17 The Effects of Perceptual Style with Mode of Instruction in a Hypermedia Language Learning Environment

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BACKGROUND

Perhaps the most intriguing question facing educators today is how to incorporate computer technology into their instruction. Like so many other technologies of the age, computer aided instruction (CAI) often ends up being the product of a rush of technology rather than an implementation of well founded design. Consequently programs come and go as their effectiveness is shown to be not as strong as once believed, and each new innovation is heralded as the new messiah of CAI. One such innovation is "hypermedia." Loosely defined, hypermedia is a nonlinear, interactive, multimedia computer based information system. Its zest is multidimensional. On one dimension, it is an integration of many different media including sound, text, still image, and moving image (video and/or animation). A second dimension deals with its interaction with the user. This can come in the form of user directing and pacing, stimulus-response feedback, and/or simulation. A third dimension is its nonlinear program architecture of information nodes and links, which frees the user from a predetermined path. From all three dimensions the potential of hypermedia in education seems boundless. Many times researchers and practitioners have found multisensory stimulus (visual, aural, tactile) to be effective in instruction. The same is true for interactivity in active learning. The notion of nonlinearity, however, is slightly less substantiated. Sometimes equated with interactivity, nonlinearity provides an element of user-control; for she must interact with the program to navigate through the linked network. This can sometimes lead, however, to undesirable consequences: unguided learning, a sense of being lost, and information overload. The question arises, then, for whom would such user-control be beneficiary?

The purpose of this study was to analyze the effects of mode of instruction (linear or nonlinear) with respect to student performance and navigational tendencies taking into account different perceptual styles (MBTI's SN and JP scales) of students participating in CAI. Theories of communication and cognition provide an overall framework while the theory of psychological type provides a framework for the independent variables of perceptual style. Additional theory of second language and culture acquisition was used for the design of the treatment. This study assesses the notion that "hyper" or "nonlinearity" may apply differently depending on the perceptual styles of the individual user.

PROGRAM ARCHITECTURE/MODE OF INSTRUCTION

> The human mind does not work as [a serial processor]. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain. It has other characteristics, of course; trails that are not frequently followed are prone to fade, items are not fully permanent, memory is transitory. Yet the speed of action, the intricacy of trails, the detail of mental pictures, is awe-inspiring beyond all else in nature (Bush, 1945).

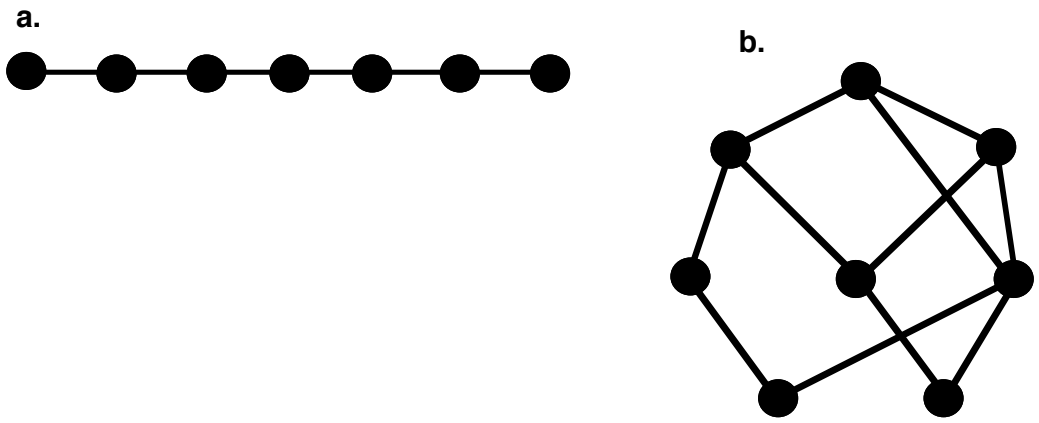
Here, Vannevar Bush describes the human mind as a model from which he designed hypertext. Some called it a "cognitive tool," others preferred the metaphor of a "knowledge threading machine." But beyond the descriptor was the intent to provide professionals with the tools to fabricate their own information structures. His design, which he himself never implemented, consisted of nodes (chunks of information) and links (relationships or ties between any two nodes). He envisioned an environment or medium where a reader would have the option to branch from one information node to another related piece of information. Unlike a book where a reference to a footnote or another page can be inconvenient (and consequently neglected), this new environment would allow the reader to quickly jump to a related piece of information and back again. Or, instead of returning right away to her original departure spot, she could quickly jump to yet another related piece of information, starting her journey through a web of related information nodes—similar to a thoughtful journey a human mind would take.

At the very heart of this knowledge tool that Bush speaks of is the synergy among computer, mental models, and the notion of "hyper" or a nonlinear symbolic relationships. Some theorists use the term "hypertext" in referring to dynamic text with nodes and links, while others use terms such as "interactive print" or "nonlinear prose." Regardless of the labels (which inevitably becomes an issue when forming new concepts), this tool adds layers of flexibility and functionality to the traditional print-based method of communication. Information can be ordered hierarchically or in association networks. Readers can quickly and seamlessly navigate through a body of material, delving into detail and peripheral information only to the depth and breadth they choose. Such a learning environment is based on the principle of accommodating individual learners rather than attempting to benefit the generic learner.

Today, almost fifty years after Bush first presented his idea of modeling human intellect, technology development has passed concept development. When discussing the concept of hypertext (or an elaboration of the concept that includes multiple media—hypermedia) two major issues stand out: user disorientation and cognitive overhead. A "hyper" or nonlinear architecture can be imagined as a large city. A traveler unfamiliar with such a city may easily become disoriented while attempting to travel from one point to another. Often times a map is helpful, but it requires a certain amount of cognitive commitment to figure out where one is, where one is going, and what is the most efficient way of getting there. Hypertext and hypermedia pose similar problems. In addition, an important element of a message lies in the order in which the information is presented to the learner. In many hypertext/hypermedia applications users fail to understand the message, simply because they view or hear it in the wrong order. Other times, the effort required to discover the appropriate order is greater than the user is willing to invest.

When considering educational uses this new method of communication and of such enabling technologies, two questions arise: How much control should a student have over her own learning strategies? and Will this differ among individual students? These

Figure 17.1
Model of Linear (a) and (b) Nonlinear Architecture



questions have puzzled educators since long before the technology brought such issues into the arena of new communication media. And yet there is still much to learn.

Figure 17.1 illustrates two simple models of a linear and a nonlinear architecture. With a linearly structured program architecture, it is the program itself that controls the content of the material. There is one predefined order of the learning material that each and every student will experience. If authors and educators were confident that their own pre-ordained structuring of exposition was optimal for each student, no problem would exist. But this is not necessarily the case. In fact, the problem is compounded when considering the optimal learning strategies of students alternating from a receptive learning mode to an active practicing mode.

With a nonlinearly structured program architecture, however, the control is within the hands of the student. The student selects her own route through a network of learning material that is best suited for herself. Each student, consequently, experiences the program in a unique way. It has been hypothesized in studies with and without technology that a student will find a path most appropriate for her own learning needs. At some point, however, we find there exists a fine line between the efficacy of program control (linear architecture) and learner control (nonlinear architecture). It is the intent of this study to determine where that line might be drawn—and for whom.

RESEARCH QUESTIONS AND DESIGN

This research investigates two questions with respect to a hypermedia language learning environment:

1. What is the effect of psychological type and mode of instruction on learner performance?, and
2. What is the effect of psychological type and previous computer experience on navigational tendencies?

Figure 17.2 illustrates the design of the two research questions. For Question 1, the independent variables are Mode of Instruction (linear vs. nonlinear) and Perceptual Style (sensing vs. intuition and judging vs. perception). The dependent variable is Performance (French in Action Knowledge Test). For Question 2, the Mode of Instruction is held constant with a nonlinear architecture and the same independent variable of Perceptual Style with Previous Computer Experience are used. The dependent variable is use of Content-Based Navigation.

THE EXPERIMENT

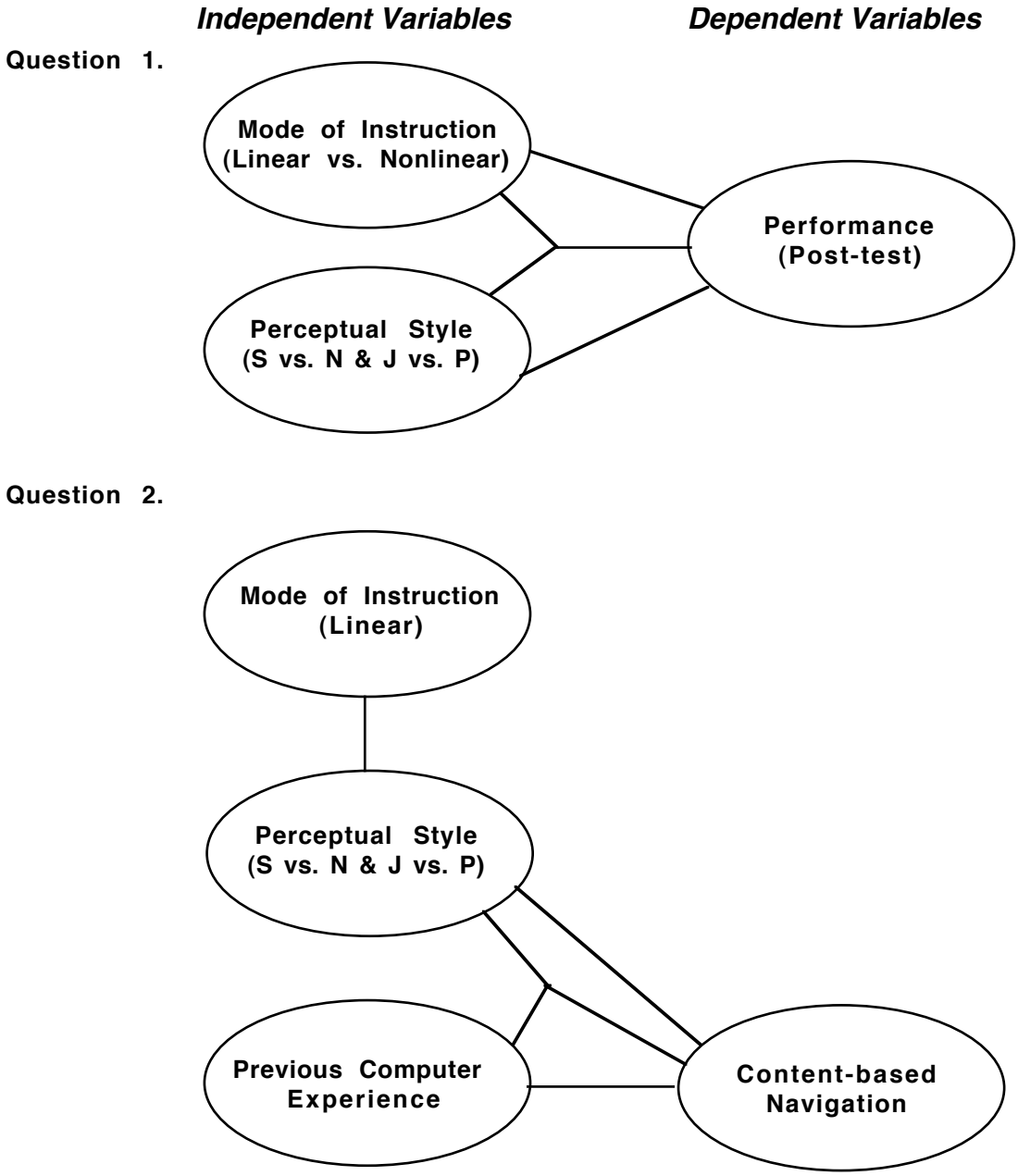
French in Action, developed by Pierre Capretz and his associates at Yale University (1987), is a multimedia course, using video, audio, still image, and text to teach French language and culture. By putting students in the presence of authentic, unsimplified French, it trains them to use it in the dynamic context of actual communication. Emphasis is placed on communicative proficiency, not the study of rules and regulations; but rather on the development of skills, self-expression, cultural insight, and the human dimension of French.

The objective of *French in Action* is total language teaching through both a structural approach and immersion. Students are made aware of the fact that the acquisition of language does not merely entail learning grammatical structures, but also calls for an understanding of the complex interdependencies of verbal and nonverbal communication, symbols, attitudes, behaviors, conventions, assumptions, and courtesies. This program subscribes to the view that language learning is holistic as opposed to atomistic, referential as opposed to linguistic, and conceptual as opposed to rule based. Each word, phrase, or gesture has meaning in relation to its context.

To achieve this objective, *French in Action* introduces students to some rather novel features not generally found in many language learning programs. These are: rich emphasis on culture, immersion and absence of English, primacy of listening, and active comprehension.

Compared to more conventional language teaching materials, *French in Action* presents an abundance of cultural references. These references are not simply limited to what one might consider to be Culture (with capital *C,* such as art, music, architecture, and literature), but they reflect above all the network of relationships, meanings, shared ideas, and expectations, all of which bind people together into a culture (with lower case *c*). The program includes the presentation of all aspects of popular culture such as media, behaviors, and trends. By giving a student access to the cultural realities that lie behind the language, they may begin to connect what they see, hear, and think into a generalized understanding of French.

Figure 17.2
Design of the Research Question



Framing these features is a story line, actually, a story within a story. The tale of young American boy meets young French girl is nested within a tale of a professor teaching college students French. Dapper, with light-hearted humor, the professor/student interactions set up rapport between the actors on screen and the students "acting" along. Regularly, the real-life students are given opportunities to participate actively in the invention and reinvention of the nested story. This classic story provides dramatic interest, with a soap opera quality (the genre is discretely parodied). Even though there is very little chance that students take the story seriously,

scenes often depict true human reactions and emotions. Preserving the convertibility of the story into endless other potential stories, an ironic distance is maintained. Hence, the indulgence and amusement of students as they participate actively and playfully in experimenting with the endless opportunities to reinvent, and recombine events and situations of the story. Through these stories arises a model of French language and culture interpreted by the student. Each new detail becomes a part of the greater understanding.

Materials. Two hypermedia versions of *French in Action, Leçon 2* were designed and implemented by the researcher using HyperCard 2.0 on a Macintosh computer. Both versions were based on the existing multimedia courseware for *Leçon 2* using a video segment, a corresponding audio tape, a textbook chapter, and a workbook chapter with observations and exercises. The hypermedia programs are rich with original video and sounds from the existing multimedia courseware. The content and language learning paradigm of the *French in Action* multimedia course was maintained as closely as possible in both versions of the hypermedia courseware.

The two versions of the hypermedia program differed only in their program architecture. One version was in a linear form where the user had the option to proceed forwards or backwards through a predefined path of instruction. Pacing and direction change within this path were totally within the user's control. The other version was a nonlinear structure in that the user navigated herself through a myriad of paths. The branches (or links) were based on the content of the courseware.

A formative evaluation of the hypermedia programs was conducted during the design and implementation phase of the program development. A number of University of Hawaii scholars specializing in hypermedia from the Depatments of Information and Computer Science, Educational Psychology, and French evaluated the program for its mechanics and content.

Once these two programs were completely implemented and tested, a pilot test with 10 subjects was conducted to determine their validity as a treatment. Revisions were made as appropriate.

Navigational Mechanisms. Within the nonlinear treatment, there were two categories of navigational mechanisms: (1) architecture-based and (2) content-based.

The architecture-based navigation allowed for travel through the program either by section *(Mise en Scène, Vocabulaire, Observations, Exercises),* or by moving linearly forward or back, or by using a map of the program as a bullet-chart by clicking on a desired node. The architecture of the program itself provided the framework for the links. The content-based navigation allowed learners to follow a link that was based solely on the content of the program. For example, by clicking on a French word or expression within the dialog of a conversation, the learner could follow a link to another part of the program that was related in content to the chosen word or expression.

Behind the scene in the nonlinear treatment was an navigational observation system that tracked the button clicks made by the user. The architecture-based factor was a sum of all mouse clicks made on the section, Forward and Back buttons, and number of visits to the map. The content-based factor was a sum of all mouse clicks made on underlined words or expressions in the conversation dialogs within the *Mise en Scène* section or the lessons within the *Observations* and *Exercises* sections.

Knowledge Pre/Post Test. The Knowledge Pre/Post Test, a test of listening and written comprehension, was developed by the researcher based on the existing courseware. An initial set of multiple-choice, fill-in-the-blank, and matching questions were drafted from (1) the baseline list of instructional objectives included in the teacher's manual, (2) exams used by instructors of *French in Action* at the University of

Hawaii, and (3) questions within the textbook. Overall, the questions reflected the learner's understanding of the vocabulary, grammar, and language usage within the specific culture.

Scholars from the French department evaluated and comment on the initial set of questions. Revisions based on these comments and suggestions were made. With these questions, both the pretest and posttest were implemented in HyperCard using text, image, and sound. The tests were identical except the ordering of questions for controlling the possibility of order effects. These tests were then pilot tested using 6 subjects who had already worked through the original multimedia program to determine the instrument's validity and reliability.

Sampling and Procedures. Experimental by nature, this study aimed at determining the effects of mode of instruction and perceptive style on learner performance using hypermedia courseware to teach French language and culture. The experiment was a 2 x 2 repeated measures design. For both research questions, the independent variable Perceptual Style was operationalized by two different scales (SN and JP), thus creating two separate analyses for each question. The second independent variable for the first research question was Mode of Instruction (Linear vs. Nonlinear). For the second research question, the Mode of Instruction was held constant with Nonlinear, and the second independent variable was Previous Computer Experience as measured by a self-reporting questionnaire concerning frequency and diversity of computer experience.

From a population of undergraduate college students enrolled in either a communication, education, or computer science class for the fall semester of 1992 at the University of Hawaii at Manoa, a sample of 74 subjects was drawn. None of the subjects had any previous experience with French. In addition, there were questions to determine other intervening variables such as: age, gender, and other language experience. These variables were considered when grouping the subjects and in the final analysis. All 74 subjects were included in the analysis of the first research question, but only half of those subjects who were administered the nonlinear program (a total of 37) were included in the analysis of the second question.

Each subject participated in two 1-hour sessions. The first session included the MBTI (Form G) test along with two other cognitive style tests and a questionnaire to determine previous computer experience and other variables. From the results of these tests, the subjects were assigned to two groups for each of the two treatments. In the second session, students first took the pretest and then spent 30 minute session with one of the two treatment programs. Lastly, the post test was administered. The subjects received their results on the MBTI and the other cognitive tests at the end of the second session.

ANALYSIS AND RESULTS

Both research questions were investigated using an ANOVA test where Perceptual Style was measured by the SN and JP scales of the MBTI. In both cases, the analysis with the SN scale did not yield significant difference, however, tests with the JP scale did. Therefore, only those analyses with the JP scale were included for further interpretation.

Question 1: What is the effect of psychological type and mode of instruction on learner performance? Descriptive statistics for the post test scores, summarized by Perceptual Style and Mode of Instruction, are shown in Figure 17.3 with the interaction line plot.

The total possible score for the Post test was 42 with scores ranging from 7 to 42.

As indicated in Figure 17.3, there was a main effect only for the JP scale factor. There was no main effect for the Instructional Mode and no significant interaction effect between Mode and Perceptual style. Js scored lower on the posttest than did Ps regardless of the Mode of Instruction. There was a greater variance among the Js and Ps with the linear treatment than with the nonlinear treatment. Ps with the linear treatment scored the highest with a mean score of 33.8 whereas Js with the linear treatment scored lowest with a mean score of 25.3.

Question 2: What is the effect of psychological type and previous computer experience on navigational tendencies? Descriptive statistics for the content-based navigation factor, summarized by Perceptual Style and Previous Computer Experience are shown in Figure 17.4 with the interaction plot.

Content-Based Navigation Factor was measured by number of times a content-based navigation button was clicked by the subject within the nonlinear treatment. This factor ranged from 5 to 22.

As indicated in Figure 17.4, there was no main effect for the Instructional Mode and significant interaction effect between computer experience and perceptual style. There was a main effect for the JP scale. Ps clicked navigation buttons the same number of times regardless of Previous Computer Experience, whereas, Js with little or no Previous Computer Experience clicked more navigation buttons (mean = 20.1) than did Js with strong Previous Computer Experience (mean = 11.3).

CONCLUSION AND RECOMMENDATIONS

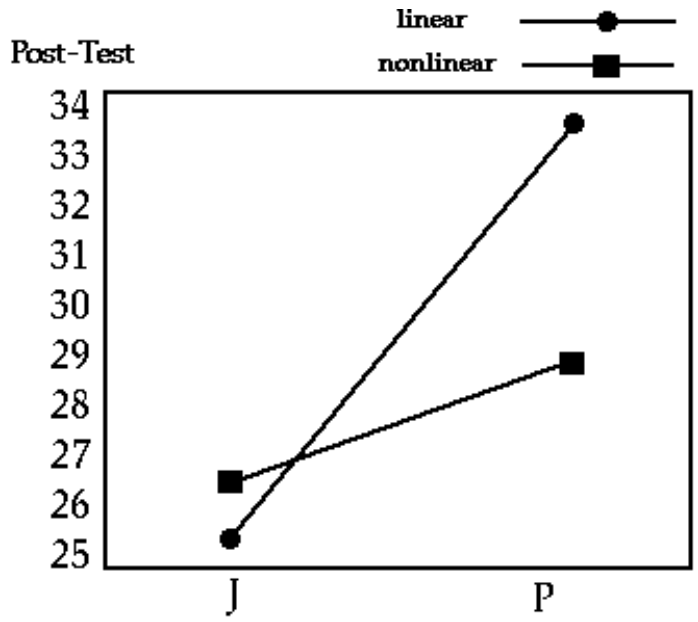
As technology charges full-speed forward, we find we are given enormous opportunity to control our learning environment and strategies. This empowerment, however, is not always optimized nor desired by different individuals. When considering the different approaches of perceiving and acting upon one's outer world, we see individuals of different perceptual styles behave very differently. It follows that these individuals will respond differently to their learning environments and, therefore, will learn differently. This study aimed at investigating these differences within a very specific context of language learning in a hypermedia environment. A significant difference was found between J learners and P learners with respect to their performance and navigational tendencies. Js performed better when given the opportunity to make immediate decisions in their own learning strategies. Furthermore, It appears that Js with much previous computer experience based their navigational decisions on the architecture of the program, whereas Js with little or no previous computer experience based their decisions on the content of the program. Overall,

Figure 17.3
Judging and Perception on the Knowledge Post Test

Mode p=.3270
JP p=.0083 **
Mode * JP p=.0905

Mode of Instruction

JP	Lin	Non	
J	19 **25.3**	20 **26.5**	39 25.9
P	16 **33.8**	19 **28.4**	35 30.86
	35 29.18	39 27.42	74 28.25



however, Js did not score as well on the post test as Ps regardless of their opportunity to make decisions.

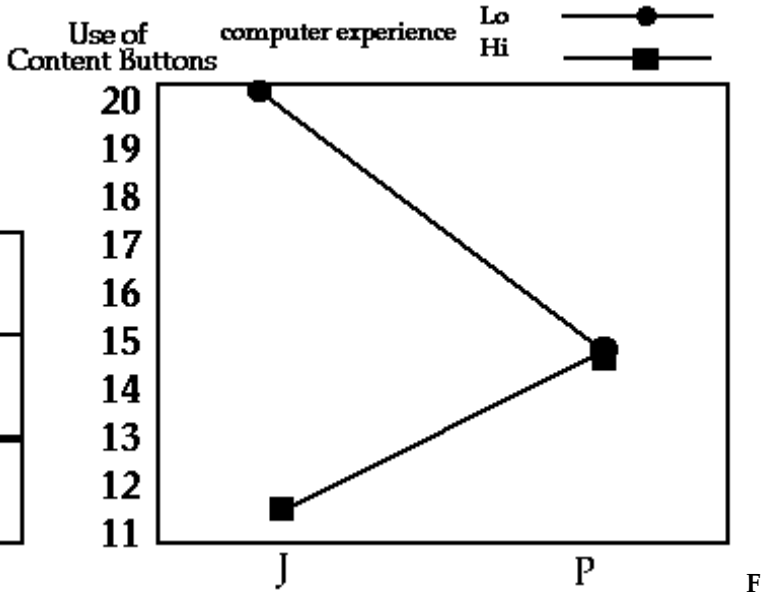
In comparison, perceiving types scored better when they were not forced to make decisions about their own learning strategies (linear format). Furthermore, those who were forced to make decisions (nonlinear format) showed no variance in their approach to navigational decisions. Their previous computer experience did not affect their

Figure 17.4
Judging and Perception on the Use of Buttons

Comp. Exp. p=.3501
JP p=.0232 **
Comp. Exp.* JP p=.3901

Computer Experience

JP	Lo	Hi	
J	6 **20.1**	9 **11.3**	15 **14.8**
P	9 **15.1**	9 **15.1**	18 **13.1**
	15 **17.1**	18 **11. 2**	33 **13.9**



choice to navigate based on the structure or content of the program.

With these results we can conclude that learners of different JP types will adapt different learning strategies. Js will tend to act upon or control their learning environment with some basis to their decision making, whereas Ps will tend to experience their environment, going with the flow. In addition, previous computer experience may influence the decisions that J learners will make in how they build their own learning strategies. J learners with a strong computer background will be more focused on the structure of the program, whereas Js with little or no computer background will rely more on the content.

RECOMMENDATIONS

As is the case with any study using the MBTI, a large number of subjects is necessary to delineate among the sixteen types. Because this study had only 74 subjects to investigate the first question, and 36 subjects to investigate the second question, the results need replication. Nonetheless, they do give indication to general expectations within one of the four scales, JP. The assertions made in this study should be tested again with a larger sample base and with investigations into the interactions of types under these various conditions.

There are two special points of caution. First, the novelty of the technology poses a threat to the reliability of the instruments and the validity of the treatment. Many of the subjects who participated in this experiment had never experienced a hypermedia program. Consequently, some of these subjects may have been more focused on the media (animation, sound, and video) than the message (French language and culture). A study over the course of several months with frequent treatments and post tests could assess this possibility, and increase both the validity and reliability of the treatment and instruments.

Second, the nature of the learning material and the instruments to measure performance play a large role in how learning is operationalized. This has been a major issue in educational evaluation for years. In the area of language and culture, knowledge and understanding are not simple constructs. What appears to be the case in this discipline cannot necessarily be generalized to other disciplines. Therefore, it is recommended that studies of performance and navigational tendencies be administered within different disciplines, such as mathematics, science, humanities, and social studies. Results from such studies could then be compared and contrasted.

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