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AUTHOR	Packard, Abbot L.; And Others
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ABSTRACT

This paper uses the Brunwik theory of probabilistic functionalism as the backdrop for discussion of interrelationships between the individual learner and the design of computer-assisted instruction (CAI). This Brunswik learning model depicts the acquisition of knowledge as governed by the proximity of various cues and distractions. It is also closely related to research on individual cognitive styles. A study was conducted which investigated the effect of different types of delivery of computerized instruction on 102 Virginia Tech graduate students with differing cognitive abilities. Types of presentations used included text only, text with static graphics, and text with animated graphics. Twenty-four questions were given as a pretest, a posttest, and a recall test. Results indicated that individuals did have different results when they were assigned to different presentation methods, although neither cognitive measure nor presentation method could reliably predict results for all individuals or create an artificially intelligent computer program. Further research should study a full model supporting a semester-long class using resources from the entire department. (Contains 7 figures and 43 references.) (BEW)

Exploration of Brunswik Learning Environment for Instruction of Basic Sampling Concepts

Abbot L. Packard

Glen A. Hoimes

Jimmie C. Fortune

Virginia Tech
College of Education

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There is an ongoing debate of the value of computerized delivery of material (Clark, 1994; Kozma, 1994). The two principle differences that have been at the center of these debates on the possible value of computer-assisted-instruction (CAI) is the lack of theoretical base and the question of whether CAI influence the learner. This exploratory study seeks to take a step toward creating a solution toward these differences.

What can a CAI presentation offer that textbooks or teachers have been unable to present? When compared to the textbook, CAI has the capacity of altering presentation through different modalities (such as graphic, animation, and interactivity). When compared to the lecture hall, CAI has the capability of delivering individualized lessons "rather than being restricted to normative characteristics of a class of students (Ross, 1984)." It is the capacity of adjusting for the individualistic characteristic which is a "continuing challenge to educators (Bovy, 1981)" and instructional designers. CAI can be beneficial as it allows the student to work at their own pace (Carlson, 1991; Chung and Reigeluth, 1992), at a time of their choosing (Tennyson and Rasch, 1988), and without the individual to be concerned about being judged (Packard, Holmes and Fortune, 1993).

The difficulty of creating a valuable CAI instructional presentation is the interrelationship of the individual learner and the instructional design (Scandura, 1984). Many studies have previously investigated delivery differences between textual, static graphic, and animated presentations (Jay, 1988; Baek and Layne, 19988; Rieber and Hannifin, 1988; and Wey and Waugh, 1993). These three different methods are often used for delivery of a basic instructional design as they are familiar to the user and easily created via a multimedia environment for the designer.

The effect of presentation of text alone was studied by Morrison, Ross, and O'Dell (1988). Although the density level demonstrated no difference in performance, it was found that individuals receiving the instruction enjoyed lower density text that also reduced learning time (Ross and Morrison, 1989).

The introduction and importance of graphic display to CAI has been studied by many educational researchers (Alesandrini, 1987; Rieber & Kini, 1991; Kobayashi, 1986). In Kobayashi's (1986) study addressing the superiority of pictures in the encoding of information into memory, he used several theorist to make his point: Paivio (Dual-coding); Craik and Lockhart (Levels of processing); Nelson (Sensory-Sematic Model), and Pylyshyn and Anderson (Propositional Theories). Graphics were suggested by others as having several advantages to computer-assisted instruction: acting as positive mnemonics for verbal and concrete information (Paivio & Csapo, 1973), bringing attention and appeal to instructional material (Surber & Leeder, 1988); and enhancing performance (Alesandrini, 1987).

Animation is defined as a series of rapidly changing computer screen displays that appear to human perception as if it was moving (Caraballo, 1985). When animation is used it should create visual stimulation that can focus attention on the important initial event for learning (Gagne 1985). Levie (1987) stated that two criteria should be applied when considering visuals in designing instruction: (1) Does it add to the learner's motivation? (2) Does it help the learner learn?

Brunswik Theoretical Base

While many studies have been conducted using various instructional designs combining computers and cognitive psychology, little theoretical work has been devoted toward incorporating individualistic learner traits into instructional design (Clark, 1985; Reeves, 1993). It is important that these designs be developed with a theory in mind to take advantage of expected learner characteristics. One model of learning which may help guide (CAI) work is that of Egon Brunswik (1955).

Brunswik's theory of Probabilistic Functionalism(1964) incorporates the interrelationships between organism and environment Probabilistic functionalism would attempt to predict the individual's successes and failures of both the understandings of the cue (object) and the subsequent reaching of the goal. It also would be probabilistic because, in the environment of the individual, what is understood by the individual will not perfectly match the original intent The importance of the learning environment has bee-- supported in later studies (Osman and Hannafin, 1992; Orey, Okey, Jones, and Stanley, 1991). The ability of emerging technologies is the creation of a computer-assisted environment to promote learning Schwier (1993).

Brunswik further defined cognition, which includes perception, as the acquisition of knowledge. Perception, the process of focusing on the intended object, according to Brunswik, is influenced by cues and distractions. He examined these influences using a three dimensional model of the perception of space and all the things contained within it.

The lens model, when combined with regional referencing of the ecology, serves to explain the differential study routes taken by learners to master a given subject. In this model, three distances of regional referencing are positioned: Central, which refers to events within the organism; proximal, which refers to events at the interface between the organism and the environment; and distal, which refers to events over which the organism does not have immediate control. The resulting array of cues from the single object is focused into a person's perception by the double convex lens. Cues and means are chosen by the learner because of experiences from their own environment and their innate makeup. This forms a basis for suggesting that any learner will make a judgment individualistically.

Following the model (figure 1) from left to right, the path of cue information must travel through the recognition of the cue to the Organism

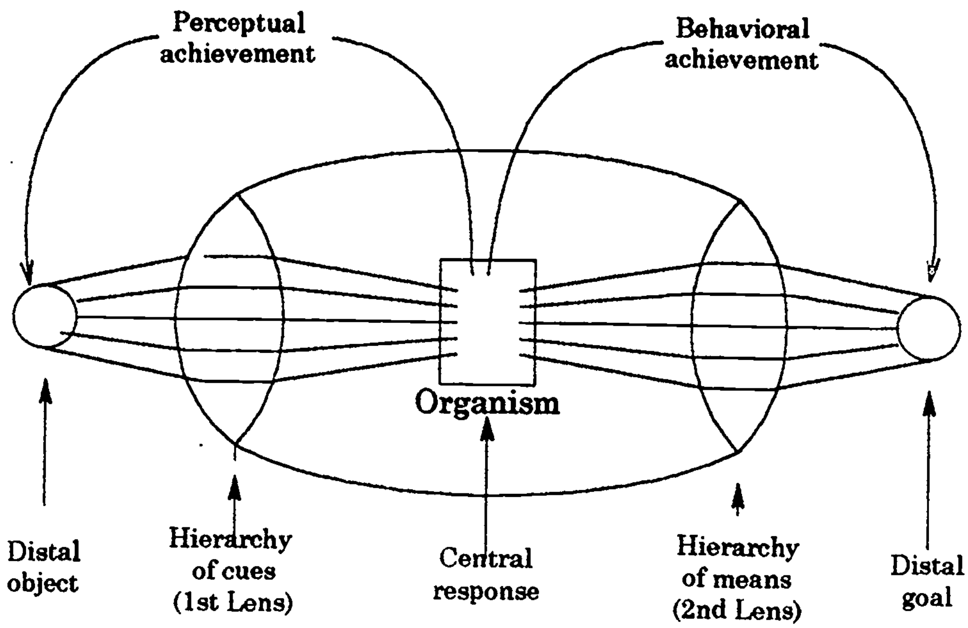

Figure 1: Extension of the lens model to behavior (Packard, 1996)

(learner) at which point a decision can be made. The learner can chose to return to the object for more information or continue by responding and using the cue to obtain the distal goal. Gagne's Instructional events (1988) suggested using cues that are available for retrieval as a form of guidance for the learner.

Education built upon the theme of this environment should have the opportunity to select clues. This was emphasized by Serverin's cue summation principle (1967) which predicts that learning is increased as more cues become available to the learner.

CAI can create a rich environment motivating learners to continue learning. The research begun by Brunswik allows the "value of ideographic analysis of teaching and learning in terms of observed behavioral cues and inferred personal traits" to be applied (Snow, 1968). This accommodation of individualistic learning preference has been studied in research on cognitive styles. The complexity of cognitive research to enhance educational instruction was understood by two early investigators, Snow and Messick. Snow's understanding was stated that "no matter how you try to make an instructional treatment better for someone you will make it worse for someone else" (Snow, 1976,p.292). Messick(1976) mirrored that remark when he spoke of the difficulty of matching cognitive styles with individual differences.

Cognitive Styles

One cognitive characteristic that has been shown to influence the ability for students to learn is locus of control (Rotter, 1966). Rotter looked at the individual differences in terms of external and internal locus of control. A person with internal control believes that his or her outcome depends on his/her choice in behavior. The external individual believes that luck, chance or powerful others control his or her outcomes and that behavior is irrelevant.

Another cognitive ability that has been heavily investigated is field independence-dependence (MacGregor, Shapiro & Niemiec, 1988). Khoury and Behr (1982) define field independence as a predisposition to observe the "environment analytically or differentiated fashion" and field dependence as a predisposition to observe the "environment in a global and undifferentiated fashion." Some of the characteristics of field independence/dependence and how they relate to learning were suggested by Thompson (1988). He states that field independent learners would sample fully from the "cues" to organize material. They would be more active, would work to gain a generalization of the material, and would often acquires concepts easily. Thompson went on to describe an overall view of field dependent individuals as ruled in a general sense by the organization of the task being presented. Whereas, field independent individuals tend to analyze and re-structure the task and therefore are not "easily influenced by a structure that is present."

Experiment

This exploratory study investigated the relationship between the creation of a learning environment and student cognitive styles. CAI has the capacity to deliver material regardless of time, pace, or method. The learner would have the flexibility to access at home, in the library, or in a computer lab at the college or university. CAI operates without regard to time of day, repetitiveness of delivery, and to the pace of the learner. The instructional design of this CAI will be based on Brunswik's psychology and will use two measures of cognitive ability, field-independence and locus of control.

Null Hypotheses

Hypothesis One: (Aptitude x Treatment interaction)

There will be no disordinal interaction using scores of measures and the levels of field dependence/ field independence.

Hypothesis Two: (Aptitude x Treatment interaction)

1. There will be no disordinal interaction using scores of measures and the levels of Locus of Control

Method

The effect of three different types of presentations (text only, text and static graphics, and text and animated graphics) of computerized instruction to graduate students with different cognitive abilities was investigated. Care was taken in designing the instruction to keep the content consistent while differing the presentation forms. Instruction content contained random sampling, systematic sampling and a type of distribution shape know as skewness.

A total of one hundred and two graduate students enrolled in various graduate classes from Virginia Tech's College of Education volunteered to participated in the study. Each participant was systematically assigned to one of three treatment groups to receive information about sampling

The instruction material and evaluative instruments were delivered through a software program called *Authorware, Macromedia, Inc.* The delivery of this material was accomplished on twenty separate computer stations using 486 IBM-PC clones equipped with *Windows, 3.1, Microsoft, Inc.* in two laboratories in the College of Education at Virginia Tech

Six instruments were used in the study: (1) the demographic instrument used to measure confounding variables; (2) Rotter's Locus of Control (LOC) Scale used to determine levels of LOC; (3) the Hidden Pattern Test was used to determine field dependence/independence (FD/FD); and (4) Pre, (5) Post and (6) Recall test to determine levels of instructional knowledge before instruction, after instruction and with delay.

The instructional material was developed using Elementary Survey Sampling by Scheaffer, Mendenhall, and Ott (1971) as reference for content. The material was "chunked" or minimized to create the computer presentation. Three different types (textual only, textual and static graphics, and textual and animated graphics) of presentations were created using a multimedia platform. This program delivered the instructional material in 21 different screens with 37 different hot spots (words) activated throughout the presentation. These hot spots (words), when activated, presented more information in the manner of the presentation (treatment) type such as textual only, textual with static graphics, or textual with animated graphics.

One set of twenty-four questions were written and given as the pre, post, and recall test to test the knowledge gained with emphasis on instruction given during the three types of presentation. For each instructional constructs (skewness of distribution, random sampling, and systematic sampling) five questions were developed to test recall of information. It is these three areas of instruction which are presented in the different methods of delivery (text-only, text and static graphics, and text and animated graphics).

The computer program is started by the participants by the entering a randomly assigned four digit code given to them. All responses to the computer program questionnaires and measures are recorded on a floppy disk. A recall test was given one week after the computer presentation as a paper and pencil test. Matching the pen and paper test with the computer generated information was accomplished by the use of the same four digit code.

Results

The results presented were determined by statistical analyses of the effect of three Computer-Assisted-Instruction (CAI) presentations. Aptitude-Treatment-Interaction (ATI) design was used to compare groups that were subjected to regression analysis. All statistical procedures were performed utilizing SPSS (Statistical Package for the Social Sciences, 1994). All graphing was performed using Excel (Version 5.0, 1993; Microsoft Corporation).

After an initial exploration using multiple regression, a single predictor was chosen as it explained as much of the variance as did the multiple predictors. Regression analysis was performed for each CAI presentation type for both post and recall measures. Two sets of predictors were included in separate regression equations: (a) total scores of Locus of Control (LOC) and (b) total scores of Field Dependence and Independence (F D/I). Using the recommendation of Cronbach and Snow (1966): a test of homogeneity of variance among CAI presentation methods was applied, followed by a test of parallelism of regression. Parallelism was rejected if F exceeded the .05 level of significance.

Figure 2 demonstrates a disordinal interaction between two CAI presentation methods and measured scores on Locus of Control. For those individual who measured less than nine on the LOC measures, the text only presentation method held better results on the random sampling question. This changed to text with static graphics for those individuals measuring above nine on the LOC measure. Figure 3 demonstrates another disordinal interaction for recall skewness questions supporting the addition of animated graphics for all individuals who measured below 18 on a 23 point scale of LOC. For those individuals scoring higher than 18 then the text only presentation helped them perform better. Figure 4 compares the regression lines for post systematic questions and their disordinal interaction. In this disordinal interaction, those individuals assigned to the text only presentation performed better than their counterparts if they scored less than 12 of the LOC scale. Externally measured individuals above the score of 12 had better results when text and animated graphics added. In these disordinal interactions, the results vary according to subject matter as to which is best for internal or external locus of control individuals. In some subject matter, both internally/external measured individuals perform best with text only and in others when graphics are added. There is no true guideline that a system can be employed with consistent results suggesting that a multiple of presentation forms would allow individuals to perform better if they were motivated or given feedback to the CAI presentation's use.

Figures 5 through 7 demonstrate disordinal interactions using field dependence/independence. Once again there is no consistent method of presentation to either field dependent or independent individuals.

The purpose of this exploratory study was not to test the differences between CAI presentations methods but was primarily interested in the possible interactions between the cognitive traits and the presentation methods. Although there were no statistically significant results supporting the original null hypothesis, interactions were present. What do these interactions tell us? Individuals with differing scores of the two cognitive measures used in this study had different results when they were assigned to different presentation methods, and that neither cognitive measure nor presentation method could be used to predict results for all individuals. This suggests that these measures are not reliable enough to create an artificial intelligent computer program but do indicate that a program with enough cues could address the remediation of most all individuals.

In five qualitative questions asking participants about the instruction program and its value to them, these participants positively agreed that they would use the program. As Levie (1987) questioned, "Does it add to the learner's motive?" can be suggested by these responses.

What is the next step? The intermediate step between drill and practice and artificial intelligent programs might be the creation of an environment that would give a variety of methods of cue delivery. Brunswik's theory might be a valid base for this development with the allowance of an individual's choice in presentation methods, pace of delivery, and time chosen to participate.

Interacting through the internet through produces such as Hot Java would allow those students with access to the internet to participate.

A full model supporting a semester long class using resources from the entire department rather than one individual is a needed development. How well does it aid individuals whose immediate goal of class completion would add relevance to the material. During this study, it is questionable how the relevance or lack of relevance effected the results. Only field testing in actual settings will suggest the value of this type of instructional design of Computer-assisted programs..

Figure 2 :Post Random questions by CAI presentation type by level of LOC

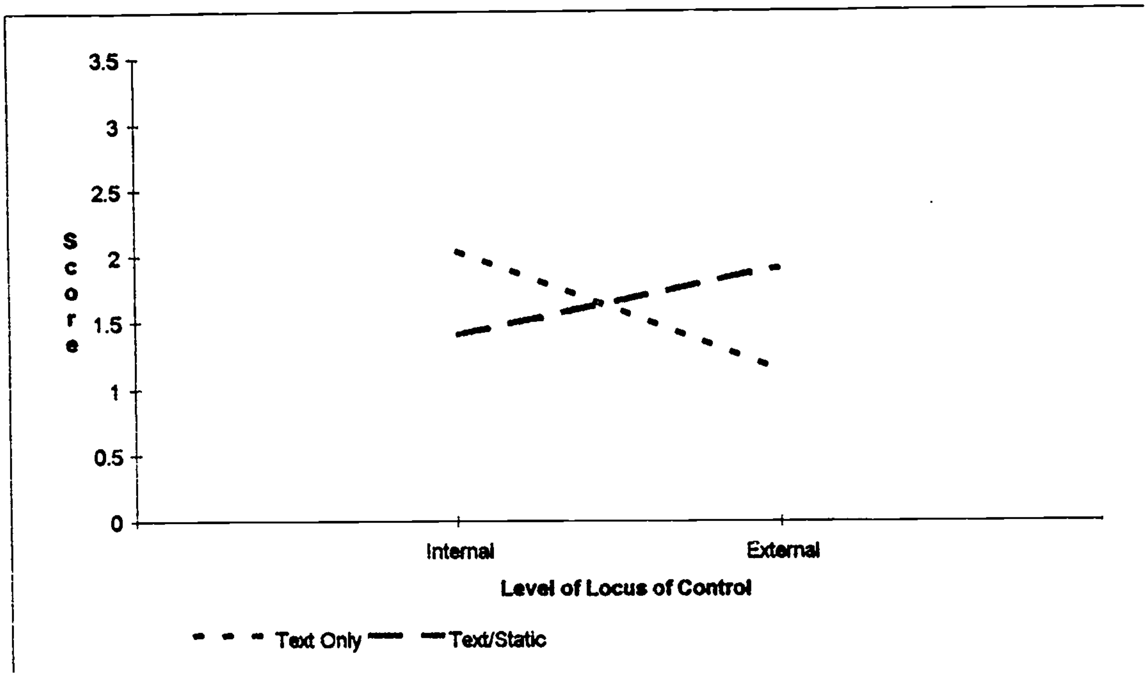

Figure 3: Recall Skewness questions by CAI presentation type by level of LOC

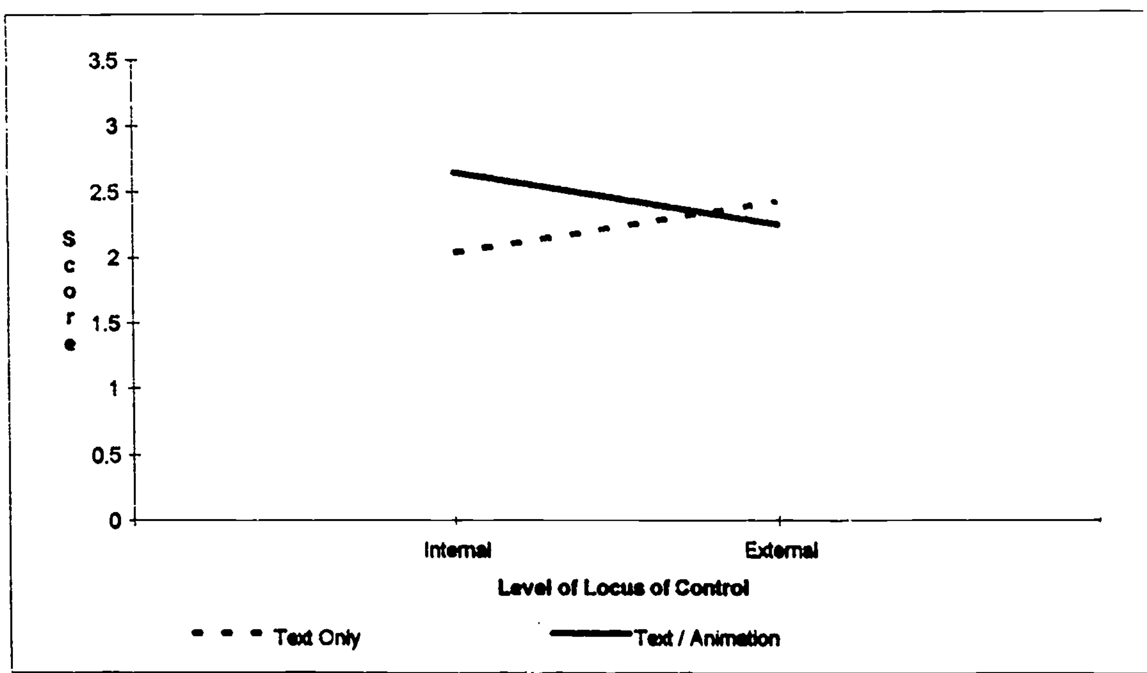

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Figure 4: Post Systematic questions by CAI presentation type by level of LOC

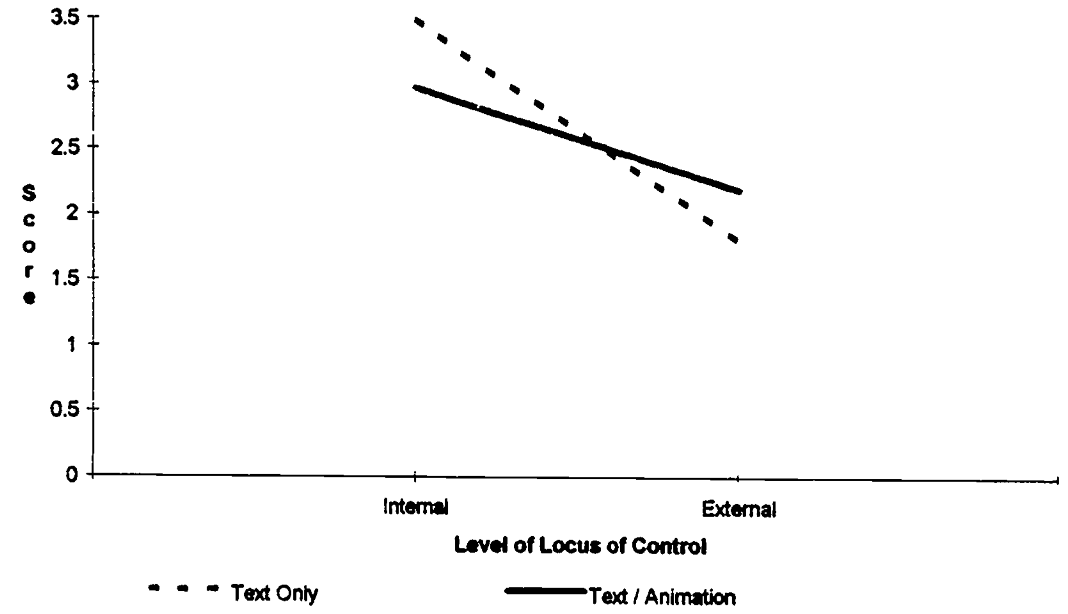

Figure 5: Post Random questions by CAI presentation type by level of F D/I

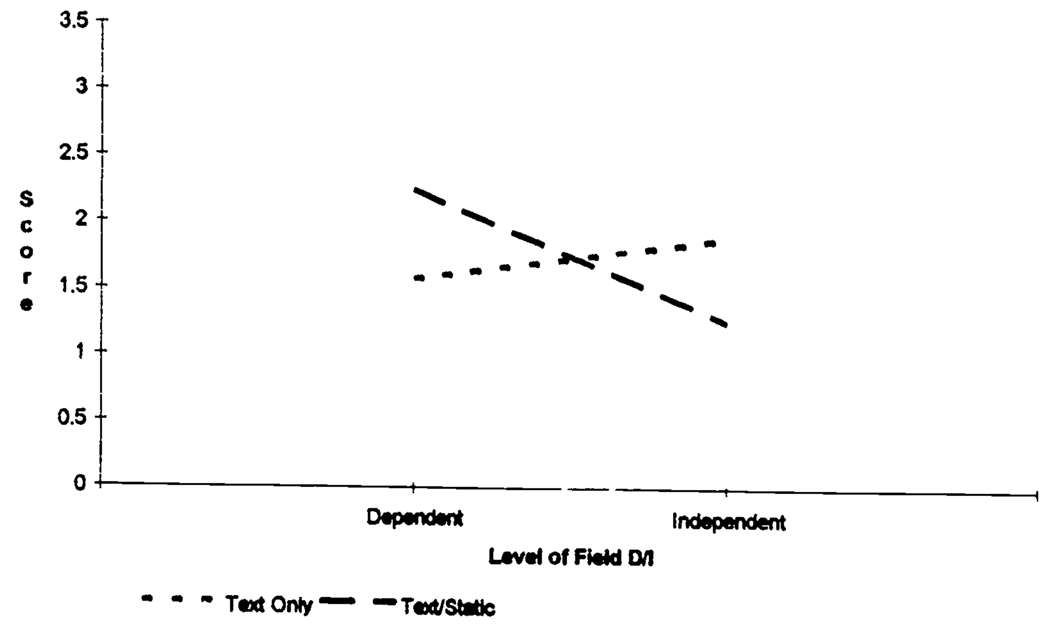

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Figure 6: Recall Skewness questions by CAI presentation type by level of F D/I

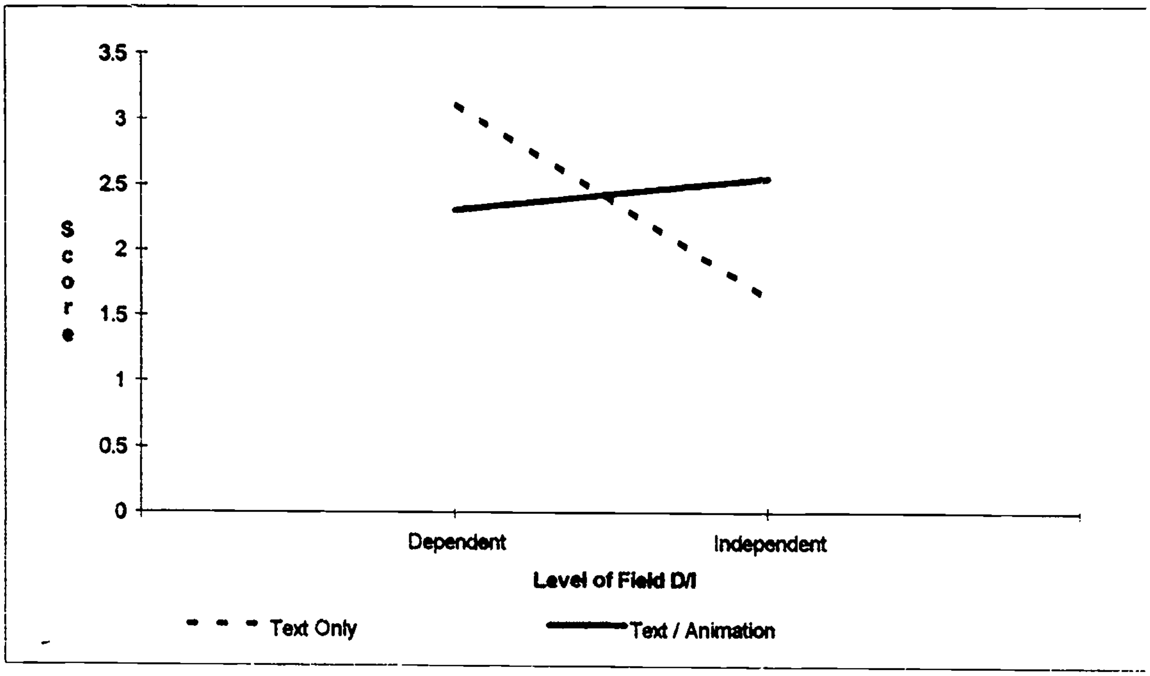
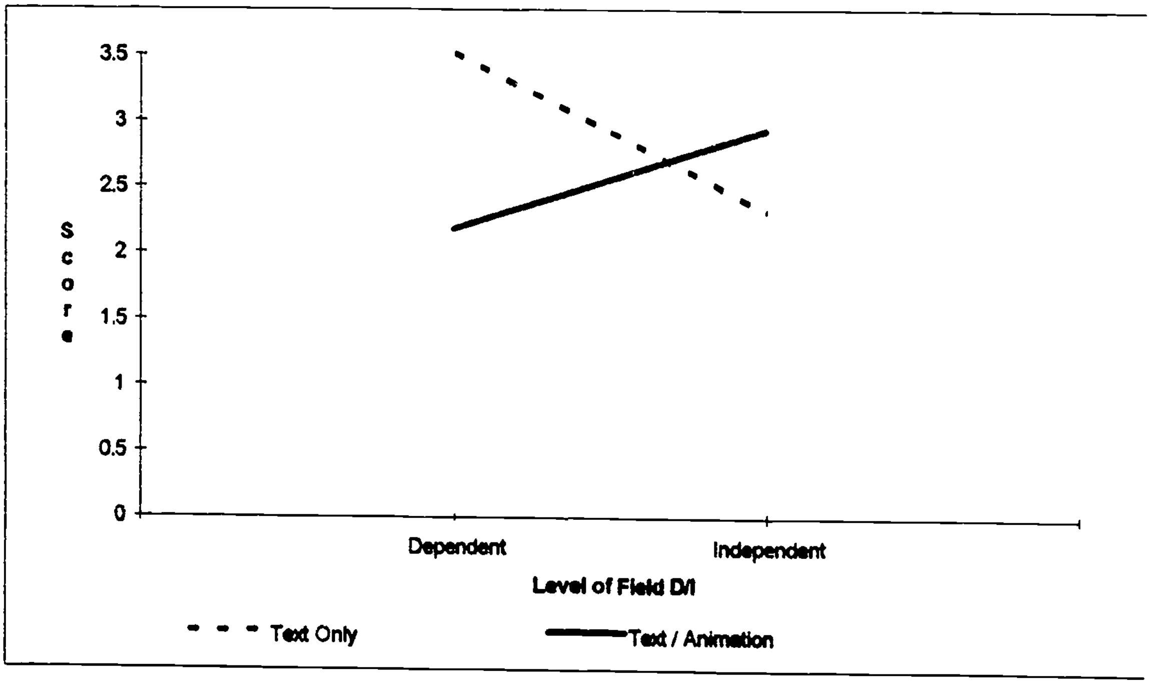


Figure 7: Post Systematic questions by CAI presentation type by level of F D/I



References

Alesandrini, K. (1987). Computer graphics in learning and instruction. In H. Houghton and D. Willows (Eds.), The psychology of illustration, volume 2: Instructional issues (pp. 159-188). New York: Springer-Verlag.

Baek, Y. and Layne, B. (1988). Color, graphics, and animation in computer-assisted learning tutorial lesson. Journal of Computer-Based Instruction, 15(4), 131-135.

Bovy, R. C. (1981). Successful Instructional Methods: A cognitive Information Processing Approach. ECTJ/ERIC-IR Young Scholar Paper Educational Communication and Technology Journal, 29(4), 203-217.

Brunswik, Egon (1955). In defense of probabilistic Functionalism: A reply Psychological Review 62(3), 236-242

Brunswik, Egon (1957). Scope and aspect of the cognitive problem. In H. Gruber, R. Jessor, and K. Hammond (Eds), Cognition: The Colorado Symposium. Cambridge, Mass: Harvard University Press, 1957. Pp. 5-31.

Caraballo, A. (1985). An experimental study to investigate the effects of computer animation on the understanding and retention of selected levels of learning outcomes. From Rieber, L. P. (1990). Animation in Computer-Based Instruction, Educational Technology Research and Development, 38(1),77-86.

Carlson, H. L. (1991). Learning styles and program design in interactive multimedia. Educational Technology Research and Development, 39(3),41-48

Carroll,-J. B. (1974). Psychometric Tests As Cognitive Tasks: A New "Structure of Intellect." Technical Report No. 4. Eric Document ED 095 215.

Chung, J.; Reigeluth, C. M.,(1992). Instructional Prescriptions for Learner Control. Educational Technology; 32 (10), 14-20.

Clark, R. E. (1985). Evidence for confounding in computer-based instruction studies: Analyzing the meta-analyses. Educational Communication and Technology Journal 33(4) 249- 262

Clark, R. E. (1994). Media will never influence learning Educational technology, Research and development 42(2),21-29.

Cooper, L. A. and Shepard, R. N. (1973). Chronometric studies of the rotation of mental images. In W. G. Chase (Ed.), Visual information processing. New York: Academic Press.

Cronbach, L. J. & Snow, R. E. (1969). Individual differences in learning ability as a function of instructional variables. A Final Report. Final Report, US Office of Education, Contract No. OEC-4-6-061269-1217. Stanford, California: Stanford University, School of Education, March, 1969

Dwyer, F. M. (1978). Strategies for Improving Visual Learning. State College, PA: Learning Services.

Gagne, R. M. (1985). The condition of learning (4th edition). New York: Holt, Rinehart, and Winston.

Gagne, R. M., Briggs, L. J., and Wagner, W. W. (1988). Principles of instructional design (3rd ed.). NY: Holt, Rinehart, and Winston

Jay,-Timothy-B. (1983). The Cognitive Approach to Computer Courseware Design and Evaluation. Educational-Technology; v23 n1 p22-26 Jan 1983

Khoury, H. A. and Behr, M. (1982). Student Performance, Individual Differences, and Modes of Representation. Journal for Research in Mathematics Education; v13 n1 p3-15

Kobayashi, S. (1986). Theoretical issues concerning superiority of pictures over words and sentences in memory. Perceptual-and-Motor-Skills; 63(2, Pt 2) 783-792

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. Educational technology, Research and development 42(2),7-19.

Levie, W. (1987). Research on Pictures: A guide to the literature. In H. Houghton and D. Willows (Eds.), The psychology of illustration, volume 2: Instructional issues (pp. 1-50) New York: Springer-Verlag.

MacGregor, S. K.; Shapiro, J. Z. and Niemiec, R. (1988) Effects of a Computer-Augmented Learning Environment on Math Achievement for Students with Differing Cognitive Style. Journal-of-Educational-Computing-Research; 4(4) p453-65

Messick, S. (ed.) (1976), Individuality in Learning: Implications of Cognitive Styles and Creativity for Human Development, Jossey-Bass, San Francisco, Cal

Packard,-Abbot-L.; Holmes, G. A. and Fortune, J. C. (1993). A Comparison of Three Presentation Methods of Teaching Statistics. Paper presented at the Annual Meeting of the Midwestern Educational Research Association (Chicago, IL, October 13-16, 1993). ED 365 696.

Packard, A. L. Holmes, G. and Fortune, J. C. (1994). Using Brunswik's Theory to construct a Multimedia Computer-Assisted Teaching Module. Paper presented at the Mid-South Educational Research Association in Nashville Tenn Oct. 1994

Paivio, A. and Csapo, K. (1973). Picture superiority in free recall: Imagery or dual coding? Cognitive Psychology, 5. 176-206.

Orey, M. A.; Okey, J. R.; Jones, M. G. and Stanley, L. S. (1991). Integrating Cognitive Theory into Gagne's Instructional Events. In: Proceedings of Selected Research Presentations at the Annual Convention of the Association for Educational Communications and Technology; ERIC ED 335 004

Osman, M. E. and Hannafin, M. J. (1992). Metacognition research and theory: Analysis and implications for instructional design. Educational Technology Research and Development, 40(2), 83-99

Reeves, T. C. (1993). Pseudoscience in computer based instruction: The case of learner control research. Journal of computer based instruction; 20(2) 39-46

Rieber,-Lloyd-R.(1990). Animation in Computer-Based Instruction. Educational Technology, Research and Development; 38 (1), 77-86
Rieber, L. P. & Hannafin, M. J. (1988). Effects of textual and animated orienting activities and practice on learning from computer based instruction. Computers in the schools, 5(1/2), 77-89
Rieber, L. P. & Kini, A. S. (1991). Theoretical foundations of instructional applications of computer generated animated visuals. Journal of Computer-based Instruction 18(3), 83-88
Ross, S. M.; Morrison, G. R. (1989). In Search of a Happy Medium in Instructional Technology Research: Issues Concerning External Validity, Media Replications, and Learner Control. Educational Technology Research and Development; v37 n1 p19-33
Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied 80(1)1- 28
Scheaffer, R. L., Mendenhall, W. and Ott, L. (1986) Elementary survey sampling. Elementary survey sampling, Boston, Duxbury Press
Schwier, R A. (1993). Classifying Interaction for Emerging Technologies and Implications for Learner Control. In: Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology Sponsored by the Research and Theory Division (15th, New Orleans, Louisiana, January 13-17, 1993); see IR 016 300. ED362201
Severin, W. J. (1967). Another look at cue summation. AV Communication Review, 15(4), 233-245.
Snow, R. E. (1968). Brunswikian approaches to research on teaching. American Educational Research Journal 5(4), 475-489
Snow, R. E. (1976). Aptitude treatment Interactions and Individualized Alternative in Higher Education, in Individuality in Learning: Implications of Cognitive Styles and Creativity for Human Development, Jossey-Bass, San Francisco, Cal
Surber, J. and Leeder, J. (1988). The effect of graphic feedback on student motivation. Journal of Computer-Based Instruction, 15(1), 14-17.
Tennyson, R. D.; Rasch, M.(1988). Linking Cognitive Learning Theory to Instructional Prescriptions. Instructional-Science; v17 n4 p369-85
Thompson, M. E. (1988). Individualizing Instruction with Microcomputer Produced Text. Paper present at the annual meeting of the Association for Educational Communications and Technology (New Orleans, LA, January 14-19,1988 (ED 295 669)
Wey, P. and Waugh, M. L (1993). The effects of different interface presentation modes and users' individual differences on user's hypertext information access performance. Paper presented at 1993 AERA Annual Meeting (Atlanta, GA April 13,1993)