

ANAGRAM SOLUTION ABILITY: A FUNCTION
OF VERBAL INTELLIGENCE

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ANAGRAM SOLUTION ABILITY: A FUNCTION OF
VERBAL INTELLIGENCE

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Abstract

The present study was designed to investigate the relationship between the subjects' verbal intelligence quotient as defined by the verbal half of the Wechsler Adult Intelligence Scale and his ability to obtain correct solutions of anagrams.

A list of twenty eight anagrams was presented to subjects with instructions to solve as many as possible in seven minutes, after which each was individually administered the verbal half of the W.A.I.S.

It was predicted that increases in I.Q. would result in significant increases in correct anagram solutions.

The results of a 2 X 3 analysis of variance show that:(A) there was a significant difference in the groups on the I.Q. variable ($P < .01$), (B) there was no significant difference between the performance of male and female Ss, (C) there was no significant interaction between sex and I.Q.

The results of Tukey tests showed that:(A) the difference between the high and low I.Q. groups was significant to the .01 level, (B) the difference between the medium and low I.Q. groups was significant to the .05 level, (c) the difference between the high and medium I.Q. groups was significant to the .10 level.

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During the past forty years there has been a great deal of research conducted concerning the many aspects involved with the solution of anagrams. Hollingworth (1935) thought that anagrams which appeared as real words or pseudo-words were harder to break up and solve than nonsense letter combinations. Devnich (1937) replicated this study and basically came to the same conclusions. Beilin and Horn (1962) also found that meaningful letter groups resisted reorganization more than did meaningless letter aggregates. They concluded that the differences were not accounted for by transition probability totals from summed trigram frequencies, initial and terminal letter frequencies, or transition probability (T. P.) totals of solution words. Nissenson and Sargent (1971) found that a general rule could not be stated which asserted that meaningful combinations were harder to solve for all subjects. Upon inquiry, however, several subjects noted that meaningful combinations seemed to "stick in their head" and thus made the individual solutions more difficult.

Maltzman and Morresett (1952, 1953) found that mental sets based on specific instructions could be formed which influence the percentage of anagram solution. In addition they found an inverse relationship between the amount of training with incompatible anagrams and subsequent success in the solution of one of these classes of anagrams. Adamson (1959) found that the einstellung or mental set when partially reinforced formed a habit strength which was harder to extinguish than one which was reinforced during every trial. Safren (1962) found that anagrams which were made from organized lists were solved more quickly than those chosen at random, and that there was a significant trial effect decrease in solution time with subsequent trials.

Mayzner and Tresselt (1958, 1962, & 1966) found that the time required for arriving at anagram solutions was a function of letter order, word frequency,

and transition probability. Ronning (1965) coined the term "rule out factor" to describe a T. P. of such a low probability that it almost never occurs. Therefore, certain anagram letter combinations could be ruled out in the subjects' mental calculations and thus make that anagram more easy to solve.

Hollingsworth (1935) compared his subjects' ability to solve anagrams with their scores on the World War I Army "Alpha test" and found no significant correlation. Devnich's (1937) study also showed no correlation between intelligence and the ability to build words. Since only a portion of Hollingsworth's subjects had been administered the Alpha test, the non-tested group was omitted from the data. This may have confounded the results. In addition, the Alpha test may not have been a reliable enough tool for differentiating the subjects. In the Hollingworth experiment the I.Q. correlation with anagram solution ability was only tangential to the main thesis of the effects of "Gestalten" on solution times.

This study will attempt to determine the relationship between the subject's verbal intelligence quotient as measured by the Verbal portion of the Wechsler Adult Intelligence Scale and the ability to solve anagrams. All the subjects will be individually administered both the anagram and the intelligence test on the same day. The Hollingworth experiment failed to administer its subjects the I.Q. test at the same time as the anagram test and thus the subjects' performance could have varied due to the time factor.

Method

Subjects

The subjects were 30 males and 30 females between the ages of 17 and 27 (Mean=19.3, S.D.=2.229). They were all volunteers obtained from the student body of Appalachian State University, Central Cabarrus High School, and Pfeiffer College. The subjects were tested between October 1973 and April 1974. None of the subjects were familiar with the contents of the Wechsler Adult Intelligence Scale or the list of anagrams. No subjects were utilized in this experiment if they received an I.Q. score of 79 or below. Thus all subjects could be classified as being "Dull Normal" or better in intelligence.

Apparatus

A list of 28 anagrams was selected from a group of basic English words, presented on page 123 of Webster's New World Dictionary. The anagram list started with three letter combinations and progressed to more difficult six letter aggregates. Since the expected solutions were all basic English words, each should be familiar to the Ss. Several unexpected solutions occurred and after they were verified in Webster's New World Dictionary, they were given full credit. It was assumed that none of the subjects would be able to correctly solve all 28 anagrams in the stipulated time limit. One subject did manage to get a perfect score in exactly seven minutes. Each subject's correct solutions were tallied and entered on a data sheet.

The verbal section of the Wechsler Adult Intelligence Scale consisting of six subtests, which are Information, Comprehension, Arithmetic, Similarities, Digit Span, and Vocabulary, was administered and the resultant scores used as the basis for dividing the subjects into groups of high, medium, and low verbal I.Q. groups.

Procedure

Each subject was taken individually, and after obtaining his name and birthdate, the examiner read the following instructions:

"Opposite each disarranged word write the correct response using all the letters and no more. Do as many as you can, if you get stuck on one skip it and return to it later if you have time. You may use the area at the right of the paper as a worksheet if you wish. You have seven minutes. Ready? Start!"

If the subject asked a question the experimenter would then re-read the entire instructions and then begin the test.

Following the completion of the anagram list, the verbal portion of the Wechsler Adult Intelligence Scale was administered and subsequently scored with strict adherence to the test manual (Wechsler, 1955).

Results

The number of correct anagram solutions was determined for each S. The mean number of correct anagram solutions for each combination of I.Q. and Sex is present on Figure 1. The data was tested for statistical significance using a 2 X 3 analysis of variance (Male X Female & High X Medium X Low). Both sex and I.Q. were between subject variables. The results of the analysis indicated that the variable of I.Q. was significant ($F=8.85$, $p < .01$ for 2 dF). There was not a significant difference for sex ($F=1.29$ for 1 dF) or for the interaction of sex and I.Q. (Table 1).

Tukey tests were employed in order to specify the locus of the differences among the I.Q. groups (Glass & Stanley, 1970). The results show the difference between the high and low I.Q. groups was significant at the .01 level. The difference between the medium and low I.Q. group was significant at the .05 level and the difference between the medium and high I.Q. group was significant at the .10 level (Table 2).

Table 1
Summary of Analysis of Variance

Source	S.S.	d.F.	M.S.	F	P
Sex	24	1	24	1.29	N.S.
I.Q.	331.3	2	165.65	8.85	< .01
SEX X I.Q.	40.7	2	20.35	1.09	N.S.
S/SEX X I.Q.	1,010.4	54	18.70	--	--
Total	1,406.4	59	--	--	--

Results of Tukey Tests to Determine Differences Between Means

	Low	Medium	High
Low	--	3.10**	5.75***
Medium		--	2.65*
High			--

*P .10

**P .05

***P .01

Discussion

The high I.Q. Ss yielded significantly ($P = .01$) more anagrams than did the low I.Q. Ss. It is seen that those people who score higher on the verbal portion of the W.A.I.S. also tend to solve anagrams more quickly and accurately. In some individual instances, however, a subject in the low I.Q. group scored as well as most of the Ss in the high I.Q. groups. In other instances some members of the high I.Q. group scored as poorly as most of the members of the low I.Q. group. It would therefore appear that some other factors, in addition to just verbal I.Q., are in play to affect the Ss anagram solution ability. In one instance a subject who scored in the low I.Q. group obtained an anagram score of 20. It was noted that she had worked a great deal of time as a secretary and thus may have gained solving ability from her daily working with words. It was also postulated by Hunter (1961) that Ss who enjoyed working crossword puzzles did significantly at solving anagrams. In subsequent studies the subjects could be quizzed as to how much or how often they worked cross-word or anagram puzzles. Perhaps there could have been a practice effect for those Ss who were more familiar with anagrams.

Since relatively easy three letter anagrams were used to start the anagram test, and the list progressed in step like order to the six letter anagrams, perhaps a learning task was structured in which the more intelligent subjects performed better because they learn faster.

Other populations, such as non-students, could be used in future experiments to discern if the same results could be obtained. In addition the full scale W.A.I.S. might be administered to see if the addition of the performance scores would alter the outcome.

Since there does seem to be a correlation between anagram solving ability and verbal intelligence, such a structured task could offer a new form of intellectual assessment. Because all ethnic backgrounds have access to the anagram word solutions, the test may be considered culture free.

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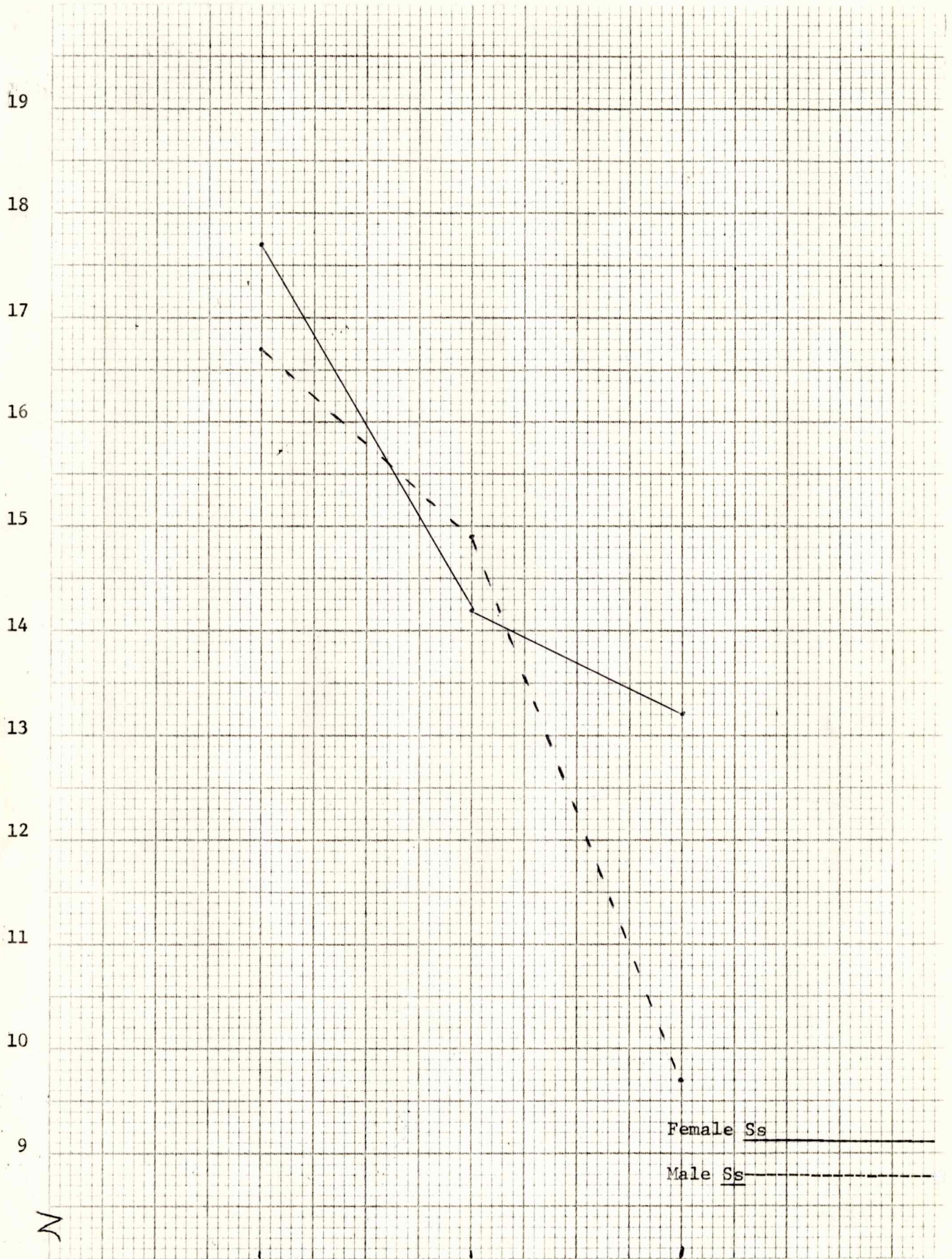
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LOI	---	---	---
BYO	---	---	---
ENP	---	---	---
YCR	---	---	---
TEW	---	---	---
LBAL	---	---	---
RUET	---	---	---
OLGN	---	---	---
STFO	---	---	---
FESA	---	---	---
ROTOP	---	---	---
GAULH	---	---	---
RUGAS	---	---	---
DONUR	---	---	---
GEINB	---	---	---
ZEIRP	---	---	---
DOISL	---	---	---
GITHN	---	---	---
TUKRC	---	---	---
CICINP	---	---	---
RONAWR	---	---	---
TRESTE	---	---	---
GINRPS	---	---	---
TINKET	---	---	---
RINGEF	---	---	---
DINOWW	---	---	---
KITYSC	---	---	---
RUTFUE	---	---	---

Solutions

OIL
BOY
PEN
CRY
WET
BALL
TRUE
LONG
SOFT
SAFE
TROOP
LAUGH
SUGAR
ROUND
BEING - BEGIN
PRIZE
SOLID
THING - NIGHT
TRUCK
PICNIC
NARROW
STREET - TESTER
SPRING
KITTEN
FINGER - FRINGE
WINDOW
STICKY
FUTURE

Figure 1



Female High	17.7	Female Medium	14.9	Female Low	13.2
Male	16.7	Male Medium	14.2	Male Low	9.7

BASIC DATA

Female Subjects

<u>S</u>	High I.Q.	Anagram Solut.	<u>S</u>	Medium I.Q.	Anagram Solut.	<u>S</u>	Low I.Q.	Anagram Solut
1	139	23	11	110	16	21	104	17
2	127	22	12	110	18	22	102	13
3	124	21	13	109	16	23	101	21
4	120	17	14	109	20	24	100	13
5	115	17	15	109	10	25	98	11
6	114	9	16	108	16	26	95	9
7	114	14	17	108	11	27	95	7
8	113	20	18	107	13	28	93	13
9	111	20	19	107	9	29	87	20
10	111	14	20	107	13	30	85	8

Male Subjects

<u>S</u>	High I.Q.	Anagram Solut.	<u>S</u>	Medium I.Q.	Anagram Solut.	<u>S</u>	Low I.Q.	Anagram Solut
31	127	9	41	112	14	51	104	16
32	124	12	42	110	17	52	103	9
33	123	15	43	110	10	53	102	10
34	123	28	44	110	19	54	101	12
35	121	13	45	108	14	55	99	9
36	119	16	46	108	18	56	99	9
37	117	26	47	108	14	57	94	6
38	117	12	48	107	12	58	91	6
39	117	18	49	107	18	59	90	13
40	114	18	50	106	13	60	80	7