Causal Relations Among YCCI Attributes
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G. Knezek, K. Miyashita, T. Sakamoto, and A. Sakamoto

Introduction

This report contains the major findings from an exploratory study of causal relations among gender, age, computer exposure and psychological dispositions measured by the Young Children's Computer Inventory (YCCI). Results are based upon data gathered from Japanese computer-using and non-computer-using schools during 1991, 1992, and 1993, as well as data from a U.S. (Texas) school where responses were paired by student for 1991 and 1992.

Subjects

The 1993 Japanese subjects were 198 students in grades 1-4 at two urban public elementary schools in Tokyo. The schools had previously been matched, based upon demographic characteristics, and were selected for the study because one was using computers and the other was not. During 1993, one-half of the classes received four-point versions of the questionnaire (described below), while the other half received three-point questionnaires. Only students completing four-point questionnaires were selected for this study, in order to maintain compatibility with data from earlier years.

1992 Japanese subjects were 720 students in grades 1-3 from an urban public school using computers, and one urban, one suburban, and one rural public school not using computers. The two schools included in 1993 were also included in the 1992.

1991 Japanese subjects were 664 students in grades 1-2 from six schools in Japan. Three schools, one urban, one suburban, and one rural, which used computers, were matched with three comparable schools not using computers. Four of these schools (3 with computers, 1 without) were also included in 1992, but the remaining two of the initial set without computers began using them during the second year and were not included in this analysis. The initial urban set of schools, one with and one without computers, were the same schools used in 1993.

The English-speaking U.S. subjects were 166 students in grades 1-3 from a rural North Texas public school system. 1991 responses from first and second graders were paired by student with their 1992 responses as second and third graders. Only those students completing questionnaires both years were included in this analysis.

Instrument

The Young Children's Computer Inventory was used to record children's attitudes and perceptions in this study. The YCCI measures children's psychological dispositions (prevailing attitudes) in six areas (Miyashita & Knezek, 1992; Knezek & Miyashita, 1993):

Computer Importance (I)	Computer Enjoyment (J)
Motivation/Persistence (M)	Study Habits (S)
Empathy (E)	Creative Tendencies (C)

The subscale structure for the 48 items of the questionnaire is provided in Appendix A. A detailed explanation of the YCCI's derivation is provided in the YCCI Handbook (Knezek & Miyashita, 1993).

Procedure

Forms were administered during March 1991, March 1992, and March 1993 at all sites. This corresponds to the last month of the year in Japan. At the U.S. site, each teacher individually led all students in his/her class, item by item, through the form, allowing every student to circle a response before proceeding to the next item. This procedure required 20-40 minutes per class. At all sites in Japan, forms were sent home with the students and parents aided their children in completing the forms, as necessary.

Data Analysis

Questionnaires were keypunched by a private company in Japan and by computing center personnel at the University of North Texas. The data were analyzed using the ANOVA and REGRESSION routines of the Statistical Package for the Social Sciences (SPSS) on Macintosh II FX and IIci computers.

Results

Analysis of Japanese Data

A previous Multivariate Analysis of Variance procedure performed on the 1993 Japanese data (MANOVA, see Technical Report 93.3) confirmed that computer exposure can have a positive impact on Computer Enjoyment ($p<.00005$), Computer Importance ($p<.0004$), Study Habits ($p<.005$) and Motivation/Persistence ($p<.01$). These relationships are graphically portrayed in Figure 1. The positive findings for Study Habits and Motivation/Persistence were new for the 1993 survey, which also contained data for fourth grade students (with four years of computer exposure) for the first time. Findings for Computer Enjoyment and Computer Exposure are consistent with ANOVAs for previous years.

Figure 1 also contains regression analysis results for the same data. In this procedure, a new dichotomous variable, computer exposure = 0 (without computers) or 1 (with computers), was constructed as the predictor in the regression equation, in order to determine the strength of the influence of computer exposure on each of the psychological dispositions previously confirmed as significant by the MANOVA procedure. Four independent regression analyses, for example: Computer Importance = f(Computer Exposure), were carried out. The resulting standardized regression coefficients (betas), which can be interpreted much like correlation coefficients, are written above the probability values on the lines indicating direction of influence in Figure 1. The strongest relationship (.42) is for Computer Enjoyment, while the weakest (.17) are for both Study Habits and Motivation Persistence. This indicates that Computer Exposure accounts for about 18% (.42 x .42) of the variance in Computer Enjoyment, but only 3% (.17 x .17) of the variance in Study Habits or Motivation/Persistence in the 1993 Japanese data.

Additional 1993 regression equations were produced by including Gender (1=male, 2=female) and Age (Grade+6) along with Computer Exposure (0=without, 1=with) as predictors for each psychological disposition. For example, Study Habits = f(Computer Exposure, Gender, Age). The purpose of this procedure was to determine the strength of the influence of Computer Exposure on each psychological disposition, after controlling for Gender and Age. After controlling for Gender and Age, the remaining effect of Computer Exposure on Computer Importance (.24 vs. .26 w/o control) and Computer Enjoyment (.41 vs. .42 w/o control) decreased slightly, while the effect of Computer Exposure on Study Habits (.19 vs. .17 w/o control) increased slightly, and effect on Motivation/Persistence remained unchanged (.17 with and w/o control). All changes were small, which is also reflected in the fact that neither Gender nor Age significantly ($p<.01$) influenced any of these dispositions.

Similar regression equations were produced for 1992 and 1991 data as well. As with 1993 data, no significant relationships were found between Gender or Age and Computer Importance, Computer Enjoyment, Study Habits, or Motivation/Persistence. 1992 and 1991 analyses reconfirmed the strong influence of Computer Exposure on Computer Enjoyment ($p<.00005$) and Computer Importance ($p<.001$), and also generally reconfirmed the lack of evidence that just one or two years of Computer Exposure has a positive impact on Study Habits or Motivation/Persistence. These trends can be seen in the group means by grade level displayed in Table 1.

Analysis of U.S. Data

Regression equations similar to those used for the 1991, 1992, and 1993 Japan data were constructed for the paired 1991-1992 data gathered from the U.S. school. The major change was that time-lag regression models were constructed in an attempt to determine the directional influences of psychological dispositions on each other (Markus, 1979). For example, in order to determine if Creative Tendencies influenced Computer Importance, or if higher Computer Importance led to greater Creative Tendencies, the outcomes of two models were contrasted: 1992 Computer

Importance = f(1991 Computer Importance, 1991 Creative Tendencies, Gender, Age) versus 1992 Creative Tendencies = f(1991 Creative Tendencies, 1991 Computer Importance, Gender, Age). As shown in Figure 2, the result was significant (b=.31, p<.001) in the direction of higher Creative Tendencies leading to higher perceived Computer Importance. The influence in the opposite direction was not significant. The most significant findings displayed in Figure 2 are:

1. Higher Creative Tendencies appear to positively influence perceived Computer Importance (B=.31, p<.001),

2. Greater Computer Enjoyment appears to lead to higher perceived Computer Importance (B=.26, p<.01),

3. Greater Empathy appears to lead to higher Motivation/Persistence (B=.25, p<.01),

4. Being female leads to higher Empathy (B=.37, p<.001),

5. Increased Age leads to lower Creative Tendencies (B=-.32, p<.001), and

6. Increased Age leads to lower Study Habits (B=-.32, p<.001).

Discussion

The analysis of the data from Japan reconfirms the positive impact of one year or more of computer exposure on Computer Enjoyment and Computer Importance. It also lends additional support to the concept that at least three or four years of exposure to computers in school is necessary before a measurable positive impact on Study Habits and Motivation/Persistence takes place. In addition, it reaffirms the negligible impact of Gender and Age on these relations. Taken all together, these results imply that positive benefits of computer exposure accrue to males and females equally, and that the effect may not differ for students of different ages (within the age parameters of grades 1-4).

The time-lag analysis of data from the U.S. school reaffirms that children tend to lower their self-reported Creative Tendencies and self-reported Study Habits as they advance from grade 1 to grade 4 in school. It also reaffirms that females are more Empathetic than males. New findings are that higher Empathy leads to higher Motivation/Persistence, and that higher Computer Enjoyment leads to higher perceived Computer Importance.

Figure 3 contains an overlay of Figures 1 and 2. Although the combined causal model cannot be presented with as high a degree of confidence as either half alone, it is interesting to note there are no conflicts between the two. The combined findings from Japan and the U.S.A. have enabled the construction of the following hypothesized causal models:

Model 1

Assumption 1: Lower Motivation and Study Habits lead to poorer performance in school.

"Fact" 1. Increased age (maturation) leads to decreased Creative Tendencies and Study Habits.
"Fact" 2. Lower Empathy leads to lower Motivation/Persistence.
"Fact" 3. Being male leads to lower Empathy.

Conclusion 1: Males should tend to be poorer performers than females in primary school, especially at higher grade levels.

Model 2

Assumption 2: Game-type computer use (Nintendo, home applications, etc.) outside of school lead to higher enjoyment of computers.

"Fact" 1. Higher Computer Enjoyment leads to higher perceived Computer Importance.

"Fact" 2. Higher perceived Computer Importance leads to greater (free choice) computer exposure in the future (Coovert, Salas, & Ramakrishna, 1992).

"Fact" 3. Early computer exposure in school leads to higher Computer Enjoyment, higher perceived Computer Importance, and eventually (over three or four years) to better Study Habits and higher Motivation/Persistence.

Conclusion 2a: Early computer exposure in school will eventually lead to better performance in school.

Conclusion 2b: Game-type computer use outside of school (in moderation) will not harm and may enhance computer use in school.

Conclusion 2c: Males with performance deficiencies in school should especially benefit from combined exposure to computers at home and in school.

Model 3

Assumption 3: Most children enter school with a high level of curiosity and creative interests, high motivation to learn, and good fundamental study habits in the form of wishing to carry out whatever is requested by an adult.

"Fact" 1. Motivation, Study Habits, and self-reported Creative Tendencies all tend to decline as students advance from grades 1 through grade 3 in school (1992 YCCI Results).

"Fact" 2. Sufficient exposure to computers in school (3 or 4 years) can have a positive impact on Motivation and Study Habits.

Conclusion 3: Early exposure to computers in school eventually leads to higher performance/achievement, not by enhancing desirable psychological attributes such as Motivation, Study Habits, and Creative Tendencies, but by retarding their "natural" decline.

Future researchers in this field may wish to test the validity of these and other hypothetical causal models which can be constructed to fit the currently available data. It is believed that Model 3 is especially in need of testing, because it implies a change in the basic computer education research paradigm. That is, researchers and program evaluators may wish to concentrate on demonstrating that computer access helps keep good psychological dispositions which exist in students at an early age from dying, rather than trying to show that computer use is directly responsible for enhancement of such characteristics.

References

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Table 1
YCCI 1993 Mean Score by Grade for USA, Japan with, & Japan without Computers

	GRADE	U.S.A. (1)	JAPAN W/ (2)	JAPAN W/out (3)	Significance
I					
	1	3.62	3.46	3.03	NS (.0101)
	2	3.61	3.30	3.08	1vs.3
	3	3.41	3.43	2.94	none (.003)
	4	3.33	3.10	3.00	none (.07)
J					
	1	3.53	3.90	3.42	NS (.011)
	2	3.81	3.77	3.30	1&2 vs 3
	3	3.62	3.71	3.30	none (.02)
	4	3.50	3.73	3.32	2 vs 3
M					
	1	3.21	3.19	3.02	NS (.54)
	2	3.14	3.10	3.04	NS (.78)
	3	3.14	3.03	2.80	NS (.06)
	4	2.65	2.96	2.63	NS(.07)
S					
	1	3.68	3.44	3.19	1 vs 2&3
	2	3.22	2.34	2.36	1 vs 2&3
	3	3.25	2.30	2.00	1 vs 2&3
	4	3.06	2.39	2.06	1 vs 2&3
E					
	1	3.70	3.33	3.21	1 vs 3
	2	3.54	3.03	3.30	1 vs 2
	3	3.25	3.14	3.27	(.63)
	4	3.37	3.18	3.18	(.19)
C					
	1	3.86	3.13	3.08	1 vs 2&3
	2	3.43	3.06	3.09	none (.005)
	3	3.33	3.13	2.97	none (.04)
	4	3.17	3.00	2.79	none (.011)

Figure 1
ANOVA/Regression Results for Impact of Computer Exposure
(1993 Japan Data, n=198)

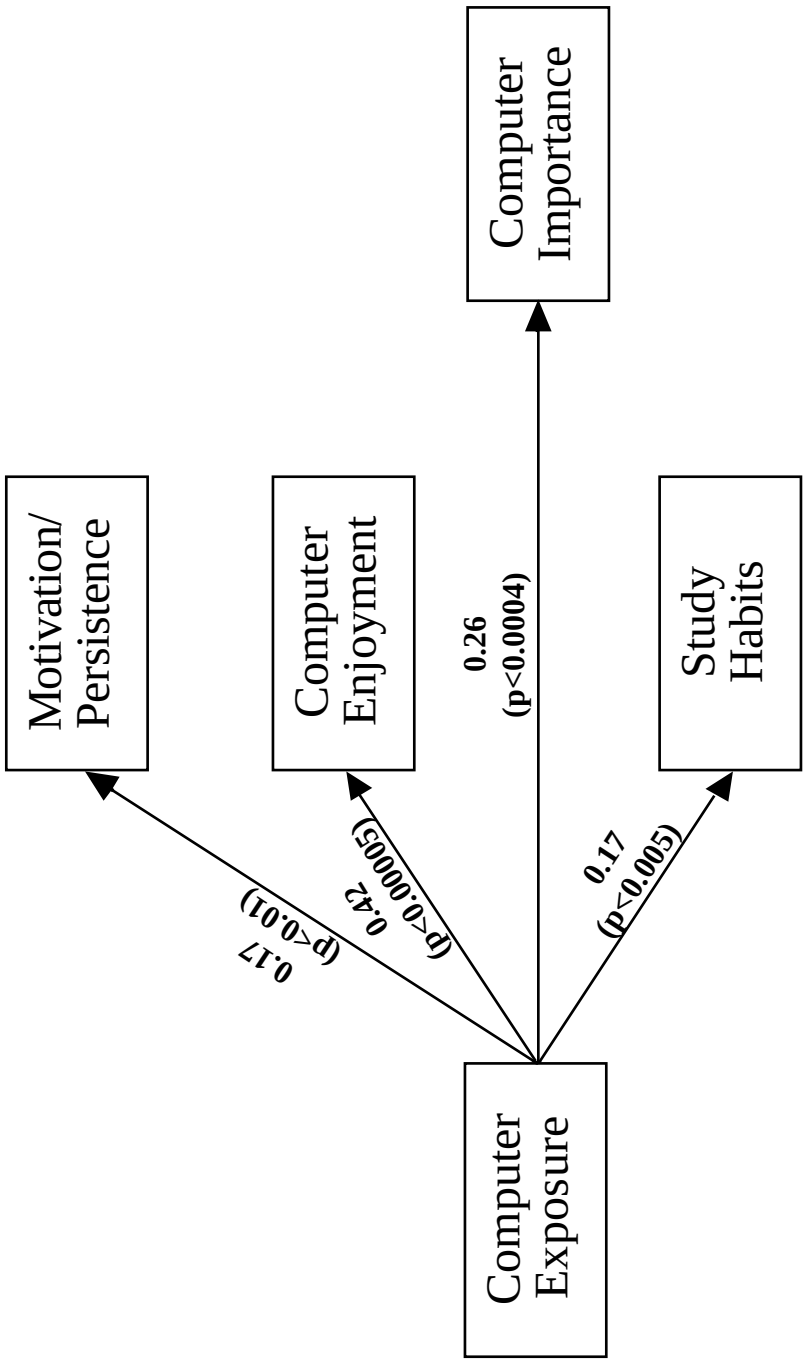

Figure 2
One Year Time-Lag Regression Results for 1991-92 U.S. Paired Data
(Standardized Coefficients, n=166)

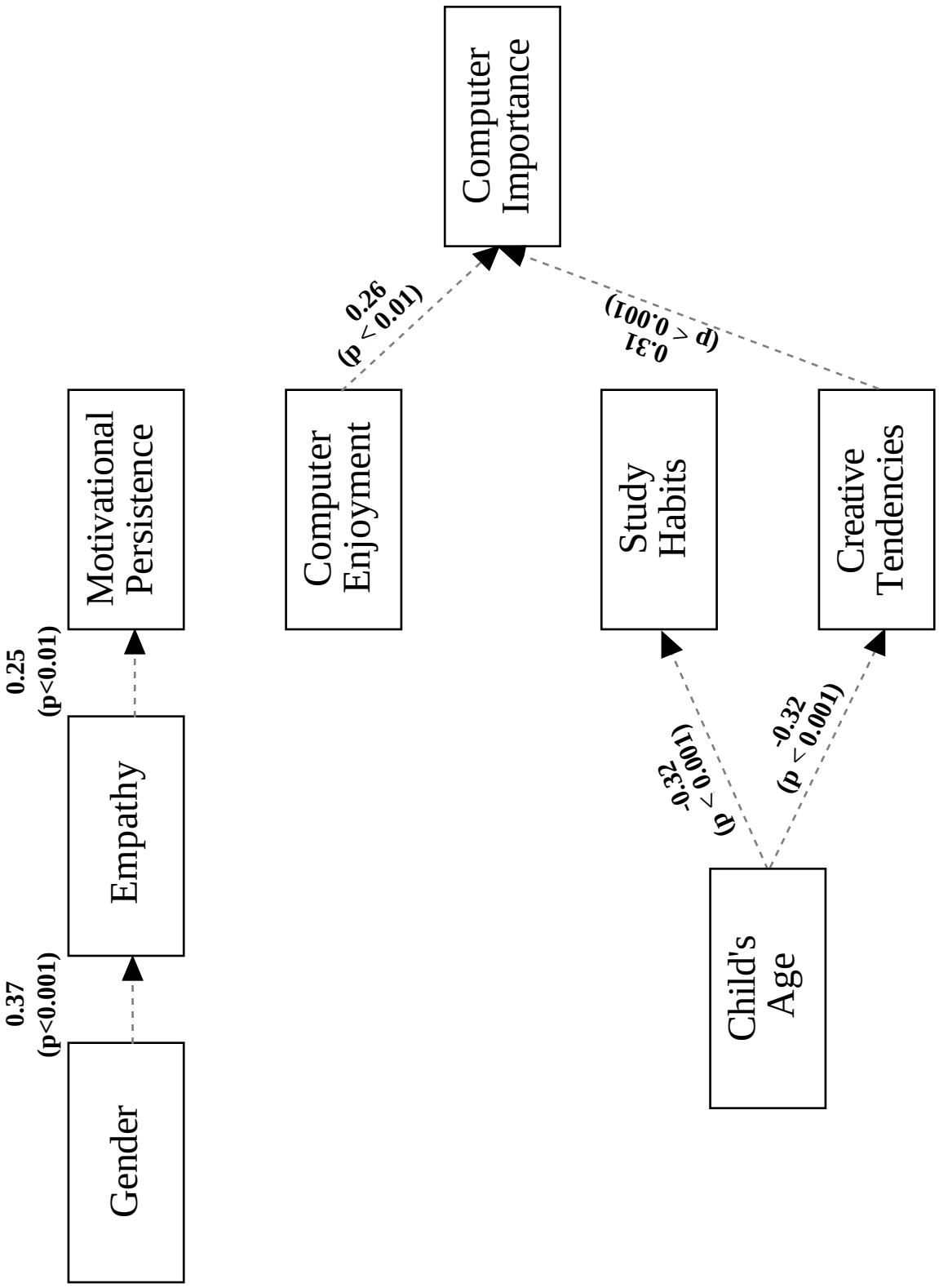

Figure 3
Causal Relations in YCCI Data