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By Guy H. Miles and Don Lewis

Miles, in two closely related investigations (5, 6), dichotomized male subjects on the basis of their statements as to how they had gone about solving several block design problems of the Kohs type. The two categories were *analyzers* and *non-analyzers*. Subjects were classified as analyzers if their *a posteriori* verbalizations indicated a tendency, at the conceptual level, to break each design down into parts before any blocks were actually moved. They were classified as non-analyzers if their statements failed to suggest that a breaking-into-parts approach had been employed. In the common run of male undergraduate students at the State University, the probability of getting an analyzer in this general way is about 45/100.

The dichotomizing was not done for its own sake but for the purpose of identifying, if possible, one (or more) of the primary determiners of the very great differences among male undergraduates in learning to perform the complex perceptual-motor tasks provided by the Iowa Pursuitmeter. As predicted, the analyzers, as a group, were markedly superior to the non-analyzers in performing the *standard* task, and superior to a lesser degree in performing the *reversed* task.[1]

The prediction stemmed, in part, from observations of the different patterns of behavior displayed during practice by performers of varying degrees of competence, and, in part, from off-hand unsolicited comments made by the subjects during rest intervals and/or after the trials were completed. Most of the good performers showed

[1]The underlying features of the Pursuitmeter have remained unchanged, despite several modifications, and consequently are the same as previously described (1, 4, 5, 7). A schematic representation of it appears in the 1956 Proceedings (7). In performing on it, a subject grasps two pistol-grip type handles placed at about chest height, and in striving to keep a spot of light continuously on the bullseye of a moving target, makes pushing, pulling, and twisting responses with hands and arms which are basically like the ordinary ones of steering and pointing. For the standard task, the required movements, through long established habits, are concordant with desired directional changes in the position of the light. For the reversed task, the required movements are opposite in direction to those expected from past experience. The target (including the bullseye) moves through the same irregular pathway during each 30-second trial period. Time on bullseye is recorded for each trial.

signs of proceeding cautiously and systematically in mastering the required movements of the controls, and some of them made remarks similar to the following: "It takes quite a few trials to figure the machine out," or "You don't realize at first how easy it is to overshoot the target." In contrast, many of the poor performers displayed haphazard and impulsive (if not reckless) movements, and afterwards were likely to say: "That's the craziest thing I ever saw," or "I don't see how anyone can make it work."

A tendency to approach new task situations analytically—an habitual tendency to begin by "trying to figure things out"—was deemed essential to superior performance on the Pursuitmeter. The analyzers were expected, therefore, to outdo the non-analyzers.

The superiority of analyzers to non-analyzers in performing the standard task is confirmed by the curves of Figure 1, in which aver-

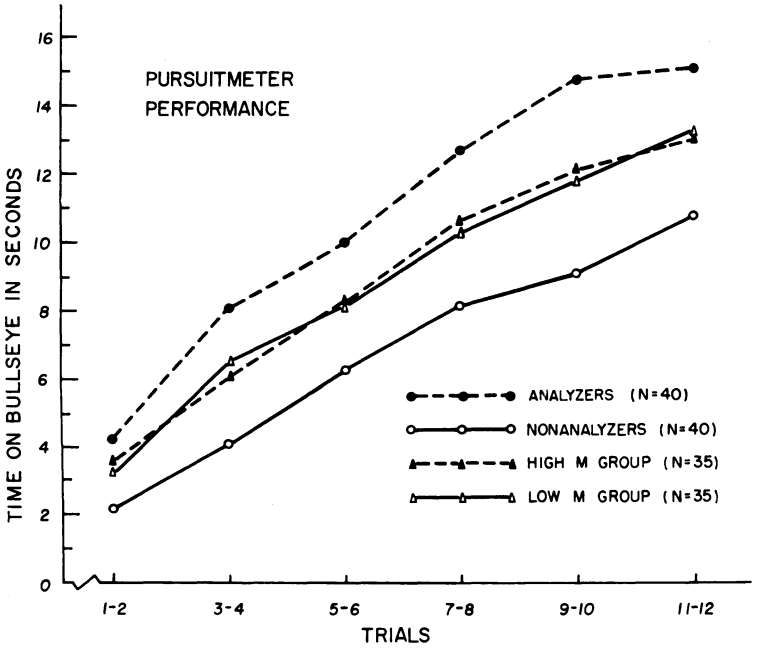

Figure 1. A plot of means of time on bullseye per block of two 30-second trials, over 12 trials on the standard Pursuitmeter task, for specified groups of male undergraduate students.

age time on bullseye in seconds is plotted against trials (in blocks of two). The trials were 30 seconds in length and were separated by 30-second rest intervals. Forty analyzers and 40 non-analyzers, all male undergraduates, were each given 12 trials. As seen from the relative positions of the top and bottom curves, the analyzers excelled throughout practice. (The two middle curves in the figure will be discussed later.)

When results similar to those summarized in Figure 1 were first obtained, skeptical critics sought easy and/or familiar explanations. A few persons, intimating that "maybe the investigator unconsciously placed the good performers, or those who looked like good performers, in the analyzer category," were eager to know about the reliability of the judgments. And they wondered whether anyone should accept, at face value, subjects' verbalizations concerning their previous way of behaving.

The investigator and his sponsor were both inclined to believe that the subjects' verbal reports were dependable and that judgments based on them were more or less inevitable. They pondered the question: Isn't asking a man how he went about solving the block design problem something like asking him if he has a wife? If he says that he divided the designs into parts before moving any blocks, shouldn't you be just as willing to call him an analyzer as you are to call him a married man if he says he has a wife? Despite a grudging willingness to give credence to the verbal reports, the critics still asked for a check on the reliability of a single dichotomizer's decisions; and they got it.

The checking was done last year, with the consequences reported to the Academy by Behrens and Miles (2). Two trained observers, using the same easily understood interviewing techniques with undergraduate males subsequent to their solutions of six 9-block designs, were found to agree in their classifying to a remarkable extent. In a first run, the two observers agreed in their classification of 60 out of 61 subjects. Then, in a second cross-validating run, they agreed on 60 out of 62. Altogether, they agreed on 120 out of 123 subjects. Very few behavioral scientists would ask for better dependability than that!

Another suggested explanation of Miles' finding that analyzers consistently surpass non-analyzers in performing on the Pursuitmeter is that analyzers are more intelligent than non-analyzers. Haven't block design problems long been used in performance-type tests of intelligence; and isn't the block design subtest of the Wechsler Bellevue Intelligence Scale recognized as a measure of "ability to analyze and synthesize" (3)? In the dichotomizing process, smart subjects (on the average) may have been separated from the not-so-smart; and it seems reasonable to believe that high intelligence is a prerequisite to high proficiency in Pursuitmeter performance.

Miles actually started (5) by administering the Wechsler Block Design Test (8) and assigning subjects to two categories (high and low) on the basis of their *time scores*. He soon discovered that the subjects with favorable (short) time scores performed no better on the Pursuitmeter than did those with unfavorable scores; and he subsequently found that there is little or no relationship between

analytic tendency (as defined by the verbal dichotomizing process) and time scores on the Wechsler test.

Even though time scores on the Wechsler block test, *taken as a whole,* are apparently not related to analytic tendency, time scores on three of the designs, all requiring nine blocks, *are* related, individually, to some extent. These three designs and three other original ones, each requiring nine blocks for solution, are the six constituting the *Test of Tendency to Analyze* described and used by Behrens and Miles (2). Interestingly enough, composite standardized time scores yielded by the Miles-Behrens test, for college males, are related to analytic tendency, through the analyzer-non-analyzer dichotomy, to a degree represented by a biserial correlation coefficient of about .80.

The question, Is strong analytic tendency an important facet of high intellectual ability? has not been answered, and may never be. However, some information bearing on it is available and will now be presented.

Eighty male undergraduates, 40 classified as analyzers and 40 as non-analyzers by two trained observers using the Miles-Behrens test, were given practice on the Pursuitmeter. The performance curves for the two groups appear in Figure 1, and have already been mentioned. The superiority of the analyzers to the non-analyzers in keeping the light on bullseye is evident. What is the outcome in average Pursuitmeter performance if the subjects (or most of them) are dichotomized on some other grounds, such as centile scores on the Test of Mathematics Skills in the Iowa Placement Battery?

Seventy of the 80 subjects had taken the Test of Mathematics Skills. Their centile scores ranged from 2 to 99. They were divided into two groups of 35 subjects each, the scores for the Low M group ranging from 2 to 66, and for the High M group from 67 to 99. The means of time on bullseye for the two groups are depicted by the two overlapping curves in Figure 1. As indicated by the curves, the performances were about equally proficient over the 12 practice trials.

The apparent equality of the performances of the two M groups is further confirmed by the very small difference between their overall means, per block of two trials, over the six blocks. The means themselves (10.68 and 10.73), along with the difference (.05), are given in the third row from the bottom, in Table 1. The difference of .05 sec. may be contrasted with the difference of 4.79 sec. (given in the first row of the table) between comparable means for the analyzer and non-analyzer groups, dichotomized on the basis of verbalizations.

The Pursuitmeter performances of the two M groups were not chosen for highlighting in Figure 1 merely because the difference

Table 1

Means of Time on Bullseye in Seconds, Per Block of Two Trials, Over Six Blocks of Practice on the Standard Pursuitmeter Task, for Groups of Subjects Dichotomized on the Basis of Scores on Indicated Variables

	Low Group			High Group				
Variable	N	Range of Scores on Variable	Time on Bullseye	N	Range of Scores on Variable	Time on Bullseye	Time Difference	t
Analytic Tendency (Verbal Report)	40	—	8.11	40	—	12.90	4.79	4.685
Analytic Tendency (Time)	25	5–27	7.67	25	28–47	12.26	4.59	3.473
Reading Rate	30	2–50	9.85	30	51–99	11.65	1.80	1.316
Reading Comprehension	36	4–70	10.22	36	72–99	11.15	.93	.634
Vocabulary	37	1–62	10.60	37	63–99	10.77	.17	—
Mathematics Skills	35	2-66	10.68	35	67–99	10.73	.05	—
English Correctness	36	4–52	10.77	36	56–98	9.99	–.78	—
Grade-Point Average	40	.83–2.30	10.63	40	2.32–3.83	10.38	–.25	—

between their overall means is the smallest of the eight differences appearing in Table 1. The choice was determined, first, by the biserial correlation coefficient of .33 between analytic tendency (the dichotomized variable) and centile scores on the Test of Mathematics Skills, and second, by the thought that the mathematics scores, among the several sets of available Placement Test scores, might come closest to reflecting an analytical facet of general intellectual capacity. As seen in Table 2, the coefficient .33 (based on an N of 128)* is the largest among the six biserial r's that were computed; and it is significant well beyond the 1% level.

Table 2

Biserial Correlation Coefficients Between Analytic Tendency and the Indicated Variables

Variable	N	r_{bis}	p*
Grade-Point Average	145	.13	.12
Placement Test Centile Score			
Mathematics Skills	128	.33	.002
Reading Comprehension	122	.27	.01
Reading Rate	112	.19	.06
Vocabulary	122	.19	.05
English Correctness	122	.02	.50

*p is the one-tailed probability that the obtained correlation coefficient would arise by chance in random sampling of a population in which the two variables are unrelated.

The biserial r for analytic tendency and grade-point average, with N = 145, is only .13 and is nonsignificant (p = .12). Grade-point averages are not unrelated to intellectual ability, even among college males. If high intellectual ability is conducive to proficient performance on the Pursuitmeter, then male students with high grade-point averages should do better than those with low averages. The 80 males were divided into two groups of 40 each, with grade-point averages ranging as shown in the bottom row of Table 1. The difference between the overall means of performance is -.25 sec., indicating (if anything) that the lower the academic record is, the higher (by a little) will be the level of Pursuitmeter performance. The difference, of course, is statistically nonsignificant.

The only differences in Table 1 that are statistically significant (at the 1% level or better) are the two for the performance of groups dichotomized on the basis of either their verbal reports concerning their block design solutions or their time scores on the Miles-Behrens test. [Only 50 of the 80 subjects could be retained in the two Analytic Tendency (Time) groups; dependable time scores for the others had not been obtained.] The difference of 1.80 sec. between the overall means for the low and high reading rate groups is sizable

*This number of male undergraduates had, at one time or another, been classified as either analyzers or non-analyzers and also had taken the Mathematics Skills Test.

but nonsignificant. The t value corresponding to it is 1.316. Even with 58 degrees of freedom, it falls below the 10% level.

The evidence shows that while analytic tendency is apparently related to the centile scores of male students on four of the five Iowa Placement Tests, the strengths of the relationships are not great enough to make the scores predictive of level of proficiency in performing the standard Pursuitmeter task. Analytic tendency, whether determined on the basis of subjects' verbalizations concerning their ways of solving block design problems or on the basis of composite time scores obtained on the Miles-Behrens test, is one of the primary factors influencing Pursuitmeter proficiency. It remains to be discovered whether or not analytic tendency, however measured, is a significant facet of general intellectual ability. A good starting point might be a correlational analysis of the relationships between time scores on the Miles-Behrens test and scores on the several parts of the Wechsler Adult Scale.

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