

FUNDAMENTAL FACTS ABOUT REFERENCE GROUPS

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The purpose of this report is to provide and introductory overview of the WAIS/PAS reference groups. Rigor and detail have been sacrificed in favor of brevity and impact. It is not the purpose of this report to "win converts" for the PAS or for Reference Groups so much as to provide a comprehensive summary for those who have contributed to the effort, as well as to provide a benchmark for future comparison. A "Reference Group" may be defined as (1) a specified set of real individuals who are both (2) demonstrably homogeneous according to meaningful behavioral criteria.

Taken as a whole, the system of Reference Groups is able to integrate and extraordinary range of individual difference data, including both "normal" and "abnormal" personality as seen through self-reports and/or tests and/or observer ratings. All this is accomplished within, a conceptually interesting, computer-compatible framework.

A -- From the perspective of psychological theory.

1. There appear to be precisely 104 groups. The groups are relatively distinct from one another, and these distinctions between groups are of primary importance.

In addition, the members of any one group will be found to vary considerably; while these differences are not insignificant, they are of secondary importance. The overriding important difference between any two groups in that the within-group rules are different. In effect, group membership is to be regarded as a "moderator variable" (Saunders, 1956) that establishes the proper interpretation of everything else.

1a. The appropriate visual analogy is provided by the distribution of numerous two-dimensional galaxies within the three dimensional physical universe.

1b. A second useful analogy is with quantum mechanics. Something akin to a "quantum jump" is required for an individual to move from one Reference Group to another. On the other hand, within-group movements relatively easy and likely. (This analogy, like all analogies, is imperfect; it applies more to some groups than to others.)

1c. A third useful analogy is with the periodic table of chemical elements, which points to the existence of only certain atomic forms and predicts many of their properties.

2. Each reference group has been provided both a name, as summarized in Figure 1, and a systematic designation, which comprises three letters and a "digit". (For example, the "Coach" is also designated as "ERU5"; "Voyer" is also labeled as "IFUB".) Either of these is intended to serve as an interpretive label, and either may also serve as an hypothesis; neither is intended to serve as a definition. We must especially anticipate the modification of some of these names in the future, as more detailed information is acquired about some groups.

3. The prime factors of 104 are $13 \times 2 \times 2 \times 2$, in which the 13 will provide a sensible interpretation, we might treat the 13 as $(3 \times 2 \times 2) + 1$. Alternatively, it may be treated as $(3 \times 3) + (2 \times 2)$. In then end, we will discover that 13 may also be treated as $(2 \times 2 \times 2 \times 2) - 3$. None of these possibilities is to be regarded as excluding another; each of then may provide a plausible perspective on the same underlying reality.

3b. As it happens, Guilford's "Structure of Intellect" (1967) postulates precisely 120 cells in a $3 \times 5 \times 8$ array. Guilford's model is focused on a different problem, however, and the possible common occuttence of "120" would have been only a coincidence at best.

3c. Riso's "Psychological Types" (1987) are presented as variations on 9 major themes, but the total number of variations turns out to be precisely 108, which still is the most plausible alternative to 104. Riso's discussion does provide support for the device of + 1, which corresponds to the possibility of groups with "balanced" characteristics.

3d. We are unaware of any precedent for

104. Clearly, 104 is 8×13 . There has never been any question but that the factor of 8 should be associated with the failiat PAS primitive patterns. To continue this discussion, we will approach the 13 as $(3 \times 3) + (2 \times 2)$, beginning with the 3×3 component. In the end, we will discover that the 13 may be reconceptualized as $(2 \times 2 \times 2 \times 2) - 3$, where in 3 of 16 otherwise plausible classes of profiles are excluded by a simple rule.

4. Thus, we give conceptual priority to the two factors of 3 contributing to the total number of groups. (In terms of Figure 1, we are addressing the 9 most centrally located blocks.) The first such breakdown encompasses Pro-active, Poly-active, and Re-active, and corresponds to the major vertical dimension of Figure 1 -- poly-active across the middle, pro-active above the middle, and re-active below the middle. These may be regarded as three modes of stress management. This aspect of the Reference Group array has been common to all versions of the model, beginning with the original 72-group version.

4a. The other factor of 3 encompasses Right-brained, Balanced, and Left-brained, and corresponds to the major horizontal dimension of Figure 1 -- Balanced down the center, right-brained to the left, and left-brained to the right. These may be regarded as three modes of information processing. This aspect of the array has also been common to all versions of the Reference Group model, beginning with the original 72-group version.

4b. Within each of these three-fold distinctions, or "contrasts" that may be isolated.

Figure 1: The Reference Group "Rose"

Disciple (a) Conservator
 Mystic (a) Inconclast
 Detacted (a) Acistocrat
 Loyalist (a) Puritan

Artisen (4) Nurturant	Coach (5) Investigator	Pragmatist (6) Practitioner
Operator (4) Teacher	Specilist (5) Theorist	Engineer (6) Technician
Therapist (4) Counselor	Professional (5) Physician	Individualist (6) Tactician
Pastor (4) Catalyst	Naturalist (5) Mediator	Programmer (6) Analyst

Exhibitionist (b) Student	Showman (3) Booster	Implementor (8) Consultant	Rulemaker (7) Empiricist	Seeker (d) Player
Enthusiast (b) Aide	Performer (3) Volunteer	Administrator (8) Executive	Coordinator (7) Organizer	Dillante(d)activist
Voyer (b) Galateen	Priest (3) Entertainer	Manager (8) Entrepreneur	Advocate (7) Leader	Perverse(d)Narcissist
Ingenue(b)Mirror	Devotee (3) Director	Conductor (8) Educator	Polititian (7) Salesman	Schemer(d)Hedonist

Yeomen (2) Adherent	Rulekeeper (9) Policeman	Authoritarian (1) Competitor
Observer (2) Famulus	Burecrat (9) Historian	Game-Player (1) Scorekeeper
Dedicated (2) Actor	Obsessive (9) Spartan	Opportunist (1) Autocrat
Counselee (2) Artist	Missionary (9) Audacious	Zealot (1) Inductor

ERU (-) ERA
 IRU (-) IRA
 IFU (-) IFA
 EFU (-) EFA

Warrior (c) Soldier
 Automaton (c) Chamelon
 Acolyte (c) Historionic
 Gladiator (c) Contrarian

One of these effects compares the two extremes against each other while the other compares the middle against both extremes. There are distinct PAS indices corresponding to each of these four effects (See paragraph C4, below).

4c. The vertical and horizontal dimensions in Figure 1 may also be roughly interpreted as corresponding to the Jungian function-pairs: S-N for the vertical axis and T-F for the horizontal axis. The orientation of these axis (by coincidence has placed the function combinations in the same quadrants as those used by Lowen (1982). Several of the labels in Figure 1 also happen to have been used by Lowen, but these are not necessarily located where he might place them. (Both Lowen and the Myers-Briggs Type Indicator (MBTI) employ 16-fold topologies, which do not map easily against 104 groups. In any event, this is not the orientation of the conventional MBTI type table.)

4d. It will be found that the groups designated as right-brained and/or feeling are preponderantly female, while their counterpart groups designated as left-brained and/or thinking are preponderantly male; other groups are mixed. This is consistent with the well-known gender correlation of the MBTI.

4e. It will also be found that the groups designated as pro-active and/or intuitive include the highest proportions of persons pursuing optional educational programs, i. e., beyond high school. On the other hand, the groups designated as re-active and/or sensing include the highest proportions of individuals dropping out even before completing high school. Again, this is consistent with MBTI findings.

5. If we view the 3x3 array in the center of

Figure 1 as designating possible patterns of "type development" for the four Jungian functions, all the common patterns are provided for, i.e., patterns are provided for, i. e., all the patterns with at least one developed function out of each pair. The block in the very center (which happens to be normatively the most common) represents development of just two out of the four, i. e., one out of each pair, which is the standard definition of normal type development. It will now be obvious that the remaining four blocks (of the 13) should represent patterns in which there is useful development of only one of the four functions in each case. These blocks now provide the North, South, East and West poles for Figure 1, and neatly account for the remaining (2x2) of the (3x3) + (2x2). It is because of the properties summarized in this paragraph that we have labeled Figure 1 as a "rose".

5a. In effect, we have described 13 patterns of type development. If each of four functions were either development or undeveloped, there would be exactly 16 theoretically possible patterns. The three patterns that are not required by the data include (1) no development at all, and (2-3) the development of both functions from one pair without the development of either function from the other pair. This is the exclusion rule we anticipated earlier.

5b. An alternative view of the 13-fold breakdown is to make the first distinction between 9 "convergent" levels (numbered 1-9) and 4 "divergent" levels (numbered a-d). Convergent and divergent are here used in a sense suggested by "chaos theory." When members of convergent groups tend to move away from their groups, they receive "negative feedback," which tends to move them back whence they came; when

members of divergent groups tend to move away from their groups, they receive "positive feedback," which tends to aggravate the move. The convergent levels may be arrayed in a 3x3 matrix, each dimension of which provides a balance point between two unbalanced alternatives. These are right-brained vs both-brained vs left-brained, and external vs balanced vs internal. The divergent levels may be identified with the four developmental processes-- expression, suppression, repression, and reaction formation.

6. The remaining 8-fold breakdown encompasses the familiar PAS primitives-- Externalizer/Internalizer (E/I), Flexible/Regulated (F/R), and Role-Uniform/ Role-Adaptable (U/A), in all combinations. This aspect of the Reference Group array has always been present and has never changed. E/I is also equivalent to Eysenck's favorite to "Field Independence," Witkin's favorite variable. U/A has never been championed.

7. The 13-fold breakdown formed by ignoring the PAS primitives is coded in the final "digit" of the group label, and is referred to as the "Level" of the Reference Group. We have found it interesting to interpret "Level" in terms of the "Meaning of Life," along lines suggested by Spranger (1928) or Morris (1956).

7a. Specifically (cf Figure 1):--

Level 1:
Re-active/Left-brained -- IS the system; life is a game.

Level 2:
Re-active/Right-brained -- Life is a personal experience.

Level 3:
Poly-active/Right-brained -- Life is to be lived/glorified.

Level 4:
Pro-active/Right-brained -- Life is for personal growth.

Level 5:
Pro-active/Left-brained -- Life is to support evolution.

Level 6:
Pro-active/Left-brained -- Life is to maintain the system.

Level 7:
Poly-active/Balanced -- Life is to run/use the system.

Level 8:
Poly-active/Balanced -- Life is opportunity to serve.

Level 9:
Re-active/Balanced -- Life is an illusion.

Level a:
Pro-active/Balanced -- Life is a religious experience.

Level b:
Poly-active/Right-brained -- Life is a struggle to survive.

Level c:
Re-active/Balanced -- Life is essentially meaningless.

Level d:
Poly-active/Left-brained -- Life is a mystery to probe.

B -- From the perspective of psychometrics

1. The general process of discovering reference groups is a multivariate procedure that has never been described. This process has some features in common with factor analysis, some in common with multiple discriminant analysis, and some with latent class analysis, but it is different from any of these. It is not our purpose here to detail the general process.

2. The specific common measurement space encompassing all of our 104 groups has 16 dimensions. Each group is a four-dimensional "galaxy" located within this 16-dimensional within-group coordinate system best for each group is unique to that group. Each set of local coordinate axes is orthogonal, and can be represented by linear combinations of the basis dimensions. ["Basis" in this context is a term from algebraic geometry, and is not to be confused with "basic" as defined in the PAS.]

2a. Operationally, the 16 basis dimensions are derived from an "extended" WAIS battery. However, we do not regard the procedure and/or the results as limited by this fact; other data could serve as well, provided they encompassed a sufficient variety of content.

2b. Specifically, the 16 basis dimensions are provided by 10 WAIS subtests (excluding Vocabulary), plus the PAS Normal Level, plus two measures from the PAS Fourth Dimension Kit (CN and TE), plus two indices derived from patterns of response to Picture Completion (Q1) and Information (Q2), plus Age. (Each pattern index can be regarded as a difference (or balance) between two subscales. Thus, Q1 is "Perspective" versus "Contact" and Q2 is "Arts" versus "Sciences.")

2c. The bulk of our available data base

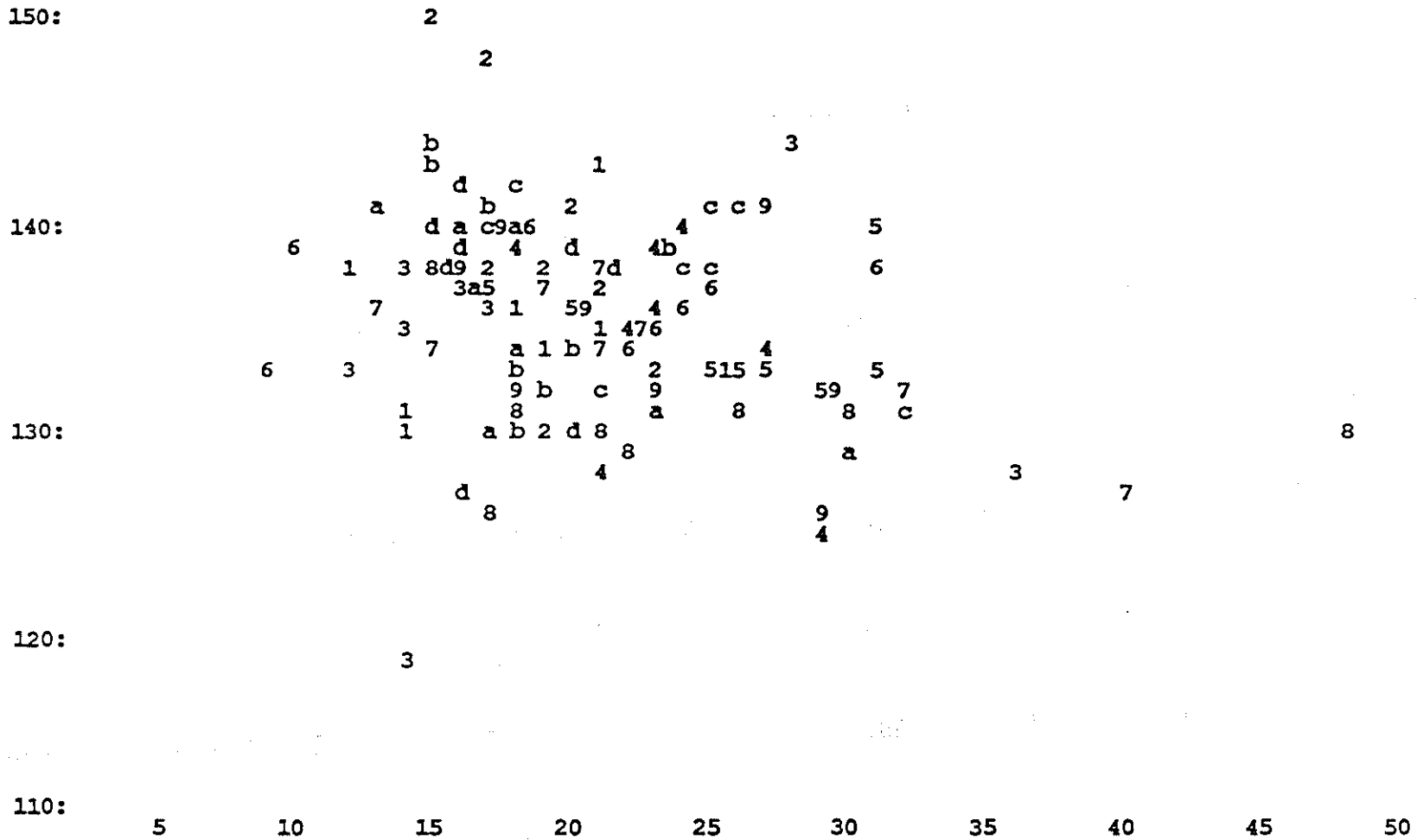
were tested on the WAIS prior to inclusion of the PAS Fourth Dimension, and therefore provide incomplete data. Moreover, cases tested with the WB-I or the WB-G cannot be consistently scored for Q2. Missing item data precludes even Q1. Since all such cases are distinctly less informative than complete cases, it became appropriate to employ a weighting scheme in the computations. The simplest scheme would be to give the incomplete cases zero weight, and this was always the long term goal. We could not leap to this goal directly, however, because many groups at the outset would still have had too few complete exemplars to define stable keys. The weight for incomplete cases have provided a temporary "scaffolding" to facilitate the building of the reference group structure; the scaffolding is no longer needed.

3. Each group is defined by its current list of exemplars. As of iteration 89.10, the number of exemplars per group ranges from 9 to 48, accounting for all 2184 complete-data cases. (Approximately 8000 additional incomplete-data cases were used as temporary exemplars in earlier iterations.)

4. It turns out that the exemplar list for each group can always be reduced to a "key," which has the same size and form regardless of the number of exemplars. In the common coordinate system, the key specifies the centroid and within-group Eigenroots and Eigenvectors of the exemplars.

4a. In turn, the keys can always be used to calculate the distance of any case (either an old case or a new one) from any group. The distance from a case to a group is always expressed in a standard-score metric uniquely defined for that group.

Figure 2: Span as a function of available complete data
 (See text, paragraph 5a)



5. The "quality" of any single key, or of any one group, is determined by an index called "span," which was defined in 1968 and has provided a stable benchmark ever since. As applied to the present groups, span is proportional to the sum of the 12 smallest Eigenroots in any given key. Low numbers for span imply tightly defined groups and are therefore preferred.

5a. Figure 2 plots the span index of each of the 104 groups exemplars used to define the group. The plotting symbol is the level-digit of the systematic group label. (The two smallest groups are IFA6 and IFU6. The three largest groups are ERU8, ERU7, and ERU3. The two groups with largest span are IRA2 and ERA2. The group with notably low span is EFA3; IFA3 is in the upper edge of the configuration.)

5b. There are actually three distinguishable criteria for assessing the quality of the system as a whole. These are (1) to minimize the mean of the spans, (2) to minimize the variance of the spans, and (3) to maximize the dispersion of the group centroids. In practice, it is necessary to look at all of these.

5c. The consideration of any case as a possible exemplar is a two-step process designed to maintain the overall quality of the groups. First, the case is measured against each of the 104 keys and the 4 smallest distances are identified. Second, the case is tentatively added to each of these 4 groups and the potential impact on mean span, span cadence and dispersion are assessed. The best assignment is the one yielding the maximum reduction (or minimum increment) in span. However, if even the best result represents "too large" an increment, no assignment should be made.

5d. The process of finding "better" groups, and eventually the "best" ones, is called "reassignment." Reassignment is closely analogous to the process in factor analysis called "rotation" --rotation with 104 factors and 10000 variables! At first, reassignment was carried out with the PAS implications in full view (i.e., "graphically"). Along the way, useful mathematical functions were discovered (cf "quartimax" and "varimax"). In the end, there is a simple, composite criterion (cf "equamax") that has been optimized by the reassignment process. This composite gives appropriate weight to all three of the quality criteria mentioned in paragraph 5b.

5e. The variance that disappears from the small Eigenroots through the reassignment process reappears either as variance on a principal root in some other group, or as between-group variance.

5f. The major implication that Figure 2 conveys is that the principal determinant of span still is the availability of complete-data exemplars. (The effect is currently much weaker than it has been through the preceding iterations.) As the number of exemplars increases, both the central tendency and the dispersion of the span values appear to decline. Projecting the asymptote in Figure 2, it is estimated that a mean span of 0.130 or less would be attained, given sufficient data. The actual current mean is 0.1354 and the current standard deviation of span values is 0.0049. (A span of 0.250 or more is likely to result when any two of the 104 groups are analyzed together as if they were one group.)

5g. It must be observed that a span of zero can be obtained for any group with five or fewer cases. (This is analogous to fitting a straight line to any two (distinct) points, or

a sphere to (almost) and four points.) Obviously, we could not attach great importance to small span values obtained in small groups. However, the minimum group size has now reached 9 complete cases, with only two groups below 12 cases. (The two smallest groups are closely related, and happen to provide a good psychological fit to the concept of "non-volunteer.")

5h. Nevertheless, there is one source of residual uncertainty. There is nothing in the reassignment algorithms to guarantee that the 104 groups and 104 group levels remain "properly" matched, even assuming they may have been properly matched at some prior stage. (This is why the list of exemplars must be regarded as the primary group definition.) In practice reviewing the data informally as the reassignment iterations have proceeded, we have perceived the need to "swap" pairs of labels and/or pairs of groups. With the elimination of incomplete-data example and the convergence of the reassignment process, we have addressed this issue directly in the context of identifying the underlying dimensions of the 104-group model. This appears to define a relatively stable solution.

6. We began with nine levels -- embracing 72 groups -- and numbered them from 1 through 9. When it was found that many cases did not fit any of these groups, a Level 0 was added, making 80 groups. In due course, it became apparent that the spans of the Level 1 groups were much too high in relation to all of the others; Level 1 was split into Levels a, b, and c, making 96 groups. Two years later, after this model had been roughly optimized, it became apparent that the groups at Levels 5, 8, and 2 now featured too-high-spans, as well as other unique features; Levels x, y, and z

were created initially as fragments of 5, 8, and 2, respectively, making 120 groups. After further optimization, this led to a very homogeneous set of span values, as well as a very satisfactory overall assignment rate. However, we were bothered by the difficulty of locating unambiguous exemplars for several of the groups. The decision to drop 12 groups (retaining 108) added only 5 cases to the unassigned list; the rise in mean span (.002) was immediately offset by reducing the weight for incomplete data from 1/9 to 1/19 -- a move now justified because the minimum number of complete exemplars had risen from 2 to 6. Similar reasoning led to a decision to drop 6 more groups, leaving 102. At this stage, 2 groups had anomalously high span values, and were each split in half, resulting in the final group count of 104, which has been stable through more than 20 iterations. We now interpret these results as evidence of convergence and closure for the model as a whole.

6a. Restating the process, we have found that the first and most difficult step has been to determine the "right" number of groups. 104 is enough to permit 100% assignability without outliers and without ill-defined groups. The reassignment algorithms can then do their thing, which is to sort the cases into the groups. Only then is it really possible to fit the groups into an overall model, with some confidence that the model may hold up. The attachment of names to the groups comes last of all; the names are really no more than an interpretation of the results, seeking to be consistent with the defining cases and the model.

6b. It is reasonable to expect that any case used as an exemplar should be closer to the group it exemplifies than to any other group. We are pleased to observe that this

is apparently true, but it is not a rule that may be blindly enforced; decisions as to group assignment must be based primarily on the implications for the system as a whole, and cannot be made just to accommodate a particular case. Indeed, there is still enough play in the system so that for some cases there is more than one assignment satisfying this criterion.

6c. There are no longer any complete-data cases that fail to qualify as exemplars. However, it is notable that towards the end of the process, the available complete cases that were most difficult to qualify as exemplars came disproportionately from certain sources, especially those employing the WB-G or the WAIS-R rather than the WAIS. It does appear that "clinical" cases are more likely than "normal" cases to manifest profile distortion reducing their value as exemplars. "Split administration" cases (4th dimension subtest given separately from the rest of the WAIS) have also been more difficult to assign.

7. Mean span is a measure of error. One major psychometric implication of the existing results is that the reliability of each separate subtest of the WAIS is substantially higher than previously believed. This helps to explain why the PAS has worked in the past.

8. Randomly-generated profiles are relatively unlikely to fit the definitions of the groups. A second major psychometric implication is that the measurement space as a whole is largely empty. This argues against the usual form of the common assumption of multivariate normality.

9. What the Reference Group Model directly provides is a way of accommodating and accounting for interaction effects in a

relatively selective and efficient manner. It is assumed that conventional (non-interactive) statistics may be safely applied on a within-group basis, but not to samples representing more than one group.

C-- From the perspective of a PAS initiate

1. For those familiar with the PAS a Reference Group is most similar to an aggregate of persons in a single Basic Pattern, rather than in a Primitive or Contact Pattern. Additionally, most, but not necessarily all, persons in a given Reference Group will belong to the indicated Primitive Pattern according to conventional PAS scoring; however, the exceptions to this rule are important, and make particularly interesting case studies.

1a. It is mechanically possible to assign a modal PAS formula to each group but, because the indicators coded by the formula are commonly significant and recognized sources of within-group variability, it is much more important to recognize that a typical group actually encompasses portions of several PAS basic patterns. For this reason, we do not present modal formulae.

2. The familiar PAS has been presented as a series of dichotomies, with every possible combination considered as theoretically legitimate. The patterns not seen in practice are simply described as "rare." The Reference Group Model suggests that many of these rare patterns are truly non-existent, i. e., the possibility must be considered that any apparent observations of these "rare" patterns are simply a result of measurement error.

3. PAS-ophiles have debated for years the optimum definition of "Normal Level," recognizing that the apparent PAS formula

of an individual often depends critically on the NL. In the end, NL has had to be recognized as a "clinical judgement," and the debate as unresolvable. The algorithms which implement the Reference Group Model happen to employ NL29, but they would yield the same end results with any other NL.

3a. An important property of the reference group algorithms is that they are independent of the absolute means and standard deviations of all the measures used, and are therefore indifferent to the fact that the WAIS was never standardized with profile interpretation in mind. In contrast, the conventional PAS is vulnerable on this point, and it is not unlikely that many of the convolutions of conventional PAS scoring have their roots in this problem.

3b. Given the "obvious" effectiveness of the PAS despite its being burdened with these problems, points 3 and 3a provide a substantial rationale for developing the reference groups as a more rigorous and possibly even more effective approach.

4. It is possible to analyze the Reference Group exemplars to determine what simple indices (if any) best approximate each dimension of the between- group structure. The following indices are relatively high intra-class correlations as predictors of group membership:--

2D-(A+NL)
predicts I/E (better than D-NL)

2BD-(S+NL)
predicts R/F (better than BD-NL)

A-S
predicts Left vs Right (T vs F)

(2C+OA) - (2I+2Q2)
predicts Balanced ve (Left or Right)

(A+S+I+C) - (PC+OA+Q2)
predicts Levels 1-9 vs Levels a-d

4a. We certainly do not wish to suggest that these indices can serve as a substitute for the reference group assignment process, even though they may yield a first guess. The correlations are only in the range .40 to .60.

4b. It will be evident that the systematic reference group labels treat the first three of these separately, while merging the remainder into a single "digit."

D -- From the perspective of a single "behavior"

1. Of course, one immediate implication of the whole reference group approach is that what passes for a "single behavior" may not be. The reference group is really a more precise diagnosis than the behavior.

2. The provision of behavioral validation for reference groups is obviously a novel problem. Fortunately, the effects are often so strong that it may only be necessary to make a clear presentation of the data, relying on the reader to apply the "Intraocular Traumatic Significance Test." (If it hits you between the eyes, it must be significant.) Figure 3 illustrates this process.

2a. The upper distribution in Figure 3 displays the group assignments for a sample of 70 college football players, comprising the entire squad in spring training at a Big Eight school. One-sixth of these players are found in a single group (IFA2); the distribution is obviously multi-modal (lumpy). The two players who later

Figure 3a:
70 College
Football
Players

		a		
	a		
		a		
		•a•		
	4	..5	6	
	4	5	6	
	•4	•5	6	
	•4	5	*.6•	
b	3•	8	7	d
b•	3	•8*	•7.....	..d
b	••3	•••8	•••7	d
•••b	3••	•8••	7	•••d
	2	•9••	•1	
	•2	9	1	
	•2••• <u>12</u> •••	•9	••1	
	••2	••9	1	
		c		
		c		
		c		
		c		

Figure 3b:
56 CalTech
Freshmen

		a		
		a		
		a		
		•a•		
	4	5•	•6••	
	4	5	•6•••	
	•4	5	6	
	•4	5	6	
b	••3•	•••8•	7	d••
b	3	8	•••••7	d••
b	3	8	••7•	•d
•b	3	•8	•7	•••••d
	2	9	•••••••1	
	•2	9	1	
	2	•9	••1	
	•2	9	1	
		c		
		c•••		
		c		
		c		

Figure 4a:
Cohen's 100
Neurotics

		a		
		a...		
		a		
		..a...		
	4.	5	...6....	
	4.	.5.	6	
	4.	..5	.6.	
	4	5.	6.	
b	3.	8...	.7.	d
b.	3..	...8...	7.	.d.
.b..	.3.	8.	...7...	d..
b	..3..	.8	.7..	...d..
	.2	.9	.1..	
	..2	9	1.	
	2	.9	.1	
	2	9	.1.	
		.c.		
		.c		
		c.....		
		c		

Figure 4b:
Cohen's 100
Schizophrenics

		a		
		.a.		
		a		
		..a		
	4	5	6...	
	4	5	6	
	4.....	...5.	6..	
	.4	5..	.6	
.b	3...	8..	7	.d
b.	3...	...8.	.7	...d
...b.	.3	8.	...7...	d
b	3....	.8	.7..	...d
	2.	9..	.1.	
	..2	9	.1	
	2...	.9.	.1.	
	2	9	1	
		.c.		
		.c		
		.c..		
		c		

Figure 5a:
35 Successful
Drug Program
Cases

		a		
		a.		
		a		
		a		
	4	5	6.	
	4	5	6	
	4	5	6.	
	4	5.	6	
...b..	3	8	7	d
b..	3.	8	7.	d
b	3..	8.	7.	d
b.	3	8.	7.	d
	2	.9...	1	
	2	9	.1	
	2	.9	1	
	2.	9	1	
		.c.		
		..c.		
		..c		
		c		

Figure 5b:
56 Unsuccessful
Drug Program
Cases

		a.		
		a.		
		a		
		..a		
	4	5	6	
	4.	..5.	.6	
	4.	5.	6	
	4	5	6	
.....b.	3	8	7..	d
..b.	.3...	..8	7	d.
b	3...	8	7..	...d
b...	3	8.	7	d
	2.	9	..1	
	2	9	1	
	.2	9.	1	
	.2..	9	1	
		c..		
		.c.		
		..c		
		c..		

Figure 6a:
50 Violent
Criminals

		a		
		a		
		a		
		a		
	4	5	6	
	4	5	6	
	4	5	6	
	4	5	6	
.b	3	8	7	d
.b	3	8	7	d
.b	3	8	7	d
.b	3	8	7	d
	2	9	1	
	2	9	1	
	2	9	1	
	2	9	1	
		c		
		c		
		c		
		c		

Figure 6b:
234 Non-violent
Criminals

		a		
		a		
		a		
		a		
	.4	5	6	
	.4	5	6	
	4	5	6	
	4	5	6	
.b	3	8	7	d
.b	3	8	7	d
.b	3	8	7	d
.b	3	8	7	d
	2	9	1	
	2	9	1	
	2	9	1	
	2	9	1	
		c		
		c		
		c		
		c		

Figure 7a:
26 Successful
Hypnosis
Volunteers

		a		
		•a•		
		•a		
		•a		
	4•	5	6	
	4	5	6	
	4	5	6	
	4	5	•6	
b	••3	8•	7	d
b	3••	8	•7	d
b	3	8•	7••	d
b	3	8••	7	d
	2•	9•	1	
	2	9	1	
	2	9•	1	
	2	•9	1	
		•c		
		••c		
		c•		
		•c		

Figure 7b:
99 Unsuccessful
Hypnosis
Volunteers

		a		
		••a••		
		a		
		•••a		
	•4•••	5•	••6•	
	•4••	••5•	•••6	
	4••	•5	6	
	•4•	5•••	6••••	
•b	•••••3••	8••	7	d•
••b•	3•••••	8••	•7•	d
••b	3	8••••	•••7•	d
b•	3	•8••	7•	•d•
	••2••	9	•1	
	2	9	1	
	2••	9	••1	
	••2	•9	1•	
		•c•••		
		c•		
		c••••••		
		c		

Figure 8a:
41 ESTP

		a		
		a.		
		a		
		a		
	4	5.	6	
	4.	.5	6	
	..4	.5	6.	
	4	5	6.	
b.	3	.8	..7.	d.
b.	3	8	.7.	d.
.b	3.	8	7	d.
.b..	3.	8	.7	d.
	.2	9	1	
	2	.9	.1	
	2	..9	1	
	.2.	.9.	1	
		..c.		
		c.		
		c		
		c.		

Figure 8b:
18 INFJ

		a		
		a		
		a		
		a		
	4	..5.	6	
	4	5	6	
	.4	5	6	
	4	5	..6	
b	..3	8	7..	d
b	3	8.	7	d
b	3	8	7	d
b	3	.8	7	d
	2	9	1	
	2	9	1	
	..2.	9	1	
	2	.9	1	
		c		
		c		
		c		
		c		

achieved All-American status are starred (an EFU6 and an IRA8); they actually seem atypical of this sample.

2b. The lower distribution in Figure 3 displays the group assignments for a stratified random sample drawn from a California Institute of Technology freshman class, using every fourth name in an alphabetical list. One-seventh of these students are found in a single group (ERU1); the distribution is once again lumpy. We are not aware that any of these students has yet won a Nobel Prize, but this does seem unlikely for an ERU1.

2c. For those who require the formality of a statistical computation, we may perform the 2×10^4 contingency analysis comparing the upper and lower distributions of Figure 3. Using information statistics (Saunders, 1975), we obtain 63.6 bits of remarkability (R) indicating that these are not both random samples of the same population, corresponding to a probability of less than 10^{-19} and an effect size of 0.50 bits/case. (As a convenient rule of thumb, the square root of effect size may be thought of as a correlation coefficient.) We would not urge that this result holds any practical utility; one hardly needs a PAS to distinguish between these two samples. The point is, however, that a methodology incapable of providing such overkill in an obvious situation like this one has little hope of clarifying a less obvious situation.

2d. It must be commented that neither of these two samples included the PAS Fourth Dimension as part of the data; both are based on similar data from the extended WAIS, including item data sufficient to obtain Q1 and Q2. Any effort to cross-validate using "complete" data will need to proceed cautiously.

3. Figure 4 illustrates a more subtle situation. These two distributions are based on the identical samples that were assembled by Cohen (1955) in a landmark study of Wechsler pattern analysis. The available data are derived from the Wechsler-Bellevue Form I, and include only the subtest raw scores, which presumably reduces the power of the present analysis. Even so, 2×10^4 contingency analysis yields 21.8 bits of remarkability to indicate that the so-called neurotics and so-called schizophrenics come from different populations; the corresponding p-value is less than 10^{-6} and the effect size is 0.11 bits/case.

3a. Unfortunately, DSM-III has made Cohen's criterion obsolescent, if not obsolete. This should not obscure the fact that Cohen's clinician judges, who did succeed in distinguishing the groups, barely achieved significance at the 0.05 level; the present procedures have extracted 3 to 4 times as much information/remarkability from the same data.

4. Figure 5 provides an up-to-date illustration, involving complete data. The subjects are 91 consecutive admissions to a particular voluntary drug rehabilitation program. Those in the upper distribution completed the program; those in the lower distribution failed to complete, for any of several reasons. The 2×10^4 contingency analysis yields $R=15.8$, for which p is about 10^{-5} and effect size is 0.17 bits/case. We may say that it is appreciably easier (using the PAS) to predict the outcome of this program than it is to distinguish schizophrenics from neurotics. There are other PAS differences associated with the various reasons for failure; for example, the pro-active failures are primarily terminated for cause, whereas others have simply run away from the program.

4a. It is notable that the visual impact of both Figures 4b and 5b may be enhanced by swapping groups IFUb and IFUd. Actually, this is a swap supported by the totality of the complete data and that must be implemented in due course. The point here is that such swaps have no bearing or impact on the 2x104 contingency analyses. Such swaps do impact, however, when we consider the possibilities for partitioning the contingency results.

5. Figure 6 provides a second illustration involving complete data. The subjects are 284 criminals, 50 of whom have been designated as "violent" on the basis of their behavior. The 2x104 analysis comparing violent with non-violent yield $R=6.9$, for which $p<.01$ and effect size is 0.03 bits/case -- marginal significance and trivial effect. If we substitute a 12x13 contingency analysis (by ignoring the PAS Primitives and clustering the groups by Level) we now obtain $R=9.4$, which clearly encompasses whatever the global analysis had going for itself. By visual inspection, we can see that certain of the poly-active levels account for the bulk of the violence in this sample. The result seems to make sense, but clearly calls for cross-validation.

6. Figure 7 provides an interesting contrast with the previous illustration. The subjects here are 125 college students who have volunteered for a laboratory study of hypnosis, and who have been evaluated as "excellent" or not-so-excellent Ss. The data were collected prior to the publication of standardized scales for hypnotic suggestibility; the PAS data come from WAIS records, including Q1 and Q2 but no Fourth Dimension. The 2x104 analysis yields $R=0.4$, totally non-significant. The 2x13 analysis, however, yields $R=10.2$, significant at the 0.001 level. Once again, the na-

ture of the effect is visually obvious; successful hypnosis, at least in this laboratory, depends on a balance of left- and right-brained functioning, and is relatively incompatible with "normal type development" (as represented by Levels 1, 2, 4, and 6).

7. Our final illustration employs a different class of "behavior," i.e., responses to a self-report personality inventory, the MBTI. Figure 8 compares the distribution for 41 clear-cut ESTP persons within the distribution for 18 clear-cut INFJ persons in the same file. The 2x104 analysis yields $R=17.4$, significant beyond the 0.00001 level with an effect size of 0.30 bits/case. This is actually the second-largest effect size we have encountered among these illustrations. Notice particularly the differences at Levels a, b, c, and d.

8. There are other modes of analysis which may be useful on occasion. If the available frequencies are very small, it is possible simply to ask whether the distribution shows a significant tendency to aggregate, based merely on the number of groups that are represented. Another methodology, more laborious but more powerful, tests for clustering in the original basis space (Saunders, 1986) with very large frequencies, it is possible to ask whether an independent variable has a similar effect in two different samples (Saunders, 1985).

E -- From the perspective of a single group.

1. All the members of a given group share a common value system, in the sense that they recognize the same set of most relevant issues -- both philosophically (as abstract concepts) and practically (in terms of personal meaning). In other words, they share a common language.

1a. Two members of the same group may disagree as to what is the ideal behavioral response to these relevant issues. This possibility is often realized when the two persons are separated by their within-group indices. Disagreements of this kind are particularly distressing for the individuals concerned (as compared with between-group differences) because each can say that the other "should know better."

2. Within-group regression is "safe." Between-group regression is "unsafe." Naturalistic groups that are dominated by one (or two) reference groups have often produced satisfactory results, i.e., uncontrolled studies have yielded statistical significance. Naturalistic groups that are heterogeneous commonly yield unsatisfactory results. Indeed, the impact of ignored interaction effects frequently is to cancel out the most important potential findings.

2a. Studies are needed that consciously enforce a within-group methodology. Our analyses using the MBTI as dependent variable will illustrate this.

3. The four within-group dimensions, while re-defined uniquely in each group, do tend to conform to a pattern and may be usefully named. They are always labeled as -- V1 = Age; V2 = Balance; V3 = Arousal; and V4 = Skew. Conventional factor analysis rotation is applied to each key in order to generate a simple structure that corresponds to these constructs.

3a. By treating age as the first within-group variable we automatically provide the equivalent of age-corrected norms for each class of profiles. This follows because all subsequent correlations and weights are really partial coefficients with age held

constant. We also imply that simple aging should not lead to any change in group assignment.

3b. The concept of balance allows us to place any profile along a continuum. At one extreme are adjustments maintained primarily through cleverness (i.e., NL). At the other extreme are adjustments maintained primarily through energy expenditure (i.e., Dsy). The ideal rotated factor vector will show correlations with both NL and Dsy, with opposite signs. Other subtests may also correlate with this effect. (It is interesting to observe in this context that NL29 has long since anticipated the inverse relationship between Dsy and Normal Level, by assigning this subtest a negative weight.)

3c. The arousal dimension is most commonly correlated with TE or OA. Time Estimation can be directly interpreted as indicating whether the subject operates a fast or a slow internal clock. Object Assembly has often been interpreted in the PAS as an indication of the possible facilitating and/or debilitating effect of anxiety.

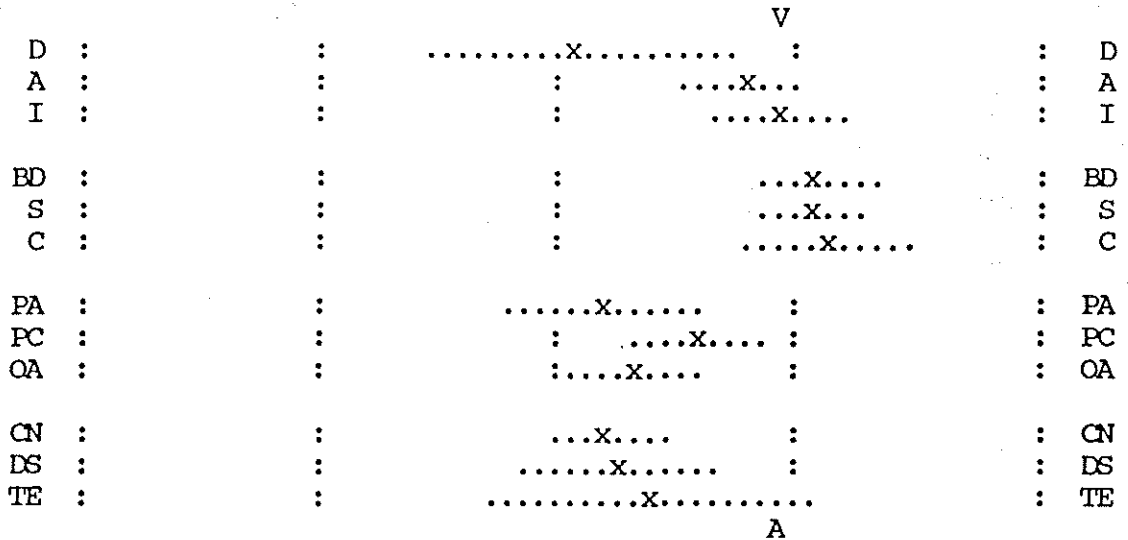
Digit Span may be regarded as an index of cortical arousal (Saunders, 1961). Arousal commonly depends upon external factors, either situational or temporal. Thus, individuals will be found to vary on this dimension, and each group may encompass a wide range of scores.

3d. The indicators of the skew dimension are relatively most varied, and the term "Skew" has been chosen deliberately as a word lacking in specific psychological connotations! In many groups this dimension appears to reveal something about the quality of interests (high vs low Q2), but this is simply irrelevant in many other groups

Figure 9

ERU8: Implementor (89.10)

Mean PAS Profile:



Locator Plot:

a=V2=NL

x=V3=TE

y=V4= D

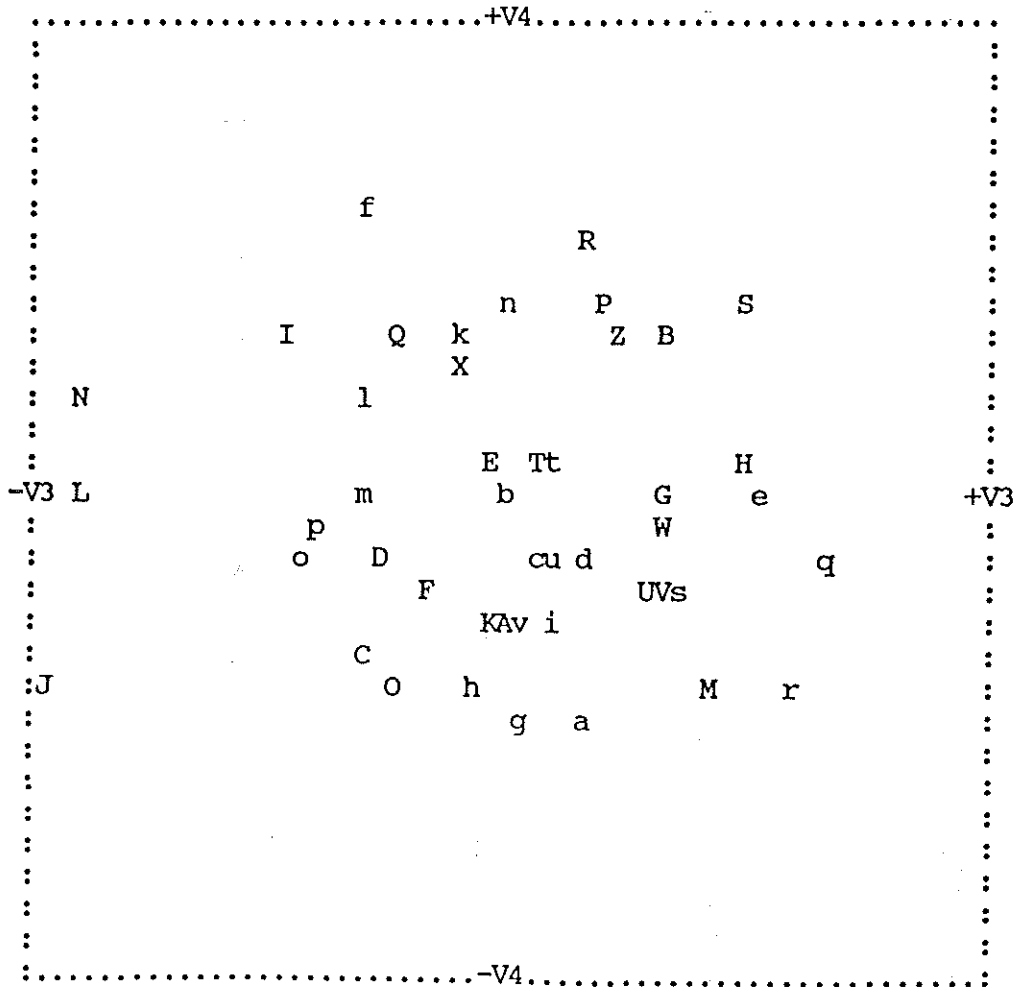


Figure 9 (continued)

					d	V2	V3	V4				
A	ACN	2*	01	23M13.	Security Empl	ESTU	13.3	8	-25	0	-7	
B	HTC	2*		20M	. Fores 1.02 Dyslexic	EXFU	11.6	9	-24	10	11	
C	AWS	2*		22M15.	ASST FOREMAN BAKERY		12.3	4	-21	-9	-9	
D	JJ	3*	01	20M14.	Undec Maj		12.5	7	-16	-8	-4	
E	SRI	3*	61	30F15.	Res Asst	DXX	12.0	5	-15	-1	2	
F	HTC	2*	01	19M	. Culin 0.00*	ISFP	12.9	5	-15	-5	-5	
G	WPS	2*		17F11.	Gifted HSStnt	EXFP	14.4	6	-14	10	0	
H	HTC	2*	01	62F17.	Instr Nursing	ISFU	13.1	8	-9	15	2	
I	ACN	2*	01	26M12.	Campus Security	ESTU	13.3	6	-9	-14	11	
J	RIT	3*	01	33M	.		13.6	9	-8	-29	-12	
K	SKN	2*	01	30F14+	Phlebotomist	ISXJ	13.4	10	-7	-1	-7	
L	ACN	2*	01	29M12.	Asst Mgr Parking Garage	INFP	13.9	3	-7	-27	0	
M	SKN	2*	01	57M17+	Retired	INIU	14.1	7	-6	13	-11	
N	DMG	2*	02	53F16+	M ; Mech Engr; Daughter of lawyer; Wife of EFA6, marriage counselee	XNDJ	14.6	4	-5	-27	7	
O	OR	3*	20	30M19+	D1; Waiter; Son of agronomist MA Biology; Seeks inner harmony through loving	XNFP	15.2	11	-4	-7	-11	
P	OR	3*	03	42F20.	S ; Veterinarian; Daughter of histologist; AB Biol Sci, DVM; Seeks freedom through intellect; Partner in a veterinary center; provides surgery, teaches younger staff; Relaxes by showing horses, reading, playing bridge; interested in writing	LXFX	15.3	6	-3	6	12	
Q	HTC	2*		30M	. Nurse 3.98	ISTU	15.1	5	-2	-7	10	
R	ACN	2*	01	24M12.	Law Enf Specialist	ESTU	14.0	6	-1	5	17	
S	DRS	2*	04	50M10*	Bldg Contractor; Rough appearance, sensitive re his children	ISTP	13.6	7	0	15	12	
T	SKN	2*	01	41M19.	Sociologist	ENIU	16.1	6	0	2	2	
U	OR	3*	02	41M17.	M ; Pres Wholesale Groc; Son of dentist; BBA; Seeks salvation through helpfulness	EXXJ	14.4	11	1	9	-5	
V	WPS	2*		18F12.	Gifted HSStnt	ISTU	14.9	2	1	10	-5	
W	SKN	2*	01	43M19+	Bank Director	ENFU	15.0	5	1	10	-2	
X	RFM	8*		34M	Bank Planning Offcr	INIU	15.7	4	1	-3	9	

Figure 9 (continued)

Y	SKN	2*	01	39F17.	Manager	INTP	15.2	3	2	-3	9
Z	AWS	2*		25M14.	MILITARY POLICE		15.7	11	2	7	10
a	SRI	3*	02	48M17.	MSEE > ResEngnr	ISTx	15.8	8	3	5	-13
b	SKN	2*	01	54M19+	Health Physics	EN&P	14.2	12	4	0	0
c	OR	2B	01	23M14+	S0; Bus/Econ Stdnt; Son of nat'l sales mgr;	INTP	14.3	3	4	2	-3
d	SRI*2B	25		53F16.	D1? Photographer (S4)		14.9	8	4	5	-3
e	SKN	2*	01	25M16.	Biologist	ESFJ	16.0	7	4	16	0
f	AWS	2*		35M15.	POLICEMAN		15.2	4	5	-9	19
g	MS	2B	01	16M11.			15.2	3	5	1	-14
h	DRS	3*	01	56F18.	S2; Counselor; First husband alcoholic; second one IRA8 lh Accepted challenge to try laboratory ESP, with "mixed" results	INFP	15.5	6	5	-2	-11
i	SRI*2B	01		54M17.	SRI Staff (S5)		16.0	6	5	3	-7
j	ACN	2*	01	20M12.	Stockperson	ESTU	14.9	6	6	-1	3
k	SRI	3*	02	36M16.	Psych > Elctrnc Tchn	ENIU	16.0	7	7	-3	10
l	BEM	8*		20M	. MORRISON"	EN&P	14.7	3	9	-9	7
m	RGN	2*	01	39F16.	M2; BFA; Artist; Bitter about what it takes to "make it" in the art world	ISXP	15.8	9	9	-9	0
n	SRI	5*		31M17	Research Volunteer		16.1	3	9	0	13
o	BEM	8*		19M	. V"	IN&J	14.6	5	11	-13	-4
p	SRI	3*	01	32M16.	M ; Writer; Army brat; AB Journalism/Broadcasting; Now "Jack-of-all-trades"	ENFX	15.8	4	11	-12	-2
q	SRI	5*		35M17	Research Volunteer		15.2	12	12	20	-4
r	CNI	3*	01	51M15*	D1; Drug maker		16.1	10	12	18	-12
					812C Only child; Studied Chem Engng; Worked 20 yrs in father's business; Socially inadequate — tics, jewelry, balding, frightened; Used cocaine 6 yrs; possible homosexual; possibly pre-psychotic						
s	SRI	5*		25M17	Research Volunteer		14.8	12	13	11	-6
t	OR	3B	01	48M18+	M ; Writer; Inventor; WASP; Son of consultant; Grad Stdnt Public Administration Drifting professionally; Marriage failing	ESTU	15.9	6	14	3	2

Figure 9 (continued)

u RGN 2* 01 45F19. M2; Prof Philosophy; Has both grown children and a young daughter VERY assertive and involved with career and family, seems masculine

ENTJ 16.6 4 15 3 -4

v SRI 3* 01 41F17. HSEnglTchr>PublDir

ENFJ 16.4 6 16 1 -7

Statistical Summary for Poly-active ERU

Group Label Region	ERU6 Exhibitionist ef*a*t/ NL V2 V3 V4	ERU3 Showman ef*a*g NL BD D	ERU8 Implementor i*f*a*g NL TE D	ERU7 Rulemaker i*ra*g NL TE A	ERUd Seeker i*ra*t/ A TE C
Version	89.10	89.10	89.10	89.10	89.10
Complete	23	36	48	40	16
Partial	76	533	361	190	42
Span/1	.1396	.1280	.1306	.1287	.1429
Delete	0	0	0	0	0
Include	0	0	0	0	0
Span/2	.1396	.1280	.1306	.1287	.1429
Cmpl/2	23	36	48	40	16
Age <20	10+28	10+106	5+87	4+22	1+7
20-29	12+40	12+191	13+151	21+90	7+18
30-49	1+7	12+156	21+85	14+56	7+16
50<	0+0	2+64	9+28	1+17	1+1
Male	12+67	10+321	35+298	27+149	13+37
Female	11+8	26+209	13+59	13+37	3+5
=V2=	-0.085	0.621	0.050	0.032	-0.385
Ed <12	9+27	0+35	3+20	1+16	2+6
Ed 12	3+12	4+67	5+49	4+20	4+7
Ed 12<	6+17	23+279	33+204	27+104	6+16
#	1+3	0+0	0+2	0+0	0+0
*	11+31	0+61	2+26	1+9	3+12
+	0+7	4+62	8+44	3+20	4+2
.	10+31	32+355	34+251	35+134	7+25
MBTI					
I	2+1	15+23	17+21	10+6	2+8
E	4+4	5+20	17+19	13+5	3+3
=V2=	-0.143	0.239	-0.262	-0.184	0.333
=V3=	0.000	0.178	-0.147	-0.175	0.333
=V4=	0.000	0.096	-0.179	0.190	-0.200
N	2+1	16+20	17+24	13+6	1+3
S	4+3	7+26	14+15	9+8	4+12
=V2=	0.143	0.370	0.385	0.573	-0.500
=V3=	-0.250	-0.243	-0.348	-0.053	-0.500
=V4=	-0.714	-0.193	-0.162	0.391	0.500
F	3+0	13+26	11+19	10+4	3+3
T	3+4	9+23	17+20	13+6	2+10
=V2=	0.750	-0.375	-0.191	0.184	0.667
=V3=	-0.111	0.297	0.000	-0.078	-1.000
=V4=	-0.250	-0.103	-0.378	0.376	0.600
P	3+2	9+15	11+22	11+7	2+5
J	3+3	12+30	21+18	10+3	4+10
=V2=	0.750	0.103	0.013	0.075	0.000
=V3=	-0.111	-0.608	-0.321	-0.196	-0.500
=V4=	-0.250	-0.151	-0.122	-0.009	-0.143

which do not have interests. In some groups skew may suggest the habitual internal or external orientation of attention (high vs low D), but only if this degree of freedom is still open. In yet other groups skew may indicate a practical vs an intellectual attitude (high vs low C), or a rational vs a personal approach to problem-solving (high vs low A). The point is that each group has its own skew dimension.

4. To illustrate some of the foregoing principles, it is easiest to go to the largest group, which is currently ERU8 with its 48 exemplars. Figure 9 is a computer-generated two-page spread that pulls together many of the details available concerning this group. Figure 10 provides a statistical summary of some of these details, along with parallel summaries for the other poly-active ERU groups. The following correlations are abstracted from the computational key which defines ERU8:

4a. Not only is ERU8 the largest group. It has the highest mean NL, shown in Figure 10 as 14.7. (It is possible that ceiling effects actually restrict the upward range of some of the subtests, contributing to the overall low span index.) The first section of Figure 9 plots the subtest means of the group, which clearly depict and ERU Primitive PAS moving to an I*f*a* Basic pattern, but without any overwhelming compensations. Conceptually, ERU8 is supposed to be a Primitive ERU who has developed in a well-balanced fashion and is able to move easily among various styles of behavior.

4b. The mean age for ERU8 is 34.7 years, which is well above the general average of 30. Age variance is also high. Despite these facts, there are no correlations exceeding .05 of V1 with any subtest. In other words, there are no consistent age-related

effects to be corrected for in this group.

4c. In accordance with the principle of "balance," V2 correlates +.32 with NL and -.46 with Dsy; V2 also presents other correlations associated with this effect in this group (See above). The listing of exemplars on the second page of Figure 9 is ranked and labeled according to standard scores on V2, so that persons shown at the top of the page are using energy whereas those at the bottom of the page are using "smarts." Within the subset of 36 exemplars with known MBTI, this ranking correlates +.38 with preference for Intuition over Sensing, as reported in Figure 10.4d. The arousal dimension of ERU8 is closely correlated with the Time Estimation subtest, but also contributes to the PA and Dsy scores of members of this group (See above). The arousal dimension defines the x-axis of the Locator Plot in Figure 9, along which we may discern the distribution of scores for the exemplars. We see that cases J, L, and N present unusually fast internal clocks, which we are willing to regard as essentially situational stress-reactions in individuals already committed to the energy pole of V2. The strongest correlation of V3 with the MBTI associates high TE scores with the preference for Judging over Perceiving ($\tau=.32$); this seems to be part of a larger pattern suggesting that low V3 and/or P-preference is associated with difficulties in adjustment, albeit minor ones, as coded in column 18 of Figure 9, part 2.

4e. The skew dimension of ERU8 is closely correlated with the Digit Span subtest ($r=.92$). The skew dimension also defines the y-axis of the Locator Plot, where the distribution may be seen to contain at least a hint of bi-modality -- a smaller cluster of high V4 cases is near the top of the

plot and a larger cluster of low V4 cases is near the bottom of the plot. Conventional PAS scoring of the upper cluster would probably regard them as Primitive I persons, and we must be prepared to consider at some point whether these cases really belong to IRU8. (Our routine algorithms for refining the group definitions are relatively blind to big moves like this.)

4f. The more extended comments imbedded in the second page of Figure 9 are a relatively recent addition to the data-base, and are not uniformly available. However, the comments now in place already suggest further hypotheses. Members of ERU8 like to write (Cf cases P, p, t, and v). ERU8 is unable to function as a "consultant" (Cf ERA8), apparently depending upon the validation of a clear line of command. ERU8 has an unusually poor track record in marriage -- among 12 exemplars coded for this there are at least 6 divorces, 2 more on the rocks, 2 still single, and only 2 apparently "normal."

F -- From the perspective of a single case

1. In a view of the overall assignment rate for complete-data cases, even a failure to classify a new case becomes a statistically highly significant event! Possible explanations for such events might be (in order of decreasing likelihood?) scoring error, administration error, use of a non-standard WAIS, retest effects, and deliberate or unconscious distortion by the subject. This can include certain forms of "abnormality". (For all of our current data sources, the assignment rate now stands at 100%.)

1a. It is not unreasonable to ask "What is the probability of a correct assignment?", but this is impossible to answer in the ab-

sence of any independent criterion as to what is "correct." In the majority of cases there will be one and only one plausible assignment, i.e., just one assignment that would qualify the case as an exemplar.

In a minority of cases there may be two or even three plausible assignments; in such cases, we recommend the interpretation that both (or all) are true, i.e., that the individual is a sort of composite or multiple personality -- what the quantum mechanic would call a "superposition." Under this interpretation, all plausible assignments are "correct," although some reflect only incomplete explanations of the individual.

2. Given a successful assignment to a group, we may identify the individual's operating value system (cf Paragraph A7a) and the behavioral style (cf Paragraph A6) by which this is supported. Other known exemplars and/or generalized descriptions of the group may be consulted.

3. Given both assignment to a group and determination of the within-group coordinates, we may employ within-group regression to predict the individual's specific behavior on whatever dimensions of interest may have been studied in the particular group. Within the near future, these dimensions will include at least the scales of the MBTI. (Cf Figure 10.)

3a. It is important to bear in mind that none of the groups are 100% "good" or 100% "bad" places to be, even though the proportions do vary considerably from group to group.

4. A two-page individual report form has been designed, similar to Figure 9, that brings together all the information from the large data base that is relevant to the inter-

pretation of the single case on which it is focused.

G - From the various perspectives of PAS critics

1. Certainly it must be recognized that the PAS is an example of what the psychological literature has called "pattern analysis" or "scatter analysis" of the Wechsler subtest profiles. This is an idea as old as the Wechsler test itself (Rapaport, *et al.*, 1945), and which was at least implicitly encouraged by David Wechsler himself (1939). Indeed, Wechsler tells us that the subtests were selected as much because they had already demonstrated useful psychometric properties. Over the years, while the test has gained in popularity as an IQ measure, it has fallen into disrepute as a clinical tool. Even PAS - ophiles will agree that the revisions leading from the WB-I through the WAIS to the WAIS-R, which may improve the measurement of IQ, also weaken the battery as a source of personality data. There are various lines of argument that have been advanced as reasons to avoid Wechsler pattern analysis altogether. Several of these have been argued against the PAS specifically, and two of them against the Reference Groups specifically.

2. Cohen and dimensionality. It will be clear from the foregoing sections of this report that the PAS regards the WAIS as a multi-factor test battery, whereas most published factor analyses of the instrument report only 3-5 factors. Cohen (1952, *et seq.*) is the principal source of these reports, but he has not been alone.

As we have reported elsewhere in detail, the apparent problem arises from limitations inherent in factor analytic methodology, whereby it is mathematically impossi-

ble for small correlation matrices (such as 11x11) to support large numbers of factors (such as more than 6) when the communalities are properly treated as unknown. Using more appropriate methodology, we have repeatedly demonstrated the presence of 18 factors in the WAIS (See Klingler & Saunders, 1975).

3. Cohen and clinical validity. In another influential study, Cohen (1955) assessed the ability of three clinicians to correctly sort WB-I profiles into three major diagnostic categories - "neurotic," "schizophrenic," and "brain-damaged." The overall results were statistically significant, but barely. When these same data are processed using reference groups (see Figure 4), the results are appreciably better. Actually, it is possible to specify fairly simple rules that will sort these profiles even more effectively; the difficulty is that these rules involve the PAS Contact Level indicators, which operate primarily within reference groups, so that a simple between-group tally conceals their worth.

4. McNemar and reliability. A more sophisticated argument was first explicated by McNemar (1957), i.e., that the reliability associated with difference scores in the WAIS is insufficient to support profile interpretation. At face value, this is a plausible argument and it can easily be elaborated to satisfy the typical clinician's expectations of statistics. The root problem is that the reliability numbers supporting this argument are not unbiased estimates they are lower-bound (i.e., "conservative") estimates; the magnitude of the conservative bias has been unknown and therefore easily ignored. However, one clear implication of the evidence for factorial complexity is that this conservative bias is probably considerable. It should be possible to work back-

wards from the reference group results to provide a more realistic estimate of reliability (cf Paragraph B7).

5. Turner and construct validity. Turner, et al (1976), made a specific attempt to formulate hypotheses that would relate the PAS to more traditional "personality" measures -- the 16PF and the MMPI. Although their data display some highly remarkable statistical effects, these did not coincide with Turner's predictions. The major lesson to be drawn from this and other similar experiences is that conventional hypothesis testing is a risky way to do business when you are working in a domain laced with interaction effects. (We have already commented more extensively on the Turner study (Saunders, 1982)).

6. Silverstein and multiple comparisons. Silverstein has repeatedly made the point (e.g., 1982) that most forms of pattern analysis are essentially varieties of "simultaneous statistical inference," which is a term used in the ANOVA literature. If one is primarily concerned with making precise statements to the effect that this or that subtest is significantly out of line with a profile, it is appropriated to recognize the issue. As a practical matter, Silverstein recommends that one forget about differences between arbitrary pairs of subtests (there are too many possible pairs), and make Bonferroni-type corrections when considering the deviations of subtests from some mean.

He also recognizes the clinician's interest in generating rather than merely testing hypotheses, and therefore recommends using not very stringent probability levels -- 0.05 is better than 0.01! Insofar as the driving concern is to minimize the number of possible effects that need to be considered, the

reference group approach, with only 104 groups, is actually less vulnerable on this point even than Silverstein's recommended procedure; 104 is less than 27, and the process of assigning a case to a group is equivalent to a series of no more than seven simple hypotheses.

7. Robinson and complexity. Robinson's recent comments (1985) are primarily a response to Winne & Gittinger's 1973 explanation of the PAS, and make a point with which we have long agreed -- that the mechanics of formal PAS scoring seem unjustifiable complex and arbitrary. We have never regarded these formalities as more than an attempt to capture Gittinger's intuitive skills as a profile interpreter. It is our present belief that the reference group approach is a better way of addressing this measurement problem, and that it is both sufficiently different and sufficiently objective as to render Robinson's comment moot.

8. Kiernan and relevance. Kiernan's (1986) comments are relatively unique in being specifically directed at the PAS Reference Group approach. The principal criticism seems to be that the process of dealing with the earlier criticisms has led to a "statistically determinate system." If it were not for the "tone of voice," we would actually regard this as a compliment! Kiernan appears to be saying that he would like to be provided with more verbiage tending to rationalize the use and interpretation of the various WAIS and especially 4th dimension measures-- that such verbiage is of more interest than any empirical finding of a reference group structure. This represents such a fundamental philosophical difference of opinion that it probably cannot be overlooked. However, particularly after Kiernan's own illustration of his preferred

approach simply leads to rediscovery of the poly-active versus non-poly-active dichotomy, we remain unimpressed.

9. Heyman and symmetry. Heyman's (1986) discussion of the PAS Fourth Dimension is predicted on treating the Color Naming and Digit Symbol subtests as simple, independent dichotomies, paralleling the rest of the PAS as formulated by Gittinger. From this perspective, the number of groups can only be an exact power of 2, e.g., 64 or 128. At this point, we see nothing that could be accomplished with 128 groups that is not already accomplished equally effectively and noticeably more efficiently with 104. In particular, insofar as "In-active" is proposed to round out the pro-active, poly-active and re-active classification, we have real difficulty; we would see inactivity as a limit existing around the periphery of the whole rose.

H -- some unanswered questions

1. As a practical matter, the WAIS-R is displacing the WAIS in the real world of psychology. If the PAS is to be used, it will be necessary to spell our guidelines for a modified WAIS-R Manual permits, restore the PAS information to the battery.

It will then be necessary to recalibrate this modified WAIS-R to conform with the WAIS norms underlying the reference group keys. (This process has been begun.)

2. Theoretically, there is no reason why incomplete data cases should not fit the reference groups just as well as the complete data cases. In fact, they do not. What is needed is a better algorithm for the estimation of missing values.

But even at best, the assignments of such

cases will remain relatively uncertain. The problem is complicated by what we may call "triple ranges." For example, Q2 is often missing in a context where it may legitimately go to either extreme as a qualitative indicator of specialized interests, but the substitution of the mean as a "best guess" may be read by the algorithms as lack of interests and thereby lead to assignment to a completely wrong group!

3. We do need a study of the "assignability" of random PAS profiles. We predict that random profiles will be substantially less identifiable than real profiles, and that this will support the notion that the total PAS profile is over determined. In turn, a real profile that is unidentifiable will be seen as "distorted." (This study is under way.)

4. We also need to work out the subtest reliability numbers that are implied by the goodness of fit parameters of the reference groups. Now that 100% of the available complete data have been used as exemplars, such a study will no longer be vulnerable to an argument that it is biased.

5. We have observed informally that the MBTI is frequently able to anticipate the final decision when there is a close call for a given case as between two groups. It would be interesting to consider how the power of the whole approach might be enhanced by enlarging the PAS basis space to include measures derived from the MBTI or other self-report data.

6. The possibility certainly exists that one or more of the 104 groups is substantially "untestable." This is not essentially different from the notion that one or more of the groups is substantially "unrecruitable" for testing, which has appealed to us as an ex-

planation for the relatively small numbers of IFA6 and IFU6 cases in the current active data base. Conceptually, IFAC and IFUC seem relatively likely to be untestable; moreover, even if they are testable, they would seem relatively likely to require institutionalization. Thus, given the relative paucity of hospitalized cases in our current data base (counting only complete cases), it seems likely that true exemplars for these groups are missing, and that the present definitions of these groups are especially vulnerable.

6a. The preceding paragraph merely cites some extreme examples. All of the groups are likely in need of refinement of their definitions. The really difficult problem has been to strike a balance between the need for stable definitions and the need for psychologically sensible definitions. We propose to deal with this problem by declaring a temporary moratorium on swaps, while allowing individual cases to be added and/or moved within the framework. It will be an empirical question how long the moratorium lasts.

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