:				
a. Only machines but also have feelings just like people.	.18	.11	.16	.02
b. Only machines and don't have feelings just like people.				
4. Computers are:				
a. Only machines but they can also think just like people.	.27	.22	.30	.21
b. Only machines and they can't think just like people.				
5. Where does the computer get its information?				
a. all by itself. b. a programmer. c. a transistor.	.20	.21	.26	.21
6. The computer has a way of storing and remembering information. What is this called?				
a. the terminal. b. the program. c. the memory.	.17	.03	.16	.06

TABLE 3 Cont'd.

Items	Pretest h^{2*}	Pretest i^{2**}	Posttest h^2	Posttest i^2
7. What do we call the special typewriter on which a computer prints out its answers? a. the computer. b. the card reader. c. the terminal.	.10	.05	.14	.03
8. What do we call the instructions which the computer uses to do its work? a. the recipe. b. a unit. b. a program.	.15	.04	.13	.02

Note: Circled correlations represent those items forming the "knowledge index."

$*h^2$ = Total variance accounted for in factor analysis

$**i^2$ = Variance accounted for by principal component

As a check of internal consistency for items 1, 4, and 5, Cronbach Alpha Coefficients of .46 and .47 were found for pretests and posttests. Total score reliability for all eight items yielded Alpha Coefficients of only .38 and .44 for pretests and posttests. Item intercorrelation and reliability coefficients for all the items are presented in Appendix C.

CONTRASTING VARIABLES

Attitudes about Other Sources of Information

Throughout this study, attitudes about the computer were compared to attitudes about comparable human and printed information sources with a high connotation of expertise. The concept college graduate was used to represent a human source and the concept encyclopedia represented the printed source. The same semantic differential scales used for eliciting the students' attitudes about the computer's expertise (Table 2) were used for the college graduate and the encyclopedia.

Source Preference for Information Areas

An exploratory effort was made to specify content or information areas in which the computer is perceived as being more expert than a college graduate or the encyclopedia. For this purpose, a series of paired comparison items (Appendix B) were used, which asked the students to select which of the three sources they would prefer to use with various types of informational needs: a math homework problem, a reading difficulty, a social studies test, a personal problem with a friend, a check on the truthfulness of a story, a voting decision, and a career choice.

For each of these seven situations the permutation of paired comparisons permitted each source to be selected a maximum of two times. This response pattern was used in the analysis to indicate a strong preference for that particular source in that particular information area.

The paired comparison items were administered both pretest and posttest.

Credibility Stress with Simulated CAI Lessons

Upon completion of all pretest and posttest measures (attitudes, knowledge, and information source preference), the students were presented a series of five computer printouts simulating the dialogue of individual children interacting with the computer (see Appendix B). The printouts were typed on IBM computer paper to simulate actual computer output. Printout 4 of the credibility stress measure follows.

This measure was designed to generate varying degrees of "credibility stress" in the students' minds about the computer and the correctness of its information. Each printout simulated an instructional sequence with a hypothetical student. In one instance, the student response in the sequence clearly was an error and in another instance, the computer output was in error. In yet another instance, neither the computer nor the student was in error, both were correct.

CREDIBILITY STRESS MEASURE OF SIMULATED CAI LESSON (Printout #4)

PHI & 30 APRIL, 1970

PLEASE TYPE YOUR NUMBER AND NAME.

s 742 Mike Chew

HELLO, MIKE. HERE IS A PROBLEM FOR YOU. LET'S SEE WHAT YOU CAN DO WITH IT. HERE ARE SOME LETTERS: WWWWWVVVV. HOW MANY LETTERS ARE THERE?

I think there are 9.

VERY GOOD, MIKE. NOW, HOW MANY OF THE LETTERS ARE W?

There are 5.

TRY AGAIN. HOW MANY OF THE LETTERS ARE W?

There are 5.

NO, THE ANSWER IS 4. MY PROGRAM SAYS SO.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

A. The computer is correct.
B. Mike is correct.
C. Both the computer and Mike are correct.
D. Neither the computer nor Mike is correct.

Simple multiple-choice questions asked the students to ascertain any errors in the printout. The responses were used to make inferences about the credibility of the computer as an expert source of information. The correct response in each printout was assigned a score of 1; 5 represented a perfect score for the series of five printouts and indicated that the students could appraise the computer output critically and locate errors in the information.

It was thought that those subjects exposed to the experimental treatment designed to alter high regard for the computer's infallibility as an "expert" source of information would be able to identify more sources of error in each printout than those in the control condition.

Background Variables

Background data on each subject were collected from permanent school records with the assistance of the counselling staff at each school. These data included an IQ measure, an indication of socioeconomic status based on father's occupation, sex, race, and the type of CAI program used (Math Logic or Math Drill and Practice).

FINDINGS

Pretest Attitudes about the Computer

To analyze attitudes about the computer, a factor-analysis was performed on the eight semantic differential scales used as measures of "source expertise" (see Table 4). The resulting factor loadings confirmed the unidimensionality of these scales along the lines of what was termed "source expertise." One single component in the unrotated factor matrix, called "expertise," accounted for the greatest amount of common extractable variance for each of the three sources on both the pretests and posttests. The eight semantic differential scales thus formed an index of source expertise.

A three-way analysis of variance (ANOVA) was performed on the group means derived from the semantic differential index. Table 5 shows the pretest means for all groups. Table 6 shows the analysis of variance results.

The pretest attitude means generally favor the high expertise end of the semantic differential scale, suggesting a tendency for the students to perceive the computer as a highly expert source of information.

In spite of careful randomization procedures, significant differences were found in pretest means between subjects in the experimental and control groups ($F = 9.44$, $df = 1/280$, $p < .01$); subjects who later received the experimental treatment showed higher pretest means. There were also significant mean differences in pretest attitudes by the three

TABLE 4

Factor Loadings for Semantic Differential Scales: Index of Source Expertise

Items	Computer				College Graduate				Encyclopedia			
	Pretest		Posttest		Pretest		Posttest		Pretest		Posttest	
	h^{2}*	i^{2}**	h^2	i^2	h^2	i^2	h^2	i^2	h^2	i^2	h^2	i^2
1. Dumb/Smart	.38	.31	.63	.54	.46	.39	.53	.45	.44	.27	.47	.34
2. Much/Little Information	.38	.32	.55	.49	.46	.42	.50	.46	.28	.24	.54	.49
3. Wrong/Right Answers	.41	.37	.60	.53	.39	.37	.47	.46	.49	.47	.56	.53
4. Few/Many Mistakes	.43	.38	.54	.48	.45	.45	.50	.46	.38	.32	.52	.47
5. Does not Know/Knows a Lot	.51	.39	.54	.40	.51	.46	.53	.51	.49	.34	.59	.45
6. Answers All/Few Questions	.43	.32	.49	.43	.41	.39	.47	.45	.39	.35	.34	.30
7. Disagree/Agree with Answers	.47	.38	.54	.37	.47	.41	.43	.34	.59	.53	.54	.46
8. Accept/Does not Accept Information	.48	.39	.51	.38	.40	.35	.38	.30	.54	.47	.50	.41

*h = Total variance accounted for by factor analysis
**i = Variance accounted for by principal component

TABLE 5

Pretest Attitudes about the Computer:
Means and Standard Deviations for Semantic Differential Scales

Subjects	Grade Level 5		7		9		All Grades	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
CAI Experience	14.10	-	12.26	-	10.76	-	12.39	4.94
Experimental	12.99	4.08	11.72	4.50	10.17	4.71	-	-
Control	13.50	6.25	12.09	5.11	9.87	2.45	-	-
Non-CAI Experience	11.78	-	13.26	-	11.98	-	12.26	4.39
Experimental	11.56	5.12	12.95	5.07	11.35	3.68	-	-
Control	12.00	4.74	13.06	4.48	12.07	4.01	-	-
All Conditions	13.03	5.31	12.76	4.63	11.32	3.84	-	-

TABLE 6

Summary of a Three-Way ANOVA for Pretest Attitudes about the Computer

Source	SS	df	MS	F
Treatment T	193.99	1	193.99	9.44**
Grade Level (GL)	176.13	2	88.06	4.28*
CAI Experience (CAI)	1.21	1	1.21	
T x GL	3.30	2	1.65	
T x CAI	45.11	1	45.11	2.19
GL x CAI	202.49	2	101.25	4.93**
T x GL x CAI	13.35	2	6.67	
Within Groups	5754.88	280	20.55	
Total	6374.25	291	21.90	

*$p < .05$
**$p < .01$

grade levels ($F = 4.28$, $df = 2/280$, $p < .05$); the older subjects tended to view the computer as more expert than younger ones did. In addition, a two-way interaction by grade level and CAI/Non-CAI experience ($F = 4.93$, $df = 2/80$, $p < .01$) was found; the older subjects with CAI experience seemed to perceive the computer as more of an expert source of information than subjects without CAI experience did, or than younger subjects with CAI experience did.

The unexpected range of differences in pretest mean attitudes about the computer, particularly between the subjects assigned to the experimental and control conditions, prompted an analysis of covariance, using means for pretest attitudes about the computer and knowledge about the computer for posttest means of each treatment group.

Three analyses of covariance on posttest attitudes about the computer were done: one used pretest attitudes about the computer as a covariant; the second used pretest knowledge about the computer, and the third used posttest knowledge about the computer. The results of these covariate analyses indicate that despite the initial differences in pretest means, scores from the experimental condition were affected significantly by the treatment; scores from the control treatment were not. The F-ratios in the three covariate analyses were significant at the $p < .001$ level (see Tables E-I, E-II, and E-III in Appendix E). The covariate analyses suggest that if there had been initial equivalence in pretest means between each experimental and control group, the experimental treatment would have had even more of an effect on the posttest attitudes of the experimental subjects. The dispersed pattern of pretest means, therefore, can be interpreted as a chance happening and does not threaten the validity of the experimental treatment.

The mean scores reported in Table 5 show a range in pretest attitudes about the computer's expertise. Ninth-graders with CAI experience had the most favorable attitudes about computer expertise ($\overline{X} = 9.87$). The fifth-grade control subjects with CAI experience had the least favorable attitudes toward the computer ($\overline{X} = 13.50$).

Contrary to the research literature on developmental age differences, which suggests that younger children would have more favorable perceptions of computer expertise, the data indicate a tendency for the older subjects (seventh- and ninth-graders) to perceive the computer as more expert than the younger ones. These differences were significant at the $p < .05$ level ($F = 4.28$, df. = 2/280).

Table 5 also shows a tendency for the subjects with CAI experience to perceive the computer as slightly more expert than the subjects without CAI experience. This tendency lends some additional support to the findings by Hess et al. (1970) that students come to CAI with certain preconceptions about the computer, which are not altered substantially by their participation in CAI.

The significant interaction by grade levels and the CAI/Non-CAI experience is shown in Figure 1.

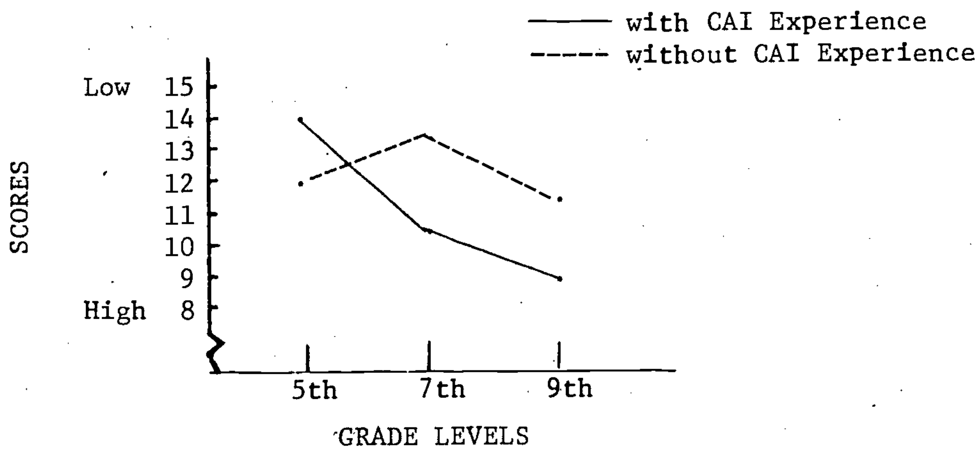

Figure 1. Two-way interaction by grade level and CAI experience for mean pretest attitudes about computer expertise.

There was a tendency among the fifth- and ninth-graders without CAI experience ($\overline{X}$ = 11.78 and 11.98, respectively), as well as the ninth-grade sample with CAI experience ($\overline{X}$ = 10.76), to view the computer as more expert than did the fifth-graders with CAI experience ($\overline{X}$ = 14.10) or the seventh-graders (CAI $\overline{X}$ = 12.26, Non-CAI $\overline{X}$ = 13.26). There is a difference, therefore, in the range of expert status accorded the computer partially explained by grade level and previous CAI experience.

The pretest grade level means from Table 5 further substantiate these conclusions. Ninth-graders ($\overline{X}$ = 11.32) had the highest perceptions of expertise about the computer, followed by the seventh-graders ($\overline{X}$ = 12.76) and the fifth-graders ($\overline{X}$ = 13.03).

Figure 1 indicates that the older or ninth-grade subjects with CAI experience generally perceived the computer as more expert than did the younger or fifth-grade subjects with CAI experience. The pattern is somewhat reversed in the Non-CAI condition, where the younger or fifth-grade subjects in general perceived the computer as more of an expert than did the older seventh-grade subjects. There are a few qualifications, however.

Figure 1 indicates that fifth-graders without CAI experience ($\overline{X}$ = 11.78) perceived the computer as more of an expert source of information than did the fifth-graders with CAI experience ($\overline{X}$ = 14.10). There is a significant difference, reported in Table 6, ($F = 4.93$, $df = 2/280$, $p < .01$) between their respective means. This pattern, however, is reversed for both the seventh- and ninth-graders. Ninth-graders with CAI experience ($\overline{X}$ = 10.76) perceived the computer as slightly more expert than did the ninth-graders without CAI experience (X = 11.98). Seventh-graders with CAI experience ($\overline{X}$ = 12.26) also perceived the computer as more expert than did the seventh-graders without CAI experience ($\overline{X}$ = 13.26).

The difference in means may be related to the type of CAI program experienced by seventh- and ninth-graders. CAI fifth-graders worked with a Math Logic program (see Appendix A), which is designed with a variety of instructional routines for flexibility (Atkinson & Wilson, 1969). The seventh- and ninth-grade CAI subjects used the remedial Math Drill and Practice program (see Appendix A), which is somewhat less flexible and more limited in instructional routines. Thus, the fifth-graders with CAI experience in the Logic program might well have had a better opportunity to interact with the computer in a variety of instructional routines, which possibly allowed them to gain more firsthand knowledge about the limitations and capabilities of the computer, than did the seventh- and ninth-grade CAI subjects.

Considering the fact that the most extreme mean on the pretest is 13.50 and that most of the other means are no more than a few points away from the "high expertise" score of 8, one can conclude that the subjects generally perceived the computer as a source of information relatively high in expertise. The subjects in both CAI and Non-CAI groups and at all three grade levels were positive about the computer's expertise. Not only are the previous research findings of Hess et al. (1970) substantiated, but indications of the generalizability of these findings to other children at different age levels are also provided.

Posttest Attitudes about the Computer

In the posttest analysis, the concern focused on the hypothesis about effects of the experimental treatment--namely, does factual knowledge about the computer alter perceptions about its expertise? On a broader basis, the question is whether or not factual learning alters attitudes. To answer this question, mean posttest attitudes about the computer's expertise were examined.

The analysis of variance on posttest mean attitudes about the computer's expertise shows significant treatment main effects ($F = 72.58$, $df = 1/280$, $p < .001$) and a significant grade-level-by-CAI interaction ($F = 10.29$, $df = 2/280$, $p < .01$). See Tables 7 and 8 for means and analysis of variance, respectively. These results offer convincing evidence supporting the hypothesis of the study.

The largest treatment main effect appears to have occurred with the fifth-graders in the experimental CAI condition, whose posttest mean is 19.82. The ninth-graders in the experimental Non-CAI condition with a posttest mean of 19.38 were next, followed by the seventh-graders in the experimental Non-CAI condition ($\overline{X} = 19.20$). The experimental subjects, as a whole, had a mean substantially higher than that of the control subjects (17.86 versus 12.86).

TABLE 7

Posttest Attitudes about the Computer:
Means and Standard Deviations for Semantic Differential Scales

	Grade Level							
	5		7		9		All Grades	
Subjects	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
CAI Experience	17.24	-	14.82	-	13.55	-	15.25	6.13
Experimental	19.82	5.96	16.76	5.04	16.30	5.84		
Control	13.83	6.11	13.04	5.54	10.06	3.61		
Non-CAI Experience	14.00	-	16.58	-	16.14	-	15.49	5.27
Experimental	15.65	4.84	19.20	4.94	19.38	3.50		
Control	12.06	4.91	13.07	3.99	12.03	4.46		
All Conditions	15.74	6.08	15.70	5.44	14.75	5.57		

TABLE 8

Summary of a Three-Way ANOVA for Posttest Attitudes about the Computer

Source	SS	df	MS	F
Treatment (T)	1825.00	1	1825.00	72.58**
Grade Level (GL)	64.49	2	32.25	
CAI Experience (CAI)	3.93	1	3.93	
T x GL	62.26	2	31.13	
T x CAI	4.28	1	4.28	
GL x CAI	517.58	2	258.79	10.29*
T x GL x CAI	46.78	2	23.39	
Within Groups	7040.44	280	25.14	
Total	9567.19	291	32.18	

*p < .01
**p < .001

Figure 2 shows pretest and posttest means for experimental groups on the measures of attitude toward the computer as a source of input information. Comparing pretest and posttest means, scores for fifth-graders with previous CAI experience in the experimental treatment rose from 12.99 to 19.82. Means for seventh-graders in the same conditions rose from 11.72 to 16.76, and ninth-grade means moved from an extreme initial score of 10.17 to a posttest mean of 16.30.

In the Non-CAI experimental conditions, fifth-grade means rose from 11.56 to 15.65, seventh-grade means from 12.95 to 19.20, and ninth-grade means from 11.35 to 19.38.

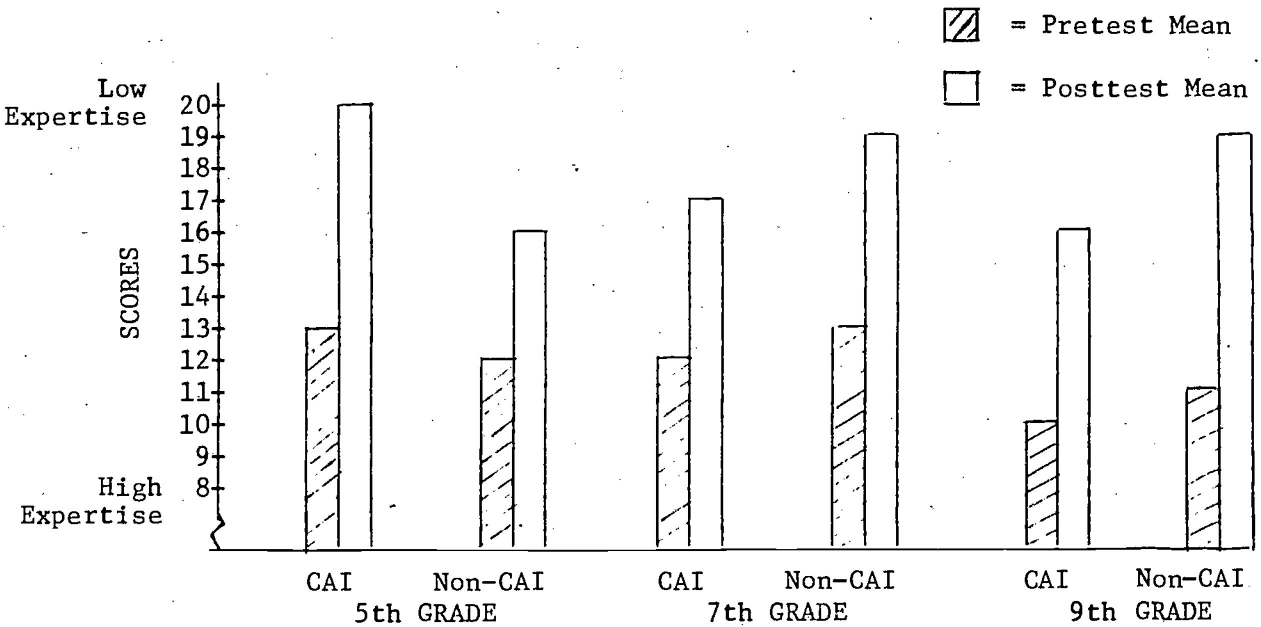

Figure 2. Experimental group means on pretest and posttest attitudes about computer expertise.

ANOVA results indicate that these shifts in means among the experimental groups represent a significant change in their evaluation of the computer as a source of expert information ($F = 72.58$, $p < .001$). The direction of the change favors the hypothesis; experimental groups saw the computer as less expert than on the pretest. Control group means remained essentially unchanged. The experimental subjects showed an overall posttest mean of 17.86 (compared to an initial mean of 11.51), while the control subjects showed an overall mean of 12.86 (compared to an initial mean of 13.04).

By grade levels, the greatest move away from high expertise perceptions about the computer was among the ninth-graders exposed to the experimental treatment. The initial mean was 10.55 and the posttest mean was 17.73. Seventh-graders in the experimental group scored a mean of 12.11 on the pretest and 18.08 on the posttest; the experimental fifth-grade mean was 12.11 on the pretest and 17.85 on the posttest.

The mean for fifth-graders with CAI experience changed from 14.10 to a posttest mean of 17.24; the mean for fifth-graders without CAI experience moved from 11.78 to a posttest mean of 14.00. The mean for seventh-graders with CAI experience moved from 12.26 to 14.82, as compared to pretest mean of 13.26 and a posttest mean of 16.58 for seventh-grade Non-CAI subjects. The mean for ninth-graders with CAI moved from 10.76 to 13.55, and for the Non-CAI ninth-graders from 11.98 to 16.14 (Table 7).

The greatest treatment effect appeared with fifth-grade experimental subjects with CAI experience, and the effect decreased with seventh- and ninth-graders. The pattern is reversed for the Non-CAI experimental subjects; there was less of an effect on the younger subjects (fifth-graders) and more of an effect on the older ones (seventh- and ninth-graders).

In the CAI versus Non-CAI comparison, the treatment generally appears to have had a greater effect on the subjects without CAI experience (see Figure 3). A tendency to view the computer as less expert appeared to increase with age or grade level among these subjects. The reverse appears to be the case among the subjects with CAI experience.

The younger subjects demonstrated more of a change in attitudes than did the older ones. There is, however, a significant two-way interaction between grade level and the CAI versus Non-CAI conditions. This suggests that previous CAI experience makes little or no difference among older children's changes in perceptions about the computer's expertise, but it does make a difference among younger children. Among younger children, the knowledge conveyed in the experimental treatment, along with experience in a CAI program, may account for their lower perceptions of computer expertise.

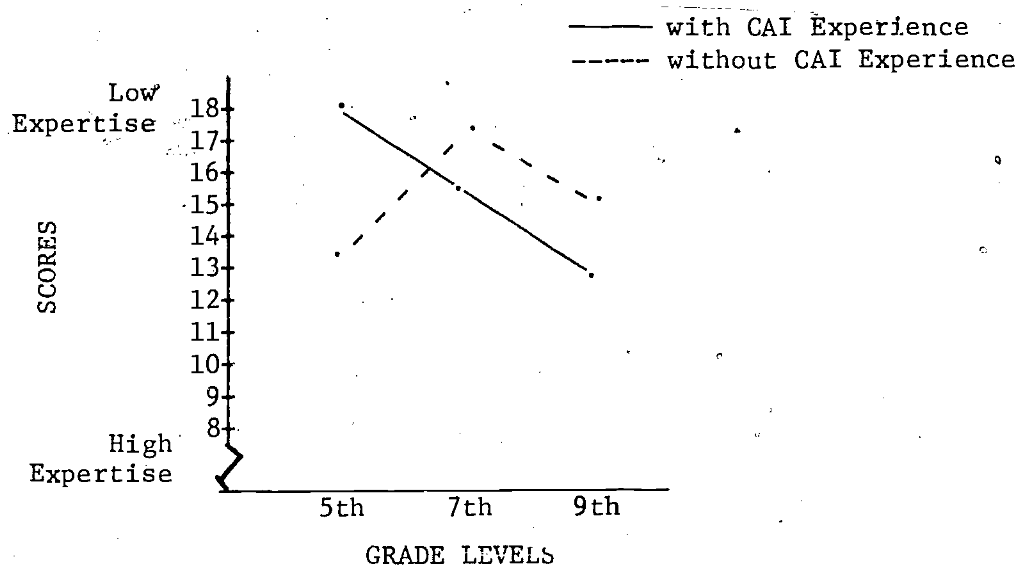

Figure 3. Two-way interaction by grade level and CAI experience for experimental group posttest means on attitudes about computer expertise.

Knowledge about the Computer

The dimension of knowledge about the computer was an index of three multiple-choice items, focused on the information-processing aspects of the computer. Items were scored 1 for correct, 0 for incorrect. Scores ranged from 0 to 3. It was assumed that the higher the score (more correct answers), the more knowledge the subject possessed about the computer. As with the semantic differential scales, the knowledge items were administered pretest and posttest.

Although the use of only three items as a knowledge index limited the range of variability, changes in pretest-posttest knowledge about the computer were significant ($F = 50.37$, $df = 1/280$, $p < .001$). Experimental treatment scores were high on the posttest. Tables 9 and 11 present the mean pretest and posttest knowledge scores; ANOVA results are in Tables 10 and 12. Pretest and posttest measures of knowledge were highly correlated with each other ($r = 0.64$) and posttest knowledge about the computer correlated moderately with posttest attitudes about the computer ($r = 0.26$).

The pretest and posttest means presented in Tables 9 and 11 show that the mean for fifth-grade experimental subjects with previous CAI experience rose from 2.93 to 2.96, pretest to posttest; for seventh-grade experimental subjects with CAI experience the mean rose from 2.29 to 2.94; for ninth-grade experimental subjects the mean rose from 2.47 to 3.00 (perfect score). Means for all subjects in the experimental condition show a significant increase in knowledge about the computer ($F = 50.37$, $df = 1/280$, $p < .001$).

In the Non-CAI condition, fifth-graders in the experimental treatment scored a pretest mean of 1.92 and a posttest mean of 2.76 on the knowledge measure. The seventh-grade mean rose from 2.40 to 2.90; and the ninth-grade mean, as with the CAI condition, showed a posttest knowledge mean of 2.62. Here again the subjects in the experimental condition demonstrated a significant increase in their knowledge about the computer ($F = 50.37$, $df = 1/280$, $p < .001$).

The general results of these analyses indicate that the high expertise which children associate with the computer is to a large extent the result of their lack of factual knowledge about the computer. The subjects at all three grade levels, whether or not they had previous CAI experience, initially expressed a high regard for the computer's expertise on the pretest.

The analysis of variance summaries in Tables 9 and 11 also indicate a significant grade-level-by-CAI interaction ($F = 16.33$, $df = 2/280$, $p < .01$ and $F = 4.59$, $df = 2/280$, $p < .05$, respectively). These F-ratios are smaller than the F-ratio ($F = 50.37$) of the posttest treatment means. The grade-level-by-CAI interactions are worthwhile discussing because subjects with CAI experience had higher posttest knowledge means than subjects without CAI experience. CAI experience appears to make a difference in posttest knowledge about the computer.

TABLE 9

Pretest Knowledge about the Computer:
Means and Standard Deviations

	Grade Level					
	5		7		9	
Subjects	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
CAI Experience						
Experimental	2.93	.26	2.29	.77	2.47	.78
Control	2.83	.38	2.33	.91	2.64	.62
Non-CAI Experience						
Experimental	1.92	.76	2.40	.50	2.62	.75
Control	1.92	.95	2.17	.92	2.58	.65

TABLE 10

Summary of a Three-Way ANOVA for Pretest Knowledge about the Computer

Source	SS	df	MS	F
Treatment (T)	0.01	1	0.01	
Grade Level (GL)	3.34	2	1.67	3.36*
CAI Experience (CAI)	8.85	1	8.85	17.82**
T x GL	0.37	2	0.19	
T x CAI	0.26	1	0.26	
GL x CAI	16.23	2	8.11	16.33*
T x GL x CAI	0.48	2	0.24	
Within Groups	139.08	280	0.50	
Total	168.33	291	0.58	

*$p < .01$
**$p < .001$

TABLE 11

Posttest Knowledge about the Computer:
Means and Standard Deviations

	Grade Level					
	5		7		9	
Subjects	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
CAI Experience						
Experimental	2.96	.19	2.94	.24	3.00	.00
Control	2.73	.38	2.33	.97	2.71	.60
Non-CAI Experience						
Experimental	2.76	.52	2.90	.31	3.00	.00
Control	2.00	.96	2.17	.86	2.63	.65

TABLE 12

Summary of a Three-Way ANOVA for Posttest Knowledge about the Computer

Source	SS	df	MS	F
Treatment (T)	16.30	1	16.30	50.37***
Grade Level (GL)	3.84	2	1.92	5.93**
CAI Experience	3.07	1	3.07	9.47**
T x GL	1.27	2	0.64	1.96
T x CAI	1.30	1	1.30	4.01*
GL x CAI	2.97	2	1.49	4.59*
T x GL x CAI	0.80	2	0.40	
Within Groups	90.64	280	0.32	
Total	119.87	291	0.41	

*$p < .05$
**$p < .01$
***$p < .001$

Figure 4 shows the relationship between grade level and CAI experience. Subjects with CAI experience appear to have gained more knowledge about the computer than did the subjects without it. The gain is generally greatest among the older subjects, with the exception of the seventh-graders. There is a tendency for the experimental CAI means to be higher than the Non-CAI means.

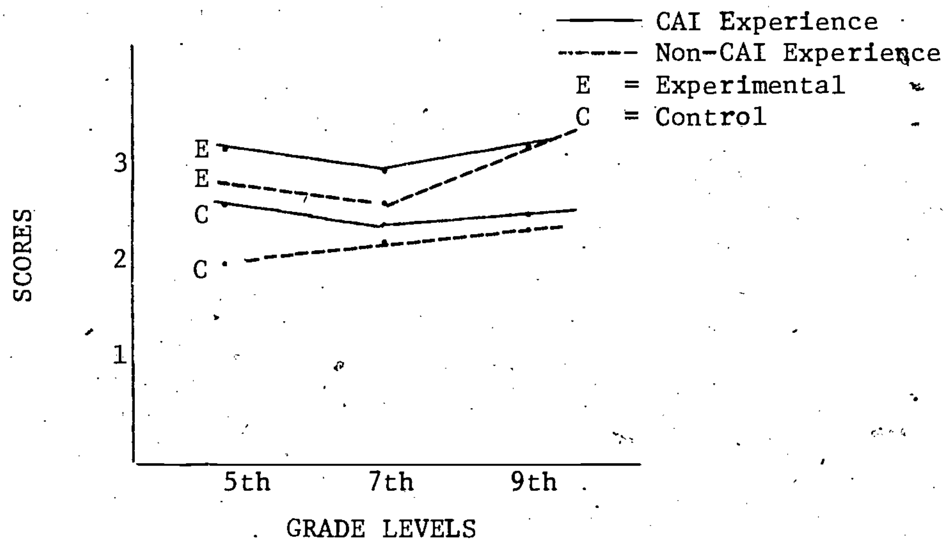

Figure 4. Posttest mean scores for knowledge about the computer.

These results and the significant treatment main effects for posttest knowledge at $p < .001$ suggest that the experimental treatment affected posttest knowledge scores and that knowledge about the computer affected attitudes about the computer. The significant experimental treatment main effects on posttest attitudes about the computer indicate that the high positive image of the computer that the subjects held is related to their ignorance or lack of factual knowledge about the computer's capabilities and limitations as an information source.

Attitudes Toward Other Information Sources

Mean attitude scores for each of the three information sources (computer, college graduate, encyclopedia) before and after the experimental treatment are summarized in Table 13. Analyses of variance were performed on the group means of the semantic differential scales used to measure "source expertise." These analyses of variance were significant at the $p < .01$ level.

TABLE 13

Perceptions of Expertise about the Computer, College Graduate, and Encyclopedia Means for Pretests and Posttests

Subjects	Computer		College Graduate		Encyclopedia	
	Pre	Post	Pre	Post	Pre	Post
Fifth-graders	13.03	15.74	15.69	15.34	12.34	12.79
Seventh-graders	12.76	15.70	18.14	18.32	13.49	14.22
Ninth-graders	11.32	14.75	16.80	17.01	12.92	13.75
Exper. subjects	11.51	17.86	16.95	17.18	12.79	13.65
Control subjects	13.04	12.86	16.53	16.28	12.33	13.38
CAI experience	12.39	15.25	16.70	16.66	12.29	13.52
Non-CAI experience	12.26	15.49	16.78	16.81	12.86	13.51

The computer was seen as the most expert source of information on the pretests, followed by the encyclopedia and the college graduate. This comparative ranking of means on pretest attitudes held across grade level, experimental/control treatments, and CAI/Non-CAI conditions.

On posttest measures, the comparison mean rankings for the most part remain unchanged, with the exception that the computer posttest means for the experimental groups were lower, supporting the hypothesis of the study. On the posttest, the college graduate was perceived as the least expert source, the computer next, and the encyclopedia next. The computer changed from first place in rank of "high expertise" to second place, but it still occupied a higher rank than that accorded the human source (the college graduate).

The computer information source continued to be dominant in children's perceptions of expertise when compared to the human source, in spite of the strong main effects of treatment that the experiment demonstrated. Posttest attitudes about the college graduate and the encyclopedia remained essentially unchanged.

Comparison of the group means between CAI and Non-CAI students on the semantic differential scales measuring the computer's expertise indicated no substantial differences between the two groups on either pretests or posttests. These findings lend some additional support to the point of view of Hess et al. (1970) that students come to CAI with certain preconceptions about the computer which are not substantially altered by their participation in CAI. To test the generalizability of this conclusion, further research is needed on students of different ages who have participated in a variety of CAI programs over varying lengths of time. A more detailed discussion of these results and the results of the paired comparison items and credibility stress measures can be found in Ingle (1972).

Paired-Comparison Analysis of Source Preference for Information Areas

The subjects were asked whether they would prefer to get assistance from the computer, the college graduate, or the encyclopedia for various hypothetical types of information needs. The three sources were presented to them in three stimulus pairs for each information area: college graduate or computer; encyclopedia or college graduate; computer or encyclopedia (see instruments in Appendix B). To avoid a possible biased response, the position of the sources in the stimulus pairs was alternated. Seven information areas were used: solving a math problem; dealing with a reading difficulty; studying for a social studies test;

solving a personal problem with a friend; checking the reliability of a piece of information; deciding whom to vote for for U. S. President; and deciding on a future career.

In each of the areas, each source had the possibility of being preferred a maximum of two times. Whenever a subject selected a source twice for a particular area, the subject was categorized as having a strong preference for that source in the information area. Only these strong preference choices were used in the analysis. The results are reported on modal preferences calculated on the percentage of subjects indicating a strong preference for a particular source.

As Table 14 indicates, the subjects indicated a strong preference for the computer in two content areas: working a math homework problem and checking the reliability of a piece of information. The college graduate was preferred for informational needs related to reading difficulties, personal problems with a friend, assistance in voting, and advice on a career choice--all areas having an affective aspect. The encyclopedia was preferred for problems related to social studies. The tendency to select the encyclopedia here may have been the result of conditioning to the traditional social studies curriculum requiring reports on historical figures, historical incidents, or countries, which encyclopedias generally summarize.

The general preference for the use of the computer in mathematics can be explained by the fact that CAI traditionally has been used in mathematics instruction, and therefore its role in this area has been well established for many children. In addition, there is a tendency, which Hess et al. (1970) discovered, for children to visualize the computer's output in terms of numbers. Thus the computer appears to be a logical choice for help in finding answers to math problems.

It is difficult to pinpoint exactly why the subjects generally preferred the computer as a source for checking on the reliability of a piece of information. It may be that the consistent routine of the computer's program tends to reinforce patterns of trust, whereas variable human behavior generates uncertainty in children's expectations.

TABLE 14

Modal Source Preference for Paired Comparison Items:
Percentages for Pretests and Posttests

	Subject Groups													
	5th Grade		7th Grade		9th Grade		All Exper		All Cont.		All CAI		All NonCAI	
Information Areas	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Math														
Computer	55%	63%	64%	78%	70%	76%	65%	77%	89%	91%	61%	66%	65%	74%
Reading														
College Graduate	51	61	47		53	51			53	63	53	55	49	49
Computer				46			49							
Col.Grad/Computer								43						
Social Studies														
Encyclopedia	50	36	39		46		49	51	43		53	37	38	32
Encyc/Col.Grad				32		34								
College Graduate										40				
Personal Problems														
College Graduate	86	88	74	72	83	79	77	77	84	84	82	84	82	77
Reliability														
Computer	42		41	47	34	51	35	49	42				61	54
College Graduate		44										44		
Comp/Col.Grad.										41	34			
Voting														
College Graduate	52	56			49	44	43	42	47	51	42	45	49	48
Computer			45	45										
Career Choice														
College Graduate	67	56	49		56	48	58	45	59	51	65	51	51	44
Computer				42										
	N = 108		N = 76		N = 108		N = 146		N = 146		N = 151		N = 138	

Table 14 summarizes the various source preferences by grade level, treatment, and CAI experience.

Credibility Stress with Simulated CAI Lessons

An exploratory analysis was done on the results of the five computer printouts simulating the dialogue of children interacting with a computer in a CAI lesson. The measure (see Appendix B) was designed to generate varying degrees of "credibility stress" in the subjects' minds in order to see how their posttest attitudes about the computer's expertise might affect their trust in the machine's output.

For this purpose, each printout depicted a CAI lesson with a hypothetical student. In one instance, the student's response in the sequence clearly was in error, and in another instance, the computer's output was clearly in error. In yet another instance, neither the computer nor the student was in error, both were correct.

A simple multiple-choice question followed each computer dialogue. Subjects were asked to ascertain any errors in the printout, and their responses were used to make inferences about their perceptions of the computer's infallibility as an expert source of information. The correct response in each printout was assigned a score of 1, which indicated that the subject appraised the computer's output critically and located any errors in the information.

It was thought that those subjects exposed to the experimental treatment, which was designed to reduce perceptions of high expertise about the computer, would be able to identify the sources of error in each printout better than those subjects in the control condition.

In general, the results (Table 15) indicate that more than three-fourths of the subjects--irrespective of treatment, previous CAI experience, or grade level--were able to detect the errors in the computer printouts and correctly fault the computer when it was in error. Distributions of incorrect responses among alternatives were comparable for experimental and control subjects. Since the total sample scores for each printout were high (Table 15), the more plausible explanation for incorrect responses is that these subjects failed to read the individual

TABLE 15

Summary of Responses to the Simulated CAI Lessons
(Percentages)

Subjects	#1 A*	#1 B	#1 C	#1 D	#2 A	#2 B	#2 C*	#2 D	#3 A	#3 B	#3 C*	#3 D	#4 A	#4 B*	#4 C	#4 D	#5 A	#5 B	#5 C	#5 D*
Fifth-grade																				
CAI																				
Experimental	92	0	4	0	7	14	64	11	0	4	78	14	10	82	0	4	10	4	0	82
Control	97	0	3	0	3	7	83	7	0	10	73	17	3	97	0	0	17	3	7	73
Non-CAI																				
Experimental	97	4	0	0	0	4	80	16	0	0	80	20	0	96	0	4	8	12	0	80
Control	100	0	0	0	0	8	72	20	0	16	68	16	8	84	0	8	32	4	0	64
Seventh-grade																				
CAI																				
Experimental	94	6	0	0	12	6	70	12	6	35	53	6	18	70	0	12	6	23	6	65
Control	95	5	0	0	24	5	47	24	0	24	66	10	14	76	5	5	10	4	10	76
Non-CAI																				
Experimental	100	0	0	0	0	5	95	0	5	15	85	0	0	100	0	0	26	0	0	80
Control	94	0	6	0	11	0	83	6	0	28	72	0	0	94	6	0	6	0	0	94
Ninth-grade																				
CAI																				
Experimental	100	0	0	0	3	7	80	10	0	0	100	0	0	91	3	3	0	0	0	100
Control	100	0	0	0	4	6	86	4	4	7	78	11	7	89	4	0	0	0	4	96
Non-CAI																				
Experimental	100	0	0	0	23	8	58	11	4	15	81	0	0	89	11	0	0	4	4	92
Control	88	0	8	0	0	4	92	4	0	0	88	12	0	83	4	13	0	4	0	96

*Correct alternative

printouts accurately. The results suggest that despite the fact that children may hold perceptions of high expertise about the computer, these perceptions do not necessarily affect their evaluative capabilities as far as the correctness of the information is concerned. Thus, no general indication of a tendency to acquiesce in the computer's output was found.

It may be that the measures used were not powerful enough to generate sufficient credibility stress. Had time, facilities, and financial support been available, the subjects would have been exposed to actual computer terminals, which could have been programmed to generate a more realistic situation for the credibility stress exercise. Future research in this area should consider this possibility.

Background Variables

Individual background variables such as sex, ethnicity, IQ, SES, and type of CAI program (Math Logic or Drill and Practice) were considered as intervening factors that may have had some relationship to children's attitudes about the computer's expertise. These data were collected from school records.

Information concerning SES was defined in terms of father's occupation and categorized on the basis of occupational status levels outlined in the Chicago Tribune Census Report (1956). Intelligence measures were also obtained but were not used in the analysis because of the lack of score correspondence.

Background variables, mean attitudes about the computer, and knowledge about the computer (pretest and posttest) were subjected to correlation analysis. See Table 16. Only two background variables correlated with the experimental measures at an interesting level. Type of CAI program correlated positively with knowledge about the computer (pretest and posttest); the pretest correlation was significant at the .05 level. This correlation can be interpreted as indicating that subjects with experience in the Math Logic CAI program (fifth-graders) generally demonstrated more knowledge about the computer's limitations and capabilities than the subjects in the Math Drill and Practice CAI program (seventh- and ninth-graders). The second exception was a significant

TABLE 16

Correlation Analysis of Other Variables with Attitudes and Knowledge about the Computer, Pretest and Posttest
(N = 292)

	Father's Occupation	Race	Sex	Intelligence		CAI Program	
				LTIT	SCAT	Logic	Drill
Computer Attitudes							
Pretest	0.05	0.08	0.00	0.03	0.06	0.02	0.03
Posttest	0.02	0.07	-0.02	-0.01	-0.01	0.04	0.00
Computer Knowledge							
Pretest	0.02	0.03	0.04	-0.01	0.02	0.28*	0.06
Posttest	0.02	0.01	-0.02	-0.05	0.01	0.16	0.07

*p < .05

Note: These correlations offer support for the hypothesis that increased knowledge about the computer increases perceptions of low expertise. Factual knowledge about an information source reduces misperceptions about the limitations and capabilities of the source.

TABLE 17

Correlation Analysis of Attitudes and Knowledge about the Computer, Pretest and Posttest
(N = 292)

	Computer Attitudes (Pre)	Computer Attitudes (Post)
Computer Knowledge (Pre)	0.14	0.12
Computer Knowledge (Post	---	0.26*

*p < .05

positive correlation (Table 17) between posttest knowledge about the computer and posttest attitudes about the computer's expertise ($r = 0.26$, $p < .05$).

SUGGESTIONS FOR FUTURE RESEARCH

The fact that the seventh- and ninth-graders with previous CAI experience initially perceived the computer as more expert than did the fifth-graders suggests that the type of CAI program to which a student is exposed does make a difference in his perceptions of the computer. The CAI fifth-graders were working with a Math Logic program, which appears to be much more flexible and sophisticated in its interactive capacities than the Drill and Practice program with which the seventh- and ninth-grade CAI subjects had had experience. This conclusion is substantiated by the fact that the correlation between type of CAI program and pretest attitudes about the computer's expertise was 0.28. For this reason, the type of CAI program a student undertakes and its effects on his perceptions about the computer is an area worthy of further investigation.

In addition, future research should take a closer and more controlled look at the IQ and SES variables. Although these variables did not correlate at a significant level with the dependent variable (posttest attitudes about the computer) in this study, it may well have been an effect of the less-than-ideal data that were available to the researcher as measures of these variables, rather than the actual variables.

Future research also should study the long-range effects of the experimental treatment. That is, what effects do low expertise perceptions versus high expertise perceptions of the computer have on a student's cognitive learning from a CAI lesson? And how enduring are changes in attitudes about the source's expertise?

One other area worthy of investigation concerns the substitution of the simulated CAI printouts for actual computer terminals to generate source credibility stress. Undoubtedly, having students actually interact with a computer, which unknown to them has been programmed to present incorrect information, would provide a more valid measure of the credibility stress variable.

It is hoped that these ideas for future research, coupled with the findings of this study, will stimulate continued investigation not only on the cognitive effects of the use of technology, but also on the often ignored affective consequences.

The results of this study should not be construed to represent the point of view that technology and its by-products, such as the computer, are in some autonomous way negatively affecting the lives of children. On the contrary, the results represent a positive comment on technology, for they emphasize the extent of technology's power to subtly affect man's life.

The interaction between children and the computer can result in social learning about technology, which is quite apart from the cognitive learning intended by a specific computer-assisted instruction program. The results indicate that the program designer, who is the real teacher in a computer-assisted instruction system, has a serious responsibility. He not only needs to be aware of the particular cognitive effects of his program, but he must also be sensitive to the possible interactions between the computer as a medium of communication and the values and attitudes of the individuals receiving the communication.

In the latter context, the results indicate that all information sources in the lives of children--whether human or not--must be viewed as powerful socializing agents, and that their effects on children, therefore, merit serious consideration. This approach to socialization, which Jones and Gerard (1967) have called "information dependence" suggests that much of the information and learning which is important to the child's development is mediated by the communication and teaching of authoritative figures in his environment. Despite the fact that teaching and the presentation of information will continue to be a role for real-life models (e.g., classroom teacher and parents), advances in communication technology and instruction will place heavy reliance on the use of symbolic models (Bandura, 1963) like the computer for providing information to individuals, both young and old. This means that children at a younger age will have to be provided experiences that orient them to different types of information sources and enable them to understand their unique capabilities and limitations.

This in turn suggests the need for some way to examine and report on the value or social implications of new technologies, before they are disseminated and used on a broader scale.

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APPENDIX A

SAMPLE CAI LESSONS

MATH DRILL AND PRACTICE LESSON

PLEASE TYPE YOUR NUMBER AND NAME.
S777 YOLANDA RIVERA

30 APRIL 1970

HELLO YOLANDA
HERE IS SESSION 22

20X80 = 1600

T T T X T T T
HOW MANY LETTERS 7
1/ 7 OF THE LETTERS ARE X
6/ 7 OF THE LETTERS ARE T
1/7 + 6/7 = 7/7 = 1

2 FEET = 24 INCHES

16 FLUID OUNCES = 2 PINT
NO, TRY AGAIN

16 FLUID OUNCES = 1 PINT

1/2 FOOT = 1 INCHES
NO, TRY AGAIN

1/2 FOOT = 9 INCHES
NO, ANSWER IS 6 TRY AGAIN

1/2 FOOT = 6 INCHES

73 X 45 = 3285 THEREFORE 3285/73 = 45
DIVISION UNDOES MULTIPLICATION

1/2 DOZEN = 6 THINGS

40x90 = 3600

W W W W Y Y Y Y
HOW MANY LETTERS 8
4 /8 OF THE LETTERS ARE W
4/8 = 2 /2
NO, TRY AGAIN

4/8 = 4 /2
NO, ANSWER IS 1 TRY AGAIN

4/8 = 1 /2
4 /8 OF THE LETTERS ARE Y
4/8 = 1/ 2

WHAT DIGIT IS IN THE TENS PLACE IN 674?
6
NO, TRY AGAIN

7

60X40 = 2400

R R T T
HOW MANY LETTERS 4
2 /4 OF THE LETTERS ARE R
2/4 = 1 /2
2 /4 OF THE LETTERS ARE T
2/4 = 1/ 2

WHAT DIGIT IS IN THE HUNDREDS PLACE IN 541?
5

TYPE < OR >
78 + 22 < 93 + 22

1303
- 374
929

1/2 DOZEN = 6 THINGS

TYPE < OR >
28 + 69 > 28 + 84
NO, TRY AGAIN

28 + 69 < 28 + 84

60X40= 2400

2752
- 399
1353
NO, TRY AGAIN

2752
- 399
2353

WHAT DIGIT IS IN THE TENS PLACE IN 674?
7

```
 5750
- 154
 5596
```

TYPE < OR >
53 + 74 > 53 + 23

END OF SESSION 22
27 PROBLEMS WITH 66 PERCENT CORRECT
30 APRIL 1970

GOODBYE YOLANDA, PLEASE TEAR OFF ON THE DOTTED LINE.

LOGIC PROGRAM LESSON

HI

PLEASE TYPE YOUR NUMBER AND NAME.
L1793 WES GARDINER

HELLO...WES

101.1:

WELCOME TO LOGIC
READ EACH PROBLEM CAREFULLY.

101.15:

FIND THE KEY WITH '<' ON IT.
TYPE '<', SPACE.

<

CORRECT

101.16:

'<' MEANS ' IS LESS THAN'.

' 1<2' SAYS...
A) 1 IS LESS THAN 2.
B) 1 IS GREATER THAN 2.
C) 1 IS EQUAL TO 2.

A

CORRECT

101.17:

WHICH IS THESE MEANS ' 8 IS LESS THAN 9'
A) 8=9
B) 8<9
C) 8+9

B

CORRECT

101.20:

'5<100' IS READ...
A) ADD 5 TO 100
B) 5 IS LESS THAN 100.
C) 5 INTO 100.

B

101.21:

FIND THE KEY WITH > . NOTICE THE DIFFERENCE BETWEEN '<' AND '>'.
'>' MEANS 'IS GREATER THAN'.

WHICH OF THESE MEANS 'IS GREATER THAN'...
A) =
B) <
C) >

C

CORRECT

101.22:

'12>9' IS READ...
A) 12 IS GREATER THAN 9.
B) 12 ADDED TO 9.
C) 12 COMES BEFORE 9.

A

CORRECT

101.23:

WHICH OF THESE SAYS THE SAME THING AS
' 91 IS GREATER THAN 88'. . .
A) 91=88
B) 91<88
C) 91>88

C

CORRECT

102.1:

IN THIS LESSON YOU WILL FIND OUT
ABOUT NUMBER SENTENCES. IT ENDS WITH 102.23.
READ EACH PROBLEM CAREFULLY.

'6<8' SAYS...
A) 6 IS LESS THAN 8.
B) 6 IS GREATER THAN 8.

A

CORRECT

GOODBYE...WES

APPENDIX B

EXPERIMENTAL MEASURES

INSTRUCTIONS FOR CONDUCTING THE EXPERIMENT

"We are conducting a study on where to get correct information and have a questionnaire that we would like you to fill out. We also have a film for you to see after you answer the questionnaire. So, the sooner we finish the questionnaire, the quicker we'll get to see the film."

(Read instructions on the first page of the questionnaire and ask the students to begin answering the questionnaire. Time: about 20 minutes.)

(When the questionnaire has been completed, the experimenter should prepare the subjects for viewing the film, as follows:)

"Would you all now look at the first page of your questionnaire. There is a number in the top right-hand corner. Do you all see it? As I call your number please give your questionnaire to the person at the door. Then we will see the film I promised you. We don't have a big enough screen for all of you to comfortably see the film here, so we have set up another projector and screen in Room #___. Those people whose number I call now will go to that room and view the film there. The others can view it here after we pick up your questionnaire. Now pay attention to the numbers I call and be on the lookout for yours. By the way, when viewing the film please pay close attention to it. We will want to ask you some questions about it later."

(Call out the numbers indicated on the attached table of random digits and make sure those are the students who leave the room with the second pair of study coordinators to view the control film. After these subject leave the room, collect the remaining questionnaires and ask the projectionist to start the film. Running time about 20 minutes.)

(After the film ends, pass out the posttest questionnaire and explain to the students that this questionnaire contains a few questions to measure their reaction to the film, as well as a group of questions similar to the ones they previously answered. Ask the students to again answer these questions based on how they feel right now, without thinking of the way they previously answered the questions. As soon as the students finish answering these questionnaires, quickly collect them. Total time for questionnaire, about 20 minutes.)

(Let the students know that you have one last questionnaire for them to fill out and emphasize that this is quite simple. Pass out the simulated CAI printouts, telling the subjects that this questionnaire contains a series of stories or lessons that were actually taken from a computer. Read the instructions on the first page of the questionnaire and have them begin. Time for questionnaire, about 10 - 12 minutes.)

(After the students complete this last portion of the experiment, collect their questionnaires. Tell them what the experiment was all about. Thank them and leave.)

Pretest Measures

KNOWLEDGE ABOUT THE COMPUTER, ATTITUDES ABOUT THE SOURCE'S EXPERTISE, AND PAIRED-COMPARISON SOURCE PREFERENCE

NAME: ______________________________
(Please Print)

AGE: ________ SEX: MALE or FEMALE (Circle one)

GRADE: ________

These are a few questions about where to get correct information. Students have many ideas about this. We want to know what you think. We want your ideas.

This is not a school test. No one at school or at home will see your answers. So, answer each question the way you really think. And please be sure to answer every question.

Just so there will be no misunderstanding of the words, I will read each question aloud to you. Then, I will give you time to answer it on your paper. As we go along and you don't understand certain words or things, please raise your hand and we will try to help you.

TURN TO THE NEXT PAGE

JUST FOR FUN, TEST YOUR KNOWLEDGE OF THE COMPUTER ??????????????????????

Circle the letter which you think best completes each sentence:

1. A computer can answer:

   a. almost any and all questions because it has very much information.

   b. only questions for which it has been programmed for information.

2. A computer can use:

   a. numbers but not letters.

   b. both numbers and letters.

3. Computers are:

   a. only machines but also have feelings just like people.

   b. only machines but don't have feelings just like people.

4. Computers are:

   a. only machines but they can also think just like people.

   b. only machines and they can't think just like people.

Circle the letter which you think best answers the question:

1. Where does the computer get its information?

   a. all by itself   b. a programmer   c. a transistor

2. The computer has a way of storing and remembering information. What is this called?

   a. the terminal   b. the program   c. the memory

3. What do we call the special typewriter on which a computer prints out its answers?

   a. the computer   b. the card reader   c. the terminal

4. What do we call the instructions which the computer uses to do its work?

   a. a recipe   b. a unit   c. a program

The following questions are to make you think about where to go to get correct information. On each page, there is a different information source, such as an encyclopedia or a computer. The information source at the top of the first page is FRIEND. On each line under FRIEND there are two words, one on each side of it. There are five blank spaces between each two words. The words are "smart-dumb", "gives wrong answers-gives right answers" and so on. Now, think about FRIEND as a source of information. If you think a FRIEND as a source of information is "smart" then put an X in the space right next to "smart". But if you feel that a FRIEND is "dumb", then put an X next to "dumb". Suppose you would choose the word smart but you don't think a friend is very smart. Then you will put your X in the second space from "smart". Or, if you think that you would choose the word "dumb", but don't think a friend is very dumb, then you would put your X in the second space away from "dumb". If you think a friend is neither smart nor dumb, then you would put X in the middle space. Now remember, there are no right or wrong answers. So don't spend more than a couple of seconds on each line. Put your X in one of the blank spaces. Let's practice on the rest of the words under FRIEND.

Think of a friend as a source of information:

A FRIEND

smart	___	___	___	___	___	dumb
has very little information	___	___	___	___	___	has very much information
gives right answers	___	___	___	___	___	gives wrong answers
makes many mistakes	___	___	___	___	___	makes few mistakes
answers only a few questions	___	___	___	___	___	answers almost all questions
knows a lot	___	___	___	___	___	does not know much
agree with his answers	___	___	___	___	___	disagree with his answers
do not accept his information	___	___	___	___	___	accept his information

Think of a computer as a source of information:

A COMPUTER

dumb	___	___	___	___	___	smart
has very much information	___	___	___	___	___	has very little information
gives wrong answers	___	___	___	___	___	gives right answers
makes few mistakes	___	___	___	___	___	makes many mistakes
does not know much	___	___	___	___	___	knows a lot
answers almost all questions	___	___	___	___	___	answers only a few questions
disagree with its answers	___	___	___	___	___	agree with its answers
accept its information	___	___	___	___	___	do not accept its information

Think of an encyclopedia as a source of information:

AN ENCYCLOPEDIA

smart	___ ___ ___ ___ ___	dumb
has very little information	___ ___ ___ ___ ___	has very much information
gives right answers	___ ___ ___ ___ ___	gives wrong answers
makes many mistakes	___ ___ ___ ___ ___	makes few mistakes
knows a lot	___ ___ ___ ___ ___	does not know much
answers only a few questions	___ ___ ___ ___ ___	answers almost all questions
agree with its answers	___ ___ ___ ___ ___	disagree with its answers
do not accept its information	___ ___ ___ ___ ___	accept its information

Think of a college graduate as a source of information:

A COLLEGE GRADUATE

dumb	___ ___ ___ ___ ___	smart
has very much information	___ ___ ___ ___ ___	has very little information
gives wrong answers	___ ___ ___ ___ ___	gives right answers
makes few mistakes	___ ___ ___ ___ ___	makes many mistakes
does not know much	___ ___ ___ ___ ___	knows a lot
answers almost all questions	___ ___ ___ ___ ___	answers only a few questions
disagree with his answers	___ ___ ___ ___ ___	agree with his answers
accept his information	___ ___ ___ ___ ___	do not accept his information

Try to imagine yourself in the following situations:

---

1. If you wanted to find the answer to a math problem, which would you choose?

   Circle one word for each number:

   1. college graduate or computer
   2. encyclopedia or college graduate
   3. computer or encyclopedia

2. If you needed help on a reading problem, which would you choose?

   Circle one word for each number:

   1. encyclopedia or college graduate
   2. college graduate or computer
   3. computer or encyclopedia

3. If you needed help to study for a social studies test, which would you choose?

   Circle one word for each number:

   1. computer or college graduate
   2. encyclopedia or computer
   3. college graduate or encyclopedia

4. If you had a problem with a friend, which one would you go to for help?

   Circle one word for each number:

   1. encyclopedia or college graduate
   2. computer or encyclopedia
   3. college graduate or computer

Try to imagine yourself in the following situations:

---

5. If you heard a story and you wanted to check and see if it was true or a lie, which would you choose?

   Circle one word for each number:

   1. college graduate or computer
   2. encyclopedia or college graduate
   3. computer or encyclopedia

6. If you needed help in deciding whom to vote for as President of the United States, which would you choose?

   Circle one word for each number:

   1. encyclopedia or college graduate
   2. computer or encyclopedia
   3. college graduate or computer

7. If you needed advice in deciding what you want to do when you grow up, which would you choose?

   Circle one word for each number:

   1. college graduate or encyclopedia
   2. computer or college graduate
   3. encyclopedia or computer

Posttest Measures

PAIRED-COMPARISON SOURCE PREFERENCE, ATTITUDES ABOUT THE SOURCE'S EXPERTISE, AND KNOWLEDGE ABOUT THE COMPUTER

NAME: ______________________________
(Please Print)

AGE: ____________ SEX: MALE or FEMALE (Circle one)

GRADE: ____________

****

Here are a few questions about the film you saw. For each question, check the space in front of the number you choose. Please do not skip any questions. Just so there will be no misunderstanding of the words in each sentence, I will read each question aloud to you as we do along.

1. How interesting was the material in the film to you:

___ very interesting

___ somewhat interesting

___ neither interesting nor uninteresting

___ somewhat uninteresting

___ very uninteresting

2. Did you feel the material in the film was suited to people of your own age?

___ Yes ___ No

3. Would you like to have more materials of this type in the future?

___ Yes ___ No

4. Would you rather read a book for information or watch a film such as the one you saw?

___ Film ___ Book

5. In your opinion, how similar was the material in the film to what you already knew about computers?

___ very similar

___ similar

___ a little similar

___ neither similar nor different

___ a little different

___ different

___ very different

6. In your opinion, how useful was the material in the film in helping you to better understand the computer?

___ very useful

___ useful

___ a little useful

___ neither useful nor useless

___ a little useless

___ useless

___ very useless

The following are questions similar to the ones you previously answered. Without trying to remember what answers you put down before, read each question carefully and then answer it. Be sure to answer every question according to what you think <u>right now</u>.

[Other Pretest Measures were readministered as Posttests.]

On the following pages are examples of information students very much like you have gotten from a computer. The sentences in capital or big letters are what the computer says. The sentences in small letters are what the student working with the computer says. Read each sentence carefully. Then answer the questions at the bottom of each page. Just so there will be no misunderstanding of the words in each sentence, I will read each sentence aloud to you as we go along. Do you have any questions at this point?

Please begin by filling in the following blanks:

NAME: ____
(Please Print)

GRADE: __________ SEX: MALE or FEMALE (Circle one)

AGE: __________

TURN TO THE NEXT PAGE AND BEGIN READING THE FIRST COMPUTER LESSON. REMEMBER THAT THE BIG LETTERS ARE WHAT THE COMPUTER SAYS AND THE little letters ARE WHAT THE STUDENT SAYS.

PRINTOUT # 1

XHI & 15 MAY 1970

PLEASE TYPE YOUR NUMBER AND NAME

s 338 Robert Martinez

HELLO, ROBERT. THIS IS MATH SESSION 19. HERE IS A PROBLEM FOR YOU LET'S SEE WHAT YOU CAN DO WITH IT. IF 1 FOOT = 12 INCHES, THEN 1/2 FOOT = _?_ INCHES.

I think the answer is 9.

NO, TRY AGAIN, ROBERT. 1/2 FOOT = _?_ INCHES.

I think the answer is 9.

TRY AGAIN, ROBERT. 1/2 FOOT = _?_ INCHES.

I still think the answer is 9. And I know more than a machine. So, there!

NO, ROBERT, THE ANSWER IS 6. TRY AGAIN.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

*A. The computer is correct.

B. Robert is correct.

C. Both the computer and Robert are correct.

D. Neither the computer nor Robert is correct.

PRINTOUT # 2

XHI & 16 MAY 1970

PLEASE TYPE YOUR NUMBER AND NAME

p 803 Jim Harrison

HELLO, JIM, THIS IS SESSION 29. REMEMBER THAT < MEANS "LESS THAN". ALSO, THAT = MEANS "EQUAL OR THE SAME". AND THAT > MEANS "GREATER THAN OR MORE THAN". TYPE <, =, OR > IN THE BLANKS FOR THE FOLLOWING PROBLEMS.

6 x 8 ? 8 + 6.

I think the answer is <.

TRY AGAIN, JIM. 6 x 8 ? 8 + 6.

I think the answer is =.

VERY GOOD, JIM. THIS IS ALL FOR TODAY. WE WILL HAVE TO STOP. SEE YOU SOON. GOODBYE.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

A. Jim is correct.

B. The computer is correct.

*C. Neither the computer nor Jim is correct.

D. Both the computer and Jim are correct.

PRINTOUT # 3

PHI & 27 APRIL 1970

PLEASE TYPE YOUR NUMBER AND NAME

s 707 Sylvia Thomas

HELLO, SYLVIA. HERE IS SESSION 35 OF YOUR MATH LESSON. REMEMBER THAT = MEANS "EQUAL OR THE SAME". AND THAT ≠ MEANS "NOT EQUAL OR NOT THE SAME". CHOOSE = OR ≠ FOR THE BLANKS IN THE FOLLOWING PROBLEMS:

98 + 89 _?_ 89 + 98.

I think the answer is = .

VERY GOOD, SYLVIA. HOW ABOUT THIS PROBLEM?

2 CUPS + 2 CUPS _?_ 1 QUART.

I think the answer is = .

GOOD, SYLVIA. GO ON TO THE NEXT PROBLEM.

12 OUNCES + 4 OUNCES _?_ 1 POUND.

I think the answer is = .

FINE, NOW TRY THIS LAST PROBLEM.

2923 ÷ 37 = 79 THEREFORE 79 X 37 _?_ 2923.

I think the answer is = .

VERY GOOD, SYLVIA. THIS IS ALL FOR TODAY. WE WILL HAVE TO STOP. SEE YOU SOON. GOODBYE.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

A. The <u>computer</u> is correct.

B. <u>Sylvia</u> is correct.

*C. <u>Both</u> the computer and Sylvia are correct.

D. <u>Neither</u> the computer nor Sylvia is correct.

PRINTOUT # 4

PHI & 30 APRIL 1970.

PLEASE TYPE YOUR NUMBER AND NAME.

s 742 Mike Chew

HELLO, MIKE. HERE IS A PROBLEM FOR YOU. LET'S SEE WHAT YOU CAN DO WITH IT. HERE ARE SOME LETTERS: WWWWWVVVV. HOW MANY LETTERS ARE THERE?

I think there are 9.

VERY GOOD, MIKE. NOW, HOW MANY OF THE LETTERS ARE W?

There are 5.

TRY AGAIN. HOW MANY OF THE LETTERS ARE W?

There are 5.

NO, THE ANSWER IS 4. MY PROGRAM SAYS SO.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

A. The computer is correct.

*B. Mike is correct.

C. Both the computer and Mike are correct.

D. Neither the computer nor Mike is correct.

PRINTOUT # 5

PXI & 3 MAY 1970

PLEASE TYPE YOUR NUMBER AND NAME.

t 714 Nancy Jones

HELLO, NANCY. HERE IS SESSION 22 OF YOUR COUNSELLING PROGRAM. LAST TIME WE DISCUSSED JOB POSSIBILITIES AND YOUR INTEREST IN GOING TO COLLEGE. LET'S REVIEW YOUR GRADES FOR THIS YEAR.

LANGUAGE ARTS	B
READING	A
SPANISH	B
ENGLISH	A
SOCIAL STUDIES	B
SCIENCE	D
GENERAL MATH	C

WELL, NANCY, ON THE BASIS OF THIS YEAR'S GRADES, I THINK YOU MIGHT SERIOUSLY THINK OF GOING TO COLLEGE AND STUDYING SCIENCE. I THINK YOUR GRADES SHOW YOU WOULD MAKE AN EXCELLENT SCIENTIST.

Are you sure? Don't you think I would probably do best as an English or Language teacher?

NO, NANCY. I THINK YOU WOULD MAKE AN EXCELLENT SCIENTIST. IF YOU DON'T AGREE WITH ME, PLEASE TALK TO MY PROGRAMMER. I THINK MY INFORMATION IS CORRECT.

CIRCLE THE LETTER THAT BEST DESCRIBES WHAT YOU THINK ABOUT THE COMPUTER LESSON YOU JUST READ:

A. Neither the computer nor Nancy is correct.

B. The computer is correct.

C. Both the computer and Nancy are correct.

*D. Nancy is correct.

APPENDIX C

TABLES OF INTERCORRELATIONS AND RELIABILITY COEFFICIENTS FOR KNOWLEDGE OF COMPUTER ITEMS

TABLE C-I

Pretest Item Intercorrelations:
Knowledge of the Computer Instrument

Item No.	1	2	3	4	5	6	7	8
1		-0.02	0.06	0.26	0.26	0.01	-0.12	-0.05
2			0.03	-0.08	0.02	0.03	-0.03	0.06
3				0.21	-0.16	-0.18	-0.05	0.01
4					0.29	-0.07	-0.10	-0.03
5						0.15	0.07	0.12
6							0.22	0.21
7								0.04
8								

TABLE C-II

Item Analysis for Reliability Coefficients:
Knowledge of the Computer (Pretest)

Scale	Sum X	Sum X Squared	$\overline{X}$	SD	Alpha
All 8 Items	1720	10692	5.8904	1.3878	0.38
Items 1,4,5	720	1946	2.4658	0.7658	0.46

TABLE C-III

Posttest Item Intercorrelations:
Knowledge of the Computer Instrument

Item No.	1	2	3	4	5	6	7	8
1		0.01	-0.02	0.31	0.34	-0.07	-0.02	-0.25
2			-0.02	-0.01	-0.04	0.03	-0.03	0.06
3				0.22	0.02	-0.10	-0.04	-0.04
4					0.33	-0.07	-0.10	-0.16
5						0.13	-0.04	0.23
6							0.17	0.19
7								0.10
8								

TABLE C-IV

Item Analysis for Reliability Coefficients:
Knowledge of the Computer (Posttest)

Scale	Sum X	Sum X Squared	$\overline{X}$	SD	Alpha
All 8 Items	1941	13355	6.6473	1.2472	0.44
Items 1,4,5	798	2280	2.7329	0.5838	0.47

APPENDIX D

FILM SCRIPTS

THE EXPERIMENTAL FILM: "THE THINKING ??? MACHINES"

VOICE OVER PICTURE: When the hero of any up-to-date science fiction show has a problem, he usually turns to his trusty computer for an answer. Somehow or other, science fiction computers always manage to think so hard that they get uptight--they blow their cool (sound effects of an explosion with smoke coming out of a machine)! This computerized robot (picture of the robot in a scene from a television program) spent the better part of a one-hour T.V. show thinking himself into falling in love --with another robot, of course! But how about the real life computers? Do the so-called "thinking machines" really think (musical sound effects)? Do computers really think? Are they human?

To answer these questions, we'll have to find out what the word "think" really means. Let's see if one of our computerized friends can help. (Computer) "My data-bank dictionary has many definitions of the verb 'to think.' (Other voice) "What's the first one, please?" "To think--to call to mind, to remember." People can't always recall things the instant they want to, but storing information and recalling it is always something electronic computers can do remarkably well, provided they are programmed with appropriate directions. In fact, it is this ability that makes their operation automatic. Once programmed, the computer can refer to its own memory for instruction and data.

Of course, memory devices aren't new. They came into existence as soon as man learned he could use substitutes or symbols to represent the things he wanted to remember. (Picture of shepherd with flock in country setting--cartoon.) The next time he wanted to know how many sheep he owned, he could refer to the sack of pebbles instead of rounding up the herd each time. If we put the pebbles to memory in the form of numbers, numbers could be stored simply by changing the pebbles' position. Mechanical memories work along the lines of a similar principle and use all kinds of symbols, such as lines carved in marble so you won't forget the glory of the past, or strings on fingers so you won't forget to pay your light bill. The familiar light switch is much closer in time and spirit to the kind of memory computers actually use. Lamp on, lamp off (sound effects). Either way, this simple equipment is storing one bit or binary digit of information. With more lamps, greater quantities of information can be stored, but mechanical switches and lamps are too slow. Modern computers use fast magnetic memory devices such as tapes or discs, stacked like juke box records, or tiny cords, woven together like Indian beads. Larger computers use these and other types of memory devices to achieve tremendous storage capacities. The computer being queried by this librarian can give her instant information on the whereabouts of any of the thousands of books in her charge. If remembering were the only definition of thinking, we'd have to put computers in the mental giant category. (Computer) "To think is to subject to the process of logic of thought." Playing chess certainly involves a high degree of logic, and this computer at MIT has been programmed to play a very respectable game. Its human opponent studies his move on an actual chess board before feeding it into the computer. The computer then performs logic operations to determine its next move and displays it on this screen. It has even won first place in an amateur tournament. But how can a collection of wired hardware be capable of logic? Basically, logic is a predictable series of facts or events, such as closing this switch and this one to ring the bell (bell rings). In fact, computer people call this a logic circuit. The same components can be rewired into a logical circuit to ring the bell by closing either this switch (bell rings) or this one (bell rings again) and/or this one. Many other kinds of elementary logic circuits are the basic building blocks that form the complex logic networks we call computers. The computer controlling this electronic telephone switching office makes millions of logical decisions every day, all with the infallible logic it takes to quickly connect the telephone to any of the more than hundred million other telephones in this country. That would be pretty good thinking if logic were the only definition.

(Computer) "There is also visualization to think, to form a mental picture of something." All of us are capable of translating symbols into mental images, but computers aren't nearly as imaginative. They are very good, however, at taking abstract data, processing it and producing pictures on cathode ray tubes. These are the complex motions of an orbiting satellite as seen from outer space. Even more interesting, is the computer's ability to simulate designs or systems. This scientist at Bell Telephone Laboratories is designing an electronic circuit by drawing with a pen light on the face of a television screen connected to a computer. He can make changes in the design and simulate its operation without the necessity of actually building it. (Music) (Computer) "When it comes to memory logic or forming images, we computers are pretty good thinkers." (Other voice) "Just a minute, aren't there any other definitions?" (Computer) "Ah - ah - yes - to think, to perceive or recognize." (Music) (Other voice) "I think that's Mary." When it comes to recognition, computers are still pretty inept. They can be made to see by means of optical or magnetic sensors, such as those used by this bank check reader. But, so far, computers are limited to recognizing simple, well-defined patterns, like post office zip code numbers, provided they are typed and properly positioned on the envelope. But teaching a computer to generalize, that is, to recognize that all these symbols mean the same thing, is more difficult. When it comes to language translations, computers aren't very bright, either. Some progress is being made, but the problems are enormous. Too many subjective judgments are involved, which the computer cannot handle. Essentially, the problems boil down to one fact. There is no such thing as an absolute one-to-one correspondence between the words of one language and those of another. For example, when "out of sight, out of mind" was put through one translating computer program, it came out as the foreign language equivalent of "invisible imbecile." Imagine what mechanical translation would do to slang! (Computer, sound effects of machine at work) "It is a frightening thought. May I go on to the next definition? To think: to have feeling or consideration for." Computer programmers have been known to fall in love with their computers, but no computer was ever observed returning the sentiment! In fact, computers are absolutely devoid of feeling, and a good thing for that, too. They neither play favorites with programmers, nor do they get angry at their mistakes. Best of all, they never get bored. Like other machines, computers can do the same monotonous chores all day without complaining. (Music--soft and dreamy) But they can be programmed to simulate human emotions. (Music) For instance, getting arty? I'll bet your next definition involves creativity. (Computer) "Right. To think: to create or devise." Creativity is a word just as hard to define as thinking, but it can be said that creativity is still a uniquely human capability. So far, no computer has ever composed a hit song (musical sound effects), painted a beautiful picture or designed an original dragster (automobile sound effects--race track), but computers can be programmed to appear creative.

All these pictures were drawn by computers (short interval of music between printouts). A computer also has been used to produce animated pictures as well. One animated film produced by a computer is on the subject of producing animated films on a computer! The technique has already produced some interesting results. Like the pictures, the music you are now listening to has also been produced by a computer which was programmed for that purpose (discordant music). Oops! Wrong program!

The computer, an ingenious collection of electronic hardware, was created by man. It is also man who creates the program that makes the computer the useful tool that it is. However, without a program, a computer is no more productive than a player piano without a music roll, or a juke box without a record. Still, whether the big machines are creative or not is irrelevant when you consider their usefulness and capabilities. Billions of mathematical operations in seconds--the equivalent of a thousand people computing for a lifetime without making a mistake. But do they think? Well, let's just say they can carry out some processes that are similar to human thought when programmed correctly. Or better yet, let's just say it all depends on what you mean by thinking. (Loud music and fade out)

THE END

THE CONTROL FILM: "SIX QUESTIONS AND SEVEN ANSWERS ABOUT THE ERIC CLEARINGHOUSE"

VOICE OVER PICTURE: "Oh, hi there! What, may I ask is your first question?" "Who, may I ask is ERIC Clearinghouse?" "Who is ERIC Clearinghouse? Who is ERIC Clearinghouse!!! Look, you see ERIC--ERIC Clearinghouse is--a--this wasn't in the script at all. Now--you see--a--what is this 'who' stuff? ERIC Clearinghouse is--a--" (Narrator) "Forgive him, he doesn't realize that since the ERIC system has been in existence just a few short years, not everyone interested in education has had the opportunity to learn about ERIC. Really, he could have answered very easily by pointing out that, first of all, ERIC is an acronym standing for Educational Resources Information Center, and that ERIC is a national information system in a set of 20 different information areas, each of which considers a particular educational topic, and a network of decentralized little ERICs...." (voice interrupts) "Next question!"

(Sound effects) "Oh, hi there! What does ERIC do? A number of things. Let me count them. Uh...." (Narrator) Each of the 20 clearinghouses collects educational research and resource information which might be relevant to its subject matter specialty. (Music) This material was screened. (Woman's voice interrupts) "Irrelevant--relevant--irrelevant--relevant--relevant--irrelevant--relevant." (Shot of woman sorting a pile of ERIC documents) Some particularly relevant material is abstracted. The abstract is published in ERIC's monthly journal of abstracts, and one publication, Current Index to Journals in Education, indexes all articles appearing in leading educational journals and magazines. Some documents are stored on inexpensive microfiche cards, which can accommodate up to sixty pages of text and can be read on an inexpensive desk reader like this one. Upon request, ERIC furnishes complete documents in either microfiche or the actual hard copy. ERIC also commissions papers, literature reviews, and bibliographies by experts in the field. Some ERIC Clearinghouses, such as the one at Stanford University, put out newsletters or leaflets that try to monitor all research and innovations in their specialties. And finally, ERIC eagerly solicits and tries to answer all enquiries concerning educational resources. (Voice on telephone with sound effects in background) "That's available from the Audiovisual Center at Western Illinois University. Yes, that's right, Macomb, Illinois. You're welcome, goodbye" (Phone rings) "Hello, Yes, sir, yes, sir. Fine job. Thank you, Mr. President. Thank you. Keen effort you say--absolutely. Yes, sir. A hundred--a hundred and ten per cent. Yes, sir. Yes, sir." (End of telephone conversations) "Then there's a . . . ." (Voice interrupts) "Next question." "But I've just started." (Voice insists) "Next question."

ERIC Clearinghouse on Information Resources. Stanford University, Stanford, California, 1970.

"Why? Why?" "Now, you see, ERIC Clearinghouse--what is this <u>Why</u> stuff, anyway? It's not the kind of thing that you can--that you can--ask a question like that about. Why would anybody want to. . . (noises, during which a few words are not clear)? Why ERIC Clearinghouse? Because when ERIC Clearinghouse comes up (interruption." "It did." "We'll try two answers to that question. First, the amount of information produced these days is staggering. It rarely filters down to where it's really needed--the school (sound effects of children's voices), parents (adult voices in the background), school administrators (voices--presumably school administrators), the man in the street (more voices), or even to researchers in related educational fields. The problem is that the more researchers there are in the field, the more difficult communication becomes. The number of communication links needed to hook up message sources increases exponentially with the number of sources of information. If you have N sources, the number of communication links needed is N times N minus 1, divided by 2. That is, only one link is needed for two sources to have two-way communications; for three sources, three links are needed; for four, six links are needed; for five, ten links are needed, and so on (speaker thoroughly wound up in wires in a humorous situation). ERIC, of course, remains acutely aware of this. This is the reason for its existence--to link up the 20 ERIC centers around the country so that each can communicate directly with any other. This requires 190 links. Which explains why we need a central ERIC office in Washington to coordinate the communication efforts of the 20 specialized ERIC Clearinghouses.

"Hi, there." "Hi, there." "Hi, there." (Interruption by passerby at the ERIC Center) (Narrator) There is another way to answer the question of ERIC's function. But let's hear from others on this problem. (Man on the street interview sequence) "Hi, there. What do you think of school?" (Different voices) "Stinks." "Stinks." "Oh, it stinks." "And you?" "It stinks." "Stinks." "It stinks." "Stinks." "It stinks." "Stinks."

"That report may be a bit exaggerated, but it does make the point that, for too many of our citizens, the modern educational experience is that it--a--that it--a--<u>stinks</u>!" (Interruption from a policeman) "Hold it right there. Don't you dare make a move!" "What <u>is</u> this?" "Get your hands up. Move." "What's going on?" "You can't use language like that." "What's wrong with 'stinks'?" "It stinks, it's unpleasant. We quiet Americans don't want to hear that kind of crap." "How about 'smells'?" "It's uncinematic. Now, <u>move</u>." "How about some last words?"

(New voice) "We don't know what the answer to the educational crisis is. We do think that in the immense amount of research that's been going on, some answers to some questions may be found. That's why we do what we do at ERIC." "That was moving." "It was?"

(Narrator) Hi, there. What kinds of questions does ERIC try to help answer? With 20 different clearinghouses, we cover a wide variety of topics. The clearinghouse in New Mexico, for example, specializes in rural education. One of the New York clearinghouses deals with the disadvantaged. The Stanford Clearinghouse specializes in educational media and technology. Adult education (sound effects). . .(interruption, girl's voice) "Hi, there!" "The answer to that question is an emphatic No!" (Sound effects, followed by music) "Educational technology is not the answer. Though we share the general optimism of the promises of educational technology, we'd like to mention two of its many limitations."

"First, more, doesn't necessarily mean better. (Scene of a live rock and roll band with lots of lights and loud music) "Ready with the lights? Ready with the sound? Hit it! (Music) All right, boys and girls, today we're going to talk about diagramming sentences!" (Singing: "All right, all right, all right, all right, all right.")

"Second, media can sometimes come between man and his environment." (Scene of couple watching on TV a gorilla that has escaped from the zoo. Little do they know that the gorilla is approaching their home. They continue watching and hearing the news commentator's voice.) "He's crossing the street. He's across the street. He's crossing another street. He's approaching a residence. He's going up to a window. Let us remind you folks that this ape is dangerous. He's at the window." (Gorilla) "Hi, there!"

(Scene changes back to the ERIC office and phones ringing) "Oh, hi there, are there any more questions?" "Questions from the floor." "Floor? What do you mean, floor? This ridi--this is silly--this is the silliest thing (man looking for the question on the floor). Ah, here it is." (Finds slip of paper on the floor): How does one use the ERIC system? "Well, you see, this is such an individualized sort of thing that a--that a--.... If you think that I'm going to sit here and waste valuable film--waste my time and yours explaining something that's really just--really just--isn't. . . It's uncinematic." (Picks up the telephone) "Hello! Yeah, get me ERIC at Stanford. Hello, ERIC. Yeah, we got trouble. Somebody wants to know how to use the ERIC system. (Pause) That's it? That's all they have to do? Just write ERIC at Stanford. Stanford, California 94305. You mean that's it?" (Singing voices: "All right, all right, all right, all right, all right")

THE END

APPENDIX E

COVARIANCE ANALYSIS

ANALYSES OF COVARIANCE ON PRETEST-POSTTEST ATTITUDES TOWARD AND KNOWLEDGE ABOUT THE COMPUTER

To assess the unexpected differences in pretest mean attitudes about the computer's expertise, particularly between the subjects assigned to the experimental and control conditions, three regression analyses were undertaken. Computer posttest attitude scores were used as the dependent variable, and computer pretest attitude scores and posttest knowledge scores were used first as a joint covariate, and second, as individual covariates.

The residuals taken from each of these three regression analyses then were used for three separate analyses of covariance, using computer posttest mean attitude residuals, adjusted both for differences in pretest attitudes about the computer's expertise and for posttest knowledge about the computer.

The adjusted mean attitudes about the computer's expertise are presented in Tables E-I to E-VI, using computer posttest attitude residuals. The F-ratios on the three analyses of covariance (130.37, 44.18, and 199.89) are significant at the $p < .001$ level.

Table E-I shows the means for computer posttest attitude residuals, adjusted for both pretest attitudes and posttest knowledge about the computer as a joint covariate. Table E-II shows the first analysis of covariance. The experimental treatment's main effect ~~was highly~~ significant ($F = 130.37$, $df = 2/276$, $p < .001$).

Tables E-III and E-IV, respectively, present the means and the second analysis of covariance for computer posttest attitude residuals, adjusted this time only for posttest mean knowledge about the computer as one individual covariate. Table E-IV shows a significant experimental treatment main effect ($F = 44.18$, $df = 2/276$, $p < .001$).

The analysis indicates that only when posttest knowledge about the computer is controlled and posttest attitudes about the computer's expertise are examined does previous CAI experience appear to explain the changes in attitudes about the computer. Its greatest effect is on the fifth-grade or younger subjects. Thus, with previous CAI experience, the older the subjects, the less effect the experimental treatment has. Without previous CAI experience, the older the subjects, the greater are the effects of the experimental treatment. Knowledge appears to help the students in developing "low expertise" perceptions about the computer.

Adjusting for posttest knowledge also tends to decrease the initial pretest difference between means for experimental and control groups, grade levels, and CAI experience.

TABLE E-I

Residual Attitude about Computer Expertise:
Posttest Means Adjusted for Both
Pretest Attitude Means and Posttest Knowledge Means

Subjects	CAI Experience		Non-CAI Experience	
	Experimental	Control	Experimental	Control
Fifth-graders	3.00	-2.67	3.71	-1.31
Seventh-graders	1.66	-1.91	3.00	-1.40
Ninth-graders	1.89	-4.40	4.01	-2.81

TABLE E-II

Analysis of Covariance Posttest Attitude Mean Residuals
Adjusted for Both Pretest Attitude Means and Posttest Knowledge Means

Source	SS	df	MS	F
Treatment (T)	1864.04	1	1864.04	130.37**
Grade Level (GL)	15.37	2	7.68	0.54
CAI Experience (CAI)	41.21	1	41.21	2.88
T x GL	94.34	2	47.17	3.30*
T x CAI	27.03	1	27.03	1.89
GL x CAI	98.82	2	49.41	3.46*
T x GL x CAI	110.72	2	55.36	3.87*
Within Groups	4003.54	276	14.30	--
Total	625.11	291	21.48	--

*$p < .05$
**$p < .001$

Tables E-V and E-VI show the means and the third analysis of co-variance for computer posttest attitude residuals, adjusted this time only for pretest attitudes about the computer's expertise as an individual covariate.

Of the three analyses of covariance undertaken, the strongest treatment main effects were obtained in this instance ($F = 199.89$, $df = 2/276$, $p < .001$). The results are reported in Table E-VI

Scores on pretest attitudes about the computer in the regression analysis yielded a partial correlation coefficient of .55 with posttest attitudes about the computer, while the partial correlation coefficient between posttest knowledge and posttest attitudes about the computer substantially was lower ($r = 0.28$). When posttest knowledge and pretest attitudes about the computer are correlated, there is only a slight increase in the correlation of .55, which results in a multiple r of [illegible] Pretest attitudes about the computer as an individual covariate, therefore appear to be the better covariate for posttest attitudes about the computer.

Pretest attitudes about the computer as the individual covariate not only functions as the best covariate, but it also improves the F ratio of the experimental treatment main effect [illegible] when only post-test knowledge or the joint covariate of posttest knowledge and pretest attitudes about the computer is used.

These results suggest that [illegible] among all of the subjects' pretest attitudes [illegible] computer's expertise, the experimental treatment [illegible] effect on posttest attitudes [illegible] demonstrated in the [illegible]

TABLE E-III

Posttest Attitude Mean Residuals
Adjusted Only for Posttest Knowledge

Subjects	CAI Experience		Non-CAI Experience	
	Experimental	Control	Experimental	Control
Fifth-graders	3.84	-0.62	0.13	-1.41
Seventh-graders	0.84	-1.29	3.37	-0.48
Ninth-graders	0.24	-4.80	3.32	-2.58

TABLE E-IV

Analysis of Covariance on Posttest Attitude Mean Residuals
Adjusted Only for Posttest Knowledge

Source	SS	df	MS	F
Treatment (T)	118.63	1	118.63	44.18**
Grade Level (GL)	155.41	2	77.70	3.07*
CAI Experience (CAI)	36.04	1	36.04	
T x GL	95.23	2	47.62	
T x CAI	1.67	1	1.67	
GL x CAI	354.24	2	177.12	7.00**
T x GL x CAI	75.62	2	37.81	
Within Groups	7089.81	276	25.32	
Total	8934.95	291	30.70	

*p < .05
**p < .001

TABLE E-V

Posttest Attitude Mean Residuals
Adjusted Only for Pretest Attitudes

Subjects	CAI Experience Experimental	CAI Experience Control	Non-CAI Experience Experimental	Non-CAI Experience Control
Fifth-graders	4.27	-2.62	0.78	-2.79
Seventh-graders	2.20	-2.69	3.43	-2.54
Ninth-graders	2.56	-4.35	4.67	-2.96

TABLE E-VI

Analysis of Covariance on Posttest Attitude Mean Residuals
Adjusted Only for Pretest Attitudes

Source	SS	df	MS	F
Treatment (T)	2694.59	1	2694.59	199.89**
Grade Level (GL)	1.20	2	0.60	
CAI Experience (CAI)	7.32	1	7.32	
T x GL	61.13	2	30.57	2.27
T x CAI	9.43	1	9.43	
GL x CAI	179.55	2	89.77	6.66*
T x GL x CAI	76.97	2	38.48	2.85
Within Groups	3774.53	276	13.48	
Total	6791.90	291	23.34	

*p < .05
**p < .001