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ABSTRACT

An empirical study investigated whether personality characteristics have a bearing on an individual's success with particular modes of instruction, in this case, computer-assisted instruction (CAI) and the programed text (PT). The study was developed in an attempt to establish useful criteria on which to base a rationale for choosing suitable modes of instruction for different students. Fifty-one third-year dentistry students were enrolled in a required oral pathology course that had been specifically adapted for either CAI or PT. The students were divided into two groups and during the semester studied a combination of the two modes. Three separate analyses were conducted to measure the variety of Aptitude-Treatment Interactions (ATI) within and between the groups. The results indicated disordinal ATI for the personality characteristics of deference, order, and aggression with some ordinal effects for endurance and nurturance. The ATI effects were clearly a function of personality measures and not academic aptitude. (MC)

Personality Characteristics and Performance on Computer Assisted Instruction and Programmed Text*

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INTRODUCTION

Recent developments in education have led to the use of a number of new instructional methods. Proponents of these methods often believe that their mode of instruction presents material in a more effective manner than any of the other methods. However, Gagne (1967), Bloom (1968), Cronbach (1957, 1967), Glaser (1967) and Jensen (1967, 1968) have all suggested that no single instructional process provides an optimum means of learning for all students. For a common set of objectives, differential instructional dynamics could enhance the achievement of students with different aptitude and personality characteristics (Cronbach and Snow, 1969). Cronbach (1967) called for a new psychological theory of aptitude which would be concerned as much with styles of thought and personality as with the old conceptions of aptitude. After reviewing Aptitude-Treatment Interaction (ATI) literature, Cronbach and Snow (1969) concluded that a student's response to classroom instruction is influenced by his personality, that is, there is an interaction between individual characteristics and instructional methods.

Yet most empirical studies that have attempted to demonstrate this widely held hypothesis have been unsatisfactory. There is little empirical justification for the development of any practical strategy for assigning students to alternative instructional procedures which would presumably optimize their learning. Yet, because of the recent developments of alternative instructional procedures from which the educator can choose, there is a pressing need to establish a basis for choosing one or another of these modes of instruction.

This study was developed in an attempt to establish useful criteria on which to base a rationale for choosing suitable modes of instruction for different students. More specifically, it was the purpose of this study to determine whether particular personality characteristics do have a bearing on an individual's success with particular modes of instruction (Computer-Assisted Instruction (CAI) and in a programmed text (PT).

Summary of Review of Literature

The literature indicates that, although learning theorists and educational psychologists widely accept the belief that different teaching methods differentially affect the achievement of students with various aptitude characteristics, little empirical research has validated this belief. Most of the ATI investigations done have been concerned with the interaction of various

academic aptitudes with differing instructional methods. The results have generally been negative. These negative results were largely attributable to the use of unsuitable measures (personological variables), poor control of instructional methods, the brevity of instructional treatment, weak analysis, lack of student involvement with treatments and, at times, poorly thought out studies. The literature indicates the need for ATI investigations which control for the above difficulties, with special emphasis on controlling treatment tasks and using personological variables that are factorially simple.

Some recent studies have attempted to relate ATI to personality characteristics. This literature, although containing some positive results, is disjointed and attempts of synthesis have been loose and impressionistic.

The literature indicates that different instructional methods and media often represent different learning environments, and that the nature of the situation has a great affect on the achievement of students. Scarcely any empirical studies, however, have investigated the validity of this contention. CAI and PT are two forms of programmed instruction which represent new learning environments. CAI presents highly an interactive instructional environment in which the student and machine engage in a dialogue. The computer actively guides the student's learning by presenting information,

testing and then evaluating the student's performance. CAI learning environments also tend to be well structured and machine controlled.

PT learning environment, although somewhat structured, permits the student more control over both his speed of learning and the order of the text presentation. The fundamental difference in the learning environments of CAI and PT stems from the difference in media Although both involve the printed work, CAI is conductive to an active dialogue, whereas PT does not tend to be responsive to the student's behavior.

Most research involving CAI and PT has delved into the effectiveness of the presentation itself, rather than focusing on the characteristics of the different learners. There have been virtually no studies comparing the interaction of CAI and PT with individual differences among students. However, references to the different learning environments of the two modes of instruction would indicate that personality characteristics do affect achievement with different modes of instruction.

Purpose of Study

It was the purpose of this study to investigate empirically whether personality characteristics have a bearing on an individual's success with particular modes of instruction. The results of this study should help students decide on what mode of instruction to use when given a choice.

Although most ATI studies have not succeeded in demonstrating disordinal interaction, this study had a greater chance of doing so by following Bracht's (1969) suggestion to control treatment variables and specific personological variables. Many critics have cited as faults in ATI studies the facts that the treatments investigated were short-term and the coursework was tangential to the student's curriculum. This study did not suffer from these problems, in that the two modes of instruction investigated are used over an entire semester and for a required course within an ongoing college curriculum.

The unique design of this study allowed each student to use both modes of instruction, CAI and programmed test, rather than having one group of subjects learn by one mode of instruction while another group learns by another mode, as was done in past studies. This design permitted comparison of each student's achievement by both modes of instruction and his opinion of each.

The Oral Pathology Course

Oral Pathology is a third-year course in the curriculum of the University of Kentucky College of Dentistry (UKCD). Until June 1969 the course was taught principally by Dr. Sheldon Rovin and in a lecture format. In 1969 Rovin, Sabes, & Howell developed a branching programmed text to replace the lectures. They felt that the programmed text would have several advantages over the lecture. First, it would

ask more questions of the student and involve him more in the problem-solving situation that a dentist is realistically confronted with in his dental practice. The programmed text would allow each student to work at his own pace, receive immediate reinforcement and gain experience in self-evaluation, since each student monitors his own progress (Rovin, 1971). Rovin believed that the relatively small unit segments which were explicitly matched to well stated and attainable objectives would aid the student in learning in a more efficient manner.

The programmed text is a 297-page branching program which is divided into eight units. It also contains 135 35-mm slides, each of which pertains to a specific frame in the text. Throughout the presentation of the material the students are asked to answer 80 multiple-choice and fill-in questions. To adapt the Oral Pathology course to CAI, the manner of presentation of the material was modified to take advantage of both the reinforcement and interactive principles involved in CAI presentation. This modification involved changing a number of statements in the programmed text to questions in the CAI presentation and adding two color slides. Slides were also made of three charts from the programmed text. The CAI presentation had 112 fill-in and multiple-choice questions, whereas the programmed text presentation had 80 questions.

PROCEDURE

The 51 students in the third-year class at the University of Kentucky College of Dentistry were divided into two sections of 25 and 26 students on the basis of their UKCD grade point average (GPA). Half of the higher GPA students and half of the lower GPA students were assigned to Group A, and the remaining students to Group B. Group A took the first part of the oral pathology course by CAI and the second part of the course by programmed text. Group B took the first part of the course by programmed text and the second part by CAI.

The final examination was constructed by Drs. Sabes and Eversole and consisted of 27 problem-solving, short essay type questions. Many questions had accompanying slides. The first part of the course which consisted of three units was worth 32 points. The school is on an honor code and thus each student could sign up for a separate finial examination when he completed the course. Twenty-two of the 51 students completed the course early.

Measures

Aptitude-Personality Measures

Before admission to the College of Dentistry, all students take the Dental Aptitude Test (DAT) and the Otis (Gama) Quick Scoring Mental Abilities Test (IQ). The DAT or IQ are used principally as tools for admission. After entering the College of Dentistry, each student is administered the Edwards Personal Preference Schedule

(EPPS). The EPPS is used primarily for counseling pruposes.

Interview

This study included an interview with each student who took the oral pathology course. The primary purpose of reporting the interview will be to expand the explanation of the results of the statistical analysis. The students were asked questions designed to help them and the interviewer gain insight into the manner each student, with his own personality characteristics, confronted and dealt with CAI and programmed text. The interview also served as the basis for developing an interview technique to determine which mode of instruction an entering dental student will tend to favor and with which he would tend to have greater achievement.

The interview itself centered on the students' likes and dislikes of the two modes of instruction and an inquiry into the aspects of each mode that might have aided or hampered the learning of the material. (For interview schedule and rationale, see Appendix A.)

Hypotheses Tested Were:

1. Individuals who tend to let others make decisions and tend to conform to what is expected of them will perform better on CAI than on PT (difference significant at the .05 level). This personality characteristic will be measured by the Deference scale of the

2. Individuals who have regular schedules and ways for doing things and who tend to keep things neat and well organized will perform better on CAI than on PT (difference significant at the .05 level). This personality characteristic will be measured by the Order scale of the EPPS.

3. Individuals who tend to receive help or affection from others, and who need the sympathy and understanding of other will do better on CAI than on PT (difference significant at the .05 level). This personality characteristic will be measured by the Succorance scale of the EPPS.

4. Individuals who have a need to be independent of others in making decisions and tend to avoid responsibilities and obligations will perform better on PT as compared to CAI (difference significant at the .05 level). This personality characteristic will be measured by the Autonomy scale of the EPPS.

5. Individuals who tend to keep at a job until it is finished and have a need to avoid being interrupted while hard at work will tend to perform better on CAI as compared with PT (difference significant at the .05 level). This personality characteristic will be measured by the Endurance scale of the EPPS.

6. Students' performances on CAI an PT will differ as a result of characteristics of their personalities (difference significant at the .05 level).

Data Analyses

Three separate analyses were conducted to look for ATI in this study. The scores on the first half of the final examination, which covered the material learned by CAI for Group A and by PT for Group B, were correlated with the personality variables from EPPS and the aptitude variables from the DAT. MULVAR significance tests (Allen, 1964) for the difference between corresponding correlation coefficients for the two independent groups were calculated. That is, the 26 correlations between the personality and aptitude variables and the achievement on the first half of the final examination were tested to see if they were different in the two groups of students.

A similar analysis was conducted for the second half of the final examination, which covered the material studied by the alternate method. Tests were made to determine if the correlations between personality and aptitude variables and achievement were different for the two groups.

The third analysis compared each subject's performance in the two methods of instruction. A standard score was determined for each subject on each of the two halves of the exam. The difference between the standard score for the CAI portion was correlated with personality and aptitude variables. Correlations were determined separately for Groups A and B in order to ascertain by comparison whether there was any order of presentation effect. Since no such effect was detected, overall correlations combining the two groups was not conducte.

Results

Of the students who took the oral pathology course through CAI and PT, 25 scored higher on th[illegible]che course they took through CAI and 26 scored higher [illegible]art of the course they took on PT. Of the 25 students in Group A, 16 scored higher on the portion of the course they took through CAI (first half of course) and 9 scored higher on the portion of the course they took through PT (the second half of the course). Of the 26 students in Group B, 17 scored higher on the portion of the course they took through PT (first half of the course) and 9 scored higher on the protion of the course where their instruction was CAI (second half of the course).

The mean score for the students in Group A on the first half of the examination (CAI) was 86% and their mean score on the second half of the examination (PT) was 83%. The mean score for the students in Group B for the first half of the examination (PT) was 85% and their mean score on the second half of the examination was 83%.

ATI Effects for Personality (EPPS) Between Groups

Tables 1 through 4 present results which compare the performance of Group A to that of Group B. Section A of Table 1 presents Pearson product-moment (PPM) correlations between personality measures (EPPS) and each student's final examination score for the first half of the oral pathology course in which Group A was instructed by CAI and Group B was instructed by programmed text (PT).

TABLE 2

CORRELATION OF CAI AND PT SCORES WITH DAT AND IQ VARIABLES DONE SEPARATELY FOR EACH HALF OF THE COURSE. PROBABILITY COEFFICIENTS INDICATE THE EXTENT TO WHICH THE DIFFERENCES BETWEEN CAI AND PT CORRELATIONS ARE DUE TO CHANCE

	Section A (first half of course)			Section B (second half of course)		
Academic Aptitudes	Group A (CAI) (N=25)	Group B (PT) (N=26)	Prob.	Group B (CAI) (N=26)	Group A (PT) (N=25)	Prob.
academic average	.458	.127	.3022	.122	.358	.6070
manual average	.316	.118	.3211	-.029	.311	.2167
quantitative reasoning	.116	-.034	.6264	.228	.168	.6998
verbal reasoning	.052	.160	.8100	.137	.241	.6937
mental level	-.020	.165	.5597	.262	.278	.9067
reading comprehension	-.037	.137	.5870	-.034	.132	.5828
biology	.369	.305	.4090	.368	.402	.6775
chemistry	.296	-.135	.1463	-.245	.258	.0855
factual science	.439	.117	.1873	.166	.434	.3831
science application	.432	.065	.1503	-.097	.452	.0617
total science	.496	.076	.0949	.116	.458	.2556
space relations	.392	-.035	.0667	-.085	.317	.1337
carving dexterity	-.010	.145	.6438	.062	.063	.9939
IQ	.008	-.299	.3968	.213	.062	.6422

Section B of Table 1 presents PPM correlations between EPPS scores and each student's final examination score for the second half of the course in which Group B was instructed by CAI and Group A was instructed by .

The probability coefficients given for each section indicate the degree to which the difference between the above mentioned correlations for Groups A and B were due to chance. Each analysis required 1 and 47 degrees of freedom.

This analysis was comparable to a Fisher Z test result. The analysis was a MULVAR regression equation analysis (Allen, 1969). It predicts x from y thrcugh a linear equation, $Y = a + Bx$, where a is an adjustment for the mean and where B is a scalar multiple of the population correlation between x and y. This B has within it the correlation coefficient for the relationship between x and y.

The MULVAR program gives a matrix which essentially compares the B weights for Group A and Group B for each personality and measure. Moreover, the program has a sub-routine which allows for the reparameterization of the original matrix so that the significance of B_1-B_2 may be tested.

Of the five hypothesis tested, the results of Table I indicated that there were consistent differences in the CAI and PT correlations for both deference (Section A: CAI-.270, PT .134, Section B CAI -.102 PT .134) and order (Section A, CAI -.302, PT .278, Section B CAI -.194, PT .166). The correlations were in a negative direction for CAI and

in a positive direction for PT and thus in an opposite direction than was hypothesized.

Table 1 correlations indicates little support for a relationship between autonomy differences in performance on CAI and PT (Section A, CAI .081, PT. 060, Sect B, CAI -.093, PT -.114) and for succorance (Section A; CAI .110, PT .016, Section B, CAI -.096, PT .206). The results for hypothesis 5, endurance for Section A (CAI .-059, PT.419), for Section B (CAI .244, PT .317) were in a direction opposite than predicted.

The personality characteristics of Nurturance (Section A CAI .006, PT .161, Section B, CAI -.099, PT.314), aggression (Section A, CAI .142, PT -.408, Section B CAI .132 PT -.067) intraception (Section A,. CAI .073, PT -.107, Section B CAI .222, PT -.123) and affiliation (Section A, CAI .005 PT .305, Section BCAI .027, PT .040) also show the possibility of having some ATI effects.

ATI Effects for Aptitudes (DAT & IQ)

The figures in Table 2 were obtained by the same statistical analyses as in Table 1. Most of the results for Sections A and B are either moderately or strongly conflicting, and none is significant at the .05 level. For example, in Section A, CAI scores correlate more positively with the DAT scores in chemistry, factual science, science application, total science, academic average, manual average and spacial relations than do PT scores, whereas in Section B, PT

TABLE 1

CORRELATIONS OF CAI AND PT SCORES WITH EACH EPPS VARIABLE DONE SEPARATELY FOR EACH HALF OF THE COURSE. PROBABILITY COEFFICIENTS INDICATE THE EXTENT TO WHICH THE DIFFERENCES BETWEEN CAI AND PT CORRELATIONS ARE DUE TO CHANCE

	Section A (first half of course)			Section B (second half of course)		
Personality Variable	Group A (CAI) (N=25)	Group B (PT) (N=26)	Prob.	Group B (CAI) (N=26)	Group A (PT) (N=25)	Prob.
achievement	.023	.123	.8145	.079	-.104	.9059
deference	-.270	.134	.1580	-.102	.134	.4233
order	-.302	.278	.0545*	-.194	.166	.2184
exhibition	.068	-.128	.5288	.100	-.230	.2810
autonomy	.081	.060	.8397	-.093	-.114	.8705
affiliation	.005	.305	.3972	.027	.040	.9584
intraception	.073	-.107	.5557	.222	-.123	.2362
succorance	.118	.016	.6187	-.096	.206	.2726
dominance	-.236	-.285	.9094	.127	-.127	.3899
abasement	.089	-.358	.1864	-.172	-.121	.9391
nurturance	.006	.161	.6462	-.099	.314	.1669
change	.096	.082	.5347	-.086	-.019	.8606
endurance	-.059	.419	.1366	.244	.317	.8161
heterosexuality	.004	-.239	.5318	-.175	-.244	.6846
aggression	.142	-.408	.0753	.132	-.067	.4955

* Significant at the .05 level

scores correlate more highly with each of these DAT measures than CAI scores.

Because of the conflicting results between the first and second halves of the course, it appears that the results are due to chance and that none of the DAT or IQ measures contribute to ATI.

Those variables that show a consistent trend, show small, highly probably differences between CAI and PT. These results are also probably due to chance.

ATI Effects for Personality (EPPS) Within Groups

In addition to analyzing the data for ATI effects by comparing different individuals on CAI and PT (standard ATI technique) the data was also analyzed by comparing the same individuals performance on the two modes of instruction. This second analysis views the results from another perspective and provides a check for the first analysis by whether the results are consistent in direction and in magnitude. It is also a more direct view of what the investigation is attempting to examine, the way in which an individual's personality characteristics differentially effect his perfomance on CAI and PT.

An analysis was conducted for Group A, Group B, and Group A and B combined by standardizing the score of each student on CAI and PT portions of the final examination and subtracting the standard score of PT from the standard score of CAI. For each of the

personality variables a Pearson r product-moment correlation was calculated (Table 3). The probability coefficient is calculated through a Z test, using 1. Positive correlations indicate that the personality characteristic varies positively with high performance on CAI. Negative correlations indicate the opposite.

The correlation and probability coefficients in Table 3 test hypotheses 1 through 5 by comparing each personality factor (deference, order, autonomy, succorance and endurance) with CAI and PT score differences for each individual within the groups.

There were consistent negative correlations of difference for deference (Group A -.3718, Group B -.1916, Groups A and B -.2558) order (Group A -.4293, Group B -.3837 and Groups A and B -3863) attiliaton (Group A -.0322, Group B -.2262, Groups A and B -.1517); succorance (Group A -.0802, Group B .0911, Groups A and B -.0920) nurturance (Group A -.2827, Group B -.2112, Groups A and B -.2487) and endurance (Group A -.3457, Group B -.1425, Groups A and B -.2480).

There were consistent positive correlations of difference for exhibition, (Group A .2739, Group B .1853, Groups A and B .2217), intraception, (Group A .1806, Group B .2682, Groups A and B .2267) abasement, (Group A .1927, Group B .1511, Groups A and B .1784), heterosexuality (Group A .2278, Group B .0518, Groups A and B 1456) and aggression (Group A .1914, Group B .4392, and Groups A and B .3414).

Table 3 indicates that the valence for correlations of difference were inconsistent for hypothesis 4, autonomy (Group A .1794, Group B -.1241).

The probability that the difference in correlation presented on Table 3 were significant (.05 level) occurred for order (Group A .032, Group B .053, Groups A and B .005) and aggression (Group B .025, Groups A and B .014).

ATI Effects for Aptitude (DAT and IQ) within Groups

Table 4 compares each subject's performance in the two modes of instruction within each of the aptitude variables of the DAT and IQ in the same manner as in Table 3. The analysis of each aptitude variable with CAI and PT scores was indentical to the analysis tabulated for Table 3.

The correlation of the difference between CAI and PT scores with each DAT variable was small in all three groups of Table 4. There were also inconsistent correlations for Groups A and B for some of these aptitude variables (academic average, manual average, quantitative reasoning, mental level, biology chemistry and spacial relations) and virtually no statistical significance given to those correlations. These results were generally consistent with the results of Table 2.

The aptitude of IQ, however, had some medium statistical results. Although the results for Group A indicated a slightly positive association between higher IQ and higher scores in PT (-.0494), the results concerning Group B indicated a much higher correlation between CAI success and IQ (.4162). This correlation is statistically significant

at the .034 level, whereas the correlation for Group A is statistically significant at the .814 level of probability. The combination of the two conflicting results (Groups A and B, .2077 correlation and .144 probability show the higher IQ students performing better on CAI.

The results concerning IQ in Table 2 indicated that IQ did vary more positively with CAI than PT (Group A: CAI .008, PT -.299; Group B: CAI .213, PT .062). However, these results are far from statistically significant at the .05 level (Group A, .3968; Group B, .6422 and thus agree with the general trend for IQ and CAI in Table 4.

Summary for Achievement

The results of the two analyses, between and within students, tended to support and complement each other. They indicated disordinal ATI for the personality characteristics of deference, order and aggression with some ordinal ATI effects for endurance and nurturance. In contrast, the more academic aptitudes showed almost no hint of any ATI effects in either analysis. The ATI effects presented were clearly a function of personality measures and not of academic aptitude.

The consistency of the results over Sections A and B of Table 1 and Groups A and B of Table 3 tended to rule out the possibility of an order of p sentation effect. For example, deferent students

performed better on PT, whether they took the first half or the second half of the course with it.

Preference for Aspects of CAI and PT as Indicated by Interview

To make the structured interview amenable to statistical analysis, the 11 separate questions (Appendix A) were divided into 30 separate questions. The students generally responded to these by indicating no preference or a preference for CAI or FT. They also indicated their preference for different aspects of CAI and PT.

The results in Table 5 indicate the number and percent of total students who preferred CAI or PT in the structured interview questions. The results in Table 6 indicate the number and percent of total students interviewed who preferred or did not prefer aspects of CAI and PT.

In general, it appeared that most of the students preferred PT to CAI, however, they were split concerning their ability to concentrate (question 26) on both. Students generally preferred the self-paceing of the PT (question 6). Of the students who did have a sense of dialogue none felt it from CAI (question 20) than CAI (question 22).

One statistically significant chi square coefficient (5.10756) within the .05 level of probability (.0238)(question 29) indicates that more students who were high in deference as compared to those

TABLE 4

CORRELATION OF DIFFERENCE IN CAI AND PT SCORES FOR EACH DAT AND IQ VARIABLE AND PROBABILITY THAT CORRELATION IS DUE TO CHANCE WITHIN GROUP A, WITHIN GROUP B AND FOR GROUPS A AND B

	Group A (N=25)		Group B (N=26)		Group A & B (N=51)	
Academic Aptitudes	Correl. of Difference	Probability	Correl. of Difference	Probability	Correl. of Difference	Probability
academic average	.0922	.661	-.0040	.984	-.0028	.984
manual average	.0051	.981	-.1197	.560	-.0878	.540
quantitative reasoning	-.0481	.820	.2125	.297	.1074	.453
verbal reasoning	-.1739	.406	-.0183	.929	-.1001	.485
mental level	-.2747	.185	.0790	.701	-.0694	.628
reading comprehension	-.1555	.458	-.1386	.499	-.1498	.294
biology	-.0307	.884	.0508	.805	.0313	.828
chemistry	.0349	.868	-.0893	.665	-.0494	.731
factual science	.0042	.984	.0396	.848	-.0098	.946
science application	-.0178	.933	-.1316	.522	-.1139	.426
total science	.0347	.869	.0323	.876	-.0032	.982
space relations	.0687	.744	-.0411	.842	-.0139	.923
carving dexterity	-.0673	.749	-.0673	.744	-.0729	.611
IQ	-.0494	.814	.4162	.034	.2077	.144

who were low in deference believed that reviewing through CAI hindered their learning. Four more significant (.05 level) chi square correlations were related to the personality characteristic of autonomy. More autonomous students prefered making appointments for CAI (question 8) as compared to the less autonomous students (chi square 7.9982, level of probability .0183). People who scored high on autonomy also felt that their learning was helfped more because they had a prescribed (question 9) time and place to work than did people low on autonomy (chi square 7.95979, significant at .0187 level). Students who scored high on autonomy tended to prefer (question 12) the question-oriented format of CAI as compared to those who scored low in autonomy (chi square 10.95086, significant at .0042 level), and in a similar manner students low in autonomy (question 14) tended to prefer the statement oriented format of PT more than the students who scored high on autonomy (chi square 9.53532, significant at .0085 level of probability)

Ther personality variables of order, endurance and succorance did not reveal significaty different chi squares on the interview questions.

The remaining ten EPPS personality variables were analyzed in the same manner as the five hypothesized variables. Those questions that distinguished (.05 level) between those who fell above and below the mean of each variable are presented in Table 12. As was

the case with the five EPPS variables discussed above, there were few suggestions of ATI effects. However, two of the variables (affiliation, aggression) had more than two questions that fell within the .05 level.

TABLE 5

FREQUENCY OF PREFERENCE FOR CAI OR PT IN INTERVIEW

Questions	Prefer CAI	No Diff.	Prefer PT
1. prefer	19(38%)		31(62%)
2. learn more from	10(20%)	18(36%)	22(44%)
3. easier	7(14%)	17(34%)	26(52%)
24. depend on answers	24(48%)	12(24%)	14(28%)
26. concentration	24(48%)	2 (4%)	24(48%)
28. review	11(22%)	4 (8%)	35(70%)
30. prefer difficult course	19(38%)	1 (2%)	30(60%)

Student #7353 dropped out of UKCD and did not take part in the interview. (N=50)

TABLE 6

FREQUENCY OF PREFERENCE FOR ASPECTS OF CAI AND ASPECTS OF PT IN INTERVIEW

Question	Yes	No Diff	No
Preference for Aspects of CAI			
4. speed hindrance	17(34%)	25(50%)	33(66%)
5. interfere with learning	14(28%)	25(50%)	11(22%)
8. stationary appointments	12(24%)	9(18%)	29(58%)
9. aid learning	8(16%)	34(68%)	8(16%)
12. question format	18(36%)	10(20%)	22(44%)
13. aid learning	15(30%)	29(58%)	6(12%)
16. direct responses	27(54%)	17(34%)	6(12%)
17. aid learning	12(24%)	37(74%)	1 (2%)
20. dialogue	26(52%)		24(48%)
21. aid learning	29(58%)	13(26%)	8(16%)
29. hinder review	6(12%)	44(88%)	
Preference for Aspects of PT			
6. self-pacing	34(68%)	3 (6%)	13(26%)
7. aid learning	24(48%)	22(44%)	4 (8%)
10. transportability	33(66%)	7(14%)	10(20%)
11. aid learning	19(38%)	29(58%)	2 (4%)
14. statement format	24(48%)	9(18%)	17(34%)
15. aid learning	12(24%)	31(62%)	7(14%)
18. leafing pages	5(10%)	16(32%)	29(58%)
19. aid learning	3 (6%)	35(70%)	12(24%)
22. dialogue	7(14%)	1 (2%)	42(84%)
23. aid learning	44(88%)	3 (6%)	3 (6%)

TABLE 12

RESPONSE DISTRIBUTIONS FOR QUESTIONS WHICH SIGNIFICANTLY INTERACT WITH NON-HYPOTHESIZED PERSONALITY VARIABLES

Response Variable	Question Numbers	Signif.		Response Table		
				CAI(Y)	ND	PT(N)
achievement	3	.0476	L	24%	28%	48%
			H	0%	43%	57%
				PT(Y)	ND	PT(N)
exhibition	14	.0099	L	17%	58%	25%
			H	42%	58%	0%
				CAI(Y)	ND	CAI(N)
affiliation	8	.0122	L	36%	19%	45%
			H	0%	18%	82%
				CAI(Y)	ND	CAI(N)
affiliation	9	.0508	L	24%	58%	18%
			H	0%	88%	12%
				PT(Y)	ND	PT(N)
affiliation	10	.0400	L	58%	12%	30%
			H	82%	18%	0%
				CAI	ND	PT
affiliation	30	.0520	L	47%	0%	53%
			H	18%	5%	77%
				CAI	ND	PT
intraception	2	.0400	L	33%	38%	29%
			H	8%	34%	58%
				CAI(Y)	ND	CAI(N)
intraception	9	.0501	L	29%	58%	13%
			H	4%	77%	19%
				PT(Y)	ND	PT(N)
dominance	11	.0561	L	47%	53%	0%
			H	22%	67%	11%
				PT(Y)	ND	PT(N)
abasement	7	.0266	L	33%	48%	19%
			H	59%	41%	0%
				PT(Y)	ND	PT(N)
heterosexuality	15	.0570	L	31%	48%	21%
			H	14%	81%	5%
				YES	ND	NO
heterosexuality	24	.0271	L	59%	10%	31%
			H	33%	43%	24%
				CAI	ND	PT
aggression	2	.0262	L	4%	42%	54%
			H	35%	30%	35%
				PT(Y)	ND	PT(N)
aggression	19	.0426	L	8%	84%	8%
			H	4%	57%	39%
				CAI	ND	PT
aggression	28	.0596	L	8%	13%	79%
			H	35%	3%	62%

DISCUSSION

The basic purpose of this study concerned ATI theory and was specifically attempted to determine whether performance in differing instructional modes is clearly linked not only to academic aspects of aptitude, but, as Cronbach (1967) suggested, also to personality characteristics. This study measured the possible ATI effects of what are considered the more traditional academic aptitudes (DAT and IQ) and personality characteristics (EPPS). ATI effects were demonstrated for personality characteristics but not for academic aptitudes.

Academic Aptitude and ATI Effects

Bracht (1970) suggested that one reason for poor ATI results is that a rationale was not employed to indicate why students with varying aptitudes would perform better on one mode of instruction than on another.

Academic aptitudes as measured by the DAT and Otis IQ are designed to measure one's ability to deal with content and subject matter. Since the difference between CAI and PT is the manner of presentation of the instructional material and not its content, it would not be likely that these aptitude measures would validly result in ATI effects. The DAT measures that might have some bearing on some dental instructional presentation, such as manual average, reading comprehension, space relations and carving dexterity, were

not differentially required for successful performance in oral pathology presented by CAI and PT. The inconsistency of the DAT and IQ results for Groups A and B (Tables 2 and 4) can be viewed as revealing the complete lack of bearing those aptitudes have on differing CAI and PT scores.

Hypotheses and ATI Effects

Of the five variables for which hypotheses were made, the results indicate that two had ATI effects, one had some suggestion of it, and two did not reveal ATI effects. The three which did have ATI implications ran counter to the direction in which they were hypothesized. Deference, order and endurance were hypothesized to vary positively with CAI and negatively with PT. These hypotheses were formulated because it was assumed that these personality characteristics would be more in consonance with aspects of CAI and not consonant with PT.

In the case of deference, it was assumed that people characterized as deferent would prefer CAI, because CAI tends to impose its pace of learning on the learner and it employs a question-answer format which can simulate a dialogue. It satisfies the need for sturcture and interaction that is characteristic of deferent people. (Appendix C) The fact that the results indicated that the more deferent students performed better on PT than CAI could be accounted for by any one of a number of reasons. One might be that, in fact, CAI does not contain the characteristics mentioned above. This

is unlikely, because both the literature concerning learning environments and the majority of the students agreed that CAI was more structured, more responsive, and provided more of a feeling of dialogue than PT. Another explanation could be that the mean and range of the students' scores on deference were so skewed as compared to the normal distribution that analysis was highly distorted. A frequency distribution on deference as well as the other 14 personality variables, however, indicated that both groups had distributions of scores that were fairly normal and approximated the same means as found on the normative sample for the EPPS. Another reason for results could be that the scales on the EPPS did not reliably measure what they purported to measure. In fact, the EPPS is widely used and has been demonstrated to be internally consistent (Edwards, 1959). The last and most likely reason for the result is that individuals who score high on deference do not react to CAI and PT as hypothesized.

The responses students made to a number of questions during the interview tend to verify this last contention, and the pattern of responses tends to support the statistical results. Hypothesis 1 implied that the more deferent students would be reinforced better by CAI than PT, get more involved in a dialogue and prefer the pacing of CAI to the self-pacing of PT, but the reverse proved to be true. This is demonstrated through response tables which

represent the distribution of answers to 30 interview questions for students who were high and low in deference. Question 24 revealed that 65% of the more deferent students, as compared with 39% of the less deferent students, believed they could concentrate better on the material presented by PT than by CAI. Very few of the students felt they could concentrate equally as well on either mode of instruction (6% with low deference and none with high deference). Forty-seven percent of the more deferent subjects, as compared to 27% of the less deferent subjects, believed that the pace imposed by CAI was a hindrance to their learning (question 4), whereas 65% of the more deferent subjects, as compared to 39% of the less deferent subjects, believed that the self-pacing of PT aided their learning (question 6). Of the students who had a sense of dialogue with CAI, 41% of them were high in deference, 58% of them were low in deference (question 20). Of these students who experienced a sense of dialogue with CAI 50% of those high in deference as compared to 66% of those who were low in deference believed this sense of dialogue aided their learning (question 21). Of those students who had a sense of dialogue with PT, 23% were high in deference as compared to 9% low in deference (quesion 22). Of these students 47% of those who were high in deference and 18% of those who were low in deference believed this sense of dialogue with PT aided their learning (question 23).

Some of the characteristics that define deferent individuals are their manifest needs to conform to custom, to avoid the unconventional and to get suggestions from others. The reasons for poor CAI performance by these students may be their inability to fulfill these needs through CAI. CAI was a new and very different type of instruction for the vast majority of students in the third-year class; it asked them to participate in learning in an unusually active manner. Despite the fact that deferent individuals have a tendency to do what is expected and to follow the leadership of others, their comments throughout the interview indicated that these characteristics did not take precedence in their confornation with CAI.

They ofter indicated that they found the mechanics of CAI (noise, watching the tuping IBM ball, and waiting for the CAI responses) to be both annoying the frustrating. They also found CAI cold and rigid, lacking in understanding and "a silly game." It appears that, instead of conforming to the pressure of CAI learning, the deferent students found this novel and unconventional situation to be distracting. Students lower in deference, however, tended to enjoy the novelty and challenge of CAI. They also considered the pressure a factor that kept them involved and moving in their learning. Thus, these students adapted more easily to the newer mode of instruction by being able to take advantage of the dynamics in CAI presentations

PT is an instructional method that asks the individual to conform by following the directions and doing what is expected. This is not unconventional, in that the student reads and responds to a book. It thus provides the potential for fulfilling many of the needs of the more deferent students. During the interview, many of them stated a preference for PT because they could take it with them and study at their own pace and at their convenience. They seemed almost to take comfort in this, compared to being agitated by the imposed pace set by CAI.

The less deferent students often found PT to be dry and boring. To learn most effectively through PT, the student must follow orders and conform to what is asked. Less deferent students have more difficulty doing this than the more deferent students. Thus they may have had a tendency to skip pages in the text, not follow branching instructions properly and cheat by looking up the answers before they dealt with the questions. This would have reduced their learning through PT. CAI, however, would improve their learning because it does not permit these deviations; it gives them no choice.

To learn best from structured material it is generally necessary to accept the format and conform to the process of learning demanded by the instructional method. Those with tendencies to conform can guide themselves more easily through this learning than those who

have difficulty conforming. Thus, the more deferent do well on PT, whereas the less deferent do poorly on PT. CAI, by branching and not giving the student a choice in proceeding, provides the structure that less deferent students need to deal with the material more successfully, whereas this control (not suggestion) may interfere with the more deferent students by not allowing them the freedom to decide on whether to conform and how to conform. This would explain the disordinal interaction for deference on CAI and PT.

The results for order given in Table 1 indicated disordinal interaction (Bracht, 1970). That is, orderly students who studied by CAI scored high in their final examination, while those orderly students in the PT group scored low. Ther reverse was true for the non-orderly students. This personality variable reveals the most impressive ATI results in the study.

Hypothesis 2, however, predicted the results in the opposite direction. This was predicated on the belief that people who tended to have orderly needs would prefer the CAI method, which is highly systematic and organized. The reverse may have occurred for a number of reasons.

An investigation of the students' responses in the interview revealed that the more orderly students appeared to learn by imposing their own sense of order on the material. The PT itself was a rather complex branching program which required a person to arrange a great

deal of the material, including slides. These orderly individuals can do this and thus they had an advantage with PT. Individuals who scored low on order would tend to have difficulty dealing with the arrangements required to best master a PT. Thus they performed less well with PT.

People who scored low on order often commented that they found PT dry, boring and lacking in sufficient organization. These same individuals often liked the novelty, challenge and "chattiness" of CAI. They also would tend to perform better on CAI because it provides the very elements they have difficulty providing for themselves: order, structure and decisions. Thus, people who scored low on order performed better with CAI than PT.

Students who scored high on order had poorer scores with CAI, largely because the rigid order presented by CAI conflicted with the order they would impose on the material. In fact the general criticism orderly students had about CAI was phrased very adroitly by one of them. He said, "CAI is orderly, but it is not my kind of order."

Hypothesis 3 was formulated in the belief that more autonomous individuals would learn better on PT where they would be less controlled by instructional methods. They would then perform less well on CAI. The results in Tables 1 and 3 did not bear out this contention. The difference between people who were high and low

in autonomy was both inconsistent and negligible between and within groups. Although the responses to interview questions 8, 9, 10 and 14 clearly indicated a preference (Table 8) for CAI by the more autonomus students and a preference for PT by the less autonomus students, the statistical analysis of the final examination did not parallel these results. The more autonomus students tended to prefer the obligation of keeping an appointment for CAI as compared to doing PT whenever and wherever they chose, and the question format of CAI to the statement-oriented format of PT. Thus, the more rigid structure of CAI was not perceived as a threat to the autonomy of these students. In fact, the very act of making an appointment may have been viewed by these students as the autonomous act, because their initiative resulted in action being taken by others (e.g., secretary). They may also have viewed their responses to CAI questions as autonomous because it involved active initiative and had impact (the computer responded to it). The responses to Question 31 showed that many of the autonomous individuals preferred CAI to PT because it helped them concentrate. They generally found it difficult concentrating on school work but dealt with CAI as a type of challenge, game or encounter which held their attention. They thus preferred to commit themselves to learning and being active in that encounter, but this preference did not appreciable assist their learning.

Hypothesis 4 was stated because it was felt that individuals who seek encouragement from others, who seek affection from others (termed "succorant") would prefer the potential CAI has to promote dialogue and this would positively effect the learning of succorant individuals. The results did not substantiate this hypothesis. Neither the analysis of the examination nor the analysis of the interview discovered any ATI effects for succorance. Interview question 31 and the reasoning behind the answers succorant individuals gave to the other questions indicated the variable effect CAI had on them. Some were caught up and involved in the dialogue, while others preferred to work at their own leisure. It did appear that the dialogue fostered by CAI is so rigid and unlike human conversation that succorant people did not associate this with fulfilling their needs, and thus it did not aid their performance.

Hypothesis 5 concerning endurance was formulated in the belief that the controlled nature of CAI would affect individuals who lacked persistence in a negative manner. They would react negatively to being pushed and guided, but they would be able to cope with these rigidities and pursue their learning. It was also expected that the CAI presentation had the potential to be pressuring, because the computer will reject some partially correct answers and require a good deal of activity on the student's part. Students higher in endurance could more easily cope with these characteristics of CAI. In fact, this did not occur.

Being a person of endurance can generally be considered an advantage in learning. The person of endurance will persist in doing what he is required to do. Thus it was expected that students who scored high in endurance would perform better on both modes of instruction than students low in endurance. However, the results in Table 1 did not support this. The interview suggested that students low in endurance seemed to be aided in CAI largely because the pressure put on them acted as a catalyst to increase their attention and interest in the material. They seemed to use the mechanisms of CAI to increase their endurance. This was not the case for those who scored higher in endurance. They could apply their greater endurance to the rather passive PT to a large extent than those who scored lower on endurance, but many implied that CAI interfered with their normal persistence. At times they used a good deal of their energy in coping with the mechanics of CAI. This they often considered as distracting and frustrating. PT tended to be a rather typical method of instruction, in that the students with more endurance performed better. However, CAI applied outside pressures to increase the endurance of those who generally lacked it and to some extent conflicted with endurant individuals by requiring them to expend energy just coping with mechanics.

ATI and Other Personality Variables

Tables 1 and 3 suggest the possibility that nurturance may act as a good variable with which to predict ATI effects. Results for

nurturance were consistent both across and within groups, but are not as statistically decisive as are those for deference, order and aggression.

Table 1 indicates that CAI scores did not vary with high or low nurturance, but PT scores did vary. Thus, being or not being nurturant did not seem to be a factor in learning from CAI but did seem to be a factor in learning from PT.

People who were nurturant (giving) did not tend to get involved in the dialogue, the give-and-take, as one might expect. They seemed to view the computer as just a machine and did not tend to give it the "alive" quality others did. Perhaps their need for interaction was clearly human and was not easily displaced. In fact, many of these students seemed to get easily bored by the mechanics of CAI.

PT, however, provided the nurturant student with his own material, something he could keep with him and deal with at his convenience. He could also fulfill some of his nurturant needs by learning by PT with other students, whereas he had to learn by CAI alone. In fact, many of the dental students often study together.

Tables 1 and 3 indicate that the personality characteristic of aggression showed ATI effects. The results were large and consistent. They were also disordinal, in that aggression and exam

performance correlated positively for CAI and negatively for PT. It would seem that neither being aggressive nor non-aggressive in and of itself was an advantage or disadvantage to learning. They could be, however, the basis for different learning styles. An aggressive individual would tend to function better in an actively interactional situation, one in which he could respond and be responded to. This type of situation would permit him to fulfill his need of being realistically active and conbative. CAI is more likely to fill this need than PT. In fact, a number of aggressive students appeared very agitated and frustrated by CAI and, although they did not seem to prefer it over PT (question 1), a greater percentage of aggressive (35%) as compared to non-aggressive (4%) students believed they learned more from CAI than PT (question 2, Table 12).

PT, which provides a more passive learning environment, could present problems to aggressive students who seek to learn through promoting active reactions to their actions. Thus, a number of aggressive students, although feeling familiar and experienced with PT, found it dry and boring. They did not feel the same challenge they felt with CAI. It did not fulfill their combative needs, and thus it became difficult for them to impose their style of learning on this instructional method.

The less aggressive students, although not preferring PT to CAI (question 1), tended to believe that they learned more from PT (54%) than CAI (4%) (question 4, Table 12). They also preferred to review the course through PT (79%) as compared to CAI (8%) (question 28, Table 12. The same logic as applied to aggressive students would seemingly apply to the less aggressive students to explain their better performance on PT. They could learn more efficiently in situations where they could reticently survey a rather passive, inactive instructional method such as PT; PT can be used whenever, wherever and however the student wishes. He has sufficient freedom to skip around and even cheat. CAI, however, is presented in a manner that keeps prodding the student to perform in a prescribed manner. This is a difficult situation for a rather non-aggressive student. Thus, the less aggressive the student, the poorer he did on CAI.

Although the final examination scores did not indicate ATI effects for affiliation, the results of the interview did demonstrate some ATI effects. The majority of students of both high and low affiliation preferred the transportability and convenience afforded by PT to the requirement of making an appointment and going to the computer to work on the material. However, some students low in affiliation (36%) preferred the stationary nature of CAI to the transportability of PT. There were, however, no students

high in affiliation who preferred this feature of CAI to the transportability of the text.

The need for students high in affiliation to form attachments (can take PT with them) and to participate with others may have been more easily fulfilled through PT than CAI.

The Interview

Although the results on the final examination revealed some rather distinct ATI effects, an analysis of the 30 interview questions for each of the five EPPS personality variables showed few ATI effects (Tables 11 and 12).

There are a number of possible reasons for the results on the interview. One reason might be that the interview questions themselves were not good criteria upon which to distinguish between the high and low scoring students on each of the personality variables. However, the rationale presented in Chapter III for each of the interview questions seemed clear and, in most cases, the questions were justified in terms of personality-environment interaction. Another possible reason for the few ATI effects may be the fact that some students were either not cognizant of or had forgotten many of their reactions to PT and CAI. However, this factor was not as large as might be expected because, as the interview progressed, most of the students became clearer about how they had felt toward the two instructional methods.

It is believed that the primary reason for the lack of ATI effects relates to the fact that the interview itself dealt primarily with the student's impressions about his performance in CAI and PT and his preference for certain aspects of the two methods. On the basis of their final examination scores, 12 of the 50 students were inaccurate in assessing which mode of instruction they learned more from. Most of these students believed they learned more from PT, when actually they had higher scores on CAI. The main difficulty is that very often a student's preference had little to do with his performance. Although ATI effects were found for five of the personality variables, there was no relationship between a student's personality and his preference for CAI or PT (question 1).

It seemed that preference for either CAI or PT was not the critical factor in determining ATI effects. The critical factor in determining how well students learned was based on the extent to which each mode of instruction aided his learning styles by fulfilling his personality needs.

Thus, orderly students could follow directions and make order out of less structured material, whereas disorderly students, although disliking instruction that imposed order on them, needed that order to best learn material. In the same manner, aggressive students may have preferred PT, but they may have learned more with CAI, because it aroused their agitation and frustration.

The key to predicting whether a student will learn more from CAI or PT is not his academic aptitudes, but more likely his preferences and attitudes, which are more a function of understanding the dynamics of the specific learning environment in conjunction with the individual's learning style and which are largely influenced by his personality characteristics. With this information, investigators cannot only predict learning, but construct learning environments to suit the individual student.

Value of Study to Education

This study has importance for education largely because it provides a basis for choosing a rational with which one can expect to achieve ATI effects. It indicates that if future ATI studies are to be successful, it would be useful for investigators to see what it takes for a person to succeed in particular learning environments. And an invaluable part of interpreting the statistical results would be the student's opinions of how he felt about the modes of instruction.

The results of this study might also lead investigators to inquire into the nature of the relationship between preference and achievement, specifically the effect of providing negative preference, high achievement instruction for the student. Replications of this study might be conducted with different students as a check on the reliability and validity of the results of this study.

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