

Intelligence, Reasoning, and Language Proficiency

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THOUGH LINKS CLEARLY EXIST BETWEEN INTELLIGENCE, reasoning, and language proficiency, the extent and nature of these links is not clear. An opinion which has been persistently advocated by Oller is that intelligence and language proficiency are virtually equivalent.¹ Others, like Carroll, while supporting a very close connection between intelligence and language proficiency, deny their equivalence.² The nature of the connection between intelligence and language proficiency can perhaps best be examined through the intermediary of reasoning, which has strong affiliation with both intelligence and language proficiency. Experimental research in this area is limited, especially when the language concerned is a second or foreign language.

Part of the problem with experimental investigation of intelligence is finding an acceptable test of it. IQ testing has been vilified by its detractors, while even its supporters admit its limitations. However, increasing agreement exists that intelligence testing can be usefully approached through tests of inductive reasoning, which is acknowledged as being a central element in intelligence. If this central aspect of intelligence, inductive reasoning, can be demonstrated to be clearly distinguishable from language proficiency, then the hypothesis that language proficiency and intelligence are virtually equivalent cannot be sustained.

This article first briefly reviews different opinions on the connection between intelligence and language proficiency; then, some of the recognized deficiencies of traditional IQ testing are outlined; next, reasoning is examined in its connection with both intelligence and language comprehension; suggestions are then

made for tests of inductive reasoning, suitable for inclusion in a battery of tests to measure the place of reasoning in language proficiency; finally, an experiment is described investigating whether inductive reasoning, and hence intelligence, can justifiably be distinguished from general language proficiency.

INTELLIGENCE AND LANGUAGE PROFICIENCY

A close connection obviously exists between language proficiency and intelligence, since language development is intimately dependent on mental development.³ However, Oller wants to go further and suggests the possibility of an equivalence between intelligence and language proficiency: "What would be the implications if the g factor turned out to be indistinguishable from global language proficiency?"⁴ Again he asks: "Is there any reason to suppose that the g factor of intelligence so widely recognised by educational psychologists and psychometrists might actually be something other than global language proficiency?"⁵ Having considered a few of the "great many relevant studies," his conclusion is: "Apparently, the g factor of intelligence is indistinguishable from global language proficiency. Moreover, the relative indivisibility of the g factor seems to hold for first or second language proficiency."⁶

Disagreeing with Oller, Carroll accepts that the correlation of general intelligence (g) with verbal ability will probably be high, but maintains that it will be far from perfect because mental development can express itself in other ways than by language: "Language proficiency tends to be related to g, but it is clearly distinguishable from it."⁷

Oller, however, still wishes to pursue his case, citing empirical results from others in support of his position.⁸ He suggests that since Carroll admits on the one hand that language proficiency makes an essential contribution to

the g factor of intelligence, and on the other that there is not enough evidence to conclude how strong this relationship may be, it would be better, "to leave open the possibility that a deep level primary language proficiency might be the very essence of what so-called 'intelligence' tests measure?"⁹

Carroll has no quarrel with leaving open "the possibility that language proficiency is fundamentally related to a general factor of intelligence," but cautions that "final conclusions on these matters will have to be quite specific about what is meant by 'language proficiency' and 'general intelligence.'"¹⁰

Oller, in trying to elucidate his position, has invoked a three-level hierarchical model, with a general semiotic system at the deepest level; linguistic, kinetic, and sensory/motor universals at a secondary level; and at a third level, particular languages, specific kinesic systems, and particular sensory motor skills. He believes, "the idea that such a general semiotic system exists has never been in doubt," and that our ability to talk intelligibly about memories and anticipations "is proof that a general meaning system, a general semiotic must exist."¹¹ The terminology here is complicated, and what precisely is meant by "general semiotic system" needs clarifying. However, Oller's basic intention is still the same, namely to support his theory of the equivalence of intelligence and language proficiency.

INTELLIGENCE AND IQ TESTING

There is a long history of attempts to define and measure intelligence, dating from the early pioneers Spearman and Thorndike.¹² Part of the problem when examining the concept has always been its complex and indistinct nature. When a construct is unclear, valid and reliable testing is bound to be difficult.

Attempts have been made to analyze the concept by broad, preliminary distinctions' for example, the distinction between "social, everyday" intelligence and "academic" intelligence. However, such distinctions have proved unfruitful, since, as Keating has shown, it is extremely difficult to define and to test 'social, everyday' intelligence.¹³

One central objection to IQ testing is that it has been too "culture bound" and favored certain classes of people. There is a great temp-

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tation, of course, when trying to get at "native intelligence" to predefine the "native." Indeed, some IQ testing theorists have been condemned as being downright racist. Discussing the perennial nature/nurture controversy—whether heredity or environment is more influential in shaping intelligence—Evans and Waites describe how Jensen and Eysenck were challenged by Kamin, who claimed their approach was racist, and was based on research findings of Burt which were seriously defective and possibly fraudulent.¹⁴

Another basic problem with IQ testing is that the influence of environment on intelligence is hard to assess or control. This question has been examined by Brady who concluded that there was "clear evidence for large-scale changes in intelligence attributable to naturally occurring environmental changes."¹⁵

Fine looks at other objections to IQ tests: "The most commonly used group intelligence tests measure only two aspects of intelligence—verbal capacity and mathematical reasoning. Even if it were agreed that these functions are important predictors of capacity to be successful in our society, conventional intelligence tests still are grossly flawed and can be considered biased."¹⁶

Fine also criticizes the inadequacy of the scoring methods, with a telling example from the WISC (Wechsler Intelligence Scale for Children).¹⁷ If the scorer follows the guidelines of the manual, then the definition of the word *swords* as, "like a knife, only longer" scores two points; the definition "has a sharp point and is used in the army to fight or kill" scores one point; but the definition, "things to fight with; to have a sword fight" scores no points. Similarly, defining *gambles* as "take a chance, try to win by luck" scores two points; "playing cards or checkers" scores one point; "lose money that way" (for all its ingenuity) scores no points. Fine gives nine similar examples, and shows how such scoring can result in a difference of eighteen points, which can mean the difference in terms of IQ labelling between "normal" (100) and "retarded" (82).

INTELLIGENCE AND REASONING

Since attempts to construct suitable intelligence tests have proved to be unsatisfactory, efforts have been made to analyze the concept

of intelligence into its essential components. We see whether some of these components are tested. Sternberg notes: "The components may be, reasoning and problem solving, which have traditionally been viewed as separate parts of it. Almost without regard to this, intelligence has been defined, reasoning and problem solving have been part of it. Intelligence is a "subset" of reasoning, though reasoning is a better candidate for testing. Intelligence is, however, just as intelligence is a subset of reasoning and testing, so do they overlap."¹⁸

Psychologists disagree as to the extent to which the factors of intelligence can usefully be separated. At the top of the scale, Guilford classifies intelligence as kinds of inductive and deductive reasoning. At the bottom of the scale, Royce believes in a general intelligence, and syllogistic reasoning. At the middle, which he calls spontaneous intelligence, is divided into one second-order factor, fluid intelligence. Cattell does not favor a general intelligence, but deduction and general reasoning are important. He considers the deduction factor to be more important than that of general reasoning. In a large-scale factor analysis of intelligence, Cattell's deduction, included tests of fluid intelligence and general reasoning, were found to be highly overlapped.²³

The first Educational Testing Service factor-referenced tests of intelligence included three different kinds of reasoning: induction, deduction, and analogy. In the second kit (1963) the tests of induction and reasoning remain, while the tests of deduction and syllogistic reasoning are dropped. (1976), induction and deduction are again treated as separate factors. Inductive reasoning has become a separate factor, integral to intelligence. Psychologists do not see the need for the centrality of the inductive factor. If a suitable test of reasoning can be found, therefore, a good candidate for a general factor of induction.

Moreover, tests of intelligence are found to be particularly suitable for measuring language proficiency, since language is thought to have an important part to play in comprehension and proficiency. Intelligence is defined in the 1976 tests as one which "identifies and uses reasoning abilities involved in the process of solving problems."²⁴

of intelligence into its essential elements and to see whether some of these can be successfully tested. Sternberg notes: "Whatever intelligence may be, reasoning and problem solving have traditionally been viewed as important subsets of it. Almost without regard to how intelligence has been defined, reasoning and problem solving have been part of the definition."¹⁸ The "subset" of reasoning, then, might seem to be a better candidate for testing purposes. However, just as intelligence poses problems of definition and testing, so does reasoning.

Psychologists disagree considerably about the extent to which the factor associated with reasoning can usefully be subdivided. At one end of the scale, Guilford claims there are sixteen kinds of inductive ability represented in his structure of intellect model.¹⁹ At the other end of the scale, Royce believes induction, deduction, and syllogistic reasoning, plus a factor which he calls spontaneous flexibility, combine into one second-order reasoning factor.²⁰ Cattell does not favor a distinction between induction and general reasoning;²¹ while Carroll considers the deduction factor to be very similar to that of general reasoning.²² Spearritt, in a large-scale factor analysis of listening comprehension, included tests of induction, deduction, and general reasoning, but found that they overlapped.²³

The first Educational Testing Service kit of factor-referenced tests (1954) distinguished three different kinds of reasoning, namely induction, deduction, and general reasoning.²⁴ In the second kit (1963) induction and general reasoning remain, while deduction is now labelled syllogistic reasoning.²⁵ In the third kit (1976), induction again remains, while syllogistic reasoning has become logical reasoning, and another factor, integral processes, is added.²⁶ Psychologists do not seem to quarrel about the centrality of the induction factor in reasoning. If a suitable test of reasoning is sought, therefore, a good candidate would seem to be a test of induction.

Moreover, tests of induction can be argued to be particularly suitable in the context of language proficiency, since inductive ability seems to have an important place in language comprehension and proficiency. The inductive factor is defined in the 1976 kit of factor referenced tests as one which "identifies the kind of reasoning abilities involved in forming and trying

out hypotheses that will fit a set of data."²⁷ Now the analysis-by-synthesis model of language comprehension of Halle and Stevens works along similar lines.²⁸ According to this model, the listener generates a sentence on the basis of a hypothesis about the grammatical structure of the incoming signal, then checks this against the actual input. If the first hypothesis does not fit, another will be tried.

More recent analyses of the language comprehension process also favor such constructive, hypothesis-forming models. Carroll says induction "entails searching for relevant hypotheses" in the "general logic store" of LTM (Long Term Memory). He adds that some subjects might perform "serial operations with STM contents to construct new hypotheses."²⁹ Rivers describes listening comprehension as a process of selecting and matching our selection against the incoming signal.³⁰ Abbott proposes a model in which short term memory (STM) holds and examines the incoming stretch of speech in order to make hypotheses about future stretches of speech.³¹ Again can be seen the principle of forming hypotheses, based on present evidence, to make predictions about what is to follow.

Induction, then, would seem to be an essential element in both the reasoning process and in the process of language comprehension.

TESTING INDUCTIVE REASONING

The question next arises how best to test inductive reasoning. In his study, Spearritt found that a test of verbal analogies, which he had used as a marker test for the deduction factor, in fact loaded on the induction factor, appearing "to call for discovery of rules as in Induction rather than application of rules."³² Indeed, the test of analogies seems to be one of the most useful types of test of inductive reasoning. Spearman used analogies as the prototypes for intelligent performance;³³ Reitman's theory of intellectual functioning is based on the solution of analogies.³⁴ Piaget makes analogies (relations between relations) the touchstone which, in his theory, distinguishes concrete and formal operations.³⁵ Turnbull, speculating on the future of intelligence testing, praises Sternberg's work on analogies:³⁶ he suggests that it may be "of enormous value not only to the understanding of intelligence but also to the development of tests."³⁷

Another well-proven type of test of inductive reasoning is a series completion, where a missing element is supplied after scrutiny of an incomplete series. Spearritt, in his study following Thurstone and many others, used this successfully as a marker test for the induction factor. Inductive reasoning and series completion tests have been examined at length by Simon and Lea and by Pellegrino and Glaser.³⁸

In testing inductive reasoning, then, tests of analogies and series completion would seem to be two acceptable and reliable types of test.

THE EXPERIMENT

The question of whether language proficiency and general intelligence are equivalent is theoretical. However, theories must be tested, where possible, through experimental investigation. A useful method for such investigation, especially when many variables are involved, is factor analysis. As Harman, the doyen of factor analysts, says: "As an exploratory tool (among others) factor analysis can be used to verify or modify theories through experiment."³⁹

Factor analysis is a technique which analyzes the interrelationships among a large number of variables (test scores, test items, questionnaire responses), and then explains these variables in terms of common, underlying dimensions (factors). The strength of the technique is that it goes beyond simple correlations and reveals common factors in a mass of complex data. Cattell describes factor analysis as "a second storey with a skylight on top of correlation."⁴⁰

Unlike multiple regression or discriminant analysis, in which one or more variables is considered the dependent variable and all others as independent variables, in factor analysis all variables are simultaneously considered: "In a sense each of the observed (original) variables is considered as a dependent variable that is a function of some underlying, latent and hypothetical set of factors (dimensions). Conversely, one can look at each factor as a dependent variable that is a function of the originally observed variable."⁴¹

The advent of the computer has led to a much wider use—and sometimes misuse—of factor analysis, since in the past the mathematical calculations involved were beyond any but

the expert. Of the various automatic analytic programs available in package form, the most frequently used are Varimax, Quartimax, Maxplane, Oblimin, Oblimax, Promax, and Harris-Kaiser. There is often little to choose between the various methods. A study by Dielman compared five methods (Varimax, Maxplane, Oblimax, Promax, and Harris-Kaiser) and found that no significant difference existed among them.⁴² Varimax, which is among the most popular and reliable, was used in the present study.⁴³

A problem about using factor analysis is that the data gathering is a large task, since the number of variables and of subjects has to be substantial. It is generally agreed among factor analysts that when the number of subjects falls much below one hundred, the results tend to disintegrate.

A factor analytic study is best approached with some hypothesis or theory in mind. Carroll emphasizes this, saying that most factor analytic work on comprehension tests has not yielded much information about the process of comprehension "because there has generally been a failure to construct the tests on the basis of any clear theory."⁴⁴

The hypothesis in the present experiment was that intelligence and language proficiency cannot be considered as equivalent, but are, in factorial terms, linearly independent. This hypothesis would be supported if factors of language proficiency and of inductive reasoning were to emerge in the analysis as two distinct factors. If, on the other hand, the language proficiency variables and the inductive reasoning variables merged into one factor, the hypothesis would not be sustained.

The test battery for such an analysis would need to include several tests of language proficiency and of inductive reasoning. Tests designed as markers of other factors should also be included in such an experiment. As Cattell explains: "When investigating domain 'A,' deliberately introduce several 'irrelevant' variables you have reason to believe have a 'not-A' nature. Hopefully this can be done with some previous knowledge of other common, broad factors that are 'not-A,' so that pairs of markers can be found for them that will yield factors standing out clearly and largely orthogonal to the factor or factors in the domain you are interested in."⁴⁵ Accordingly, marker tests for the

factors of span and rote memory normally stand out clearly, within the battery.

THE TEST BATTERY

It is generally recognized that language proficiency is best measured by a battery of tests rather than by one particular test. However, ever, some testers, especially those who favor particularly vocabulary tests, have favored particularly vocabulary tests. Editions of the Education Kits for Factor Reference Vocabulary Tests as marker tests. Northrop has shown that this type of test has proved to be reliable. In addition to their reliability, they have the advantage of being easy to administer.⁴⁷ Six different tests were included in the battery.

There is also considerable evidence of the efficacy of a combination of tests in determining language proficiency. Two cloze tests and two dictation tests were included.

Listening comprehension tests used in TOEFL have been found to correlate highly with proficiency as measured by batteries of tests. Two TOEFL listening comprehension tests were included in the battery, making up a total of four tests aimed at measuring language proficiency.

It was initially proposed to include four tests of inductive reasoning: two analogies, and two of series completion. However, during preliminary testing, it emerged. In verbal tests of inductive reasoning, vocabulary knowledge tends to be a confounding factor when the subjects are second language learners. If the vocabulary is not kept constant, then the test ceases to measure inductive ability and becomes simply a test of vocabulary. One way to avoid this is to test reasoning by means of non-verbal items (numbers, shapes) rather than verbal items. This was done with the series completion test. In using letters, the other

With the analogies test, a battery was made to find examples of vocabulary interference. Selected, the Otis-Lennon Aptitude Test (DAT). Both the analogy items. However

factors of span and rote memory, which normally stand out clearly, were also included in the battery.

THE TEST BATTERY

It is generally recognized that language proficiency is best measured by a variety of tests, rather than by one particular kind of test. However, some testers, especially psychologists, favor particularly vocabulary tests. All three editions of the Educational Testing Service's Kits for Factor Referenced Tests use simply vocabulary tests as markers for the verbal factor.⁴⁶ Northrop has shown how reliable this type of test has proved to be over many years. In addition to their reliability, vocabulary tests have the advantage of being swift and simple to administer.⁴⁷ Six different vocabulary tests were included in the battery.

There is also considerable evidence for the efficacy of a combination of cloze tests and dictation in determining language proficiency.⁴⁸ Two cloze tests and two dictation tests were accordingly included.

Listening comprehension tests of the type used in TOEFL have been found to correlate highly with proficiency as measured by larger batteries of tests. Two TOEFL-type listening comprehension tests were therefore added to the battery, making up a total of twelve tests aimed at measuring language proficiency.

It was initially proposed to test reasoning by four tests of inductive reasoning, two of verbal analogies, and two of series completion. However, during preliminary testing a problem emerged. In verbal tests of reasoning, vocabulary knowledge tends to interfere, especially when the subjects are second language speakers. If the vocabulary is not known to the subjects, then the test ceases to be one of reasoning ability and becomes simply another test of vocabulary. One way to avoid this problem is to test reasoning by means of symbols (letters, numbers, shapes) rather than by words. This was done with the series completion tests, one using letters, the other numbers.

With the analogies tests a determined effort was made to find examples which would not cause vocabulary interference. Two tests were selected, the Otis-Lennon and the Differential Aptitude Test (DAT). Both have several verbal analogy items. However, the vocabulary prob-

lem was found to be more acute than envisaged, since complicated analogy test items can involve the knowledge of as many as twelve words. The DAT manual claims that the vocabulary used in the test is relatively simple, but many words were found to be unknown to the subjects of this experiment, e.g., *bray, ibex, levee, atlantis, hazel, moult, wan*. Only seventeen items in the DAT out of the original fifty in fact remained after preliminary testing, and after item analysis another eight items had to be dropped, leaving only nine items which could be confidently said to pose no problems of vocabulary for the subjects.

With the Otis-Lennon, though the vocabulary was simpler than for DAT, only twelve of the twenty-two verbal analogy items could be used because of vocabulary difficulty in the other ten. With the permission of the copyright holders, Psychological Corporation, the nine items of DAT and the twelve of Otis-Lennon were combined to give one verbal analogy test, which at least represented a fair attempt to avoid the problem of the confusion of reasoning ability and vocabulary knowledge.

A description of the tests is given in the Appendix below, with the full text where there are no copyright restrictions, and with sample items as illustration where copyright and test security demand.

SUBJECTS AND TEST ADMINISTRATION

The subjects were Chinese, aged between eighteen and twenty, all first-year students at a commercial college in Hong Kong. Their mother tongue was Cantonese, but several spoke other Chinese dialects as well, such as Chiuchow, Hakka, and Shanghaiese. Most understood Mandarin, but professed to speak it poorly. Their level of English was fairly high, since all had studied it in school for ten years or more. However, most of them rarely had the opportunity to use English outside of the classroom. There were 205 subjects (106 female, 99 male).

The tests were administered to all the subjects together on two consecutive afternoons in the college assembly hall. Since listening tests were included in the test battery, care was taken to ensure equal audibility for all. The public address system, though already satisfactory, was supplemented by the addition of extension

speakers, covering parts of the hall where audibility might be less than perfect.

Pretesting was done on all the tests with a group of forty first-year students. Item analysis was performed and the tests altered in the light of this information. The tests were also carefully timed during pretesting and any snags noted. During the final testing adequate time was given for all to finish each test, to avoid the intervention of a speed factor. A break was also given during each of the testing sessions to avoid fatigue.

All listening tests were taped in advance and played on a high-quality Sony tape recorder. Before each test started, time was given for questions on the test instructions, in case these were not clear to any subject.

Since for some of the tests it was important that subjects should obey the test instructions strictly, by refraining from writing while listening to the text, six student volunteer "inspectors" patrolled the hall to encourage compliance with instructions. In fact, only one student was observed to write during one of the memory tests and his results were discounted in the analysis.

RESULTS

Table I gives the factor matrix. The loadings of the tests on the five factors which were extracted are given, to two decimal points (though the decimal points themselves have been omitted). Loadings above .3 have been highlighted with an *.

At the bottom of each factor column is given the amount of variance accounted for by that factor (technically known as the "eigenvalue" or "latent root"). This is normally presented as a percentage of the total amount of variance the factor solution is based upon (technically called the "trace").

A factor matrix is interpreted by reading across the rows and down the columns, and examining the correlations between variables (tests) and factors. The nature of a factor can be deduced by seeing which variables have high loadings on (i.e., correlations with) the factor. A loading of .3 and above is generally considered of significant interest in interpreting factors.

Thus, reading down the first factor column (F.1), it can be seen that the tests which loaded

TABLE I
Varimax Rotated Factor Matrix

	F.1	F.2	F.3	F.4	F.5
1. Voc ELBA	26	58*	-02	16	-03
2. Voc CELT	19	74*	10	07	02
3. Voc STEP	13	58*	10	05	07
4. Voc EPVT	33*	56*	03	05	09
5. Voc Read	40*	47*	05	-05	01
6. Voc Mich	28	50*	18	06	-10
7. Cloze m/c	58*	34*	02	04	13
8. Cloze Open	72*	28	03	14	16
9. Dict 1	68*	34*	35*	07	-01
10. Dict 2	76*	32*	26	16	-00
11. LC Stat	58*	32*	03	10	05
12. LC Conv	44*	21	02	19	13
13. Reas SC 1	06	07	08	05	79*
14. Reas SC 2	20	01	18	16	30*
15. Reas DAT/OL	21	48*	-13	-09	17
16. Mem Span 1	06	06	70*	02	15
17. Mem Span 2	14	09	74*	06	03
18. Mem Rote 1	21	06	05	75*	04
19. Mem Rote 2	05	06	04	66*	07
20. Mem Verbal	29	40*	22	09	-02
% of variance	29.4	6.3	5.0	3.7	3.4

highly on this factor (marked with an *) were the language proficiency tests, especially cloze, dictation, and listening comprehension. Two of the vocabulary tests also loaded highly on this factor. This factor, which accounts for the largest percentage of total variance (29.4), can therefore reasonably be labelled a general language proficiency factor.

Reading down the second factor column (F.2), we see that it is associated with vocabulary knowledge. The tests which loaded highest on this factor were the vocabulary tests. One of the cloze tests, both dictations, and one of the listening comprehension tests also loaded above .3. This result is not unexpected, since vocabulary knowledge also enters into these tests.

Most interestingly, the other two tests which loaded highly on F.2 were Test 15 (Verbal Analogies, DAT/OL, .48) and Test 20 (Verbal Memory, .40) which were aimed at testing reasoning and memory, respectively. This indicates that, for second language speakers at any rate, tests which aim at reasoning or memory, but whose questions are framed verbally, are more likely to test vocabulary knowledge than reasoning or memory ability.

F.3 and F.4 emerge clearly as span and rote

memory factors, with two marker tests in

F.5 is the factor which was the focus of the experiment. The reasoning tests loaded highly on F.5, especially DAT/OL, the other reasoning tests, loaded more heavily on the vocabulary factor (.17) on F.5 is appreciated for a sample size of 40 at the five percent level of significance. F.5 therefore can justifiably be labelled as a factor underlying

CONCLUSION

The results of this study indicate that inductive reasoning tests tested with symbols clearly distinguish language proficiency. Since inductive reasoning may be central to intelligence, this study provides evidence that language proficiency, intelligence, and foreign language connection, but also foreign language ability, are two.

Apart from this study, such as this serves to identify some practical consequences of it is true that an intelligent person will be good at languages.

NOTES

¹Language in Education: Theory and Practice, by John Oller & Kyle Perkins (Rowley, MA: Houghton Mifflin, 1979): 450-56; *Issues in Foreign Language Education*, John Oller (Rowley, MA: Houghton Mifflin, 1979): 1-16; *Language Tests at School*, John Oller (Rowley, MA: Houghton Mifflin, 1979): 450-56; *Issues in Foreign Language Education*, John Oller (Rowley, MA: Houghton Mifflin, 1979): 1-16.

²John B. Carroll, "Psychometric Foundations of Foreign Language Testing," in Oller 1983 (p. 10).

³E. H. Lennenberg, *Language: Its Origins and Development* (New York: Wiley, 1967).

⁴Oller & Perkins (note 1 above).

⁵Oller 1979 (note 1 above).

⁶Oller 1979 (note 1 above).

⁷Carroll (note 2 above).

⁸Jim P. Cummins, "Linguistic Proficiency and Educational Development," *Journal of Educational Research* 49

memory factors, with very high loadings on the two marker tests in each case.

F.5 is the factor which is of most interest for the experiment. The two series completion reasoning tests loaded highest on the factor, one extremely highly (.79). Verbal analogies DAT/OL, the other test which aimed at reasoning, loaded more highly, as has been seen, on the vocabulary factor. However, its loading (.17) on F.5 is appreciable (a correlation of .17, for a sample size of 205, would be significant at the five percent level of confidence, and just short of significance at the one percent level). F.5 therefore can justifiably be interpreted as a factor underlying reasoning ability.

CONCLUSION

The results of this experiment provide evidence that inductive reasoning, especially as tested with symbols rather than with words, is clearly distinguishable from language proficiency. Since inductive reasoning is agreed to be central to intelligence, the experiment effectively provides evidence against the theory that language proficiency is indistinguishable from intelligence, and for the theory that there is a connection, but also a distinction, between the two.

Apart from this theoretical question, a study such as this serves to remind language teachers of some practical considerations. First, though it is true that an intelligent person will often be good at languages, this need not always be

the case. As experience shows, a highly intelligent science student may be poor in languages.

Second, teachers who use IQ tests for selection or placement must choose tests which include items which are independent of language proficiency, otherwise they are only testing one side of intelligence. This is especially true when the test is given to non-native speakers of English. With tests which are too language dependent, the intelligence of a potential mathematician or physicist, or indeed automobile mechanic or supermarket manager, may fail to be recognized.

One further practical point emerges from the present study, namely the importance of emphasizing vocabulary in language learning. It is significant that a separate vocabulary factor F.2 appeared in the analysis, indicating that this aspect of language learning needs special consideration, at least with the type of students used as subjects in the study. The importance and influence of vocabulary is reinforced when it is observed how the tests of verbal reasoning and verbal memory loaded highest on the vocabulary factor and not on the reasoning and memory factors.

Finally, if language proficiency and intelligence are too readily considered as equivalent, this can be detrimental to good language teaching. Faced with a slow learner, it is all too easy for the teacher, instead of reassessing curriculum and methodology, to lay the blame on the student's lack of intelligence.

NOTES

¹Language in Education: *Testing the Tests*, ed. John W. Oller & Kyle Perkins (Rowley, MA: Newbury House, 1978): 1-16; *Language Tests at School*, ed. John Oller (London: Longman, 1979): 450-56; *Issues in Language Testing Research*, ed. John Oller (Rowley, MA: Newbury House, 1983): 106.

²John B. Carroll, "Psychometric Theory and Language Testing," in Oller 1983 (note 1 above): 80-107.

³E. H. Lennenberg, *Biological Foundations of Language* (New York: Wiley, 1967).

⁴Oller & Perkins (note 1 above): 15.

⁵Oller 1979 (note 1 above): 454.

⁶Oller 1979 (note 1 above): 456.

⁷Carroll (note 2 above): 103.

⁸Jim P. Cummins, "Linguistic Interdependence and the Educational Development of Bilingual Children," *Review of Educational Research* 49 (1979): 222-51; K. Prapphal,

"Learning English in Thailand: Affective, Demographic, and Cognitive Factors," Diss. Univ. of New Mexico, 1981.

⁹Oller 1983 (note 1 above): 106.

¹⁰Carroll 1983 (note 2 above): 107.

¹¹John W. Oller, "Consensus and Controversy," *Language Testing* 1 (1983): 227-32.

¹²C. Spearman, "General Intelligence, Objectively Determined and Measured," *American Journal of Psychology* 15 (1904): 201-93; E. L. Thorndike, "Intelligence and Its Measurement: A Symposium," *Journal of Educational Psychology* 12 (1921): 124-27.

¹³D. P. Keating, "A Search for Social Intelligence," *Journal of Educational Psychology* 70 (1978): 218-23.

¹⁴Brian Evans & Bernard Waites, *I.Q. and Mental Testing* (London: MacMillan, 1981); A. R. Jensen, "How Much Can We Boost I.Q. and Scholastic Achievement?" *Harvard Educational Review* 39 (1969): 91-123; H. J. Eysenck, *The Inequality of Man* (London: Smith, 1973); Leon Kamin, *The Science and Politics of I.Q.* (Hillsdale, NJ: Erlbaum, 1974); Kamin's accusation of fraudulence was supported, some

would say substantiated, by Oliver Gillie, *The Sunday Times*, 24 October 1976.

¹⁵Ernest Bright Brady & Nathan Brady, *Intelligence* (New York: Academic, 1976): 164.

¹⁶Benjamin Fine, *The Stranglehold of the I.Q.* (New York: Doubleday, 1975): 6.

¹⁷Fine (note 19 above): 235.

¹⁸Robert J. Sternberg, *Handbook of Human Intelligence* (Cambridge: Cambridge Univ. Press, 1982): 225.

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²⁰Joseph R. Royce, "The Conceptual Framework for a Multi-Factor Theory of Understanding," *Multivariate Analysis and Psychological Theory*, ed. Joseph R. Royce (London: Academic, 1973): 305-407.

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APPENDIX

The full text of tests is restricted by copyright, a of items in each test is i title.

A. Language proficiency tests

Tests 1-6. Vocabulary Tests

Test 1. English Language

FADE: 1. lose colour / 2.

Test 2. Comprehensive En

VERY LARGE: 1. gor

4. gigantic

(In this test the test wo

Test 3. Sequential Test o

(Here the test word wa

multiple choice alternative

Test 4. English Picture

(The test word was hea

pictures.)

Test 5. Reading Vocab

We _____ our han

1. wash / 2. scrub / 3

Test 6. Michigan Test

The boy was feeling A

1. shocked / 2. nervo

Tests 7-10. Cloze and I

Test 7. Cloze, Multipl

This test was constr

tions Authority as an e

passage on the subject

a word missing from

covered by a bleep sou

without stopping, the

allowing time for the

First is given the tes

text on the students' a

were done for them to

do.

1. The drug trade in

cated (history).

2. At one time it was

opium.

3. Since the second w

money have been spe

4. Recently drug price

age in supply, as a

5. Also, there was a

amount harvested _

6. This is much less

7. According to the

Number 3 Heroin i

8. This is forty-six

9. In the streets, ad

of drugs, compared

10. The high price h

APPENDIX

The full text of tests is given where possible, and for tests restricted by copyright, a sample item is given. The number of items in each test is indicated in brackets after the test title.

A. Language proficiency tests.

Tests 1-6. Vocabulary Tests.

Test 1. English Language Battery (ELBA).⁴⁹ [25]

FADE: 1. lose colour / 2. tastelessness / 3. destiny / 4. fashion

Test 2. Comprehensive English Language Test (CELT).⁵⁰ [25]

VERY LARGE: 1. gorgeous / 2. mellow / 3. ingenious / 4. gigantic

(In this test the test word/phrase was *heard*, not read.)

Test 3. Sequential Test of English Proficiency (STEP).⁵¹ [32]

(Here the test word was written in English, but the multiple choice alternatives were given in Chinese.)

Test 4. English Picture Vocabulary Test (EPVT).⁵² [40]

(The test word was heard, and choice made between four pictures.)

Test 5. Reading Vocabulary.⁵³ [36]

We _____ our hands on a towel.

1. wash / 2. scrub / 3. wet / 4. dry / 5. brush

Test 6. Michigan Test of English Proficiency.⁵⁴ [20]

The boy was feeling *pleased* with his result . . . *pleased*.

1. shocked / 2. nervous / 3. happy / 4. clean

Tests 7-10. Cloze and Dictation.

Test 7. Cloze, Multiple choice. [35]

This test was constructed by the Hong Kong Examinations Authority as an experimental pilot test. A continuous passage on the subject of opium smoking was read, with a word missing from each sentence, the missing word covered by a bleep sound. The passage was read twice, first without stopping, then with a pause after each sentence, allowing time for the student to choose an answer.

First is given the text which the students heard, then the text on the students' answer sheet. The first three examples were done for them to make sure they understood what to do.

1. The drug trade in Hong Kong has a long and complicated (history).
2. At one time it was not even against the (law) to smoke opium.
3. Since the second world war, huge amounts of time and money have been spent trying to (solve) our drug problem.
4. Recently drug prices reached a record level due to a shortage in supply, as a _____ of strong police action.
5. Also, there was a poor opium crop last year, and the amount harvested _____ to about 100 tons.
6. This is much less than the _____ average of 500 tons.
7. According to the latest _____ the wholesale price of Number 3 Heroin is \$23,000 per 100 grams.
8. This is forty-six times its _____ in 1970.
9. In the streets, addicts are paying up to \$90 for a packet of drugs, compared to \$40 for a packet a year ago.
10. The high price has made life so difficult for the addicts

that more than 7,000 of them are now _____ each day to the government's methadone clinics.

11. Looking back over the 1970's, it is now clear that the _____ of the methadone treatment scheme has made a great impact on the drug scene.

12. Last year 11,000 new addicts were _____ to the rolls of this scheme.

13. This is solid proof that addicts have found it _____ and helpful.

14. Recent figures show that the success rate now varies from around 40% for a twelve month treatment period down to _____ 25% for a two year period.

15. It has been found that addicts under thirty five are more _____ to slip back into old habits.

16. One of the attractive features of methadone treatment has been that addicts receiving it are, in many cases, able to live and work _____.

17. This has led to much less _____ and unemployment among addicts.

18. Police _____ show that 6,500 fewer people were prosecuted for minor drug offenses last year than in 1970.

19. However, apart from police action, much of the success in the war against drugs has been _____ to publicity and education campaigns.

20. Such campaigns were unheard of in Hong Kong _____ decade ago.

21. Last year three _____ campaigns were held as well as many small scale activities.

22. The education and publicity _____ will this year exceed one million dollars for the first time.

23. The government has thus shown itself willing to spend large _____ of money in the fight against drugs.

24. This is an indication of how important this problem is considered to _____.

25. In the modern world computers are playing an increasingly important role in our _____ lives.

26. The police force and other government departments _____ in the fight against drugs are also making heavy use of computers.

27. With their help it is now _____ to have a central registry of drug addicts.

28. This is done by _____ a record of every addict who comes in contact with the police, government departments and welfare agencies.

29. From these computer records, it is possible to obtain a _____ clearer picture of the size and nature of the drug problem.

30. We can, for example, discover how many addicts belong to different age _____.

31. We can learn about their education, economic and social _____.

32. As the years pass, we can see _____ the pattern of addiction is changing, and what new trends are developing.

33. And so the government can see how the available money can be _____ used.

34. Has the use of computers produced results which surprised the government _____?

35. The answer to this has to be Yes, since the total number of addicts in Hong Kong is now thought to be no more than 50,000—less than half the figure frequently _____ in the past.

Students' answer sheet.

EXAMPLE 1. A. record / B. affair / C. history / D. setting.

EXAMPLE 2. A. government / B. custom / C. law / D. society.

EXAMPLE 3. A. solve / B. change / C. increase / D. restore.

4. A. cause / B. result / C. outcome / D. fact.

5. A. produced / B. increased / C. destroyed / D. fell.

6. A. previous / B. unusual / C. frequent / D. before.

7. A. scene / B. information / C. summary / D. prosecution.

8. A. frequency / B. position / C. value / D. situation.

9. A. compared / B. rather / C. as / D. like.

10. A. seeking / B. examining / C. going / D. bringing.

11. A. habit / B. way / C. introduction / D. method.

12. A. included / B. added / C. placed / D. increased.

13. A. accountable / B. presentable / C. liveable / D. acceptable.

14. A. at / B. on / C. in / D. about.

15. A. effective / B. sensitive / C. able / D. likely.

16. A. normally / B. subsequently / C. occasionally / D. frequently.

17. A. work / B. crime / C. police / D. prison.

18. A. statistics / B. numbers / C. details / D. plans.

19. A. consequence / B. due / C. caused / D. resulted.

20. A. the / B. a / C. this / D. that.

21. A. major / B. minor / C. maximum / D. minimum.

22. A. situation / B. income / C. budget / D. economy.

23. A. totals / B. sums / C. figures / D. incomes.

24. A. become / B. have / C. do / D. be.

25. A. usual / B. existing / C. average / D. everyday.

26. A. received / B. involved / C. touched / D. wanted.

27. A. possible / B. want / C. can / D. hope.

28. A. putting / B. keeping / C. detailing / D. destroying.

29. A. that / B. quite / C. more / D. much.

30. A. sizes / B. groups / C. classes / D. sorts.

31. A. backgrounds / B. studies / C. kinds / D. cases.

32. A. whether / B. what / C. which / D. though.

33. A. good / B. success / C. best / D. so.

34. A. technicians / B. opinion / C. experts / D. situation.

35. A. referred / B. known / C. spoken / D. quoted.

Test 8. Cloze, Open. [30]

Two passages were read aloud to the students, with a word missing from each sentence. The task was to supply an acceptable word. No multiple choice alternatives were given.

Passage 1.

1. Yesterday a man was shot dead at point blank range and robbed of \$9,000 which he had just withdrawn from a _____ in Meifoo estate.

2. The bullet pierced his chest and Mr Lo, a twenty seven year old bachelor, was certified _____ on arrival at Queen Elizabeth hospital.

3. Ballistics experts examined the bullet and said it could have _____ from a police revolver.

4. Special Crime Division detectives are especially _____ to find the murder weapon.

5. No police revolver has been stolen this year, but one was snatched _____ year.

6. Superintendent Peter Jones, who is investigating the _____, said he considered it a difficult one to solve.

7. "All our resources at Special Crimes Division are being _____ to track down the killer", he said.

8. "One theory we are working on", he told reporters, "is that Mr Lo was followed as he _____ the bank with his money".

9. Superintendent Jones appealed to anyone who had seen Mr Lo in the bank to come forward to _____ the police with their enquiries.

10. The deceased lived with his parents on the second _____ of Block 14 of Meifoo Estate.

11. He left his home at 9.20 yesterday and withdrew \$9,000 from his savings account from the Meifoo _____ of the Hang Seng Bank.

12. About fifteen minutes later his mother heard a _____ similar to that of a gunshot.

13. She opened the door to see what was _____.

14. Then she saw Mr Lo lying about twenty yards from the door of his _____ with a gunshot wound in his chest.

15. Investigations showed there was no sign of a struggle before the shot was _____.

Passage 2.

1. Many of the people who died in the recent plane crash in China _____ parents.

2. The Cheung family suffered particularly with eight _____ being made orphans overnight.

3. The dead Mr and Mrs Cheung are survived by a son and seven _____ aged between twelve and twenty four.

4. The two eldest daughters are married, but the rest still _____ school.

5. The bereaved family say they will have difficulty paying their school _____, since they are poor.

6. Except for the two eldest the other eight members of the family _____ in a small unit at Wong Tai Sin Estate.

7. Mr Cheung worked as a cook in a Chinese restaurant while his _____ was a factory worker.

8. One of the daughters said the family planned to go to Canton to identify their parents' _____.

9. She blamed the travel company for not informing them of their parents' _____.

10. "It was only when we went to the company office _____ they gave us details of the accident", she said.

11. Since many bodies were still buried in the wreckage, the _____ number of victims was not clear.

12. However, according to the travel company, there were about seven couples whose names were on the passenger _____.

13. A Mr and Mrs Wong were also killed, although they were sitting right beside the emergency _____.

14. Like Mr Cheung, Mr Wong also _____ as a cook in a restaurant.

15. Fortunately his children are grown up, and are financially able to _____ after themselves.

Test 9. Dictation 1. The passages were read three times, once at normal speed, then line by line, then again at normal speed.

1. In the fast-moving world of oil tankers, aircraft-carriers and submarines,

2. we hardly give much thought to the junk.

3. Yet one is now creating 100,000 miles.

4. With a cosmopolitan character, it was founded in 1846.

5. I saw it when it stopped in Java.

6. The aim of the voyage was to explore Asia.

7. and develop cultural relations between Asia and Europe.

8. The junk is built of wood and is 100 feet long.

9. The crew are professional sailors.

10. The crew are professional sailors.

Test 10. Dictation 2.

1. He was a little man with a very short height.

2. He was enormously muscular and very fleshy face.

3. with the cheeks hanging over his eyes.

4. His small features were very prominent.

5. Except for the crescent-shaped head.

6. he was completely bald.

7. Though he was a first-class man, he had no dignity.

8. His blue eyes, behind his thick, bushy eyebrows, were lively.

9. and there was a certain amount of intelligence in his face.

10. He was sixty, but he looked much younger.

11. He was sixty, but he looked much younger.

12. He was sixty, but he looked much younger.

13. He was sixty, but he looked much younger.

14. He was sixty, but he looked much younger.

15. He was sixty, but he looked much younger.

16. He was sixty, but he looked much younger.

17. He was sixty, but he looked much younger.

18. He was sixty, but he looked much younger.

19. He was sixty, but he looked much younger.

20. He was sixty, but he looked much younger.

21. He was sixty, but he looked much younger.

22. He was sixty, but he looked much younger.

23. He was sixty, but he looked much younger.

24. He was sixty, but he looked much younger.

25. He was sixty, but he looked much younger.

26. He was sixty, but he looked much younger.

27. He was sixty, but he looked much younger.

28. He was sixty, but he looked much younger.

2. we hardly give much thought to such craft as the Chinese junk.
3. Yet one is now creating history making a voyage of 20,000 miles.
4. With a cosmopolitan crew, it is repeating a voyage made in 1846.
5. I saw it when it stopped in Singapore before leaving for Java.
6. The aim of the voyage is to spread Asian culture beyond Asia
7. and develop cultural and economic ties between Asia and Europe.
8. The junk is built of very hard wood and has three cotton sails.
9. The crew are professionals who fully intend to finish the voyage.

Test 10. Dictation 2.

1. He was a little man considerably less than of middle height.
2. He was enormously stout, with a large, clean-shaven, fleshy face
3. with the cheeks hanging down on each side of his jaw.
4. His small features were all hidden in mountainous fat.
5. Except for the crescent of white hair at the back of his head
6. he was completely bald, like a large, overweight ostrich.
7. Though he was a figure of fun, still he retained some dignity.
8. His blue eyes, behind large, gold-rimmed spectacles, were lively
9. and there was a certain shrewdness and determination in his face.
10. He was sixty, but his vitality triumphed over advancing years.

Tests 11-12. Listening comprehension tests, TOEFL.⁵⁵

Test 11. Listening to Statements. [20]

(A short statement is heard, and a choice has to be made between four written sentences to decide which best fits the meaning of the original statement.)

Frank's mother is my sister.

1. Frank is my cousin / 2. I am friendly with Frank /
3. Frank is my nephew / 4. I hardly know Frank.

Test 12. Listening to Conversations. [15]

(A short conversational exchange is heard between a man and a woman, then a third person asks a question. A choice has to be made between four written sentences which is the best answer to the question asked by the third person.)

Woman: I hardly ever go shopping by car now. The shopping centre is within walking distance.

Man: Well, you're lucky. The nearest store I can go to is about two miles away.

Third person: How does the woman usually go shopping?

B. Reasoning Tests.

Tests 13-14. Series Completion.⁵⁶

Test 13. Series Completion 1, Numbers.

Fill in the missing number.

1. 8 10 14 18 — 34 50 66
2. 8 24 12 — 18 54

3. 2 5 9 19 37 —
4. 2 7 24 77 —
5. 5 6 7 8 10 11 14 —
6. 6 12 24 48
- 2 4 16 —
7. 6 8 —
- 12 2 9 3 4 5
8. 7 14 12
- 4 12 9
- 6 24 —
9. 14 9 5
- 21 8 13
- 28 9 —
10. 8 3 21
- 6 5 25
- 12 2 —
11. 6 8 7
- 36 64 49
- 24 48 —
12. 2 5 7
- 4 7 5
- 3 6 —
13. 9 4 20
- 8 5 12
- 7 6 —
14. 4 12 10 5
- 10 3 6 7
- 6 8 — 5
15. 7 9 5 11
- 4 15 12 7
- 13 8 11 —

Test 14. Series Completion 2, Letters.

Fill in the missing letter.

1. E H L O S —
2. R O L I —
3. D H L R —
4. W S O K —
5. N O M Q I —
6. C V H O Q —
7. M N O L R I V —
8. R V K Q
- N P C —
9. D M I —
- K F P —
10. A D G —
- E I N —
11. L O T
- D H O
- P S —
12. S P L
- O K F
- U P —
13. H K Q
- C G O
- E J —
14. K N H
- P T L
- I N —
15. K N E
- M O I
- T X —

Test 15. Verbal Analogies, DAT/Otis-Lennon.⁵⁷ [21]
 _____ is to water, as eat is to _____

- A. continue drive
- B. foot enemy
- C. drink food
- D. girl industry
- E. drink enemy

C. Memory tests.

Test 16. Span Memory 1.

The students listen to a series of numbers. When the series is finished they have to write down the numbers. The number of digits is gradually increased.

- 1. 5917483
- 2. 4173926
- 3. 58291647
- 4. 31295864
- 5. 471836259
- 6. 527964183
- 7. 9683917438

Test 17. Span Memory 2.

As above, but with letters.

- 1. CHLGYSR
- 2. YFKHSLG
- 3. HRPGCKFS
- 4. PFHYRGCK
- 5. FPLCGKSHR
- 6. KRLYCSFPG
- 7. GLKRHSYCPF

Test 18. Rote Memory 1.

The students hear a list of seventeen pairs of words. The list is read twice. Then, given one word of the pair, they must provide its partner.

- 1. buy/star 2. spoon/teach 3. up/ask 4. read/new 5. fire/boy
- 6. long/hear 7. hot/desk 8. cow/shop 9. tree/clock
- 10. grass/ship 11. song/car 12. green/big 13. day/hand
- 14. job/black 15. kick/page 16. run/eat 17. time/man.

Test 19. Rote Memory 2.

As above, only the list consists of words and numbers paired.

- 1. key/9 2. put/17 3. you/4 4. cold/13 5. meat/15 6. drive/7
- 7. smoke/12 8. buy/1 9. sad/16 10. city/3 11. about/8
- 12. idea/14 13. hope/10 14. guitar/5 15. go/11 16. large/16
- 17. dollar/2.

Test 20. Verbal Memory.

The students were given four minutes to read a list of thirty unconnected sentences. The sheets with the sentences were then collected. The thirty sentences were then read aloud to the students, but with one word missing. The task was to supply the missing word. The word which was omitted

0045-12

Joseph P. Boyle

in the reading aloud is underlined in the following text, but of course it was not in the version which the students read.

1. Women are as good as men at climbing hills.
2. Smoking is now allowed in some public places.
3. One of the greatest dangers for children is too much television watching.
4. My mother thinks she knows the answer to everything.
5. Fat people are often more cheerful than thin ones.
6. If you always wear the latest fashions in clothes, it can become expensive.
7. We went camping last summer during the holidays.
8. Boys and girls should be educated together in coeducational schools.
9. Hong Kong has an enormous number of minor traffic accidents.
10. Boxing is such a dangerous sport that it should be forbidden by law.
11. Chinese folk songs are quite a bit different from western ones.
12. Some of the better advertisements on television are very funny.
13. Children seem to be allowed by their parents to do whatever they like these days.
14. On some beaches you are not allowed to play a transistor radio.
15. The value of the Hong Kong dollar has fallen considerably.
16. China has one of the largest armies in the world.
17. If you think about childhood days, it brings back happy memories.
18. I knew a man whose office was so untidy he could never find anything in it.
19. Cycling along the road is enjoyable, but a bit too dangerous for my liking.
20. Since we were very young we have had examinations to sit nearly every year.
21. I wonder if Cantonese films are very expensive to make.
22. If a person is hard-working, he or she will do well in life.
23. The number of hotels in Hong Kong is increasing every year.
24. Mong Kok is an exciting place to visit, but it is too crowded.
25. I don't know why so many of the richest people in Hong Kong live so simply.
26. Do you think it would be nice to live till you were a hundred?
27. Criminals who shoot a policeman deserve to be hanged, don't you think?
28. I wonder when they will send the next rocket into space.
29. Coloured people in Britain are sometimes treated badly, but not too often.
30. I like to be in the company of people who laugh a lot.

A Decade Language

ELIZABETH BELL

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