PREDICTING PROGRAMMING APTITUDE USING INTELLECTUAL DEVELOPMENT MEASURES

by

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THIS IS AS RECEIVED FROM CUSTOMER.

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CHAPTER 1: INTRODUCTION

When students indicate an interest in computer science or when the advisor of an incoming freshman feels the student's background is compatable with computer science, it would be an asset to have a simple tool to predict with reasonable accuracy a student's performance in an introductory computer programming course. This predictor would also be beneficial in screening the students of the introductory course into an advanced section versus the regular sections. This masters report deals with the problems of developing and testing the use of such a predictor.

Since Jean Piaget's stages of learning development measure the ability of the student to think abstractly and computer programming requires abstract thinking, these stages seem to lend themselves to being used as a predicting tool. The stages are not discreet, but should be thought of as on a continuum. The lower part of the continuum would be the pre-operational level followed by the concrete level and finally to the formal level. With college students, they are expected to be at least at the concrete level, so the levels of concrete and formal were divided into early and late. This study used late concrete, early formal, and late formal for intellectual development levels. The late prefix indicates that the student exhibits most of the criteria of the overall classification. The early prefix indicates that

the student exhibited some of the criteria, but were missing most of the criteria of the overall classification.

The pre-operational level is the only classification which is greatly influenced by chronological age. This level starts around the age of 2 years and continues to the ages of 7-8 years. At this level a person perceives static states, but are unable to follow modifications. For example, in transferring water from a wide jar to a thin jar, a pre-operational person would think the higher level of the water indicates more water. The concrete level starts around the ages of 7-8 years, but there is no set chronological age for progress to formal, in fact some people never progress past the concrete level. The concrete level person can transfer from reality to theory, but is unable to go from theory to reality. There are three types of reasoning invloved in the concrete level: classifications and generalizations, all dogs are animals but not all animals are dogs; conservation logic, the water problem of pre-operational would be done correctly; and serial ordering and 1-1 correspondence, for example, in a ratio problem of 6 to 8 and 15 to unknown, the concrete would add 9 to 8 because 6+9=15. The person at the formal level of reasoning is able to do abstract thinking and transfer from theory back to reality that the concrete person was unable to do. At the formal level, all the conrete types of reasoning are present, with the addition of being able to deal with these abstractly. In addition, the concrete person has combinatorial reasoning ability and the ability to reflect

on his reasoning to find and correct inconsistencies and contradictions.

A study was done by Barry Kurtz at San Francisco State University using Intellectual Development (ID) levels. The study found a significant correlation between ID-levels and course grades for the high and low ID-levels. However the sample size of the study was only 23 students, which is not large enough to endorse the accuracy of Kurtz's predictor(see Appendix B). The predictor also required 80 minutes to administer, which is not convenient in the university environment.

Three tasks were selected to be accomplished. The first was to reduce the size of the predictor to a test which would take 40-45 minutes. The longest time anyone required to take the new predictor was 45 minutes. Adding the 5 minute explanation at the beginning, this allowed the students time to finish the predictor within one normal university class period. The second task was to administer the new predictor to all CS 200 students. This was done, but the classes of one instructor were not used because his dismissal over halfway through the semester was disruptive for his students. The final task was to statistically analyse the results of the predictor and to determine if there is any correlation between the ID level and the final grade in the course. This was accomplished and the results were both encouraging and disappointing.

Chapter two of this report explains the test administration procedure, the method of evaluating the test,

and the establishment of intellectual development levels. The statistical analysis of the results are discussed in chapter three. The statistical analysis was done using the SAS package on the university computer., The conclusions of the report are presented in Chapter 4.

CHAPTER 2: METHOD AND SELECTED RESULTS

The subjects were students in the CS 200 Fundamentals of Computer Science class during Fall Semester 1980. The test was given in early October to 353 students(150 females and 203 males). There was a significant difference at the .05 level between the sexes for the grade in the course. The mean grades were female-3.58(C+) and male-3.18(C). There were 15 separate sections of the class. In three of those sections FORTRAN was taught as a first language while in 12 sections PL/1 was taught as a first language. The 3 FORTRAN sections had 45 students(7 female and 38 male). The 12 PL/1 sections had 308 students(143 females and 165 males). There was a different instructor for each FORTRAN section . For PL/1 there were 7 different instructors, all but 2 of which taught 2 sections each.

In assembling the data there were 87 students who received a grade in CS 200 who did not take this predictor. The predictor was strictly voluntary and some students didn't take it, while others may not have attended class that day. These 87 students were divided with 15 from FORTRAN sections and 72 from PL/1 sections. Also there were 71 tests for people who were non-existant on the grade sheets, indicating that for some reason, these students had dropped the course. Of these 71, 9 came from the FORTRAN sections and 62 from the PL/1 sections.

Appendix D has the raw data generated by this study. There is a 4 digit number first, which is the subject

number. The subject number has 2 parts, the first two digits represent the line number from the 1980 Fall line schedule of the CS 200 class. All the 1980 Fall CS 200 class line numbers are in the 3400's so only the last 2 digits were needed. The last two digits represents the subject number within the given class. The next entry is the sex of the student as M of F. To do the statistical analysis, some of the procedures required a numeric value, so M was translated to a 1 and F to a 2. The next entry is the letter grade received in the course; A,B,C,D, or F. When numeric values were required, the grades were translated as follows A-5, B-4, C-3, D-2, and F-1. The next 5 entries are the self-reported questions each coded as a single digit. First was previous programming experience, coded as 0-omit, 1-none, 2-some, and 3-much. The next was previous programming classes, coded as 0-omit, 1-none, 2-one or two classes, and 3-three or more classes. The next entry, the average of the grades received in these courses, was coded as 0-omit, 1-F, 2-D, 3-C, 4-B, and 5-A. The GPA was the next entry, coded as 4.0-3.5 to 5, 3.5-3.0 to 4, 3.0-2.5 to 3, 2.5-2.0 to 2, 2.0-below to 1, and omit to 0. The attitude was the last of these 5 entries and was coded as 0-omit, 1-yes, 2-no, and 3-undecided. To have a continuum for the analysis, this was changed by the program to 0-omit, 1-yes, 2-undecided, and 3-no. The final 11 single digit entries were the scores of a 0 or 1 from the 11 questions on the predictor.

The predictor had four self-reporting questions, 1.

previous programming experience, 2. previous programming classes and grades, 3. the student's GPA and 4. whether they liked programming. I feel they were quite honest with these self-reporting questions as the correlation coefficient between the grade in the course and their self-reported GPA was .34357 the largest coefficient that was found between any two elementary items. A value of p<=.05 was the criteria for testing the significance of all the correlation coefficients in this report, as suggested by a statistical consultant.

There were 308 students with no programming experience, 40 with a minimal amount of experience (for example classwork in high school) and 5 with a great deal of experience, for example programming for someone, using a home computer, or completion of several programming classes. The programming experience question had a significant correlation with 2 elementary items, propositional logic and ID level(see Figure 2.1 below).

Q11 Propositonal Logic	R=.168	p=.0015
ID level	R=.104	p=.05

Figure 2.1

With respect to previous programming classes and grades see Figures 2.2 and 2.3 below.

No answer	18
None	289
1-2	41
3+	5

Figure 2.2 Previous Programming classes

No answer	308
F	0
D	0
C	3
B	13
A	29

Figure 2.3 Grades in Previous Classes

Previous programming classes had significant correlation with question 11 on propositional logic, R = .14898 p = .005. The self reported grades had a significant correlation with the grade given in the course R = .15385 p = .0038.

The self-reported GPA generated Figures 2.4 and 2.5. Figure 2.4 provides the frequency distribution of GPA and Figure 2.5 lists all the elementary items which had a significant correlation with the self-reported GPA.

4.0-3.5	50
3.5-3.0	134
3.0-2.5	114
2.5-2.0	37
2.0-below	1
Omitted	17

Figure 2.4 Frequencies for Self-reported GPA

Q2 inverse proportion	R=.145	p=.0065
Q4 separation of Vars.	R=.145	p=.0064
Q5 direct proportion	R=.145	p=.0062
Q8 permutations	R=.131	p=.0140
Q9 combinations	R=.185	p=.0005
TOTAL on test	R=.227	p=.0001
Grade in course	R=.344	p=.0001
ID-Level	R=.129	p=.0153

Figure 2.5 Significant Correlation with Self-reported GPA

The final self-reported question concerned attitudes, it was "Do you like programming?". The frequency table for the question is found in Table 2.1.

Table 2.1 Frequency Table

Omitted	23
Yes	224
Undecided	57
No	49

This question had a significant correlation with the grade in the course R = -.10925 p=.0402. This negative correlation is reasonable because of the way the data was coded, a high number for attitude matched with No and a high number for grade matched with A. Since the correlation was negative this means there was correlation between an A and liking programming, and between an F and disliking programming.

Contruction of the formal reasoning test

The predictor was created by reducing the 15 questions of Kurtz's test (Appendix A) to 11 questions (Appendix C). Kurtz's questions 3,5,10,and 13 were removed as they were duplicates of other questions; this means that there were two questions on Kurtz's test that tested the same type of reasoning. Question 3 concerned probability, question 5 involved inverse proportion, question 10 concerned correlation, and question 13 involved direct proportion. The removal of these duplicates should not affect the

overall usefulness of the predictor, but does allow it to be given in a 50 minute period. The one set of duplicates that was left in the test was the set of 2 questions using propositional logic. These questions were difficult and being successful on one or the other or both was treated as being successful in propositional logic. This was also an important part of determining the ID-level, so this set of duplicates were left in.

The questions on the new predictor were not numbered to help avoid the student feeling it was a test. However, on page 3 the question on proportion at the bottom, was not answered by all the students. It is possible that the students couldn't find the question. In the future, numbering the questions should be seriously considered.

The test was evaluated by hand. For each question, the answer and reasons for that answer were evaluated. If the reasoning reflected formal reasoning for that question, a 1 was recorded, otherwise a 0 was recorded. Then the scores were added to obtain a raw test score. The histogram of the raw test scores is shown in Figure 2.6.

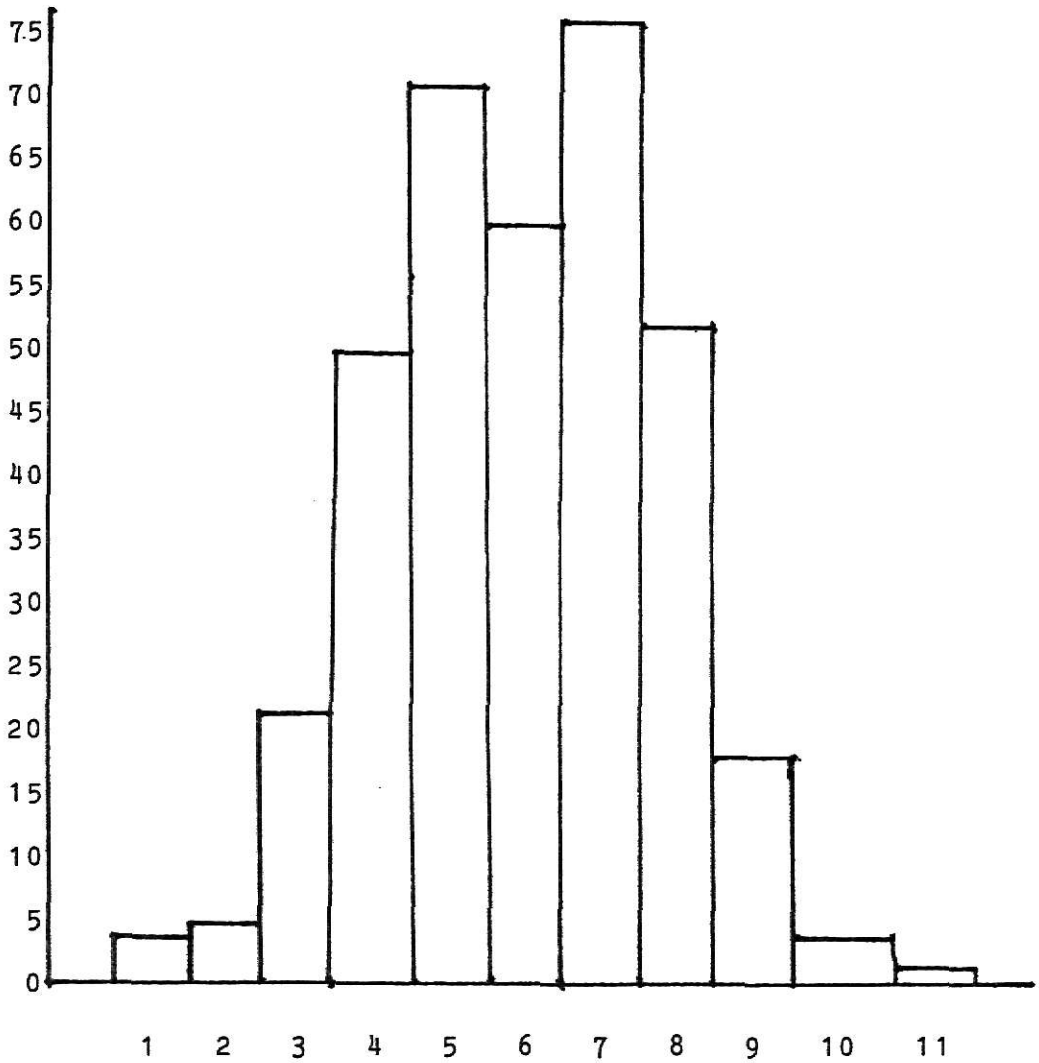

Figure 2.6 Histogram of raw scores.

Table 2.2 Percent of Correct responses on Individual Reasoning Tasks

Type of Reasoning	This Study	Kurtz's study
Separation of Variables	92.6%	91.3%
Inverse proportion	88.7%	73.9%
Conservation of Displaced Volume	84.1%	100.0%
Probability	76.2%	65.2%
Direct Proportion	74.8%	78.3%
Correlation	54.7%	56.5%
Combinations	47.8%	78.3%
Permutations	46.7%	60.9%
Deductive Logic	16.7%	27.3%
Propositional Logic	11.6%	13.0%

The percentage of correct responses for each of the reasoning categories are contrasted with the results obtained by Kurtz's study in Table 2.2. Notice there is almost no change between the top and the bottom of the table between the two studies.

To establish the ID levels, the specifications were the same used by Barry Kurtz on his test, since one of the purposes of this report was to repeat his study with a larger sample size and with slight modifications to the instrument. To be classified as late concrete, the student had to recieve a 0 for both direct proportion and probability, since chronologically these categories develop before the rest of the formal reasoning. Hence, if a student fails in both of the categories, he is classified as late concrete. If the reasoning they used reflected formal reasoning in either of these, the subject was at least early formal. To be classified as late formal, the student must be early formal and exhibit formal reasoning on any 3 of the following 4 areas: Correlation, Permutation, Deductive Logic, and Propositional Logic. Note that propositional logic had 2 questions, success on one or the other or both was treated as success for this category. Using these specifications, Table 2.3 was generated.

Table 2.3 Frequency Table on ID Levels

ID Level	Number	Percent
Late Concrete	32	9%
Early Formal	384	80.5%
Late Formal	37	10.5%

The evaluation of the course performance was taken from the students final grade in the course. There was a wide range of instructors and two different languages, so the methods of grading, teaching, and testing were quite varied. So the only realistic measure was the final grade, which was taken from the final grade sheets turned in by the instructor to the departmental office. Table 2.4 has the frequency table for the distribution of the grades.

Table 2.4 Frequency table for final grade distribution

Grade	Number	Percent
A	61	17.3%
B	132	37.4%
C	86	24.4%
D	44	12.5%
F	30	8.5%

To match the results of Kurtz's study, the grades were grouped into the performance levels given in Table 2.5.

Table 2.5 Performance Level Distribution

Level	Grade	Number	Percent
High	A	61	17.3%
Average	B-C	218	61.8%
low	D-F	74	21.0%

Several other methods for grouping the grades were used to test for correlation with the ID Level. The groupings are shown in Tables 2.6, 2.7, and 2.8..

Table 2.6 Grouping 1

Level	Grade	Number	Percent
High	A-B	193	54.7%
Average	C	86	24.4%
Low	D-F	74	21.0%

Table 2.7 Grouping 2

Level	Grade	Number	Percent
High	A-B	193	54.7%
Low	C,D,F	160	45.3%

Table 2.8 Grouping 3

Level	Grade	Number	Percent
High	A	61	17.3%
Low	B,C,D,F	292	82.7%

CHAPTER 3 : DATA ANALYSIS

An analysis of variance was performed on grade in the course by ID level. The ANOVA table is printed in table 3.1. Table 3.2 has the means standard error, frequency, and a grouping indicator for the grades associated with the three levels; late concrete, early formal, and late formal. Entries with the same grouping letter are not significantly different at the .05 level. Tables 3.1 and 3.2 provide statistics to allow comparison with Kurtz's study.

Table 3.1 ANOVA Table grade in class by ID level

Source	df	Sum of Sq	Mean Sq	F-value	pr>F
Between levels	2	9.234	4.617	3.46	.0325
Within levels	350	467.026	1.334		
Total	352	476.261			

Table 3.2 Groupings of means

Group	Grouping	Freq	Mean Grade	Std Error
Late concrete	A	32	3.00	.204
Early formal	B	284	3.43	.069
Late formal	B	37	3.73	.190

As seen in Table 3.1 the p-value is .0325 which indicates the rejection of the null hypothesis, which is that there is no significant difference between the means of the ID levels, at the .05 level of significance. This rejection indicates that there is a significant difference between some of the means, but doesn't indicate which means differ. Table 3.2 gives this information. The mean of the late concrete level is significantly different from both the mean of early formal and late formal. The contingency table in Table 3.3 gives the results of a chi-square test on performance levels and ID levels. This test was run to allow comparison with the results in Kurtz's study. This is a test of the independence between performance levels and ID levels. The p-value given by the test is .1229, which indicates that, at the .05 level of significance, performance level and ID level are independent. Note that there is a slight trend, though not statistically significant, of the row percentages to the higher performance level in moving from late concrete to late formal. A correlation was run between ID Level and Performance levels, with a Pearson correlation coefficient, R=.11615 and R-squared=.0135 with a p=.0291. This is not an impressive correlation, however it is statistically significant at the .05 level. A Pearson correlation coefficient of R=.13729 and R-squared=.019 was also calculated between the grade in the course and the ID level.

Table 3.3 Contingency table for chi-square
ID Level vs Performance Level

	Low D-F	Average B-C	High A	Total
Late Concrete	9 28.1%	21 65.6%	2 6.3%	32
Early formal	58 20.4%	178 62.7%	48 16.9%	284
Late formal	7 18.9%	19 51.4%	11 29.7%	37
Total	74	218	61	353

chi-sq=7.257 df=4 p=.1229

Tables 3.4, 3.5, and 3.6 show the results of a chi-square test for independence between ID Level and each of the new grade groupings given in Tables 2.6, 2.7, and 2.8 in Chapter 2. These tests were significant at the .05 level, which indicates that there is a relationship between ID Level and each of the groupings.

Table 3.4 Contingency table for chi-square
ID Level vs Grouping1(AB-C-DF)

	Low DF	Average C	High AB	Total
Late Concrete	9 28.1%	12 37.5%	11 34.4%	32
Early Formal	58 20.4%	71 25.0%	155 54.6%	284
Late Formal	7 18.9%	3 8.1%	27 73.0%	37
Total	74	86	193	353

chi-sq=11.901 df=4 p=.0181

Table 3.5 Contingency table for chi-square
ID Level vs Grouping2(AB-CDF)

	Low CDF	High AB	Total
Late Concrete	21 65.6%	11 34.4%	32
Early Formal	129 45.4%	155 54.6%	284
Late Formal	10 27.0%	27 73.0%	37
Total	160	193	353

chi-sq=10.321 df=2 p=.0057

Table 3.6 Contingency table for chi-square
ID Level vs Grouping3(A-BCDF)

	Low BCDF	High A	Total
Late Concrete	30 93.8%	2 6.2%	32
Early Formal	236 83.1%	48 16.9%	284
Late Formal	26 70.3%	11 29.7%	37
Total	292	61	353

chi-sq=6.7 df=2 p=.0340

To help in the interpretation of Tables 3.4, 3.5, and 3.6, the row percentages were included for each of the cells. All of these tables show a shift of the percentages from Low level and Low Concrete to High and Late Formal. Table 3.5 gives the best pattern. At late concrete 65.6% of the students were at a low performance level and only 34.4% at the high level. In early formal the percentages are about equal, but at the late formal there is the shift to

27% at the low performance level and 73% at the high performance level.

The correlation coefficients and p-values for each of these groupings with ID Level are given in Table 3.7.

Table 3.7 Pearson correlation coefficients

Grouping	ID Level with R	p
AB-C-DF	.13046	.0142
AB-CDF	.17084	.0013
A-BCDF	.13796	.0095

CHAPTER 4 CONCLUSIONS and RESULTS

Was the ID level a useful predictor of course performance? Not with respect to substantiating Kurtz's study. The Pearson correlation coeffiecient between ID level and Kurtz's performance level was only .11615 compared to Kurtz's study which had a Pearson correlation coefficient of .7954. The ambiguity of the interpretations of the figures in Table 3.3 is also unsettling. The slight trend of the row percentages to the high performance (A grade) level as the table is scanned from late concrete to late formal raises some possibilities, but the chi-square test was not statistically significant at the .05 level.

The results from table 3.5 are encouraging with respect to the use of the new predictor to segregate advanced students from students at a normal level. The ID level had a significant relationship with the performance levels of AB and CDF. The Pearson correlation coefficient for this relationship was R=.17084 at p=.0013. The correlation coefficient is not large enough for the predictor to be used alone, but used in conjunction with other information on the student's past performances, it could be a useful tool to the department, as well as A & S College, advisors.

In comparing the results of this study with Kurtz's results, one must remember that he was able to control almost every factor which might affect the results and had a small(23) sample size. The small sample size lowers the confidence with which one can rely on the results of the

statistical analysis. In this study, there were 10 different instructors, 15 different sections, 2 different languages, 4 different classrooms, and 12 different class times. All these uncontrolled factors probably forced the magnitude of the correlation coefficient to be smaller. The fact that the chi-square test was significant in Table 3.5 even with these uncontrolled factors indicates that this new predictor could be useful in the right context. In the furture this study could be run with some or most of these variables controlled enough to get some meaningful results of a larger magnitude. For example it is suggested that one or two instructors be selected who are considered good teachers and are enthusiastic about participating in the study. They would then communicate this enthusiasm to their students such that the students would put in more concentrated effort on the predictor.

In the fall semester, 1980, the Department of Computer Science changed the method of teaching CS 200 Fundamentals of Computer Science. There is some debate upon whether the grade in the course actually represents a reasonable indicator to the student's programming ability. Added to the changed method is the fact that some of the instructors were not trained in teaching methods as had been done in the past. All of these factors influenced the results of this study. When the transitive impacts of these changes in CS 200 are stabilized, it would be appropriate to attempt another study similar to this one.

There was some problem with the attitude of the

students towards the predictor. A great deal of effort should be expended to impress the student with both the importance of doing his best on the test and the usefulness of the research.

The first question on the test, conservation of volume, was not used for any calculation with respect to ID levels. In the future, this question might be considered for removal to shorten the test more, or to allow space for one of the questions removed from the original test.

It would also be useful to attempt a replication of the Kurtz work. Classes in Summer School when the length of the class period allows the 80 minute test would be a good environment for such an attempt. Our results can then be evaluated to allow a better informed decision on the test length reduction by simple question removal. Actually this researcher attempted this last summer, but the cooperation of the instructors was inadequate. They had a short time to cover a large amount of material and were reluctant to devote a whole class period to the predictor. The test was given as a take-home and asked to be returned, but the response(<10%) was so low that there was no meaningful information gained by the effort. One thing for future researchers to keep in mind is that even a 45 minute test like the new (11 question) predictor is a chore for the student so he must be motivated as much or more for the full 15 question test.

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APPENDIX A

Brief description of ID test items

Item 1: Conservation of Displaced Volume (Karplus and Lavatelli, 1969)

Students are shown a picture of two identical containers filled to the same level with water. There are two weights of the same shape, but different densities. Shown a picture of the water level displaced by the light weight in one container, students are asked to predict the level of water(higher,lower,same) displaced by the heavy weight in the other container.

Item 2: Direct Proportion -1(Kurtz, Karplus, 1979)

Students are told that in a particular photograph a mother is 8 cm high and her daughter is 6 cm high. If the picture is enlarged so that the daughter is 15 cm high, students are asked to predict the mother's height.

Item 3: Probabilistic Reasoning -1(adapted from Lawson, 1977)

Four red chips and six blue chips are placed in a container on the left, while six red chips and nine blue chips are placed in a container on the right. Students are asked to predict which container they would choose (left,right,doesn't matter) to have the best chance of drawing a red chip on the first try.

Item 4: Inverse Proprotion -1

Suppose that you are investigating the running abilities of a horse and a dog. You find that each time the horse takes a step, the dog also takes a step. You measure the stride of the horse and find that it is 12 feet long. This horse can run a particular course in 30 seconds. If the dog has a 4 foot stride, how long will it take the dog to complete the course?

Item 5: Inverse Proportion -2

Suppose that you are comparing a different dog with the same horse. (Again, each time the horse takes a step, the dog takes a step.) This dog has a 5 foot stride. How long will it take this dog to complete the same course?

Item 6: Propositional Reasoning - 1(after Wason and Johnson-Laird, 1972)

Students are asked to test the truth or falsity of the following rule: If a card has a vowel on one side, then it has an even number on the other side. Students are shown successive pictures of cards displaying E, 4, K, 7 and, in each case, asked, "Would you need to know what is on the other side of this card?-------Why?"

Item 7: Correlational Reasoning -1 (adapted from Lawson,1978)

Shown a picture with 6 birds having long beaks and short tails, 2 birds having short beaks and short tails, 2 birds having long beaks and long tails, and 6 birds having short beaks and long tails, students are asked if there is a relationship between the length of beak and the length of tail.

Item 8: Deductive Logic (Karplus and Karplus, 1970)

Shown a picture of four islands, named bean, bird, fish, and snail, students are given the following clues:
Clue 1: There is a way to fly between bean island and bird island.
Clue 2: There is no way to fly between bird island and snail island.
Clue 3: There is a way to fly between bean island and fish island.
The students are asked:
Is there a way to fly between bird island and fish island?
(yes, no, not enough information. Why?)

Is there a way to fly between fish island and snail island?
(yes, no, not enough information. Why?)

Item 9: Separation of Variables (Lawson, private communications)

Students are shown four pictures: (1) a healthy plant that received a tall glass of water and light plant food, (2) an unhealthy plant that received a tall glass of water, dark plant food and leaf lotion, (3) a healthy plant that received a small glass of water, light plant food, and leaf lotion, and (4) an unhealthy plant that received a small glass of water and dark plant food. Told that another plant is receiving a small glass of water, light plant food, and no leaf lotion, students are asked to predict how the plant is doing.

Item 10: Correlational Reasoning - 2(adapted from Lawson,Karplus, Adi 1979)

Shown a picture of 8 squares with lines, 4 squares with dots, 2 circles with lines, and 1 circle with dots, students are asked if there is a relationship between the shape and the design.

Item 11: Permutations(adapted from Longeot, 1965)

Students are given a hypothetical situation in which four stores(a barber shop,a discount store, a grocery store, and a coffee shop) are to be arranged side-by-side on the ground floor of a shopping center. The students are asked to list all the possible ways that the stores can be arranged.

Item 12: Probabilistic Reasoning - 2(adapted from Lawson, 1977)

Three blue chips and seven red chips are placed in a container on the left,awhile two blue chips and four red chips are placed in a container on the right. Students are asked which container they would choose (left,right, doesn't matter) to have the best chance of drawing a blue chip on the first try.

Item 13: Direct Proportion - 2

Students are told that it takes 6 cups of flour (along with other ingredients) to make four dozen cookies and asked to predict how many cups of flour would be needed to make six dozen cookies.

Item 14: Combinations (Lawson,1976)

Students are told that biologists ae dissecting crab stomachs to find out if they are eating red, yellow, blue, or green algae (all locally plentiful) or other food. They are to list all possible varieties of algae the crabs might be eating (assuming order is not important).

Item 15: Propositional Reasoning - 2 (Lawson, Karplus, Adi, 1978)

Students are asked to test the truth or falsity of the following hypothesis: if a rat has lipids in its blood, then it will be fat.
Students are asked:
(i) Given blood samples with lipids, would you need to know if they came from fat or thin rats?
(ii) Given blood samples with no lipids, would you need to know if they came from fat or thin rats?
(iii) Given several fat rats, would you need to know is there are lipids in these rats' blood?
(iv) Given several thin rats, would you need to know if there are lipids in these rats' blood?

APPENDIX B

NAME_____

This survey is being conducted under guidelines established by Kansas State University. By cooperating, you will help provide answers to important questions; however, your participation is strictly voluntary. You should omit any questions which you feel unduly invade your privacy or which are otherwise offensive to you. Confidentiality is guaranteed; your name will not be associated with your answers in any public or private report of the results.

What programming experience have you had?

What programming classes have you taken and what grades have you recieved?

What is your G.P.A.?
(approx.) 4.00-3.50 3.00-3.50 2.50-3.00 2.00-2.50 Below 2.00

Do you like programming?

*** Suppose that you are given two identical cylinders filled to the same height with water. (see fig. a) You have two weights with the same shape; a light weight made out of aluminum and a heavy one made out of steel. Suppose the light weight is put into one cylinder and the water rises, as shown in figure b.

Figure a.

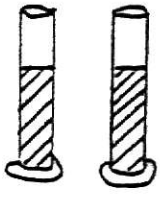
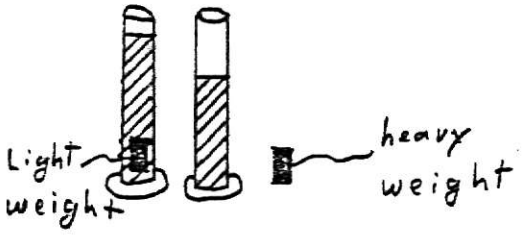


Figure b.



If the heavy weight is put into the other cylinder, then the water will rise to:

(a) a higher level.
(b) a lower level.
(c) the same level.

Please explain your answer.

*** Suppose that you are investigating the running abilities of horses and dogs. You find that each time the horse takes a step, the dog also takes a step. You measure the stride of the horse and find it is 12 feet long. This horse can run a particular course in 30 seconds. If the dog had a 4 foot stride, how long will it take the dog to complete the same course?

Answer_____

Please explain your answer.

Suppose you are comparing a different dog with the same horse. This dog has a 5 foot stride. How long would it take this dog to complete the same course?

Answer_____

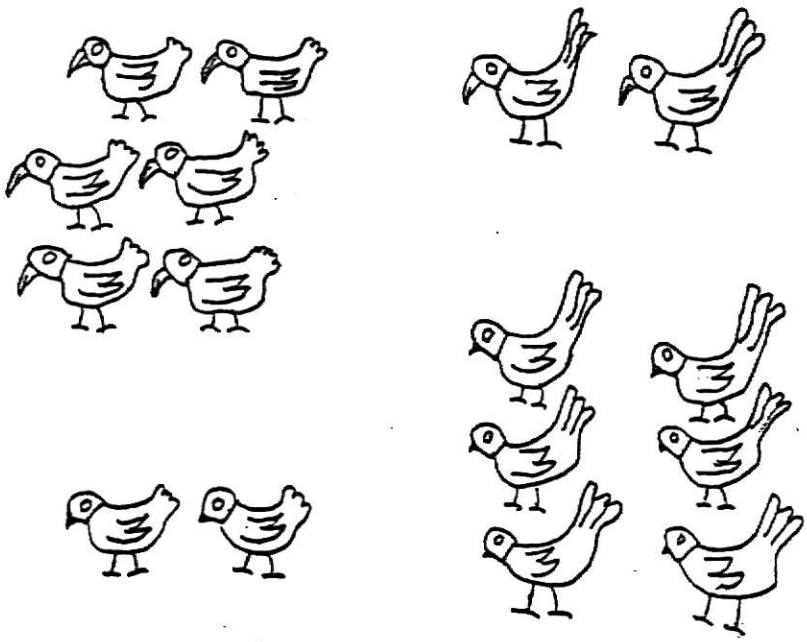
Please explain your answer.

*** Look at the pictures below. Some of the birds have short tails and some have long tails. Some of the birds have short beaks and others have long beaks. Do you think there is a relationship between the length of the beak and the length of the tail in these birds?

(A "relationship" means that knowing the length of a particular bird's beak would make it more likely that it has a particular length tail, and vice versa.)

YES NO

Please explain your answer.



*** Below are some plants a person grew:

Plant number one was given a large glass of water and light plant food each week. It is doing well.

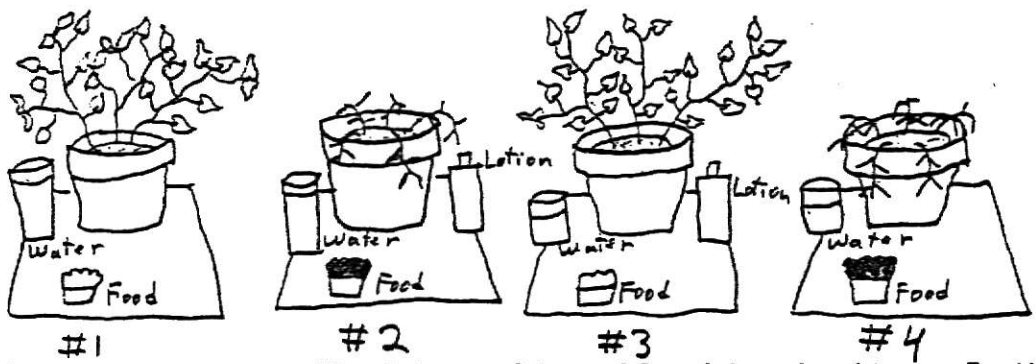
Plant number two was given leaf lotion, a large glass of water and dark plant food each week. It is not doing well.

Plant number three was given a small glass of water, light plant food, and leaf lotion each week. It is doing well.

Plant number four was given a dark plant food, no leaf lotion and a small glass of water each week. It is not doing well.

At home this person has another plant and once a week is giving it a small glass of water, light plant food and no leaf lotion. Do you think it is doing well? (You may assume that only one factor is responsible for poor growth.)

Please explain your answer.



*** A mother has a small picture of herself and her daughter. In this picture the mother is 8 centimeters (cm) high and the daughter is 6 cm high. She decides to have an enlargement made of this picture. In the enlargement the daughter is 15 cm high. How high will the mother be in the larger picture?

Answer_____

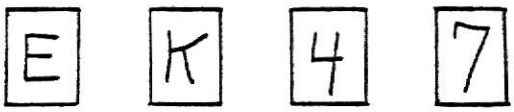
Please explain your answer.

*** In the container on the left, there are four red chips and six blue ones. In the container on the right, there are six red chips and nine blue ones. If you wanted to pick a red chip on the first try, from which container would you take a chip?

(a) the one on the left.
(b) the one on the right.
(c) it doesn't make any difference.

Please explain your choice.

*** Below are pictures of four cards.



You know that each of these cards has a letter on one of its sides and a number on its other side. Read the following rule:

If a card has a vowel on one side, then
it has an even number on the other side.

You want to find out whether this rule is true or false. In the spaces below, name those cards, and only those cards, that need to be turned over to find this out.

Need to be turned? YES NO

Why?

Need to be turned? YES NO

Why?

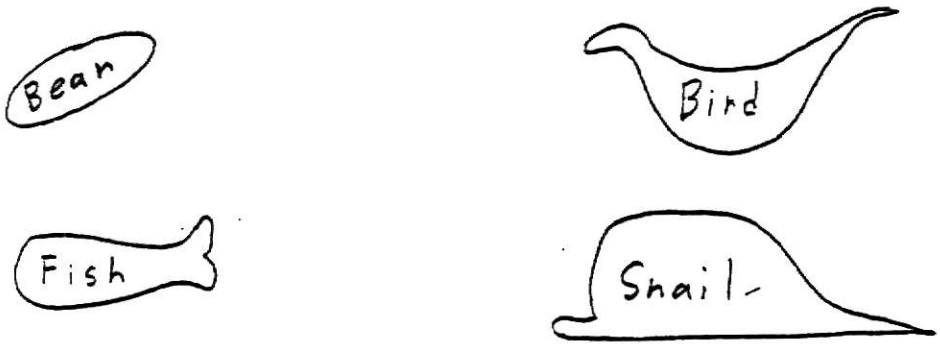
Need to be turned? YES NO

Why?

Need to be turned? YES NO

Why?

***



This is a puzzle about four islands in the ocean. People have been traveling among these islands by boat for many years, but recently an airline started in business. A plane trip between islands may be direct or it may include stops on the other islands. To say a trip is possible means it can be made in both directions between the islands.

Above you are given a map of the four islands, called Bean, Bird, Fish, and Snail island. You may make notes or marks on your map to help you remember the clues.

Use only the given clues to answer the following questions:

Clue 1: There is a way to fly between Bean and Bird island.
Clue 2: There is no way to fly between Bird and Snail island.

Question 1: Is there a way to fly between Bean and Fish island?

YES NO NOT ENOUGH INFORMATION (circle one)

Why?

Now suppose you also know:
Clue 3: There is a way to fly between Bean and Fish island.
(don't change your answer to question 1)

Question 2: Is there a way to fly between Fish and Bird island?

YES NO NOT ENOUGH INFORMATION (circle one)

Why?

Question 3: Is there a way to fly between Fish and Snail island?

YES NO NOT ENOUGH INFORMATION (circle one)

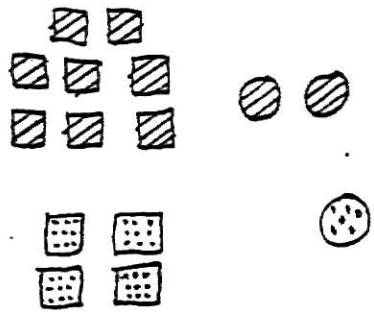
Why?

*** Look at the pictures below. Some of the shapes are circles and the others are squares. Some of the shapes have a dotted design on them and the others have a stripped design on them. Do you think there is a relationship between the type of shape and the design?

(a "relationship" means that knowing the shape of a particular object would make it more likely it has a particular design, and vice versa.)

YES NO

Please explain your answer.



*** In a new shopping center, 4 stores are going to be opened on the ground floor. A BARBER shop, a DISCOUNT store, a GROCERY store, and a COFFEE shop want to move in there. Each one of them can choose any one of the 4 stores. Count ALL THE POSSIBLE WAYS that they can occupy the 4 stores.

BDGC would be one combination which means that the barber shop is in the first store on the left, the discount store in the second store, the grocery store in the third store and the coffee shop in the fourth store(the rightmost store). How many possible ways can the stores be arranged in the shopping center? (include BDGC in the count).

Please explain your answer.

*** A biologist is trying to discover the eating habits of a local species of crab. He knows there are four types of seaweed available to eat: red(R), yellow(Y), green(G), and blue(B). The crabs are free to eat various types of seaweed (or none at all). The biologist can find out what a crab is eating by dissecting its stomach. List ALL(including RYGB) possible varieties of seaweed the biologist might find the crabs are eating. For example, if a crab ate all four types, you would list RYGB. (you may assume the order of the seaweed is not important.)

*** In the container on the left, there are three blue chips and seven red ones. In the container on the right, there are two blue chips and four red ones. If you wanted to pick a blue chip on the first try, which container would you pick from?

(a) the one on the left.
(b) the one on the right.
(c) it doesn't make any difference.

Please explain your choice:

*** Suppose that it takes 6 cups of flour (along with other ingredients) to make four dozen cookies. How many cups of flour would you need to make six dozen cookies?

Answer_____

Please explain your answer.

*** Suppose that you are trying to find out why rats are fat and you suspect that one of the causes may be lipids in the blood. You want to test the hypothesis:

If a rat has lipids in its blood, then it will be fat.

Which of the following data relate to the hypothesis, in the sense of supporting the hypothesis or causing it to be rejected. (circle one or more choices)

(a) Given several blood samples with lipids, you would need to know whether these samples came from fat or thin rats.

(b) Given several blood samples with no lipids, you would need to know whether these samples came from fat or thin rats.

(c) Given several fat rats, you would need to know whether there are lipids in these rats' blood.

(d) Given several thin rats, you would need to know whether there are lipids in these rats' blood.

Please explain your choice or choices.

APPENDIX C

NAME_____

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Do you like programming?

*** Suppose that you are given two identical cylinders filled to the same height with water. (see fig. a) You have two weights with the same shape; a light weight made out of aluminum and a heavy one made out of steel. Suppose the light weight is put into one cylinder and the water rises, as shown in figure b.

Figure a.

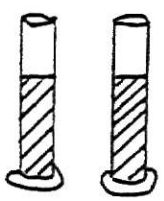
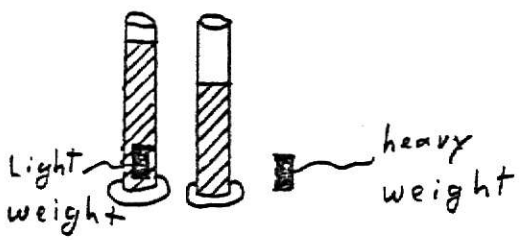


Figure b.



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Answer_____

Please explain your answer.

*** Look at the pictures below. Some of the birds have short tails and some have long tails. Some of the birds have short beaks and others have long beaks. Do you think there is a relationship between the length of the beak and the length of the tail in these birds?

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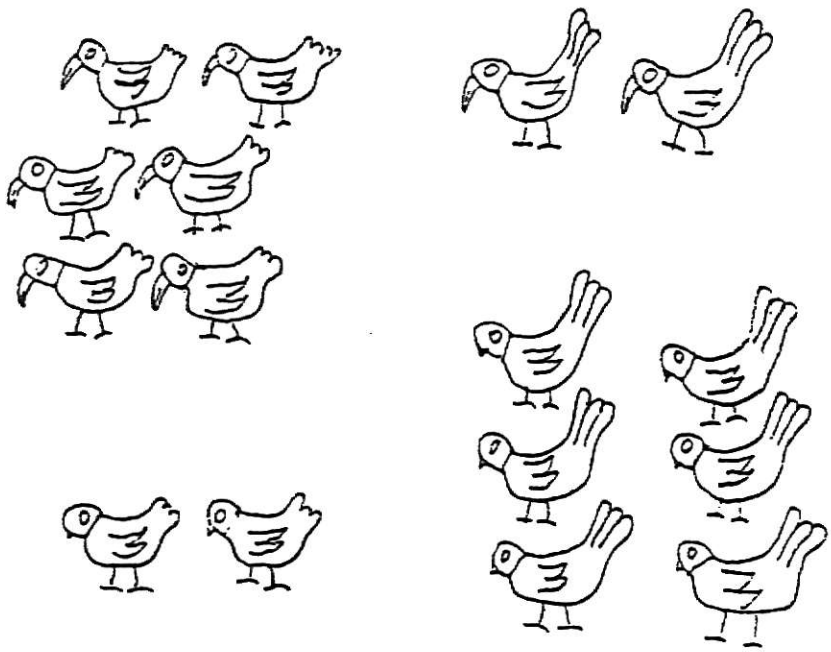
YES NO

Please explain your answer.



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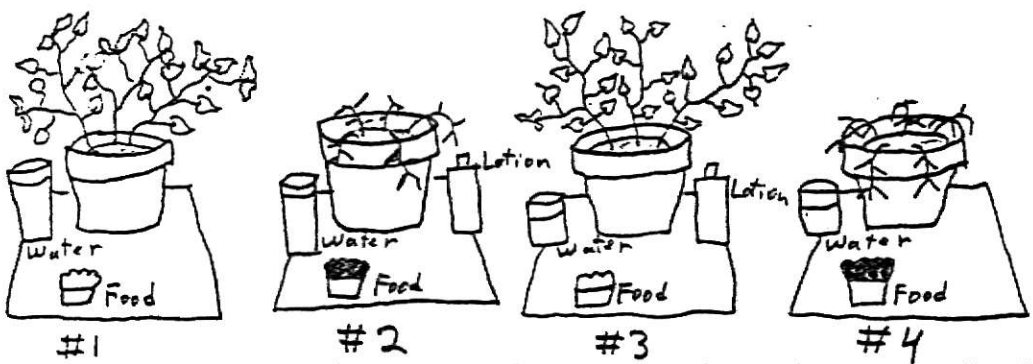

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Answer_____

Please explain your answer.

*** Suppose that you are trying to find out why rats are fat and you suspect that one of the causes may be lipids in the blood. You want to test the hypothesis:

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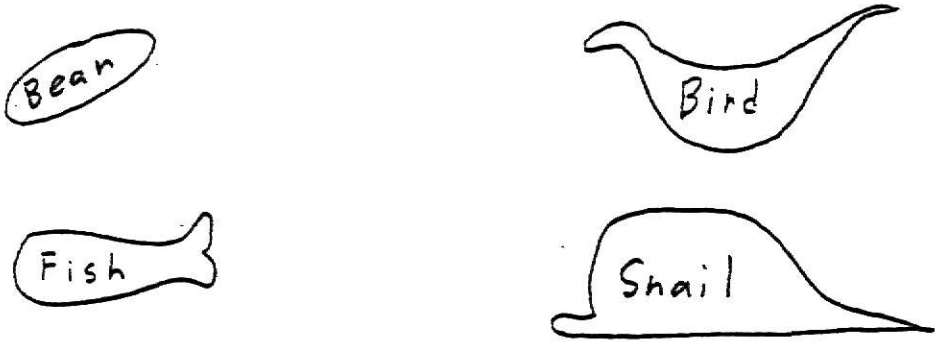
(d) Given several thin rats, you would need to know whether there are lipids in these rats' blood.

Please explain your choice or choices.

***



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Question 1: Is there a way to fly between Bean and Fish island?

YES NO NOT ENOUGH INFORMATION (circle one)

Why?

Now suppose you also know:
Clue 3: There is a way to fly between Bean and Fish island.
(don't change your answer to question 1)

Question 2: Is there a way to fly between Fish and Bird island?

YES NO NOT ENOUGH INFORMATION (circle one)

Why?

Question 3: Is there a way to fly between Fish and Snail island?

YES NO NOT ENOUGH INFORMATION (circle one)

Why?

*** In a new shopping center, 4 stores are going to be opened on the ground floor. A BARBER shop, a DISCOUNT store, a GROCERY store, and a COFFEE shop want to move in there. Each one of them can choose any one of the 4 stores. Count ALL THE POSSIBLE WAYS that they can occupy the 4 stores.

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Please explain your answer.

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(c) it doesn't make any difference.

Please explain your choice:

*** Below are pictures of four cards.

You know that each of these cards has a letter on one of its sides and a number on its other side. Read the following rule:

If a card has a vowel on one side, then
it has an even number on the other side.

You want to find out whether this rule is true or false. In the spaces below, name those cards, and only those cards, that need to be turned over to find this out.

Need to be turned? YES NO

Why?

Need to be turned? YES NO

Why?

Need to be turned? YES NO

Why?

Need to be turned? YES NO

Why?

APPENDIX C

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
601	F	D	1	1	0	3	3	1	1	0	1	1	0	0	1	0	0	0
602	M	C	1	1	0	3	3	1	1	0	1	0	0	0	0	0	1	0
603	M	F	1	1	0	3	1	1	1	1	1	0	0	1	1	0	1	0
604	M	C	1	0	0	3	1	1	1	1	1	1	0	0	0	0	1	0
605	F	A	1	1	0	0	3	1	1	0	1	1	0	0	1	1	0	1
606	M	B	1	1	0	3	2	1	1	1	1	1	0	0	0	1	1	0
607	M	A	1	1	0	2	1	1	1	1	1	1	0	0	0	0	1	0
901	M	C	1	1	0	4	2	1	1	1	1	1	0	0	1	1	0	0
902	F	D	2	2	4	4	1	1	1	0	0	0	0	0	0	1	1	0
903	F	F	1	1	0	4	3	1	1	0	1	1	0	0	0	0	1	0
904	F	D	1	1	0	4	2	0	1	0	1	0	0	0	1	1	0	0
905	F	A	1	1	0	4	3	1	1	1	1	1	0	0	0	1	1	0
906	M	B	1	1	0	3	1	1	1	0	1	1	0	0	1	0	1	0
907	M	D	1	1	0	3	2	1	1	0	1	1	1	0	1	1	0	0
908	M	D	1	1	0	2	1	1	1	0	1	1	0	1	1	1	1	0
909	M	A	1	1	0	5	1	1	1	1	1	1	0	1	1	1	0	1
1101	M	B	2	2	3	4	1	1	0	1	1	1	0	0	0	1	1	1
1102	F	A	2	2	5	5	1	0	1	0	1	1	0	1	0	1	0	0
1103	M	D	1	1	0	4	1	0	1	0	1	1	0	0	0	1	1	0
1104	F	B	1	1	0	4	3	1	1	0	0	1	0	0	1	1	0	0
1105	F	B	2	2	4	4	1	1	1	0	1	1	0	0	0	0	1	0
1106	M	F	1	1	0	0	1	1	1	0	0	1	0	0	0	0	0	0
1107	F	B	1	1	0	4	1	0	1	0	0	0	0	0	0	0	0	0
1108	F	C	1	1	0	3	2	1	1	1	1	0	0	0	0	0	0	0
1109	M	A	2	2	5	3	1	1	1	1	1	1	0	0	0	0	1	0
1110	F	F	1	1	0	2	3	1	1	1	1	0	0	0	1	1	0	0
1111	M	C	1	1	0	4	1	1	1	0	1	1	0	0	0	0	0	0
1112	M	A	3	3	5	5	1	1	1	0	1	1	0	0	0	0	0	0
1113	M	F	1	1	0	4	1	1	0	1	1	1	0	0	0	1	0	0
1114	F	A	1	1	0	4	1	1	1	0	1	1	0	0	1	0	1	0
1115	M	F	1	1	0	3	1	1	1	0	1	1	0	0	0	0	1	0
1116	M	F	2	3	3	0	1	1	1	1	1	1	0	0	1	1	1	1
1117	M	B	2	2	4	2	1	1	0	0	1	1	0	0	0	0	0	0
1118	F	C	1	1	0	4	1	1	1	0	1	1	0	0	0	1	1	0
1119	M	A	2	2	5	4	1	1	1	0	1	1	0	0	1	0	1	1
1120	M	F	1	1	0	2	0	1	0	0	0	1	0	0	1	0	1	0
1121	F	D	1	1	0	5	1	0	1	1	1	1	0	0	1	0	1	0
1122	M	A	2	1	0	3	1	1	1	1	1	1	0	0	0	0	1	1
1123	F	F	2	3	5	4	1	0	1	1	1	1	0	1	1	1	1	0
1124	M	B	1	1	0	5	1	1	1	1	1	1	0	0	1	0	1	0
1125	F	B	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1
1126	F	F	2	1	0	4	1	1	1	0	1	1	0	0	1	1	1	0
1127	F	B	1	1	0	5	1	1	1	1	1	1	0	0	1	0	0	0
1128	F	B	2	2	4	5	1	0	0	0	1	0	0	0	0	0	1	1
1129	M	D	1	1	0	5	3	1	1	0	1	1	0	0	0	1	1	0
1130	M	A	1	0	0	5	1	1	0	1	1	1	0	0	1	1	1	0
1131	F	A	1	1	0	5	1	1	1	1	1	1	0	0	1	1	1	0
1132	F	C	2	3	5	4	1	0	1	1	1	0	0	0	0	0	0	0
1133	M	D	1	1	0	4	1	1	0	1	1	0	0	0	0	0	1	0
1134	M	F	1	1	0	5	1	1	1	0	1	1	0	0	1	1	1	0
1136	M	C	1	1	0	3	0	0	1	1	1	1	0	0	0	0	0	0
1136	M	C	1	1	0	3	0	0	1	1	1	1	0	0	0	0	0	0
1137	M	F	2	1	0	4	1	1	0	0	1	1	0	1	0	0	1	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
1139	M	C	1	1	0	4	3	1	1	1	1	1	0	0	0	0	1	0
1140	F	A	2	2	5	5	1	1	1	0	1	1	0	0	1	0	1	0
1141	F	D	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1142	M	D	1	1	0	5	1	1	1	1	1	1	0	0	0	0	1	0
1143	M	B	2	2	4	4	1	1	1	1	1	0	0	1	1	0	1	0
1144	F	B	1	1	0	4	1	1	1	0	1	0	0	0	0	0	1	0
1145	F	C	1	2	5	2	1	0	1	0	0	0	0	0	0	1	1	0
1146	M	F	2	1	0	3	1	1	1	0	1	1	0	1	0	0	1	1
1147	M	A	1	2	5	3	1	0	1	1	0	1	0	0	0	1	1	0
1148	M	D	1	1	0	3	1	1	1	1	1	1	0	0	0	1	1	0
1149	F	B	1	1	0	5	1	1	1	1	1	1	0	0	1	0	1	0
1150	M	B	2	2	4	4	1	1	1	0	1	1	0	0	0	1	1	1
1151	F	A	1	1	0	5	3	1	1	0	1	1	0	0	1	1	1	0
1152	M	D	1	1	0	3	1	1	1	1	0	1	0	0	1	0	0	0
1153	M	A	2	2	5	4	1	1	1	1	1	1	0	0	1	1	1	1
1154	M	B	3	2	4	2	1	1	1	1	1	1	0	0	0	0	0	0
1155	F	A	2	2	5	3	1	1	0	0	1	0	0	0	0	0	1	0
1156	F	B	1	1	0	5	1	1	1	0	1	1	0	0	1	0	0	0
1157	F	B	1	1	0	5	1	1	1	0	1	1	0	0	1	1	1	0
1158	F	B	2	1	0	4	1	1	1	0	1	1	0	0	1	0	1	0
1159	F	B	2	2	5	5	1	0	1	1	1	1	0	0	1	1	1	0
1160	M	A	1	1	0	5	1	1	1	1	1	1	0	0	1	1	1	0
1161	F	B	2	2	5	4	1	1	1	0	1	1	0	0	0	1	0	0
1162	M	D	2	2	5	2	0	1	1	1	1	1	0	0	1	1	1	0
1163	M	D	1	1	0	3	1	0	1	1	1	1	0	0	0	0	1	0
1164	M	B	1	1	0	3	1	1	1	0	1	0	0	0	1	0	1	0
1165	M	A	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0
1166	M	F	1	1	0	3	1	1	1	0	1	0	0	0	0	0	0	0
1301	M	B	1	1	0	5	1	1	1	1	1	1	0	0	0	1	1	0
1302	M	D	1	1	0	3	1	1	0	1	1	1	1	0	0	0	1	0
1303	M	F	1	1	0	2	3	1	1	0	1	1	1	0	0	0	0	0
1304	M	C	2	2	5	5	2	1	1	1	1	1	0	0	1	1	1	0
1305	F	C	1	1	0	4	1	0	0	0	1	0	0	0	1	1	1	0
1306	F	A	1	1	0	4	1	1	1	1	1	1	0	0	1	1	0	0
1307	M	B	1	1	0	3	1	1	0	1	1	1	0	0	1	1	1	0
1308	M	D	1	1	0	3	2	1	1	1	1	1	0	0	1	1	1	0
1309	M	F	1	1	0	3	1	1	1	1	1	1	0	0	1	1	1	0
1310	M	C	1	1	0	3	3	1	1	0	1	1	0	0	0	0	1	0
1311	M	B	2	2	5	3	1	1	1	1	1	1	0	1	0	1	1	0
1312	F	A	1	1	0	5	1	1	1	1	1	1	0	0	0	1	1	0
1501	M	B	1	1	0	3	1	1	1	0	1	0	0	0	0	0	0	0
1502	M	B	1	1	0	4	1	1	1	0	1	1	0	0	1	0	1	0
1503	F	C	1	1	0	3	3	1	1	1	1	0	0	0	0	0	1	0
1504	M	C	1	1	0	2	2	1	0	1	1	1	0	0	1	0	1	0
1505	F	B	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0
1506	M	D	1	1	0	3	1	1	1	1	1	1	0	0	0	0	1	0
1507	F	B	1	1	0	3	3	1	1	0	1	1	0	0	0	1	1	0
1508	M	C	1	1	0	2	3	1	0	0	1	0	0	0	0	0	1	0
1509	F	D	1	1	0	3	3	1	1	1	1	0	0	0	0	1	1	0
1510	M	B	2	2	5	4	1	1	1	0	1	1	0	0	0	1	1	0
1511	F	C	1	1	0	3	1	1	1	0	1	1	0	0	0	0	1	0
1512	M	F	1	1	0	0	1	0	0	1	1	0	0	0	1	0	1	0
1513	F	C	1	1	0	4	3	1	1	1	1	1	0	0	0	1	1	0
1514	M	D	1	1	0	2	3	1	1	1	1	0	0	0	0	1	1	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
1516	F	B	1	1	0	5	1	0	1	1	1	1	0	0	1	1	1	1
1517	F	C	1	1	0	4	1	0	1	0	1	0	0	0	0	0	1	0
1518	M	B	1	1	0	4	1	1	1	0	1	1	0	1	0	1	1	0
1519	F	C	1	1	0	3	1	1	1	0	1	1	0	0	0	0	0	0
1601	M	C	1	1	0	4	3	1	1	1	1	1	0	0	0	0	1	0
1602	M	C	1	1	0	2	2	0	1	1	0	1	0	0	0	0	1	0
1603	M	D	1	1	0	4	2	1	0	0	1	1	0	0	0	0	1	0
1604	F	A	1	1	0	0	0	1	1	1	1	0	0	0	0	1	1	0
1605	F	B	1	1	0	4	2	1	1	0	1	1	0	0	0	1	1	0
1606	F	B	1	1	0	4	0	0	1	1	1	0	0	0	1	0	1	0
1607	M	D	1	1	0	3	1	1	1	0	1	1	0	0	0	0	1	0
1608	M	B	1	1	0	3	0	1	1	0	1	0	0	0	0	1	1	0
1609	M	B	1	2	5	4	1	1	1	0	1	1	0	0	1	1	1	0
1610	F	C	1	1	0	2	3	0	1	0	1	0	0	0	1	0	0	0
1611	F	C	1	1	0	3	1	1	1	0	1	0	0	0	0	0	1	0
1612	F	A	2	2	5	4	1	1	1	0	1	1	0	0	0	1	1	0
1613	M	A	1	2	5	4	1	1	1	1	1	1	0	1	0	1	1	0
1614	M	A	1	2	5	4	1	1	1	1	1	1	0	0	0	0	1	0
1615	M	B	1	0	0	3	3	1	1	1	1	1	0	0	0	0	1	0
1616	F	A	1	0	0	5	2	0	1	1	1	0	0	1	1	1	1	0
1617	F	C	1	1	0	3	1	1	1	1	0	1	0	0	0	0	1	0
1618	F	C	1	0	0	0	1	1	1	1	1	1	0	0	1	0	1	0
1619	M	B	1	1	0	2	1	1	0	1	1	1	0	0	0	1	0	0
1620	F	B	1	1	0	4	1	0	0	0	1	0	0	0	0	0	0	0
1621	F	B	1	1	0	5	1	0	1	0	1	1	0	1	0	0	0	0
1622	F	B	1	1	0	4	1	1	1	1	1	1	0	1	1	1	1	0
1623	F	C	1	1	0	4	1	1	1	0	1	1	0	0	1	1	1	0
1624	M	C	1	1	0	4	2	0	1	1	1	1	0	0	0	1	1	0
1625	M	B	1	1	0	2	1	1	0	1	1	1	0	0	0	0	0	0
1626	M	C	1	1	0	3	1	0	1	1	1	0	0	0	0	1	1	0
1627	F	C	2	2	5	3	1	1	0	1	1	1	0	0	1	1	0	0
1628	F	D	1	1	0	2	1	1	1	0	1	1	0	0	0	1	0	0
1629	F	C	1	1	0	2	1	0	1	0	1	1	0	0	0	1	1	0
1630	M	B	1	1	0	0	1	1	1	1	1	1	0	0	1	0	1	1
1631	M	B	1	1	0	0	0	1	1	0	1	0	0	1	0	0	1	0
1632	M	F	1	1	0	3	1	1	1	0	0	0	0	0	0	1	1	0
1633	M	C	1	1	0	4	2	1	1	1	1	1	0	0	1	0	1	0
1634	F	A	1	1	0	4	1	1	1	0	1	1	0	0	0	0	1	0
1635	F	A	1	1	0	4	2	1	1	0	0	0	0	0	0	1	1	0
1636	M	B	1	1	0	4	2	1	1	1	1	0	0	0	1	1	1	0
1637	M	C	1	1	0	3	1	1	1	1	1	0	0	0	1	0	1	0
1638	F	C	1	0	0	1	3	1	0	0	1	1	0	1	0	0	1	0
1639	M	C	1	1	0	3	3	1	1	0	1	1	0	0	1	0	1	0
1640	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	1	0	0
1641	F	B	1	1	0	3	0	0	1	0	1	1	0	0	1	0	1	0
1701	M	D	1	1	0	4	1	1	1	0	1	0	0	0	0	1	1	0
1702	F	B	1	1	0	3	1	1	1	1	1	0	0	0	0	0	1	0
1703	F	C	1	0	0	3	3	1	1	1	1	0	0	0	0	0	1	0
1704	F	A	1	0	0	4	1	0	1	0	1	0	0	0	0	1	1	0
1705	F	C	1	0	0	4	2	0	1	0	1	1	0	1	1	0	1	0
1706	F	B	1	1	0	4	3	1	1	0	1	1	0	0	0	1	0	0
1707	F	C	1	1	0	3	1	0	1	1	1	1	0	0	1	0	1	0
1708	F	D	1	1	0	5	3	0	1	1	1	0	0	0	1	0	1	0
1709	M	A	1	1	0	5	1	1	1	1	1	1	0	0	0	1	0	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
1711	M	B	1	1	0	4	3	1	1	1	1	1	0	0	0	0	1	0
1712	M	C	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1713	F	C	1	1	0	3	1	1	1	0	1	1	0	0	0	0	1	0
1714	F	C	1	1	0	0	3	1	1	1	1	1	0	0	0	0	1	0
1715	M	D	1	1	0	2	2	1	1	0	1	1	0	0	0	0	0	0
1716	M	C	1	1	0	4	1	1	1	0	1	0	0	0	0	0	1	0
1717	M	B	1	0	0	4	2	1	1	1	1	1	0	0	1	1	1	0
1718	M	C	1	1	0	4	1	0	1	1	1	0	0	0	0	0	0	0
1719	M	C	1	1	0	4	1	1	1	1	1	1	0	1	0	0	1	0
1720	M	B	1	1	0	5	1	1	1	1	1	1	0	1	0	0	1	0
1721	F	D	1	1	0	3	3	0	0	0	1	1	0	0	1	0	1	0
1722	M	C	1	1	0	3	0	1	1	1	1	1	0	1	0	0	1	0
1801	F	B	1	1	0	4	3	1	1	1	1	1	0	0	1	1	1	0
1802	M	C	1	1	0	0	1	0	0	0	1	1	0	0	1	0	1	0
1803	M	D	1	1	0	3	1	1	1	1	1	1	0	0	0	1	1	0
1804	F	A	1	1	0	4	2	1	1	1	1	1	0	1	1	1	1	0
1805	F	D	1	1	0	3	1	0	0	0	1	0	0	1	0	1	1	0
1806	F	D	1	1	0	3	2	0	1	1	1	0	0	0	0	1	0	0
1807	F	D	1	1	0	3	1	1	1	0	1	0	0	0	0	0	0	0
1808	F	C	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1809	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1810	M	B	1	1	0	3	1	1	1	1	1	1	0	1	0	1	1	0
1811	F	A	1	1	0	5	3	1	1	1	1	1	0	0	1	1	0	0
1812	F	B	1	1	0	5	3	1	1	1	1	1	0	1	1	1	1	0
1813	F	A	1	1	0	4	1	1	1	0	1	0	0	0	1	1	0	1
1814	M	F	1	1	0	2	2	1	1	1	1	1	0	0	1	1	1	0
1815	F	B	2	2	4	4	1	0	1	1	1	1	0	0	0	1	0	0
1816	F	B	1	1	0	4	3	1	1	0	1	1	0	1	1	0	1	0
1817	M	F	1	1	0	3	1	1	0	0	1	1	0	0	0	0	1	0
1818	F	A	1	1	0	4	1	1	1	1	1	1	0	0	0	1	1	0
1819	F	B	1	1	0	3	1	1	1	1	1	1	0	1	0	0	1	0
1820	M	B	1	1	0	4	1	1	1	0	1	0	0	0	0	0	1	0
1821	M	B	1	1	0	3	3	1	1	0	1	1	0	0	1	0	1	0
1822	F	A	1	1	0	5	1	1	1	1	1	1	0	0	0	1	1	0
1823	F	A	1	1	0	4	1	1	1	0	1	1	0	0	0	0	1	0
1824	M	B	2	1	0	4	0	1	1	1	1	1	0	1	1	1	1	0
1825	F	B	1	1	0	4	1	1	1	0	1	0	0	0	1	0	1	0
1826	M	C	1	1	0	3	1	1	1	0	0	0	0	0	1	0	1	0
1827	M	A	1	1	0	4	1	1	1	1	1	1	0	1	0	1	1	0
1901	F	A	1	1	0	5	1	1	1	1	1	1	0	0	1	1	1	0
1902	F	C	1	1	0	5	1	0	1	0	1	1	0	0	1	0	1	0
1903	M	C	1	1	0	3	3	1	1	0	1	1	0	0	0	0	1	0
1904	F	B	1	1	0	4	1	1	1	1	1	1	0	1	0	1	1	0
1905	F	B	1	1	0	3	1	1	1	1	1	1	0	1	1	1	1	1
1906	M	A	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1907	M	C	1	1	0	4	2	1	1	1	1	1	0	0	1	0	1	0
1908	F	B	1	1	0	4	3	1	1	1	1	0	0	0	0	0	0	0
1909	F	B	1	1	0	4	3	1	1	0	1	0	0	0	1	0	0	0
1910	F	D	1	1	0	3	2	1	1	0	0	0	0	1	0	0	1	0
1911	F	B	1	1	0	3	2	1	1	1	0	0	0	0	0	0	0	0
1912	M	A	1	1	0	4	3	1	1	1	1	1	0	0	0	1	1	0
1913	M	A	1	1	0	5	1	1	1	1	1	1	1	1	1	1	1	1
1914	F	B	1	1	0	3	3	1	1	1	1	1	1	0	1	0	1	0
1915	M	B	1	1	0	0	3	1	1	0	0	1	0	0	0	0	1	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
1917	M	B	1	1	0	4	0	1	1	0	1	0	0	0	0	0	1	0
1918	M	C	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
1919	F	B	2	2	4	3	3	1	1	0	1	0	0	0	0	0	1	0
1920	M	C	1	1	0	2	3	1	1	0	1	1	0	0	0	0	1	0
1921	F	C	1	1	0	3	1	0	1	1	1	0	0	0	0	0	0	0
1922	F	B	1	1	0	5	1	1	1	1	1	1	0	1	1	0	1	1
1923	F	C	1	1	0	3	1	1	1	1	1	1	1	1	1	0	1	0
1924	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	0	1	0
1925	F	B	1	1	0	5	2	1	1	1	1	1	0	1	0	0	1	0
1926	F	B	1	1	0	4	1	1	1	0	1	0	0	0	0	1	1	0
1927	M	B	1	1	0	3	1	1	1	1	1	1	0	0	1	1	1	0
1928	F	C	1	1	0	3	2	1	1	1	1	0	0	0	1	0	0	0
1929	M	B	1	1	0	4	1	1	1	1	1	1	0	0	0	0	0	0
2001	F	B	1	1	0	5	1	1	1	0	1	1	0	1	0	1	0	0
2002	M	C	1	1	0	4	1	1	1	1	1	1	0	0	0	0	1	1
2003	M	B	1	1	0	4	1	1	1	0	1	1	0	0	1	0	0	0
2004	M	B	1	0	0	4	1	1	1	0	1	1	0	0	1	1	1	0
2005	F	B	1	1	0	3	1	1	1	0	1	1	0	0	1	0	1	0
2006	F	D	1	1	0	3	1	1	0	1	1	0	0	1	0	0	1	0
2007	M	D	1	0	0	3	1	1	1	1	1	1	0	1	0	1	1	0
2008	M	B	1	0	0	3	1	1	1	1	1	1	0	0	0	1	1	0
2009	M	C	1	1	0	4	1	1	1	0	0	0	0	0	1	0	0	0
2010	M	A	1	1	0	5	1	1	1	1	1	1	0	0	0	0	1	0
2011	M	B	1	1	0	4	1	1	1	1	1	1	0	1	0	1	0	0
2012	M	B	1	1	0	3	3	1	1	0	1	1	0	0	0	0	1	0
2013	F	D	1	1	0	3	1	0	1	0	1	0	0	0	0	0	0	0
2014	F	A	1	1	0	5	1	1	1	1	1	1	0	1	1	1	1	0
2015	F	B	1	1	0	3	1	1	1	1	1	1	0	0	1	1	1	0
2016	M	B	1	1	0	4	1	1	0	1	1	1	0	0	1	1	0	0
2017	F	A	1	1	0	4	3	1	1	1	1	1	0	1	1	1	1	1
2018	F	C	1	1	0	4	0	1	1	0	1	1	0	1	1	1	0	0
2019	F	B	1	1	0	3	1	1	1	0	1	1	0	0	0	1	1	0
2020	F	B	1	1	0	4	2	0	1	0	1	0	0	1	0	0	0	0
2021	M	B	1	1	0	5	2	1	1	1	1	1	1	0	1	1	1	0
2022	F	B	1	1	0	4	1	1	1	0	1	1	0	0	1	1	0	0
2023	M	B	1	1	0	3	1	1	1	1	1	0	0	0	1	1	1	0
2024	F	D	1	1	0	3	1	1	1	0	1	0	0	0	0	0	0	0
2025	M	F	1	1	0	3	1	1	1	0	1	1	0	1	1	0	1	0
2101	F	C	1	1	0	2	2	0	1	0	0	0	0	0	0	1	1	0
2102	M	B	1	1	0	4	1	1	1	0	0	1	0	0	0	0	1	0
2103	F	F	1	1	0	2	1	1	0	0	1	0	0	0	0	0	0	0
2104	F	B	1	1	0	3	1	1	1	0	1	1	0	0	1	1	1	0
2105	M	C	1	1	0	4	1	0	1	1	1	0	0	0	0	1	0	0
2106	F	A	1	1	0	5	0	1	1	1	1	1	0	0	1	1	1	1
2107	M	D	1	1	0	4	1	1	1	0	1	1	0	0	0	0	0	0
2108	M	B	1	1	0	4	1	1	1	1	1	1	0	0	0	0	1	0
2109	M	C	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
2110	M	A	1	1	0	4	1	0	1	0	1	1	0	1	0	0	1	0
2111	M	B	1	1	0	5	2	0	1	0	1	1	1	1	0	0	1	0
2201	F	C	3	3	4	4	1	0	1	1	1	1	0	0	0	1	1	0
2202	F	B	1	1	0	2	0	1	0	0	1	0	0	0	1	1	0	0
2203	F	F	1	1	0	4	1	1	0	0	1	1	0	0	1	1	0	0
2204	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	0	1	0
2205	F	B	1	1	0	4	1	1	1	0	1	1	0	0	1	0	1	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
2207	M	D	1	1	0	3	0	1	1	1	1	1	0	1	1	0	1	0
2208	M	C	1	1	0	3	1	1	1	0	1	0	0	1	0	1	1	0
2209	M	B	1	1	0	2	1	0	1	0	1	0	0	0	0	1	1	0
2210	M	B	1	1	0	3	2	1	1	1	1	1	0	0	1	0	1	0
2211	M	B	1	1	0	4	1	1	0	0	1	1	0	0	0	1	0	0
2212	F	C	1	1	0	4	1	0	1	0	1	0	0	0	0	0	0	0
2213	F	B	1	1	0	4	2	1	1	0	1	1	0	0	0	0	1	1
2214	M	C	1	1	0	3	1	1	1	0	1	1	0	0	0	1	1	0
2215	F	B	1	1	0	4	1	1	1	0	1	1	0	0	0	0	1	0
2216	M	C	1	2	5	4	0	0	1	0	1	1	0	0	1	1	1	0
2217	M	C	1	1	0	2	1	1	1	1	0	1	0	0	0	0	1	0
2218	F	D	1	1	0	3	2	1	1	1	0	1	0	0	1	0	0	0
2219	M	A	1	1	0	4	1	1	1	1	1	1	0	1	1	1	0	0
2220	F	C	1	1	0	4	1	0	1	0	0	0	0	0	0	0	0	0
2221	M	D	1	1	0	3	1	1	1	1	1	1	0	0	1	0	1	0
2222	M	C	2	2	5	4	2	1	0	0	1	1	0	0	0	0	1	0
2223	F	B	1	0	0	0	3	0	0	0	1	1	0	0	1	1	1	0
2301	M	C	1	1	0	3	2	1	1	0	1	0	0	0	1	1	0	0
2302	F	A	1	1	0	4	1	1	1	1	0	1	0	0	0	1	1	0
2303	F	B	1	1	0	4	2	1	1	1	1	1	0	0	1	1	1	0
2304	F	D	1	2	3	2	2	1	0	1	1	1	0	0	1	0	1	1
2305	F	C	1	2	4	5	3	1	1	0	1	1	0	1	1	1	1	0
2306	M	B	1	0	0	3	3	1	0	0	1	0	0	0	0	1	1	0
2307	F	C	2	1	0	3	2	1	1	0	1	0	0	0	0	0	1	0
2308	M	C	1	1	0	3	2	1	1	0	1	1	0	1	1	1	1	0
2309	M	B	1	0	0	3	0	1	1	1	1	1	0	0	1	1	1	0
2310	M	B	1	1	0	3	1	1	1	1	1	1	0	1	1	0	1	0
2311	F	A	1	1	0	5	2	1	1	0	1	1	0	0	0	0	1	0
2312	M	B	1	1	0	4	2	1	1	1	1	0	0	0	1	0	1	0
2313	M	C	1	1	0	4	2	1	1	0	1	0	0	0	0	0	1	0
2314	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
2315	F	B	1	1	0	4	2	1	1	0	1	1	0	0	0	0	1	0
2316	M	B	1	1	0	3	0	1	1	1	1	1	0	0	0	1	1	0
2317	M	A	1	1	0	5	1	1	1	1	1	0	1	0	1	1	1	0
2318	M	C	1	1	0	3	2	1	1	1	1	1	0	1	0	0	1	1
2319	F	C	1	1	0	2	3	0	1	0	1	1	0	0	1	0	1	0
2401	M	C	1	1	0	3	3	1	1	0	1	1	0	0	0	0	1	0
2402	M	D	1	1	0	3	1	1	1	0	1	0	0	0	1	0	1	0
2403	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
2404	M	C	1	1	0	2	2	1	0	0	1	1	0	0	1	0	1	0
2405	F	C	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0
2406	F	B	1	1	0	3	2	1	1	1	1	0	0	0	1	0	1	0
2407	F	B	1	0	0	3	1	1	1	1	1	1	0	0	1	0	1	0
2408	M	A	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
2409	M	C	1	1	0	4	3	1	1	1	1	1	0	0	0	0	1	0
2410	M	B	1	1	0	3	0	1	1	0	1	1	0	0	0	1	1	1
2411	F	A	1	1	0	3	1	0	1	1	1	1	0	0	0	0	1	0
2412	F	A	1	1	0	5	1	1	1	1	1	0	0	0	0	1	1	0
2413	M	B	1	1	0	3	3	1	1	1	1	1	0	0	1	1	1	1
2414	F	B	2	2	5	2	1	1	1	1	1	1	0	0	0	1	1	0
2901	M	F	1	1	0	3	1	1	0	0	1	1	0	0	1	1	0	0
2902	M	D	2	2	4	2	1	1	1	0	1	1	0	0	1	0	0	0
2903	M	B	1	1	0	3	1	1	1	1	1	1	0	1	1	1	1	1
2904	M	F	1	1	0	3	1	1	1	1	1	1	0	0	0	1	1	0

SUBNO	SEX	GRADE	SELF-REPORTED					TEST QUESTIONS										
			1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11
2906	M	A	1	1	0	2	1	1	1	1	0	0	0	0	1	1	0	0
2907	M	B	1	1	0	5	1	1	1	1	1	1	0	1	1	1	1	0
2908	M	D	1	1	0	4	3	0	1	1	1	1	1	0	1	1	1	1
2909	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	1	1	0
2910	M	A	3	2	4	4	1	1	1	1	1	1	0	0	1	0	1	0
2911	M	A	2	2	5	4	1	1	1	1	1	1	0	0	1	0	1	0
2912	M	C	1	1	0	4	1	1	1	1	1	1	0	1	0	1	0	0
2913	M	B	3	2	5	4	1	1	1	1	1	1	0	0	1	0	1	1
2914	M	B	1	1	0	4	1	1	1	1	1	1	0	0	1	0	1	0
2915	M	F	1	1	0	3	1	1	1	1	1	1	0	0	1	1	1	0
2916	M	B	1	1	0	2	0	1	1	1	1	1	0	0	0	1	0	1
2917	M	C	1	1	0	2	1	1	1	1	1	1	0	0	1	1	1	0
2918	M	B	1	1	0	3	3	1	1	1	1	1	0	0	0	1	1	0
2919	M	F	2	2	0	3	1	1	1	1	1	0	0	0	1	0	1	1
2920	M	A	2	2	5	4	1	1	0	1	1	1	0	0	1	1	1	0
2921	M	F	1	1	0	4	3	0	0	0	1	1	0	0	1	0	1	0
2922	M	B	1	1	0	3	1	1	1	1	1	1	0	0	0	0	1	1
2923	M	A	2	2	5	5	1	1	1	1	1	1	0	0	1	1	1	0
2924	M	A	1	1	0	3	3	1	1	1	1	1	0	1	1	0	1	0
2925	M	B	1	1	0	3	3	1	1	0	1	1	1	0	0	1	1	1
2926	M	B	1	0	0	2	1	1	1	1	1	1	0	0	0	1	0	0
2927	M	F	1	1	0	2	1	1	1	0	0	0	0	0	0	0	0	0
2928	M	C	1	1	0	3	0	1	1	1	1	1	0	1	1	0	1	0
2929	F	A	1	1	0	0	0	1	1	0	1	1	1	0	1	1	1	1

PREDICTING PROGRAMMING APTITUDE USING INTELLECTUAL DEVELOPMENT MEASURES

by

RICKY JOE BARKER

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Computer Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1981

The field of computer science is quite appealing to students because of the vast employment opportunities. A test to predict success in a beginning programming class would allow this influx of students to be placed in the classes most beneficial to each student.

This report deals with the development of a 45 minute test for predicting success in a beginning programming class. The 45 minute test was developed by reducing an 80 minute test which had a high correlation with the final grade; but the 80 minute test was tested on a small(23) sample size and was too long for easy use. The 45 minute test was given to 353 beginning students and the results correlated with their final grade in the course.

This study was inconclusive with respect to Kurtz' study, but some valuable knowledge was attained. The test could be used as an aid in advising, but more study and analysis is needed before extensive use.