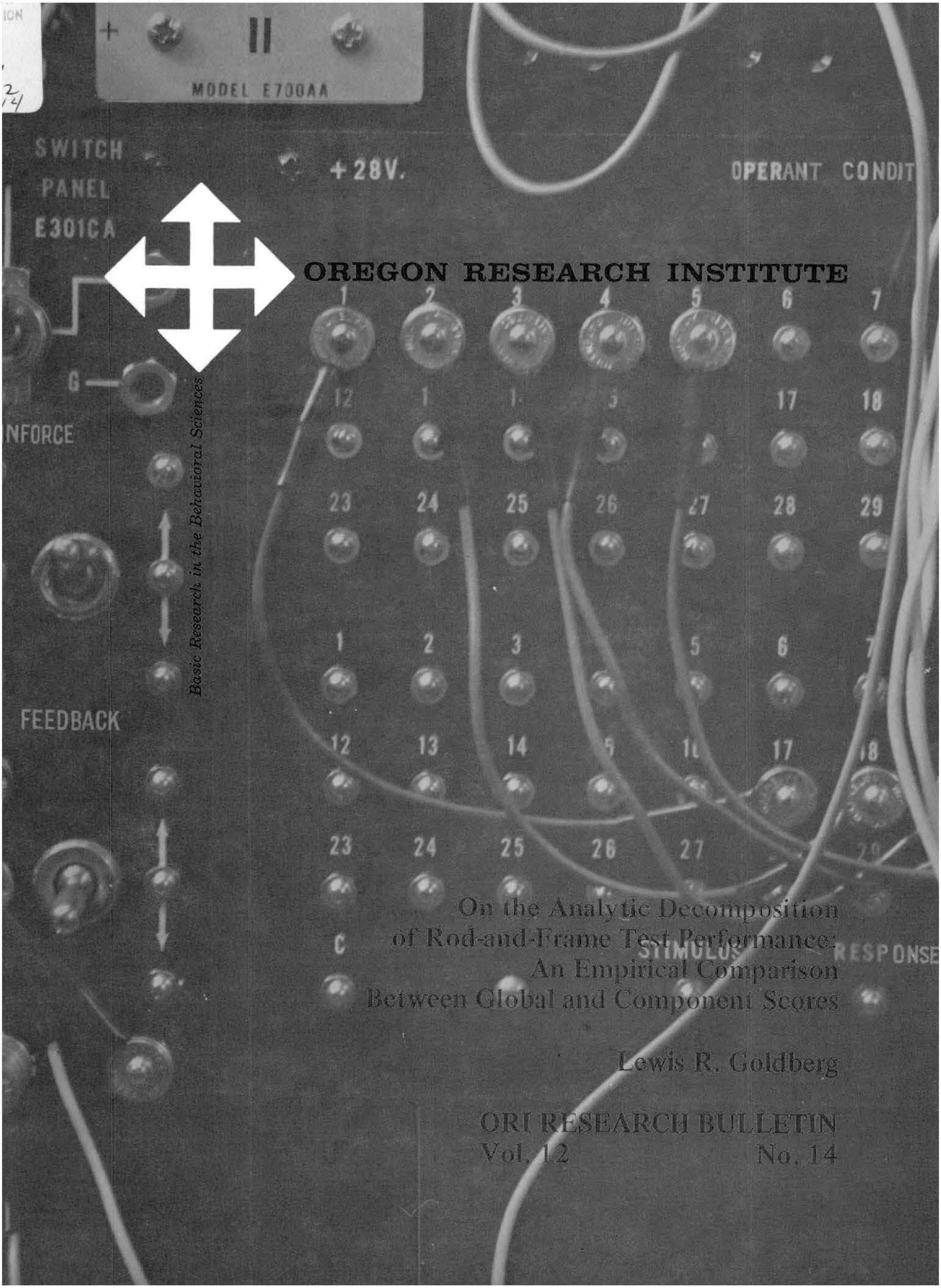

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Abstract

An analytic schema is presented for decomposing the traditional global accuracy score from the Rod-and-Frame Test into a set of component scores. As a preliminary comparison of the usefulness of these component scores with the traditional composite measure, the data from a study by Hettema (1968) were re-analyzed. A sample of 70 male subjects was used to investigate the linear and nonlinear relationships between 22 RFT scores and scores from the Street Gestalt, Gottschaldt Hidden Figures, PMA Spatial, Hidden Pictures, PMA Reasoning, Muller-Lyer Illusions, Poggendorff Illusions, Peripheral Span, Squares, and Verbal Analogies tests. The RFT global accuracy score was not significantly related to any of these measures. In contrast, an intriguing pattern of significant relationships emerged between various RFT component scores and most of the cognitive and perceptual tests.

ON THE ANALYTIC DECOMPOSITION OF ROD-AND-FRAME TEST PERFORMANCE: AN EMPIRICAL COMPARISON BETWEEN GLOBAL AND COMPONENT SCORES[1]

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Stimulated both by the pioneering multivariate explorations of Raymond Cattell and his collaborators (e.g., Cattell & Warburton, 1967; Hundleby, Pawlik, & Cattell, 1965) and by a resurgence of theoretical attention to perceptual and cognitive styles (e.g., Blake & Ramsey, 1951; Klein, 1970; Witkin, et al., 1954; Witkin, et al., 1962), the past decade has witnessed a burgeoning interest in the development of "objective" or "performance" measures of personality. The prototype of such personality measures is the Rod-and-Frame Test (RFT), originally reported by Witkin and Asch (1948b) and Witkin (1949a), and used over the years in a host of investigations (e.g., Arbuthnot & Gruenfeld, 1969; Barrett & Thornton, 1967; Barrett, Thornton, & Cabe, 1970; Cancro & Sugerman, 1969; Elliott, 1961; Gardner, 1961; Goldstein, et al., 1968; Goodenough & Karp, 1961; Gross, 1959; Jacobson, 1966, 1968; Jacobson, Pisani, & Berenbaum, 1970; Karp, 1963; Kristofferson, 1968; Linton, 1955; McAllister, 1970; Powell, 1970; Schimek, 1968; Schooler & Silverman, 1969; Silverman & King, 1970; Vaught, 1965; Vaught & Ellinger, 1966; Witkin, Goodenough, & Karp, 1967; Young, 1959).

While early attempts to develop objective tests of personality for use in applied settings date back at least to the early 1920's (see Burtt, 1923; Travis, 1925), the RFT emerged as a byproduct of some basic experimental studies of spatial orientation, especially perception of the upright (Asch & Witkin, 1948a, 1948b; Witkin, 1949b; Witkin & Asch, 1948a, 1948b). In these early experiments, Witkin and Asch observed that while the perception of the upright was generally determined both by internal (proprioceptive) and by external (visual) cues, there were large individual differences among subjects in their reliance on external cues when these visual cues were experimentally placed in opposition to the internal ones. For example, when seated in a dark room and asked to vertically position a luminous rod within a luminous square frame which was tilted to one side, subjects generally positioned the rod in some compromise position between the true vertical and the "visual vertical" provided by the tilted frame. However, some subjects appeared to disregard the cues provided by the tilted frame, while others appeared to rely almost completely on such visual cues. Individual differences in accuracy of rod positioning from the true vertical, which were found to relate to accuracy in a variety of similar spatial tasks, were originally conceptualized as a trait of "field dependence" (Witkin, et al., 1954). Later, after further investigations suggested that RFT accuracy scores were also related to analogous measures from a number of other tasks (especially the Embedded Figures Test), the concept was broadened and re-titled "psychological differentiation" (Witkin, et al., 1962).

Perhaps because of their initial focus on perception of the upright, Witkin and Asch--as well as most of the investigators who later used the RFT technique--elected to compute only a single global accuracy score for each subject, namely the sum of the absolute values of the deviations of the subject's rod setting from the true vertical across all of the RFT trials. However, such an aggregate index necessarily obscures such factors in RFT performance as the direction of the deviations, their sequential order within the set of RFT trials, and their relationship to the initial rod and frame settings. A finer-grained analysis of the potentially complex processes involved in the RFT may serve to reconcile some of the conflicting evidence regarding the correlates of, and the factors underlying, RFT performance. The present report, which presents a preliminary schema for analyzing some of the component processes which are obscured in the traditional global RFT index, should hopefully provide a first step toward this goal. Ultimately, this schema should increase the significance of the RFT as a personality assessment technique by clarifying some of the controversial issues regarding its construct validity (e.g., Gruen, 1957; Zigler, 1963), especially the relationship between individual differences in RFT performance and general intelligence, the perceptual closure factors, and responses to optical illusions. Before discussing this proposed scoring scheme, however, let us briefly review the RFT technique.

The Rod-and-Frame Test

The RFT consists of a luminous square frame pivoted at its center so that it may be tilted to the left or to the right. Pivoted at the same center, but moving independently of the frame, is a luminous rod. The test is conducted in a completely darkened room, so that only the rod and frame are visible. Both rod and frame are initially presented in a tilted position. While the frame remains in its initial tilted position, the subject is asked either to personally adjust the rod to the vertical (subject-operated mode) or to verbally instruct the experimenter, who in turn adjusts the rod until the subject is satisfied that the rod is vertical (experimenter-operated mode). RFT accuracy scores based upon eight trials from each of the two modes have been shown to correlate around .90 (Adevai, Silverman, & McGough, 1968). However, accuracy scores from the experimenter-operated mode, which has many practical and theoretical advantages over the subject-operated mode, have been shown to correlate more highly than the latter with scores from the theoretically-related Embedded Figures Test (Adevai, Silverman, & McGough, 1968). Consequently, whenever possible, RFT responses should probably be obtained via the experimenter-operated mode.

In most of the early RFT investigations (e.g., Witkin, 1949a), the subjects were seated in a movable chair and tested for eight trials in each of three body positions: (_a_) the subjects were tilted 28° in the same direction as the tilt of the frame (Series 1); (_b_) the subjects were tilted 28° in the direction opposite that of the tilt of the frame (Series 2); and (_c_) subjects were tested while seated in an upright position (Series 3). The original RFT global accuracy score was the sum of the subject's standard scores from the three series. For reasons of economy and portability, most later investigators have used only the Series 3 scores, thus eliminating the need for the expensive and cumbersome tilting chair. Moreover, Barrett, Cabe, and Thornton (1968) and Cabe (1968b) showed that the Series 3 RFT accuracy scores were considerably more highly correlated with scores on the theoretically-related Embedded Figures Test than were accuracy scores based upon either Series 1, Series 2, or the total of the three series. In addition, Barrett and Thornton (1968a, 1968b) found that the Series 3 RFT accuracy scores were consistently more highly related to various measures of emergency behavior and discomfort in an automobile simulator than were accuracy scores based upon either Series 1, Series 2, or the three series combined.

In spite of a vigorous plea for the standardization of all performance tests of personality (Krathwohl & Cronbach, 1956), variations in RFT apparatus and procedures are legion. Uncontrolled variations between different RFT studies include: (a) the size of the square frame, from 30" (e.g., Rosenfeld, 1967) to 42" (e.g., Witkin, et al., 1954); (b) the distance between the subject and the frame, from 3' (e.g., Crutchfield, Woodworth, & Albrecht, 1958) to 12' (e.g., Pressey, 1967); (c) the occasional use of a head clamp to restrict subjects' movement (e.g., Adevai, Silverman, & McGough, 1968; Gruenfeld & Arbuthnot, 1969); (d) the occasional use of goggles to eliminate peripheral vision (e.g., Barrett & Thornton, 1968a); (e) the occasional elimination of a chair (movable or not) in favor of standing erect (sometimes on a tiltable board); (f) the use of instructions to set the rod at the vertical, the horizontal, or both; (g) the initial positions of the frame; (h) the initial positions of the rod; and (i) the number of trials run under each experimental condition.

However, with very few exceptions (e.g., Benfari & Vitale, 1965; Cabe, 1968a; Coan, 1964; Hettema, 1968; Pressey, 1967), the single most standard aspect of the RFT has been its scoring, perhaps in part because RFT investigators have been influenced by the following argument:

> "There are a number of possible alternative scoring methods for the RFT and for the other orientation tests. For example, the mean error in the direction of the tilt of the frame has been used by some workers instead of the absolute error. These alternatives may be useful for specific research problems, but we have not found a scoring method that has greater construct validity as a measure of field dependence than does the absolute error" (Witkin, et al., 1962; p. 37; Footnote 2).

Such an argument would seem more compelling if the evidence for the assertion were somewhere presented. In fact, since the conceptual status of the RFT accuracy score is far from clear (see Gruen, 1957; Zigler, 1963), it does not seem unreasonable to propose that RFT investigators analyze a set of component scores, along with the global index.

Paramaters of RFT Performance and Scoring

The traditional RFT global accuracy score represents an aggregate pattern of performance across such situational and instructional factors as (*a*) the subject's body orientation (tilted vs. erect), (*b*) the initial frame position (tilted to the right vs. to the left), (*c*) the initial rod position (tilted to the right vs. to the left), and (*d*) the sequential order within the total set of trials (early trials vs. late trials). In addition, the index might be averaged across such factors as (*e*) the subject's physical stance (seated vs. standing), and (*f*) instructions to position the rod to the vertical vs. the horizontal. Each of these factors can be viewed as exerting a "main effect" on individual differences in RFT performance, as can the various two-way, three-way, and higher-order interactions among these factors (see Table 1). Among these latter effects, the body orientation by frame position interaction (e.g., subject and frame both tilted to the same side vs. subject and frame differing in orientation) and the analogous frame position by rod position interaction effect would *a priori* seem to be worthy of particular scrutiny.

Insert Table 1 about here

As indicated in Table 1, at least six types of scores can be computed for each of these factors (and each of the interactions). First of all, accuracy ($\underline{A}$) scores can be differentiated from measures of response bias ($\underline{B}$). All accuracy scores are averages of the absolute values of the discrepancies between the final rod setting and some standard (e.g., the true vertical); measures of response bias are analogous averages of the algebraic (i.e., signed) discrepancies. Moreover, among accuracy scores, deviations can be computed from the true ($\underline{T}$) vertical or from the "personal ($\underline{P}$) vertical" (the algebraic mean of the individual's final rod settings over all trials). And, finally, most of these indices can be calculated either as directional ($\underline{D}$) or as nondirectional ($\underline{N}$) scores. Directional scores retain their algebraic sign, while each nondirectional score is the absolute value of its directional analogue.

A Simple Computational Example

To make these distinctions clear, let us now describe how these scores may be calculated, using a simplified example. Assume that there are only four RFT trials and that the initial frame settings are alternated from left to right between each trial; thus, the frame is initially set to the right on trials 1 and 3 and to the left on trials 2 and 4. Consider the first two trials as the earlier trials, and the last two as the later trials. The initial data consist of four signed discrepancies between the final rod setting for each trial and the true vertical; arbitrarily, assume that errors toward the subject's right are given positive signs, while those toward his left are given negative signs.

Let us designate the four responses as C_1, C_2, C_3, and C_4. The "personal vertical" ($\overline{C}$) is therefore defined as:

$$\overline{C} = \frac{1}{4} \sum_{i=1}^{4} C_i \quad . \tag{1}$$

Discrepancies from the personal vertical, designated E_i, are defined as:

$$E_i = C_i - \overline{C} \quad . \tag{2}$$

Finally, let us define the absolute values of C_i as M_i, and analogously define the absolute values of E_i as Q_i:

$$M_i = |C_i| \tag{3}$$

$$Q_i = |E_i| \quad . \tag{4}$$

The computing formulae for each of the six "frame position" effects are given in Equations 5 - 10:

$$FATD = M_1 + M_3 - M_2 - M_4 \tag{5}$$

$$FATN = |M_1 + M_3 - M_2 - M_4| \tag{6}$$

$$FAPD = Q_1 + Q_3 - Q_2 - Q_4 \tag{7}$$

$$FAPN = |Q_1 + Q_3 - Q_2 - Q_4| \tag{8}$$

$$FBD = C_1 + C_3 - C_2 - C_4 \tag{9}$$

$$FBN = |C_1 + C_3 - C_2 - C_4| \quad . \tag{10}$$

The analogous computing formulae for each of the six "sequential" effects are given in Equations 11 - 16:

$$SATD = M_1 + M_2 - M_3 - M_4 \tag{11}$$

$$SATN = |M_1 + M_2 - M_3 - M_4| \tag{12}$$

$$SAPD = Q_1 + Q_2 - Q_3 - Q_4 \tag{13}$$

$$SAPN = |Q_1 + Q_2 - Q_3 - Q_4| \tag{14}$$

$$SBD = C_1 + C_2 - C_3 - C_4 \tag{15}$$

$$SBN = |C_1 + C_2 - C_3 - C_4| \quad . \tag{16}$$

The computing formulae for each of the six "interaction" effects are given in Equations 17 - 22:

$$\text{K A T D} = M_1 + M_4 - M_2 - M_3 \tag{17}$$

$$\text{K A T N} = |M_1 + M_4 - M_2 - M_3| \tag{18}$$

$$\text{K A P D} = Q_1 + Q_4 - Q_2 - Q_3 \tag{19}$$

$$\text{K A P N} = |Q_1 + Q_4 - Q_2 - Q_3| \tag{20}$$

$$\text{K B D} = C_1 + C_4 - C_2 - C_3 \tag{21}$$

$$\text{K B N} = |C_1 + C_4 - C_2 - C_3| \quad . \tag{22}$$

Finally, the computing formulae for each of the four "total" effects are given in Equations 23 - 26:

$$\text{Z A T N} = M_1 + M_2 + M_3 + M_4 \tag{23}$$

$$\text{Z A P N} = Q_1 + Q_2 + Q_3 + Q_4 \tag{24}$$

$$\text{Z B D} = C_1 + C_2 + C_3 + C_4 \tag{25}$$

$$\text{Z B N} = |C_1 + C_2 + C_3 + C_4| \quad . \tag{26}$$

Note that for the total effects, though not for the main effects and the interaction effects, the two directional accuracy scores need not be calculated; ZATD is identical to ZBD, and all values of ZAPD are zero.

Correlates of RFT Component Scores: An Illustrative Empirical Study

The use of the RFT in personality assessment is predicated on the assumption that RFT scores relate to a host of other cognitive, personality and/or perceptual measures. Consequently, to the extent that the proposed RFT component scores are useful additions to the global accuracy index (ZATN), these scores should correlate more highly--and/or more consistently--

with such non-RFT indices. As a preliminary test of this hypothesis, the data from a study by Hettema (1968) were re-analyzed, using 22 indices from the new scoring design.

Subjects

The subjects were 70 young male adults from the Dutch army, who are further described in "Study I" of Hettema (1968).

RFT Procedures and Scores

Series 3 of the RFT was administered under the experimenter-operated mode. Subjects were seated erect three meters (about 9') from the RFT apparatus. Twelve trials were administered, with the frame alternately rotated 28° to the right and 28° to the left of the true vertical. The rod was always set 28° from the true vertical, to the opposite side of the tilt of the frame. Algebraic (signed) deviations of the rod from the true vertical were recorded at the end of each of the 12 trials.

From these initial 12 deviation values, the 22 scores which are marked by an asterisk in Table 1 were computed. Of these 22 indices, six were based upon the initial frame position (the six even-numbered trials, in which the frame was initially tilted to the right, vs. the six odd-numbered trials, in which it was tilted to the left): FATD, FATN, FAPD, FAPN, FBD, FBN. (Since the initial rod and frame positions were completely confounded in this study, it was not possible to include any independent scores based on the initial rod settings; consequently, these six "frame position effects" are actually "rod-by-frame interaction effects" in the more complex design displayed in Table 1. However, for conceptual simplicity, they will be considered as if they were solely "frame effects" in the present analyses.) Six scores based upon "sequential effects" (the first six trials vs. the last six trials) were included: SATD, SATN, SAPD, SAPN, SBD, and SBN. Six "frame position by sequence" interaction effects (trials 1, 3, 5, 8, 10, and 12 vs. trials 2, 4, 6, 7, 9, and 11) were included: KATD, KATN, KAPD, KAPN, KBD, and KBN. And finally, the four "total" RFT scores were included: ZATN, ZAPN, ZBD, and ZBN.

Other Measures

Ten additional cognitive and perceptual tests were included in the study. Eight of these tests, which were borrowed from Thurstone's (1944) factorial analysis of perceptual tasks, were included as marker variables for four perceptual factors:

Factor	Marker Test
Speed and Strength of Closure	Street Gestalt Test
	Gottschaldt Hidden Figures
	PMA--Spatial Test
Flexibility of Closure	Hidden Pictures Test
	PMA--Reasoning Test (Letter Series)
Optical Illusions	Muller-Lyer Illusions
	Poggendorff Illusions
Perceptual Speed	Peripheral Span--Test B

Seven of these tests were adapted for group administration, while the Peripheral Span Test was administered individually. All test materials were copied from Thurstone (1944), except for the Hidden Pictures Test for which new designs were constructed (three drawings of complex landscapes in each of which a number of human faces were hidden). All tests were scored so that high scores reflected less accurate perception (i.e., more errors).

In addition, a measure of the cognitive style labeled "leveling vs. sharpening" (the Squares Test) and a measure of general verbal aptitude (a Verbal Analogies Test) were included in the study. For the Squares test, white outlines of squares on a black background were projected on a screen in 20 series of five slides each. Subjects were told that the sides of the first square were exactly 10 centimeters, and they were asked to estimate the size of the sides of the other squares. The first two series each consisted of five squares with sides varying from 10 to 18 centimeters. In all series, the squares were presented in order of increasing size, each square two centimeters larger than the preceding one. The third and fourth series included squares ranging in two-centimeter increments from 12 to 20 centimeters; the fifth and sixth series ranged from 14 to 22 centimeters; etc. The nineteenth and twentieth series included squares ranging from 20 to 28 centimeters. The usual type of nondirectional accuracy score (Hettema, 1968) was computed for each subject.

Analyses

Both linear (Pearson *r*) and nonlinear (*eta*) correlations were computed among these 32 measures (the 22 RFT scores and the 10 additional indices).

Results

Table 2 presents the means, standard deviations, and intercorrelations among the 22 RFT scores. In Table 2, linear correlations are presented above the main diagonal, while those *eta* coefficients which were both significantly larger ($p < .05$) and numerically at least .20 greater than the corresponding linear correlations are presented below the diagonal. Since

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Insert Table 2 about here

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these results are presented solely for illustrative purposes--and since such statistics may be expected to fluctuate between studies as a function of both procedural and sampling differences--they will not be discussed at any length. However, a brief inspection of the standard deviations of the 22 RFT scores may be instructive. Note that, in this sample, individual differences in RFT performance were greatest for the two response bias scores based upon frame position: FBD and FBN. Both of these measures, as well as the total accuracy index based upon deviations from the personal vertical (ZAPN), provided as large or larger standard deviations as did the traditional global accuracy score (ZATN).

Table 3 presents the intercorrelations among the 10 additional cognitive and perceptual tests. For these 10 measures, none of the eta coefficients were significantly greater than the corresponding linear correlations.

Insert Table 3 about here

The most substantial linear correlations, which could well be attributed to general scholastic aptitude, were found among the Verbal Analogies, PMA Reasoning, Gottschaldt Hidden Figures, and PMA Spatial tests. In addition, the PMA Spatial Test was significantly correlated with the Hidden Pictures Test and the Poggendorff Illusions; the Muller-Lyer Illusions were significantly related to the PMA Reasoning Test and the Poggendorff Illusions; and the Street Gestalt Test was significantly related to the Hidden Pictures Test. However, three-quarters of the intercorrelations among these 10 tests were not significantly greater than zero, including all of the intercorrelations among the putative marker tests for each of the two closure factors.

Table 4 presents the significant correlations, both linear and non-linear, between the 22 RFT scores and the 10 additional cognitive and perceptual tests. Roughly 15% of the linear correlations between these

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Insert Table 4 about here

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two sets of measures were significantly greater than zero ($p < .05$), and about 6% of the _eta_ coefficients were significantly greater than the corresponding linear correlations. The highest of these relationships was that between one of the RFT nondirectional accuracy scores based upon sequential effects (SAPN) and the Gottschaldt Hidden Figures Test (r = .34; _eta_ = .62). This same RFT index also had significant linear correlations with the PMA Reasoning, Verbal Analogies, and Street Gestalt tests, as well as a significant nonlinear correlation with the Peripheral Span Test. Other RFT scores which produced significant correlations with three or more of the additional measures included ZBN, FBN, WBN, and ZAPN--all but the latter being nondirectional measures of response bias. At the other extreme, four RFT scores failed to correlate significantly with _any_ of the additional measures: FAPN, WAPN, SBN, and--of most importance--ZATN, the traditional RFT global accuracy score!

Among the 10 additional cognitive and perceptual measures, the Peripheral Span Test produced the largest number of significant relationships with the RFT component scores, most of them being nonlinear in character. The Muller-Lyer Illusions also produced a variety of significant RFT correlations, as did the Street Gestalt, Gottschaldt, and PMA Reasoning tests. At the other extreme, the PMA Spatial Test failed to correlate significantly with _any_ of the RFT scores, and the Squares Test produced only one significant (nonlinear) correlation.

While the intriguing correlational pattern displayed in Table 4 will generally be left undiscussed, pending its replication in other samples, two unusual findings merit brief mention. Note that FBD, the directional measure of response bias based upon frame effects, correlated positively with scores from the Poggendorff Illusions ($r = .31$; $p < .01$) and negatively with scores from the Muller-Lyer Illusions ($r = -.30$; $p < .01$), in spite of a modest positive correlation between the scores based upon the two illusions ($r = .23$; $p < .05$). This finding, if replicated, would suggest that individual differences on some attribute reflected in FBD is differentially related to performance in the two types of illusions, a not unparadoxical state of affairs. Moreover, should this pattern of correlations hold its strength in future replications, one could predict any of these three variables by means of the other two with a linear multiple correlation of roughly .50.

Finally, note that FBN, the nondirectional measure of response bias based upon frame effects, correlated significantly with scores on the Street Gestalt Test ($r = .30$; $p < .01$), while ZATN (the traditional global accuracy score) was not significantly correlated with the same test ($r = .10$); however, as Table 2 indicates, ZATN and FBN were very highly correlated in this sample ($r = .88$; $p < .001$). This finding, if replicated, would suggest that scores on the Street Gestalt Test can be predicted from these 2 RFT indices with a multiple correlation of around .45, with ZATN functioning in a suppressor role in the two-variable linear regression equation.

Discussion

Had an investigator, using this same sample of subjects and this same battery of perceptual and cognitive tests, computed only the traditional RFT global accuracy score (ZATN), he would have been forced to conclude that there was no relationship between RFT performance and scores on the other ten tasks. Consequently, the intriguing pattern of cross-task linkages displayed in Table 4 provides some preliminary evidence for the usefulness of these RFT component scores. However, the use of 22 scores, instead of one global index, greatly increases the probability that some of the significant relationships displayed in Table 4 arose from chance vagaries of the particular sample under study. While it is clearly tempting to speculate on the theoretical basis for this correlational pattern (and it is even more tempting to factor analyze various subsets of these RFT and additional variables), both temptations should probably be avoided. For, the goal of the present report is primarily to alert RFT investigators to the potential utility of a more complete and analytic scrutiny of RFT performance. Only future replications of these procedures, hopefully based upon larger samples of subjects and utilizing more elements from the experimental design displayed in Table 1, will demonstrate whether the use of RFT component scores improves our theoretical understanding of these tantalizing individual differences.

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Footnotes

[1]The initial work on this project was undertaken while the author was a Visiting Professor at the University of Nijmegen, under a fellowship from the Fulbright Foundation; this report was completed while the author was a Visiting Professor in the Department of Psychology and the Institute of Personality Assessment and Research at the University of California at Berkeley. Data analyses were carried out at the Computing Center of the University of Nijmegen and at the Health Sciences Computing Facility, UCLA, sponsored by NIH Special Research Resources Grant RR-3. The project was supported by Grant MH 12972 from the National Institute of Mental Health, United States Public Health Service.

[2]Reprints may be obtained from Lewis R. Goldberg at Oregon Research Institute, P. O. Box 3196, Eugene, Oregon 97403.

Table 1

A General Design for the Analysis of RFT Performance

	Accuracy (A)				Response Bias (B)	
	True Vertical (T)		Personal Vertical (P)			
Main Effects	Dir. (D)	Non. (N)	Dir. (D)	Non. (N)	Dir. (D)	Non. (N)
Body Orientation (O)	OATD	OATN	OAPD	OAPN	OBD	OBN
Frame Position (F)	FATD*	FATN*	FAPD*	FAPN*	FBD*	FBN*
Rod Position (R)	RATD	RATN	RAPD	RAPN	RBD	RBN
Sequence (S)	SATD*	SATN*	SAPD*	SAPN*	SBD*	SBN*
Interaction Effects						
O x F (G)	GATD	GATN	GAPD	GAPN	GBD	GBN
O x R (H)	HATD	HATN	HAPD	HAPN	HBD	HBN
O x S (I)	IATD	IATN	IAPD	IAPN	IBD	IBN
F x R (J)	JATD	JATN	JAPD	JAPN	JBD	JBN
F x S (K)	KATD*	KATN*	KAPD*	KAPN*	KBD*	KBN*
R x S (L)	LATD	LATN	LAPD	LAPN	LBD	LBN
O x F x R (U)	UATD	UATN	UAPD	UAPN	UBD	UBN
O x F x S (V)	VATD	VATN	VAPD	VAPN	VBD	VBN
O x R x S (W)	WATD	WATN	WAPD	WAPN	WBD	WBN
F x R x S (X)	XATD	XATN	XAPD	XAPN	XBD	XBN
O x F x R x S (Y)	YATD	YATN	YAPD	YAPN	YBD	YBN
Total Effect (Z)	--	ZATN*	--	ZAPN*	ZBD*	ZBN*

* Indices included in the empirical study.

Table 2

Linear (r) and Nonlinear (Eta) Correlations among 22 RFT Scores
(N = 70)

	ZBD	ZBN	ZATN	ZAPN	FBD	FBN	FATD	FATN	FAPD	FAPN	SBD	SBN	SATD	SATN	SAPD	SAPN	WBD	WBN	WATD	WATN	WAPD	WAPN
ZBD	---	.63*	.22*	-.14	-.13	-.10	.52	.06*	.05	-.06	-.38	-.38	.11	-.17	.10	-.17	-.02*	-.19	-.42	-.32	-.36	-.36
ZBN	1.00	---	.52	.11	.13	.15	.13*	.50	.13	-.13	.06	.10	.07*	-.03	.13	-.10*	-.05	-.12	.03	.17	.08	.14
ZATN	.61		---	.88	.15*	.88	-.18*	.64	-.25	.15	.28*	.36	-.15*	.45	-.08	.44	-.21*	.47	.31*	.58	.29*	.58
ZAPN				---	.16*	.98	-.26*	.64	-.30	.18	.35*	.47	-.20*	.52	-.13*	.53	-.23*	.59	.39*	.66	.35*	.67
FBD			.80	.95	---	.17*	.35*	.29*	-.22	.20	.21*	.27	-.47	.23*	-.47	.22*	-.04*	.29*	.47*	.35*	.49*	.38*
FBN					1.00	---	-.21*	.71	-.21	.09	.34	.43	-.19*	.50	-.12*	.56	-.29*	.57	.34*	.62	.31*	.63
FATD		.57	.66	.69	.70	.73	---	.03*	.12	-.17	-.41	-.44	-.15*	-.13*	-.21*	-.08*	-.01	-.09*	-.34*	-.44	-.34	-.45
FATN	.63				.74		1.00	---	.05	-.14	.31	.43	-.11	.21	.00*	.27	-.19*	.22*	.31*	.54	.31	.52
FAPD									---	-.78*	-.14*	-.17	.10	-.05	.14	-.01	-.20	-.21	-.39	-.38	-.34	-.38
FAPN									1.00	---	.05	.08	-.06	-.01*	-.03	-.05	.32	.17*	.35	.34	.38	.34
SBD			.54	.56	.53				.49		---	.57*	.16	.09	-.11	.03	-.23	.07	.48	.49	.60	.59
SBN											1.00	---	-.17	.32	-.14	.11	-.15	.23	.63	.66	.62	.75
SATD		.55	.54	.67		.66	.54						---	-.49*	.78	-.44*	.24*	-.39*	-.27	-.23	-.18	-.20
SATN		.50			.58		.49			.52			1.00	---	-.49*	.86	-.32*	.75	.15*	.33	.14*	.31
SAPD				.65		.66	.54	.50						.80	---	-.40*	.46	-.35*	-.16	-.18*	-.24	-.21
SAPN		.58			.64		.56						.88		1.00	---	-.34*	.83	.09*	.28*	.08*	.26
WBD	.51		.54	.72	.54	.67		.51					.67	.65		.78	---	-.24*	.18*	-.12*	.02	-.12*
WBN					.66		.54	.54		.58			.72		.81		1.00	---	.18*	.41*	.17*	.34
WATD			.70	.77	.73	.75	.55	.53						.56		.60	.63	.65	---	.71*	.89	.76
WATN					.77										.54	.60	.62	.72	1.00	---	.71	.92
WAPD			.71	.77	.74	.75								.53		.59		.54			---	.79*
WAPN					.74												.51				1.00	---
Mean	13.3	16.1	24.5	17.9	6.8	13.9	2.2	6.6	-.6	1.5	1.1	4.3	-.8	3.3	-.7	2.7	-1.2	3.6	.6	3.1	1.0	3.2
σ	14.0	10.7	17.0	17.4	22.0	18.3	9.3	6.9	2.2	1.8	6.1	4.5	4.7	3.3	4.3	3.4	5.0	3.6	5.5	4.5	5.2	4.3

Note: --Linear correlations are presented above the main diagonal. An asterisk (*) indicates that one of the two *eta* coefficients is significantly larger ($p < .05$) and at least .20 greater than the corresponding linear *r*; for these relationships, the value of the largest of the two *eta* coefficients is listed below the main diagonal.

Table 3

Intercorrelations among the 10 Additional Cognitive and Perceptual Tests

($\underline{N}$ = 70)

	Peripheral Span	Street Gestalt	Hidden Pictures	Poggendorff	Muller-Lyer	PMA Spatial	Gottschaldt	PMA Reasoning	Verbal Analogies
Squares Test	-.01	.03	.02	.05	.18	.07	.15	.05	.10
Peripheral Span	--	.10	.22	.01	.04	-.02	-.07	.10	.10
Street Gestalt		--	.36**	.18	-.05	.21	.15	.11	.19
Hidden Pictures			--	-.03	-.07	.27*	.14	.05	.02
Poggendorff				--	.23*	.26*	-.12	.08	-.04
Muller-Lyer					--	.15	.16	.35**	.13
PMA--Spatial						--	.37**	.30**	.25*
Gottschaldt							--	.46**	.46**
PMA--Reasoning								--	.66**

* $p \leq .05$

** $p \leq .01$

Table 4

Significant Relationships between the 22 RFT Scores and the

10 Additional Cognitive and Perceptual Tests ($\underline{N}$ = 70)

	Squares Test	Peripheral Span	Street Gestalt	Hidden Pictures	Poggendorff	Muller-Lyer	PMA Spatial	Gottschaldt	PMA Reasoning	Verbal Analogies
BD		(.52)								
BN		-.23*		-.26*		(.55)			-.30**	
ATN										
APN			.26*					.24*		.23*
BD					.31**	-.30**				
BN			.30**	.23*				.25*		.24*
ATD					.27*					
ATN			.29*							
APD				-.24*						
APN										
BD	(.62)									
BN										
ATD		.24* (.59)				.25*				
ATN		(.53)						.24* (.61)		
APD		(.56)				.26*				
APN		(.52)	.25*					.34** (.62)	.28*	.26*
BD			-.24*						(.49)	
BN		(.54)						.31**	.33**	
ATD						-.29*				
ATN									(.45)	
APD		(.49)				-.25*				
APN										

ote: --Values in parentheses are eta coefficients. All other values are linear correlations.

p $\leq$ .05

p $\leq$ .01