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POLICY STATEMENT

The primary aim of *Multivariate Experimental Clinical Research* is to provide a publication outlet for research in the areas covered and indicated currently by the terms personality study, clinical diagnosis and therapy, extending into the learning, social, physiological, applied and developmental aspects of these. Although due representation is given to theoretical articles which may have a methodological basis, the journal is not one of multivariate statistical methods. Although multivariate in outlook, both manipulative and non-manipulative research is accepted. In fact preference is given to dynamic, manipulative and time-sequential studies. Particular encouragement is provided for pioneer experimental attacks on what is designated personality dynamics and motivation, as well as the natural expansion thereof into structured learning theory.

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PILOTS WHO CRASH: PERSONALITY CONSTRUCTS UNDERLYING ACCIDENT PRONE BEHAVIOR OF FIGHTER PILOTS

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ABSTRACT

Personality factors have been shown to be related to accident prone behavior, and generic profiles and regression equations have been developed to identify those more likely to experience behaviors associated with accidents events. Using the *16PF,* the ultimate purpose of this study is to assess differences between a group of F-4 Phantom fighter pilots who "crashed" (N=47) versus another deemed to be "safe" (N=44). Several subsidiary objectives were established using comparative profiles of four pilot groups: airline, airline/military fighter, general military, and F-4 fighter. The study reveals that: (a) pilot personality in general differs substantially from that of the general population; (b) there are both striking similarities and dissimilarities between the four pilot groups; (c) there is only minimal consistency or agreement between pilot personality profiles and the prediction equation for generic "freedom from accidents:" the airline pilots show the greatest consistency and the F-4 pilots the least; and (d) most important, five significant personality factor differences discriminate the "safe" from the "crashed" F-4 pilot group. Using set correlation techniques, it is shown that 27% (33% attenuated) of the variance in "crashing" is explained by personality differences and that over 70% of the pilots are correctly classified.

PILOTS WHO CRASH: PERSONALITY CONSTRUCTS UNDERLYING ACCIDENT PRONE BEHAVIOR OF FIGHTER PILOTS

Intuitively, most would agree that a disproportionately fewer number of people are involved in a disproportionately higher number of misfortunate incidents that could generically be called "accidents." In other words, it is a popularly accepted generalization that accident events are not random. Rather, there is a discernible pattern associated with their occurance (e.g., Blum & Naylor, 1968).

CONCEPTUAL FRAMEWORK

The designation "accident proneness" or "accident prone behavior" has emerged to describe people who individually incur disproportionately high repetitive accidents or who, as a group, incur more single accidents than would be expected by chance. Such a pattern, if it in fact exists, is not in itself sufficient to establish a construct and operational theory of accident proneness (Mintz & Blum, 1949). They point out that accidents are "rare events," and maintain that the appropriate statistical model for studying accident outcomes is the poisson distribution. Under the poisson distribution, by chance, 9% of a given population should have 39% of the accidents, and 39.5% should have 100% of the accidents. Thus, for the notion of accident proneness to be validated and persist as a viable explanation, the accident distribution must be significantly more extreme than the pattern arising from the poisson chance predictions (Mintz & Blum, 1949). Therefore, Mintz and Blum tend to dismiss the concept of accident proneness, and, largely because of their study, a number of researchers have relegated it to the role of statistical artifact, results of poor research design, careless reporting, poor data collection, etc.

Kerr's research on accident proneness incorporates the notions of "alertness" and "stress adjustment" as additional independent variables. His conclusions, however, are generally supportive of the findings of Mintz and Blum. In terms of their degrees of importance, accident proneness accounts for only 1-15% of the variance in accident events, alertness 30-40%, and stress adjustment 45-60% (Kerr, 1957). Moreover, an extensive literature review by Golstein (1962) was essentially negative with respect to accident proneness. There are a number of other researchers also critical of the concept of accident proneness (e.g., Cobb, 1940; Johnson, 1946; Arbous & Kerrich, 1951). However, Arbous & and Kerrich (1951) do not summarily dismiss the notion of accident proneness; rather, they seem to point out that, if it exists, it has not been adequately defined, it defies accurate assessment, and it has not evolved into an operationally satisfactorily technique.

Conversely, there is a large body of research generally supportive of the accident proneness construct (e.g., Greenwood & Woods, 1919; Farmer & Chambers, 1939; LeShan, 1952; McFarland & Mosely, 1954; Davids & Mahoney, 1957; Keehn, 1959; Haner, 1963; Kunce, 1967; Greenshields & Platt, 1967; Babarik, 1968; Mallikarjunan, 1973; Colbourn, 1978; and Wilson, 1980). Davids & Mahoney (1957), e.g., found that high rates of accidents were associated with low trust, low sociocentricity, pessimism, resentment, and negative employment attitudes. Similarly, LeShan (1952) found accident events associated with a lack of warm, supportive, emotional relationships and a distrust and hatred of actual superiors and even general authority figures. In a review of the literature by Miner & Brewer (1976), extending through 1970, they concluded that, contrary to the earlier views of Mintz & Blum (1949), there do appear to be certain individuals who are consistently more susceptible to accidents and injuries than others.

Interestingly, the concept or construct of accident proneness enjoys general acceptance in Europe; however, as highlighted in the preceding overview, in the United States there has been something less that enthusiastic endorsement and universal acceptance (Shaw & Sichel, 1971). Failure to endorse the concept of accident proneness in the United States is principally attributed to definitional ambiguity coupled with inconsistent, incomplete, and contradictory research findings; and these are mainly due to failure to identify, assess, and hold constant an almost inexhaustable array of contingent risk factors (Beall, 1972; Colbourn, 1978; Connolly, 1981). The diversity of the confounding risk variables is such that anomolous results become the rule rather than the exception. Obviously, the accident proneness construct is controversial, so much so that Miner (1976), e.g., prefers the term "accident repetition," and Manheimer and Mellinger (1967) use the expression "accident liability." Cattell, Eber, and Tatsuoka (1980) defer to the inverse term: "freedom from accidents." One might also use such terms as "accident propensity" or "accident proclivity." Such linguistic machinations, however, serve little purpose other than avoiding the polemics inherent in the use of the apparently more pejorative term. This should not be infered as a criticism of Miner, Manheimer and Mellinger, and others who have used such approaches. Rather, it is a commentary on the perceived need to do so in an effort to avoid controversy.

A major stumbling block seems to be one of defining exactly what is meant by the term accident proneness. If it exists, is it a unitary set of imperatives, much like the now debunked "great man" theories of leadership (Stogdill, 1974), that preordains accident events regardless of situational contingencies? Alternatively, if it exists, is it a function of the complex interactions of ability, motivational, and personality characteristics; interacting with ambient environmental situations; exacerbated by focal stimuli; producing behavioral responses; resulting in greater than expected accident event outcomes (Cattell, 1986)? There is no definitive answer, but the theoretical framework on which this study is based is one that accepts the construct of accident proneness (by whatever name), but one that is characterized by the latter of the above rhetorical questions, *not the former*. Thus, the assumption is, there is *not* a unitary set of personal characteristics that will give rise to accident outcomes under any set of circumstances; but there are personal characteristics that, depending on circumstances, predispose one person more than another to engage in behaviors that are more likely to result in accident outcomes.

The following hypothetical scenario, admittedly overly simplistic, illustrates the theretical perspective taken in this study. Given that two equally competent pilots, flying separate but identical aircraft, have just entered an Instrument Meteorological Condition (IMC) environment (the ambient environment); both encounter violent thunderstorms and, however unlikely, both lose vacuum, resulting in failure of primary attitude and directional instruments (the focal stimuli); one continues into the storm where there is, say, a 15% probability of crashing; the other immediately returns to a Visual Meteorological Condition (VMC) environment, with only, say, a 3% crash probability until leaving IMC and reaching safe VMC (the respective response behaviors). Pilot ability factors and aircraft type and servicability are controlled. The likelihood of crashing is the dependent variable. The independent variables are: (a) ambient environment, (b) focal stimulus situation, (c) behavioral responses, (d) and individual personality and dynamic motivational characteristics. Unfortunately, at least in the present study (which is all too typical), little is known about the ambient environment or the focal stimuli. The question then becomes, to what extent do the psychological variables contribute to explaining the variance associated with the likelihood of crashing? This is the context in which the term "accident proneness" or "accident prone behavior" is used in this study. This is not the same as saying that a given set of psychological characteristics give rise to a given accident outcome.

Of course, the "real world" is complex. What if a second dependent variable were involved: e.g., the mission essential requirement for arriving at a destination at a specified time. The pilot in this example who continued through IMC and successfully arrived is a "hero;" the one who turned back is derided as cowardly. Had the first pilot crashed, he/she would be considered reckless and foolhardy. The second, not having crashed, would be viewed as prudent and wise. Thus, it is not sufficient merely to examine the differential responses of the two pilots. The larger question is one of assessing the probable consequences of the differential responses in terms or "crashing" and "not crashing." Such is the elusiveness and complexity of any operational definition of "accident prone behavior." In there a unitary accident prone behavior pattern that presages accident outcomes? Probably not. Are there personality, motivational, and other psychological variables associated with behavioral responses that, under various contingent conditions, are more or less likely to result in accident outcomes? Probably yes, and that is the premise on which this study is based.

PILOT COMPETENCE, SAFETY, AND ACCIDENT BEHAVIOR

Despite its complexity and elusiveness, accident occurance, or its inverse, freedom from accidents, is of paramount concern to all segments of society; and, directly or indirectly, safety affects every citizen: insurance rates, taxes, personal loss, etc. Nowhere is this concern more critical than in pilot safety, whether military, general, or commercial. The sheer volume of literature on the subject of pilot safety — both popular and professional, journalistic and scientific — attests to its importance and reflects society's concern.

Cognitive ability factors (intellectual, perceptual, psychomotor, physiological, experience, etc.) are crucial to pilot safety; but to what extent do these factors constitute relative deficits that might explain differences in accident rates within the military and major airlines? The fact is, rigorous selection standards, training requirements, and attrition for substandard performance all serve to minimize variance in ability factors. Thus, ability factors *per se* among pilots in a given unit, say a fighter wing (the subjects in this study), tend to equalize, yield minimal variability, and in essence form a constant. As Tatsuoka (1973) points out, when variance in ability factors is reduced to a minimum, other factors become highly relevant as possible sources of accident prone behavior. Principal among such other factors are personality, motivational, behavioral, and situational variables as well as the interaction among and between them.

Before describing the specific methodology used in this study, a brief overview of the typical pattern of flying behavior and experience of fighter pilots should helpful. According to Cline (1976), a convenient way to categorize fighter pilots is by years of experience and flying hours. Typically, the fighter pilot with less than six years of experience has less than 700 hours flying time; those with between six and twelve years experience have between 700 and 1500 hours; and those with more than twelve years experience have more than 1500 hours. Statistics reveal that pilot-error accidents peak between 700 and 1500 hours (Cline, 1976), and there are plausible explanations for this pattern.

The description which follows is purely generic and is not intended to represent precisely an invariate pattern for all pilots. It is merely a general pattern laced, to be sure, with many exceptions. In the Air Force (as well as in the other services), a person is selected for pilot training based in large part on his ability factors and perceived potential (by law, women cannot become fighter pilots). During the first several hundred hours of flying, the fledgling pilot remains under the watchful eye and strict control of his instructor pilots, more experienced colleagues, and unit commanders. During this phase, the focus is on rote learning, adherence to rules, standardized procedures, normative socialization into the "fraternity," and achieving minimal standards of proficiency. Clearly, ability factors are emphasized during the first few years. During the second phase (700-1500 hours), other variables begin to play more active roles. Attitudes, motivation, and personality (earlier suppressed or constrained) are increasingly free to vary and begin to emerge as factors influencing flying proficiency and sophistication. Flying by the rules *per se* no longer produces the old thrill. Complacency, overconfidence, a search for short-cuts, and a preoccupation with innovative techniques and approaches are likely to appear during this phase. Then, in the third phase (over 1500 hours), the fighter pilot, having survived, is more the wiser.He has acquired experience and developed judgement. He has at least implicit insight into his and his aircraft's limitations and capabilities, although he may not be able to verbalize it.

Christy (1975) has pointed out that many personality traits positively associated with success in completing pilot training become liabilities to flying proficiency later in the pilot's career. For example, linear thinking, compulsivity, perfectionism, rigidity, etc. seem to contribute to learning to fly. However, later in a pilot's career, such traits may actually mitigate against safety and proficiency (Reinhardt, 1966, 1967, 1970).

Though anectdotal in nature, the author has indirectly observed examples of this phenomenon in military pilots, especially fighter pilots. In administering the *MBTI (Myers-Briggs Type Indicator)* (Myers & McCaulley, 1986) to hundreds of military pilots, in about three percent of the cases a fighter pilot (major, lieutenant colonel, or colonel) would emerge as an E/INTP (extraverted or introverted, intuitive, thinking, perceiving). This is a very unusual pattern, since the dominant pattern for the military officer in general and the pilot in particular is ISTJ (introverted, sensing, thinking, judging). Intrigued, I would personally interview these "anomolous" NTP pilots (totaling about 15-18 over a 6 year period), and their description of their flying experience was invariably the same. They all had an extremely difficult time in pilot training, and each considered attriting or feared he would be involuntarily attrited. Focusing on rote learning of concrete, ordered, sequential data was most frustrating and demanding. They had a difficult time learning and executing procedures in the precise, and required manner. They felt dumb and inept. They were repeatedly admonished by their instructor pilots. Now, 12 to 18 years later, each was identified as a fighter pilot par excellence: A-one, first class. Each was moving on to higher positions with greater responsibility, usually within the fighter pilot community. Thus, at least through rational conceptualization, personality and other psychological constructs are shown to be contingently important variables in pilot training and flying proficiency. Characteristics that mitigate against "success" at one stage of a pilot's career may actually contribute to "success" at another stage.

Some researchers (e.g., Alkov, 1976; Beall, 1972; McGuire, 1976; Schwenk, 1967) distinguish between two types of accident proneness: permanent and temporary. Conceptually, it seems to make more sense to think of the permanent-temporary paradigm, not so much as representing discrete and independent causal domains, as a continuum influenced by three identifiable but interacting psychological processes: personality; motivation; and attitudes, moods, responses to life-change events, and other short-term affective influences. As pointed out earlier, cognitive ability factors do not constitute a major variable, at least in the highly selective environment of military flying they don't.

Personality, at least in the sense of temperament, is the characteristic and dominant way in which a person deals with his or her world. Its structures are relatively permanent, stable over time, and comparatively more reliably assessed than those of affective attributes which are more dynamic. Motivation structures, e.g., are less resilient, more dynamic, and, thus, more difficult to measure reliably. Yet, motivation structures do operate with relatively measurable cohesion and persistence. What motivates a person today is likely to remain next week and next year; but maybe not five years hence. Attitudes, moods, and the consequences of life change events, however, are the most unstable, dynamic, and difficult to assess. They may change weekly, daily, or even hourly. Instruments like the *Adjective Check List* (Zuckerman & Lubin, 1965), however, are reasonably successful in capturing some mood and attitude dynamics. Also, life change event scales (e.g., Holmes & Rahe, 1967) are intended to measure perceived stress arising from life changes.

While the literature on accident proneness is replete with studies using various psychometric instruments and simulation exercises, the author found no evidence of attempts to link personality, motivation, attitudes, moods, life changes, operational demands, flying experience, physiological status, and environmental variables into an integrated, global, contingency model. While such an effort would be monumental in size and necessarily extend over many years, it would seem essential to the development of an operationally satisfactory global theory of accident proneness. At the present time, however, what is feasible are limited domain studies, recognized as such, designed to provide well focused "snapshots" of accident prone vis-a-vis accident free behavior. Such is the goal of this study.

METHOLOLOGY

SUBJECTS

At the request of Koz (1984) (at that time a student at the Air War College), the Human Factor Studies Division of the Air Force's Directorate of Aerospace Safety identified 89 F-4 fighter pilots who had experienced at least one "class-A" accident. Presumably, these 89 pilots constituted the entire population of F-4 fighter pilots who had survived "class-A" accidents, although this assumption cannot be conclusively verified. The survival rate in such accidents is low. Preventable class-A accidents are incidents involving death, serious injury, aircraft destruction, or over $500,000 in damage. Moreover, pilot error in class-A accidents is determined to be one of the principal causes of the incident. Only F-4 Phantom fighter pilots were included in the data collection effort. Participation was voluntary and anonymous, with the identity of the pilots known only to the Directorate of Aerospace Safety. There was no official or formal pressure on the part of the Air Force for the respondents to complete the assessment devices or to otherwise respond. Of the 89 fighter pilots who had class-A accidents, 47 responded with usable data; for whatever reasons the other 42 did not. Each of the 89 pilots had in excess of 400 hours flying time. Among the responding subjects who revealed their ages (11 declined), the mean was 37.7, with a SD of 6.2, and a range of 28 to 52.

Another group of 89 fighter pilots was identified by the Directorate of Aerospace Safety as being free from accidents and, thus, "safe."Subjects in the "safe" control group were individually matched in so far as possible with the "crashed" group according to age, experience, type aircraft, etc. Like the "crashed" group, all pilots in the control group had in excess of 400 hours flying time in the F-4 Phantom aircraft.Of the 89 pilots who were accident-free, 44 responded with usable data. The mean age was 36.8, with a SD of 5.0, and a range of 29 to 49. The precision of the matching technique was attenuated, of course, since it is not known which matched pairs actually responded. Still, the summary statistics, relative to age, suggest little if any diminution in original group similarity.

Of course, there are potentially relevant data that remain unknown insofar as matching is concerned: e.g., what categories of F-4 aircraft were involved (F-4C, D, E, etc.?); what was the primary mission of the respective wings to which the pilots belonged (air-to-air, close air support, reconnaissance, etc.?); under what conditions did the accidents occur (IMC, marginal VMC, or VMC?); what were the operational demands at the time of accident occurrances; what stress levels had the "crashed" pilots, vis-a-vis the "safe" pilots, been subjected to prior to their accidents; what were the spans of time between the accidents and the completion of the assessment devices? The point is, even though this study is rather narrowly focused and controlled in terms of intergroup matching, due to practicability constraints and the sensitivity and confidentiality of the data, there remain many risk contingencies that are unknown and uncontrollable.

ASSESSMENT DEVICES

Form A of the *16PF* was used to assess personality traits and develop profiles (Cattell, Eber, & Tatsuoka, 1980). The description, intended uses, theory, validities, reliabilities, and representative profiles are reported in the *Handbook for the 16PF* (Cattell, et al., 1980). The instrument yields 16 "source" or primary factors which are conceptualized as the basic building blocks of personality structure. Also, Form A yields two validity scales based on assessing the motivational distortion of the subject, plus a third validity scale, developed by Karson and O'Dell (1976, pp. 153-154), designed to measure "random faking." In addition, eight "surface" or secondary factors emerge from the interaction and loading of various source traits; however, only four of them are commonly used since criterion associations for the other four have not been adequately established. The *16PF* has been in widespread use for over 30 years, and is generally accepted as a standard for assessing normal dimensions of personality.

The *16PF* distribution is most often expressed in STEN (standard ten) units with a range of 1-10, an overall population mean of 5.5, and a SD of 2. The instrument is the product of factor analytic studies, so what is most important are the factor structures, not the semantics used to describe the factors. Nevertheless, descriptive labels are necessary to communicate, and the most commonly used descriptive words are shown in Table 1. In the results tables, however, only the factor codes and, where space permits, one word descriptions of the high side meaning of each variable will be used.

An adaptation of the *Holmes-Rahe Social Readjustment Rating Questionaire* (*SRRQ*) was also used in this study (Holmes & Rahe, 1967). The purpose was to assess the impact of life event changes on temporary accident proneness. The instrument assigns relative weights to events that occurred during the preceding two years (usually) of a person's life. The weights are summed, yielding an overall measure of stress the organism is presummed to be encountering. Unlike the *16PF,* the *SRRQ* has not withstood the rigors of widespread validation studies. Its results are frequently inconsistent, contradictory, or insignificant (see, e.g., Brown, 1974; Vinokur & Selzer, 1975; Zeiss, 1980; Byrne & White, 1980). In fact, test-retest reliability studies have produced reliability coefficients ranging from .26-.90, thus attenuating validity that may in fact exist (Rahe, 1974). One should not conclude that life event changes are unimportant; nor should one infer that the selective use of the SRRQ is without merit. It is an excellent device for assessing the dynamic events occuring in a persons life and their possible influences on levels of stress. Under controlled conditions it yields valid and reliable results with respect to the influence of life event changes. Rather, the major problems with the *SRRQ* arise from controllability of confounding variables and involve subjective interpretation of events, weighting schemes, time passage and recall horizons, and assumptions of unidimensionality of events in their comprising an overall stress score.

Both the *16PF* and the *SRRQ* were sent to the 178 fighter pilots identified and selected by the Directorate of Aerospace Safety. Neither this author nor Koz (1984), who originally requested the data, are aware of the identity of the subjects. This author did not see the original raw data, nor was he involved in the scoring process; this was performed by Koz (1984). The author only received *16PF* sten scores (not raw scores) and summed *SRRQ* scores for each of the 91 pilots who provided usable data.

TABLE 1

SELECTED COMMON DESCRIPTIVE NAMES FOR THE 16PF FACTORS

Factor	Low Score Meaning (-)	versus	High Score Meaning (+)
	— Primary or Source Factors —		
A	Reserved, Cool, Aloof	vs	Warm, Outgoing, Participating
B	Less Intelligent	vs	More Intelligent
C	Emotional, Low Ego Strength	vs	Stable, High Ego Strength
E	Submissive, Accepting	vs	Dominant, Competitive
F	Serious, Cautious, Sober	vs	Impulsive, Happy-go-lucky
G	Nonconforming, Low S-Ego	vs	Conscientious, High S-Ego
H	Shy, Timid, Restrained	vs	Bold, Adventurous, Active
I	Tough-Minded, Insensitive	vs	Tender-Minded, Sensitive
L	Trusting, Permissive	vs	Suspicious, Dogmatic
M	Practical, Prosaic	vs	Imaginative, Bohemian
N	Forthright, Naive, Genuine	vs	Shrewd, Astute, Calculating
O	Sel-fassured, Secure	vs	Guilt Prone, Apprenhensive
Q_1	Conservative, Traditional	vs	Experimenting, Liberal
Q_2	Group dependent, "Joiner"	vs	Self-sufficient, "loner"
Q_3	Uncontrolled, Lax	vs	Controlled, Compulsive
Q_4	Relaxed, Low Tension	vs	Tense, Driven, Frustrated
	— Second-Order or Surface Factors —		
Q1	Introversion	vs	Extraversion
QII	Adjustment	vs	Anxiety
QIII	Emotionality	vs	Cortertia (Tough Poise)
QIV	Subduedness	vs	Independence
QV	Naturalness	vs	Discreetness
QVI	Cool Realism	vs	Prodigal Subjectivity
QVIII	Low Superego Strength	vs	High Superego Strength

NOTE: Second-order factor QVII is not shown since it is comprised almost entirely of Primary Factor B (intelligence.

Second-order factors QV and QVI have not been fully researched, and criterion associations have not been established (Cattell, et. al., 1980). In addition to the Primary and Second-Order Factors, the *16PF* Form A also yields two motivational distortion measures: "faking good" and "faking bad" (Cattell, et. al., 1980) and a "random faking" measure developed by Karson (Karson & O'Dell, 1976, pp. 153-154). These scales could not be used here since they must be computed form raw data, and the data used in this study are previously scored STEN data.

SELECTED COMPARISON PROFILES

From the perspective of personality structure alone, a *16PF* profile of and a regression specification equation for predicting "freedom from accidents" have been devised (Cattell et al., 1980). Compared to the population norms in general (means=5.5), and people more prone to accidents in particular, the generically "safe" person is more intelligent (B+), higher in ego strength (C+), less dominant or competitive (E-), less impulsive (F-), much higher in conscientiousness (G+), less Bohemian or imaginative (M-), less guilt prone (O-), more compulsive or disciplined (Q_3+), and less tense (Q_4-). While Cattell's generic profile and specification equation predicting "freedom from accidents" enjoys some empirical support (pp. 164-165), there are many exceptions arising from a wide array of contingency factors. For example, in a study of Washington State automobile drivers reported by Tatsuoka (1973), "accident prone" drivers, compared to "safe" drivers, were found to be competitive (E+), impulsive (F+), nonconformist (G-), unimaginative (M-), naive (N-), guilt prone (O+), self-sufficient (Q_2+), and tense (Q_4+). Thus, there was significant directional agreement with five of Cattell's factors (E, F, G, O, and Q_4) and disagreement with one (M); two do not appear in Cattell's equation (O and Q_2) and three did not emerge that do exist in Cattell's equation (B, C, and Q_3).

In a specialized domain more relevant to the present study, Sanders and Hoffman (1975) conducted a study of 51 Army pilots (both helicopter and fixed wing), 14 of whom had at least one accident while 37 were considered "safe." The pilots who crashed were dramatically lower in imaginativeness (M-) and self-sufficiency (Q_2-) and moderately higher in shrewdness (N+). No other *16PF* variables were significant at less than the $\underline{P}$=.05 level; however, the three significant variables correctly classified 86% of the pilots. Thus, of the three variables that discriminated "safe" from "accident prone" Army pilots, one is in opposition to Cattell's generic "safe" profile equation (M), and the other two are noticably absent (N and Q_2). Apparently, personality factors associated with "freedom from accidents" in the general population are only moderately congruent with those for automobile drivers (at least in Washington State) and are not at all congruent with those for Army pilots. To Sanders and Hoffman's credit, they also subjected their findings to the poisson distribution test advocated by Mintz and Blum (1949). The results were negative in that they resembled what would be expected by chance. However, in summary, they posed a question suggested by Thorndike (1951): by only considering data more extreme that those expected under the poisson distribution, is a real phenomenon being neglected? The question persists. Nonetheless, the full *16PF* profile of the Army pilots in Sanders and Hoffman's (1975) study is very similar to those of other military pilots. Is it reasonable to infer, therefore, that pilots in general constitute a sub-population that differs significantly and cohesively from the general population? Table 2 suggests this to be the case.

Profile 1 reflects a normative profile for airline pilots from which the 16PF specification equation for airline pilots has been derived (S. E. Krug, who personally conducted the research, personal communication, December 18, 1989; Cattell et al., 1980, p.189-191). Profile 2 reflects 40 Air Force Reserve fighter pilots,

TABLE 2

16PF PROFILES OF FOUR GROUPS OF PILOTS IN DIVERSE DOMAINS

	Profile 1[a]		Profile 2[b]		Profile 3[c]		Profile 4[d]	
	AL		AL/A-10		AWC		F-4	
FACTOR	M	SD	M	SD	M	SD	M	SD
— Primary Factors —								
A	5.1	2.0	4.8	2.3	5.0	2.0	3.9	1.8
B	7.2	1.5	7.2	1.7	7.7	1.5	7.9	1.5
C	7.8	1.8	7.3	1.9	5.7	1.6	5.3	1.7
E	6.6	1.7	7.4	2.0	7.5	2.0	7.6	2.0
F	6.7	1.6	5.5	1.8	5.7	1.9	6.1	2.2
G	7.2	1.4	6.9	2.1	6.4	1.7	6.9	2.1
H	6.9	1.8	7.0	2.0	6.2	2.2	5.8	2.3
I	3.8	1.7	4.1	2.3	4.7	2.0	4.1	1.9
L	3.7	1.9	4.1	1.8	5.7	1.9	5.7	1.9
M	4.1	1.5	6.0	1.7	6.3	1.6	5.4	1.6
N	5.7	1.8	4.9	1.7	5.2	1.8	4.8	1.9
O	3.5	1.8	3.8	1.9	4.9	1.6	5.2	1.8
Q_1	5.8	1.9	4.7	2.0	5.6	1.9	5.8	2.0
Q_2	5.1	2.1	7.1	1.4	6.5	1.9	6.7	2.0
Q_3	7.5	1.7	7.4	1.4	6.0	1.5	6.2	1.6
Q_4	3.0	1.6	3.8	1.8	6.4	1.8	6.3	1.7
— Secondary Factors —								
QI	6.7	n/a	6.1	n/a	6.2	1.9	6.1	2.0
QII	2.9	n/a	3.4	n/a	5.7	1.4	5.9	1.5
QIII	7.1	n/a	7.6	n/a	6.9	1.8	7.9	2.0
QIV	5.7	n/a	7.1	n/a	7.0	1.5	6.9	1.7
QV	n/a	n/a	4.8	n/a	5.4	1.7	5.0	1.9
QVI	n/a	n/a	5.6	n/a	5.8	1.9	5.1	1.9
QVIII	n/a	n/a	6.7	n/a	6.2	1.6	6.4	1.5

NOTE: Profile 3 is corrected for motivational distortion; the other three profiles are not.
[a]Normative profile of airline pilots n=360. From S.E. Krug, Metritech, Inc. (personal communication, December 18, 1989). Profile also appears in Cattell et al. (1980, p. 190).
[b]Profile of A-10 Fighter Pilots (reserve) who are also airline pilots (n=40). From *Development of a Viable Pastoral Counseling Model to Meet the Ministerial Requirements of US Air Force Reserve Fighter Pilots* (p. 65) by C.W. Lewis, 1984. Unpublished, non-copyrighted doctoral dissertation, New Orleans, LA: New Orleans Baptist Theological Seminary.
[c]Profile of Pilots attending the Air War College, 1984 (n=94). Unpublished data collected by author.
[d]Profile of combined "safe" and "unsafe" F-4 Fighter Pilots analyzed by this study (n=91).

flying theA-10 close air support fighter aircraft, all of whom are also airline pilots (Lewis, 1984, p. 65). Profile 3 reflects 94 military pilots in attendence at the Air War College in 1984 (Lardent, 1985). They comprise a composite group of fighter, bomber, and air transport pilots, about 85% of whom are Air Force pilots with the rest being Army or Navy/Marine/Coast Guard. Profile 4 reflects the combined profile of the "safe" and "accident prone" F-4 fighter pilots comprising the heart of the present study.

What is immediately obvious is that pilots in general are indeed different from the general population in terms of personality structure. All four pilot groups differ substantially from the general population norms on most of the factors. This is not unexpected. What is unexpected is the degree to which the exclusive airline pilots (profile 1) differ from the exclusive military pilots (profiles 3 and 4). The exclusive military pilots are similar (within 0.5 STENS) on all but three factors: A and M (which obviously differ significantly) and I (which reveals a difference of only 0.6). Taking the averages of the factor scores of the exclusive military pilots (profiles 3 and 4), since they are so similar, and using these means as a basis for comparison, it is clear that the exclusive airline pilots (profile 1) are different from the exclusive military pilots on 14 of the 16 factors at magnitudes greater than 0.5 STENS. Only G and Q_1 differences between the two groups are within 0.5 STENS.

Those pilots functioning in both domains, the "hybrid" group (profile 2), differ from the exclusive military pilots, by more than 0.5 STENS, on eight of the 16 factors: B, C, H, L, O, Q_1, Q_3, and Q_4. The exclusive airline pilots (profile 1) differ from the "hybrid" pilots, by more than 0.5 STENS, on seven of the 16 factors: E, F, M, N, Q_1, Q_2, and Q_4. The only factor differences (greater than 0.5 STENS) common to both the "hybrids" vs. the exclusive military pilots and "hybrids" vs. the airline pilots are Q_1 and Q_4. In the case of Q_1, the "hybrid" group (profile 2) is significantly lower than either of the other two groups (profile 1 and the average of profiles 3 and 4), and in the case of Q_4, the mean score of the "hybrids" falls between those of the other two groups. The most plausible explanation for these patterns is one of self-selection and socialization, first into the pilot community generally, followed by further self-selection and socialization according to the role prescriptions of the more specific pilot domains.

In summary, Table 2 reveals that all four pilot groups tend to be decidely cool and aloof, very intelligent, competitive, conscientious, tough minded, and disciplined. If normal range scores are included, then, in addition, all pilots could also be considered emotionally stable, impulsive and happy-go-lucky, socially bold, suspicious, and free from guilt. Thus, discounting the magnitude of differences, there exists a commonality among all pilots on 11 of the 16 factors in the *16PF*. Of course, the magnitude of differences cannot be discounted any more than can the differences in direction. For example, both airline pilots and the "hybrid" airline/A-10 pilots (profiles 1 and 2) are much higher in ego strength or emotional stability than the purely military pilots (profiles 3 and 4). Similarly, they are also more socially bold, adventurous, and thick-skinned. Likewise, they are substantially more disciplined, compulsive, and have an increased ability to bind and focus anxiety, rather than permit it to free-float. They are dramatically more relaxed and tranquil than the relatively tense and driven purely military pilots.

All pilots with some military orientation (profiles 2, 3, and 4) are much more competitive and dominant than the exclusive airline pilots (profile 1). Also, they are far more self-assured; and they are far more naive and forthright. Other differences could be mentioned, but these cited are sufficient to highlight the personality dimensions that tend to differentiate pilots from the general population and further differentiate pilot groups from each other. Especially intriguing is the pattern for A-10/airline pilots (profile 2) which embodies distinctive elements from both the military and the airline domains, thus forming what has been called a "hybrid" profile. While not subject to statistical evidence, it is nonetheless interesting to note that, of the nine variables in Cattell's (1980) specification equation for "freedom from accidents," the airline pilots' profile (profile 1) reveals seven of the nine tending in the corresponding "safe" direction; the A-10/airline pilots' profile (profile 2), six; the AWC pilots' profile (profile 3), four; and the F-4 pilots' profile (profile 4), only three.

Therefore, if the admittedly questionable inference is made that airline pilots (including the A-10/airline pilots) are by definition "safe," and if there is a generalized pattern for pilot safety, then the profile for the F-4 pilots who were deemed to be "safe" would tend to be most similar to that for the airline pilots. Conversely, the profile for the F-4 pilots who "crashed" would tend to be most dissimilar.

RESULTS

Table 3 reveals the respective profiles of the two F-4 pilot groups when they are classified according to outcome: "crashed" (profile 1) vs "safe" (profile 2). For convenience of reference, the combined profile (profile 3) is also shown in Table 3; it is the same as profile 4 in Table 2. To determine if there are significant differences between the two groups, and if an accident prone profile could be identified, a relatively recently developed multivariate methodology was used: Cohen's (1982) Set Correlation. Set Correlation is a multivariate generalization encompassing multiple regression and correlational analyses. It employs overall measures of association which are interpreted as proportions of variance, along with set-partialed sets of variables. The technique will accomodate multiple dependent as well as multiple independent variables.

The intercorrelation matrix consisted of all 16 primary or source factors of the *16PF,* the Holmes-Rahe *SRRQ* data, and the "safe-crash" data, the latter constituting the single dependent variable. "Crash" was coded 1, and "safe" was coded 0. The seven second-order or surface factors were also analyzed in a similar manner; however, that analysis yielded less significant and thus less powerful outcomes.This is not unexpected since second-order data are summary in nature, less sharply focused, and subsume multiple primary factors. Therefore, the second-order analysis will not be further addressed.The results of Cohen's set correlation analysis of the primary factor data are shown in Table 4.

TABLE 3

PROFILES OF "SAFE" AND "CRASHED" F-4 PILOTS

	Profile 1[a] "crash"		Profile 2[b] "safe"		Profile 3[c] "combined	
FACTOR	M	SD	M	SD	M	SD
— Primary Factors —						
A Outgoing	3.7	1.7	4.1	2.1	3.9	1.8
B Intelligent	8.0	1.7	7.7	1.3	7.9	1.5
C Ego Strength	5.4	1.7	5.1	1.6	5.3	1.7
E Dominant	7.7	1.9	7.4	2.0	7.6	2.0
F Happy-go-lucky	6.1	1.9	6.1	2.4	6.1	2.2
G Conscientious	7.2	1.6	6.1	1.9	6.9	2.1
H Socially bold	5.8	2.0	5.8	2.6	5.8	2.3
I Tender-Minded	3.9	1.8	4.4	2.0	4.1	1.9
L Suspicious	5.5	1.9	6.0	2.0	5.7	1.9
M Imaginative	5.5	1.4	5.3	1.9	5.4	1.6
N Shrewd	4.6	1.7	5.0	2.2	4.8	1.9
O Guilt Prone	5.1	1.8	5.2	1.8	5.2	1.8
Q^1 Experimenting	6.0	2.1	5.5	1.8	5.8	2.0
Q^2 Self-sufficient	7.0	1.7	6.4	2.2	6.7	2.0
Q^3 Controlleld	6.3	1.4	6.1	1.8	6.2	1.6
Q^4 Tense	6.0	1.7	6.5	1.8	6.3	1.7
Stress[d]	265	155	245	134	255	145
— Secondary Factors —						
QI Extraversion	6.1	1.6	6.1	2.4	6.1	2.0
QII Anxiety	5.7	1.4	6.1	1.6	5.9	1.5
QIII Tough Poise	8.2	2.0	7.6	1.9	7.9	2.0
QIV Independence	7.1	1.6	6.7	1.8	6.9	1.7
QV Discreetness	4.8	1.7	5.2	2.1	5.0	1.9
QVI Subjectivity	4.9	1.8	5.3	2.0	5.1	1.9
QVIII Superego str.	6.7	1.3	6.0	1.7	6.4	1.5

NOTE: Second-orde factor QVII is now shown since it is comprised almost entirely of Primary factor B.
[a]Pilots involved in "class A" accidents — "crashed" (n=47).
[b]Pilots deemed to be "safe" (n=44).
[c]Combined profile of "crashed" and "safe" pilots (n=91).
[d]The stress variable is derived from the *Holmes-Rahe SRRQ* not the *16PF*.

TABLE 4

DERIVED SET CORRELATION FUNCTION PREDICTING "CRASH" AND MAGNITUDE EACH BETA DIFFERS FROM ZERO

Factor	BETA	t-radio	P
G Conscientious	.50(.55)	4.89(5.45)	.000
L Suspicious	-.25(-.29)	-2.48(-2.93)	.015(.004)
N Shrewd	-.27(-.31)	-2.76(-3.24)	.007(.002)
Q_2 Self-sufficient	.19(.21)	2.00(2.27)	.046(.024)
Q_4 Tense	-.18(-.20)	-1.88(-2.15)	.060(.033)

NOTE: Data in parenthesis reflect correlation for attenuation. R^2=T^2 since "crash" is the single dependent variable. Variables not shown in function are not significant at conventional levels.
n=91: 45 "crashed," 44 were deemed "safe."
t-ratios reflect differences between BETA values and Zero.
R=.52(.58) (Multiple R between derived function and "crashing").
R^2=.27(.33)—, Shrunk R^2=.23(.29), T^2.23(.29).
Rao's F=6.339(8.475) for df=5 and 85; P=.000.

Five of the *16PF* factors were significant at conventional levels and comprised the predictor set of BETA coefficients. The Holmes-Rahe *SRRQ* made no significant contribution toward explaining accident prone behavior. As shown in Table 4, compared to those deemed "safe," the F-4 pilots who "crashed" were extremely more conscientious (G+); substantially more trusting (L-), naive (N-), and self-sufficient (Q_2+); and moderately more relaxed and tranquil (Q_4-). The multiple correlation between the predictor set and "crashing," R=.52 (.58 attenuated), is significant far beyond conventional levels. The index of determination (R^2) shows that 27% (33% attenuated) of the variance in "crashing" is explained by the predictor set. Actual cross-validation was not feasible due to small sample sizes, but the R^2 shrunk, which estimates the minimum magnitude of common variance that cross-validation would yield, is .23 (.29 attenuated). Since there is only one variable in the dependent set, T^2 (trace squared) is identical to R^2. These results are quite unexpected and revealing. They are inconsistent with the conventional views of the relationship between personality attributes and accident prone behavior, and they obviously constitute a "limited domain special case." This anomaly will be explored in the discussion section.

To determine how accurately the predictor-set BETAs are able to identify the individual pilots who "crashed," vis-a-vis those who were "safe," the five relevant predictor variable STEN scores for each pilot were transformed to standard Z scores. They were then weighted by the corresponding BETAs and summed to yield a prediction score (PS). Theoretically, the higher the PS, the greater the likelihood of "crashing." Interestingly, the mean of the PS distribution, M=.41, falls at a point where 47 pilots score higher and 44 score lower. Though statistically meaningless, this is precisely the same proportion of pilots who "crashed" versus those who were "safe." The SD of the standardized Z distribution is .50.

Table 5 reveals the individual results of prediction (classification) outcomes in descending order of magnitude. Notice that at the extremes of the distribution the predicted outcomes, with one exception, are perfect. Of the ten highest PSs, nine were associated with "crashing" and only one with "safety." Of the ten lowest PSs, all were associated with "safe" outcomes. A contingency table was also constructed to better portray the prediction efficacy of the model. The PSs were grouped into seven intervals, with each group interval equal to one-half standard deviation, except for the two extreme intervals; they are open-ended.The middle interval is centered on the distribution mean.

The contingency table shown in Table 6 provides bold evidence supporting the potential utility of the set-correlation, accident proneness, prediction model. At least it does for the F-4 fighter pilots comprising this study. Not unexpectedly, the model offers little utility within the middle one-half standard deviation. However, moving outward toward the tails of the distribution, there is dramatic improvement. Below a PS of -.23, the model offers 100% improvement over chance in identifying "crashed" pilots, and 107% improvement in identifying "safe" pilots. At the other extreme, above a PS of 1.03, the model offers 76% improvement over chance in identifying "crashed" pilots, and 81% improvement for "safe" pilots. The $\underline{X}^2$ statistic ($\underline{X}^2$=15.2, df=1, $\underline{P}$=.000) is significant far beyond conventional levels. At least for the pilots in this study, the model provides a level of discrimination that is operationally promising.

TABLE 5

PREDICTION OUTCOME PATTERN

Predict	Outcome		Predict	Outcome		Predice	Outcome	
Score	Crash	Safe	Score	Crash	Safe	Score	Crash	Safe
1.45	*		.61	*		.25	*	
1.30	*		.59	*		.24	*	
1.15	*		.57		*	.20		*
1.14	*		.53	*		.19		*
1.12	*		.53	*		.16	*	
1.11	*		.52	*		.15	*	
1.11	*		.52		*	.10	*	
1.10	*		.51		*	.09		*
1.09		*	.50		*	.06		*
1.05	*		.49	*		.06		*
1.05	*		.48	*		.06		*
1.00	*		.48		*	.06		*
.96	*		.45	*		.04		*
.96		*	.45		*	.04	*	
.93	*		.44		*	.02		*
.86	*		.44		*	-.01	*	
.83		*	.42	*		-.03		*
.81	*		.40		*	-.07		*
.81	*		.40		*	-.09		*
.80	*		.39		*	-.12		*
.78	*		.38		*	-.20		*
.71		*	.38	*		-.31		*
.70	*		.38	*		-.33		*
.69	*		.36	*		-.40		*
.68	*		.36	*		-.43		*
.67	*		.34		*	-.54		*
.66		*	.32	*		-.58		*
.64	*		.28		*	-.70		*
.64		*	.28		*	-.75		*
.62	*		.25		*	-.91		*
.61	*							

NOTE: For total distribution (n=91), prediction score M=.41, SD=.50; for "crash" distribution (n=47), M=.65, SD=.38; for "safe" distribution (n=44), M=.16, SD=.46. Prediction scores are calculated from BETAs uncorrected for attenuation; correction has no effect on prediction outcomes.

TABLE 6

THEORETICAL UTILITY OF MODEL TO PREDICT ACCIDENT PRONENESS

	Observed		Expected		% Improvement	
	"Crash"	"Safe"	"Crash"	"Safe"	"Crash"	"Safe"
PS>1.03	10	1	5.7	5.3	76	81
PS>.78<1.04	7	2	4.6	4.4	51	54
PS>.53<.79	10	4	7.2	6.8	38	41
PS>.28<.54	12	12	12.4	11.6	3	3
PS>.03<.29	7	10	8.8	8.2	20	22
PS>-.22<.04	1	6	3.6	3.4	72	77
PS>-.23	0	9	4.6	4.4	100	107
Total	47	44	46.9	44.1		

NOTE: PS="Prediction Score" calculated from BETA weights. Prediction scores are grouped in 7 One-half SD intervals centered around $\underline{M}$; $\underline{M}$=.41, $\underline{SD}$=.50.
% Improvement reflects improvement over chance outcomes.
$\underline{X}_2$=15.2 for df=1; $\underline{p}$=.000.

DISCUSSION

The results of analysis of the F-4 fighter pilots are unexpected and rather unique. They are in clear opposition to Cattell's (1980, p. 164) generic profile of "freedom from accidents." Apparently, fighter pilots constitute a "special case," and, for them, conventional views of accident prone behavior do not apply. The findings lend credence to the general reluctance of some American researchers to endorse a generalized, unitary model of accident proneness (Mintz & Blum, 1949). Obviously, a given quantity of a unitary set of psychological variables does not presage inevitable accident outcomes, irrespective of dynamic contingent variable interactions and their relationships to situational risk factors. This means that, e.g., just as there is no satisfactory "grand theory" of leadership (Stogdill, 1974), this study provides no evidence for a "grand theory" of accident proneness. This conclusion, however, does not at all warrant a rejection of the construct of accident prone behavior patterns. Instead, it gives credence to the need to conduct what Miner (1977, pp. 230-234) has called "limited domain" research in the interest of developing "limited domain" theories. Just as there is no satisfactory "grand theory" of leadership (Stogdill, 1974), there is no viable "grand theory" of accident proneness, at least there isn't at our present level of knowledge. Fighter pilots comprise a very small segment of the population, and the risk contingencies with which they must deal are quite unique. Therefore, rather than summarily rejecting the construct of accident prone behavior patterns, it seems more promising to actively study these "special cases" and develop limited domain models for them.

The most striking finding to emerge from the present study is the high level of conscientiousness (G+) associated with "crashing." At first glance, this makes no sense, since high G has been associated traditionally and generically (until this study) with freedom from accidents. It is relevant to point out, however, that in a study by Fineberg, Woelfel, Ely, and Smith (1979), six categories of causal factors were identified as being particularly sensitive in their possible influence on aircraft accidents: channelized attention, disorientation, vertigo, distraction, excessive motivation to achieve, and overconfidence. It is entirely possible that factor G may be involved in one or more of these six categories. Also, Krug (1981, p.7) has pointed out that people scoring extremely high on G may set unrealistically high standards for themselves and, since flexibility is not part of their behavioral repertoire, may not know when to back off or quit. Thus, while high levels of G is generally associated with freedom from accidents, too much G may exacerbate accident prone behavior. In any event, as revealed in Table 2, pilots in general tend to be high in factor G. Why then should those fighter pilots highest in G be more prone to crash? What follows is a proposed "best" explanation, and it requires a fuller discussion of factor G, the fighter pilot and his environment, and the influences of the other significant explanatory variables: L, N, Q_2, and Q_4.

Factor G has been described as conscientiousness, conformity, and a major component of superego strength. Other names sometimes used include persistence, sense of duty, dedication, concern for moral standards, concern for rules and regulations, adherence to reference group norms, and perseverence (Cattell et al., 1980, pp. 88-89). These translate operationally into doing "what is right, what is expected, what is prescribed." For the fighter pilot, though, a principal wellspring for his standards or codes is the norms of the fighter pilot "fraternity" itself, not societal norms, religious imperatives, legal edicts, or even rules and regulations of the formal organization.Here are the roots for the "top-gun syndrome" and its inherent mystique.

This conclusion is indirectly reinforced by an unpublished study by the author (Lardent, 1985). The Air War College (AWC) pilots identified in Profile 3, Table 2 also completed the *Motivational Analysis Test* (*MAT*) (Cattell, Horn, Sweney, & Radcliff, 1964). The *MAT* assesses the more dynamic domain of motivation structure. The *MAT* scores, like those of the *16PF*, are expressed in STENS. One of the factors on the *MAT* is Superego, and, in the general population, it is positively related to primary factor G and the second-order factor of superego strength (QVIII) on the *16PF*. However, unlike the items that load on factor G, those loading on the *MAT* superego factor address more specifically deference to societal norms and organized religion. In a sense, the *MAT* captures the more dynamic and environmentally induced aspects of superego strength, which are different from, but complementary to, primary factor G and second-order factor QVIII. Expressed in operational terms, at least for the North American culture on which the MAT is normed, deference to parental authority, respect for authority figures, conscientiousness, and conformity to reference group norms (the essence of factor G and second-order factor QVIII) are positively related to the motivational appeal of the norms and expectations of the larger society and organized religion (the essence of the *MAT* superego factor).

Interestingly, while the AWC pilots produced a *16PF* factor G mean score of 6.4, and a QVIII mean score of 6.2 (see Table 2), their *MAT* superego strength mean score was only 3.1 with a standard deviation of 2.1. Moreover, the correlation between factor G and Superego was nonsignificant at a level of only r=.01. Thus, while the AWC pilots, like the F-4 pilots, possessed a relatively strong sense of duty, it arose from sources more operationally relevant to them than the norms, ideals, and edicts of the larger society and organized religion. If this pattern is true for AWC pilots, who were then currently in an academic environment and not actively flying in an operational unit, it must be at least equally true (probably more so) for fighter pilots whose "purpose in life" is to fly and train to fight on a daily basis.

The point is, a sense of duty to do "what is right" and "what is expected" is not an absolute. It is a function of situational contingencies and the reference criterion source of the imperative to behave in prescribed ways. Thus, while factor G may be a major determinant of general safety in the general population, and maybe even for some pilot groups, it is not a sufficient or appropriate one for fighter pilots. The fighter pilot sees himself as a member of a special breed. He is extremely competitive, self-assured, and achievement oriented. He tends to be something of a loner; however, he is fiercely loyal to his comrades, his unit, and the fighter pilot "fraternity." He strives to excel, besting his fellow pilots, while, at the same time, being careful not to undermine group cohesion. His general self-concept is: "Few are as good, and nobody is better than I am." These general attributes are epitomized in the fighter pilot.

Now, consider these general attributes in context with the personality profile of the F-4 pilots who "crashed." They had a strong sense of duty or a high level of conscientiousness; however, it arose from a sense of personal challenge, accomplishment, and adherence to the norms of their reference group. Moreover, they were more trusting, accepting, tolerant and unsuspecting than the "safe" pilot group. While a mean of 5.5 on factor L is not at all low when compared to the general population, it is significantly different from the mean score of the "safe" group (5.5 vs. 6.0). Karson et al. (1976, pp. 56-59) describe factor L as "anxious insecurity" and make the point that low scores, even as low as 2, should be regarded as healthy. That may be true for the general population, but it apparently isn't for the fighter pilot who routinely functions in contingent situations that demand alertness and questioning.

The pilots who "crashed" also tended to be somewhat naive compared to those who were "safe." Naive, in the sense used here, does not at all mean simple-minded, shallow, or less bright. In fact, those who "crashed" actually produced a higher mean score on intelligence (factor B) than those deemed "safe." Rather, it refers to being more forthright, unpretentious, ingenuous, open, spontaneous, etc. These may be desirable characteristics in the general population, but apparently mitigate against safety among fighter pilots. Instead, shrewdness, astuteness, calculativeness, fastidiousness, etc. tend to be associated with safety. The "crashed" pilots are also more self-sufficient than those deemed "safe." This is not a paradox, though it initially may appear to be. Those who "crashed" were fiercely loyal to the norms and expectations of their reference group (G+), but they tended to meet and exceed them more through individual effort (Q_2+) than cooperative group effort.

The last explanatory variable in the set of prediction BETAs is ergic tension (Q_4), although the appropriateness of the term "ergic" is questionable (see Cattell, H. B., 1989, pp. 293-305). Both the "crashed" pilots and the "safe" pilots were moderately high on this factor (6.0 and 6.5 respectively), with those "crashing" being the lowest. Note (Table 2) that the airline pilots (profile 1) scored 3.0 on Q_4, and the "hybrid" airline/A-10 pilots (profile 2) scored 3.8. Also note that the composite group of AWC pilots (profile 3), like the F-4 pilots, also obtained a Q_4 score which is relatively high. Thus, the magnitude of difference on Q_4 between the exclusive military pilots on the one hand and those flying for airlines on the other (including the "hybrids") is generally in excess of a full standard deviation. This is a paradox, and it resists rational explanation. High Q_4 is strongly associated with accident proneness in general (Cattell, 1980, p.164) and automobile accidents in particular (pp. 107-109). Karson and Pool (1957) report on 71 Air Force pilots referred for medical/psychiatric/psychological evaluation due to flying deficiency (but not necessarily accident proneness *per se*). High Q_4 was a major characteristic among those pilots, and it is generally associated with performance degradation.

The airline pilots and the A-10/airline pilots shown in Table 2 are very low in Q_4, suggesting healthy release and appropriate directiveness of their ergic tension. Both the AWC pilots and the F-4 pilots, however, are moderately high compared to the general population, and very high compared to the other two pilot groups. Why should this be? Is this pattern "state" or "trait" induced? Is there something in the active duty, military environment, persisting even to the less operationally demanding educational climate (AWC), that promotes high ergic tension and anxiety? Alternatively, is there something in the airline and/or reserve military environment that mitigates tension and promotes tranquility? Complicating the enigma, the "crashed" F-4 pilots are moderately, but significantly, lower on Q_4 than the "safe" F-4 pilots. Why? Answers to these questions remain elusive and resist rational explanation at this time. In spite of the enigma, however, what emerges from the findings is a picture of the "special case" domain of the accident prone fighter pilot. Compared to his "safe" comrades, he is much more conscientious and deferential to the norms and expectations of his primary reference group: the fighter pilot "fraternity." He is more trusting, naive, self-sufficient, and, for whatever reason, experiences less tension.

Hopefully, this study has shown that a generic personality profile for accident proneness, in the sense of a "grand theory," is not tenable, at least it isn't for fighter pilots, and probably not for other pilots as well. At the same time, the study does provide support for the concept of "limited domain" theories of accident proneness. Personality attributes, interacting with contingent variables, may be associated with an increased likelihood of accident event outcomes. However, certain personality factors that mitigate against accident prone behavior in one set of contingencies might serve to exacerbate it in another.

More limited domain research needs to be undertaken and appropriate explanatory models developed. In addition to personality variables, which is the focus of this study, the more dynamic processes of motivation, attitudes, values, etc. need to be incorporated. Also, increased awareness and control of situational context variables, along with life change events, demand attention. Is such a massive research effort worth the cost? In the present study, which is merely exploratory in nature, had a prediction score (PS) cutoff been established at .79, 20 of the 91 F-4 pilots would have been subjected to increased scrutiny and possibly temporarily grounded. Seventeen of the 20 were true positives, and preemptive action might have precluded their "crashing."Only three with PSs above .79 were false positives. At the very minimum ($500,000 per class A accident), $8.5 million would have been saved. The costs: possibly mistakenly grounding three pilots pending further evaluation. Of course, this scenario is merely hypothetical, and it is certainly not suggested that the present study is operationally adequate to make such decisions. The sample size was relatively small, only about half the respondents submitted usable data, nothing is known about the ambient situation or focal stimuli associated with the "crash" events, the relevant population is not defined, data collection was retrospective, nothing is known about those pilots who did not survive, and, after all, the model was "folded back" on the sample from which it was derived. Still, the study does open a new vista and suggests the potential to be derived from more definitive, "limited domain" research into accident prone behavior.

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AUTHOR NOTES

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DETERMINING A 16 PF PROFILE AND FOUR-POINT CODES FOR MENTAL-HEALTH CENTER CLIENTS[1]

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ABSTRACT

This study was designed to determine the incidence of 16PF four-point codes and overall 16 PF profile for clients assigned to the adult outpatient department in a comprehensive community mental-health clinic. Subjects consisted of 282 clients who were seen for intake during a four-month time period. Form A of the 16 PF was administered to clients at the time of intake. The incidence of four-point codes was determined, and means and standard deviations were computed for the sample. The mean scores of this mental-health center group were compared to the means reported by Reuter, Wallbrown, and Wallbrown (1985) for a private-practice group, as well as the means for the standardization sample.

DETERMINING A 16 PF PROFILE AND FOUR-POINT CODES FOR MENTAL HEALTH CENTER CLIENTS

In a recent work, Cattell (1986, pp. 116-121) calls attention to the need for collecting descriptive data for clients in different diagnostic categories, different clinical settings, and at different stages in the process of counseling/psychotherapy. Specifically, R.B. Cattell (1986, p. 121) proposes a "three-file system" which includes a "third-file" consisting of "... behavioral specification equations, type profiles (as implied in DSM), age curves and other bases of practical prediction and diagnosis emanating from research." Cattell (1986) acknowledges that such a "third file" can be achieved only through the collaboration of researchers and practitioners who work together in the collection and dissemination of research data. A considerable amount of research data are gradually accumulating (see Cattell, Eber, & Tatsuoka, 1970; Krug, 1981; H.. Cattell, 1989), but thus far the Sixteen Personality Factor Questionnaire (16 PF) scores are not available for clients seen for counseling/psychotherapy in a comprehensive community mental health center. Collecting data for such clients should provide a noteworthy contribution to the "third-file" proposed by Cattell (1986). Consequently, the present study was designed to obtain a profile of 16 PF scores for clients assigned to the adult outpatient department of a comprehensive community mental health center. Another aspect of the present study involved determining four-point codes based on the Krug (1981) system for classifying clients based on their scores for the four most thoroughly validated 16 PF secondaries (Extraversion, Anxiety, Tough Poise, and Independence). Determining the incidence of Krug (1981) four-point codes was included in the analysis since this provides the basis for establishing linkage between 16 PF scores and a wide range of research data. The usefulness of the Krug (1981) system is such that one can justify its inclusion in the overall rubric of the "third-file." A supplementary analysis was also performed to compare the present sample of mental health center clients with a previous sample of clients seen in a private practice setting.

METHOD

SUBJECTS

Subjects consisted of 282 clients (111 men and 171 women) who were seen for intake in a comprehensive community mental-health clinic during a four-month time period. The total number of clients seen for intake and assigned to the adult outpatient department during this time period was 307, but 25 clients either chose not to participate or were excluded because of psychiatric disturbances requiring hospitalization and/or inability to read or comprehend test materials. The racial composition of the sample consisted of 206 whites and 76 nonwhites. The exact racial/ethnic breakdown of the nonwhite clients is not available, but one can safely assume that they are predominatly black given racial/ethnic composition of the urban area served by the clinic. Provisional diagnoses, made at the time of intake, resulted in 254 diagnoses on Axis I and 71 diagnoses on Axis II of Diagnostic and Statistical Manual for Mental Disorders (American Psychiatric Association, 1980). Twenty-eight clients had diagnoses only on Axis I, and 43 clients had diagnoses on both Axis I and Axis II. The Axis I results were as follows: dysthymic disorders (n= 108) adjustment disorders (n=86), general anxiety disorders (n=22), alcohol and substance-related disorders (n= 11), schizophrenic disorders (n= 10), other affective (n= 8), control disorders (n=5), and one each in four other diagnostic categories (n=4). Axis II personality disorders were as follows: atypical (n= 34), dependent (n= 17), antisocial (n= 17), passive-aggressive (n= 5), borderline (n= 3), schizotypal (n= 2), and schizoid (n= 1).

INSTRUMENTATION

Form A of the Sixteen Personality Factor Questionnaire (Cattell, Eber, & Tatsuoka, 1970) was administered and scored in accordance with the standardized procedures described in the test manual. Sten scores for the two validity scales

(Faking Good and Faking Bad) were determined, and sten scores on the primaries were corrected for faking good and/or bad using the standard procedures described in the test manual (IPAT Staff, 1970). Sten scores for the four more thoroughly validated secondaries (Extraversion, Anxiety, Tough Poise, and Independence) were also obtained and four-point codes were determined using the procedures described by Krug (1981).

PROCEDURE

All adult clients requesting service at this comprehensive community mental-health center were seen for an intake interview by a therapist in the Intake and Emergency Unit. Client responses were recorded on a standardized intake assessment form. This intake procedure is fairly typical of what is routinely used in adult outpatient facilities. Aside from the exclusions noted earlier, all clients assigned to the Adult Outpatient Department received form A of the 16 PF. In this regard, it is important to note that low-functioning clients with a history of chronic mental disability were routinely assigned to the Aftercare Unit as a matter of agency policy. These clients were automatically excluded from the study.

RESULTS AND DISCUSSION

OVERALL PATTERN

In order to provide an overall picture of personality characteristics of individuals who seek services at a mental-health center, means (Ms) and standard deviations (SDs) were computed for 282 subjects on sixteen primary factors and four second-order factors. Two-tailed t-tests ($p. < 05$) were performed to determine whether subjects in the mental-health center group differed significantly from persons in the standardization sample. The results are summarized in Table 1.

The present sample (mental-health center) differed significantly from the standardization sample on thirteen of the sixteen primary factors. Examination of Table 1 indicates that the following thirteen factors showed statistical significance: Q4 (t = 11.99), O (t = 11.66), L (t = 10.22), M (t =-9.48), C (t = -8.83), Q2 (t = 7.16), I (t = 5.66), A (t = -3.40), H (t = -3.28), N (t = 3.16), Q3 (t = -2.77), G (t = -2.54), and Q1 (t = 2.05). When compared with the standardization sample, the present sample may be described as having more free-floating anxiety (Q4+), more guilt proneness (O+), more suspiciousness (L+), more practicality (M-), less ego strength (C-), more reserve (A-), more shyness (H-), more shrewdness (N+), less ability to bind anxiety (Q3-), more expedience (G-), and more radicalness (Q1+).

On the second-order factors, the present sample differed from the standardization sample on three of the four secondaries: Anxiety (QII, t = 14.13), Extraversion (QI, t = -3.17), and Independence (QIV, t = -3.11).In other words, the present sample, when compared with the standardization sample, tended to be more anxious, less independent, and more intraverted.

Further examination of Table 1 indicates that the present sample (mental health center group) and the private-practice sample showed no significant

TABLE 1

COMPARISON OF A MENTAL HEALTH CENTER GROUP WITH STANDARDIZATION Sample and Private Practice Sample — 16 PF Profile

Variable	Present Sample (Mental Health Clinic N=282)		Private Practice Sample (Reuter, Wallbrown & Wallbrown, N=132)		Comparison with Standardization Sample M=5.5, SD=2.0; N=2,984)				Comparison with Private Practice Sample			
	M	SD	M	SD	diff	SE_D	t	p<	diff	SE_D	t	p<
A) Reserved vs. Outgoing	5.10	1.88	4.8	1.9	-.40	.118	-3.40	.01	.30	.20	1.50	NS
B) Concrete vs. Abstract Thinking	5.52	1.70	6.3	1.8	.02	.108	.19	NS	-.78	.187	-4.18	.01
C) Weak vs. Strong Ego	4.47	1.86	4.6	2.1	-1.03	.117	-8.83	.01	-.13	.214	-.61	NS
E) Submissive vs. Dominant	5.46	1.94	5.7	2.1	-.04	.121	-.33	NS	-.24	.216	-1.11	NS
F) Serious vs. Impulsive	5.25	2.16	5.2	2.4	-.25	.134	-1.87	NS	.05	.245	.20	NS
G) Expedient vs. Conscientious	5.18	2.02	5.3	1.8	-.32	.126	-2.54	.05	-.12	.198	-.61	NS
H) Shy vs. Bold	5.05	2.22	5.1	2.2	-.45	.137	-3.28	.01	-.05	.233	-.21	NS
I) Tough-Minded vs. Emotionally Sensitive	6.09	1.64	5.6	1.6	.59	.104	5.66	.01	.49	.170	2.88	.01
L) Trusting vs. Suspicious	6.71	1.89	6.4	2.1	1.21	.118	10.22	.01	.31	.215	1.44	NS
M) Practical vs. Imaginative	4.41	1.83	4.9	1.9	-1.09	.115	-9.48	.01	-.49	.198	-2.47	.05
N) Naive vs. Shrewd	5.89	1.98	5.4	2.0	.39	.123	3.16	.01	.49	.210	2.33	.05
O) Secure vs. Guilt Prone	6.88	1.89	6.3	2.2	1.38	.118	11.66	.01	.58	.222	2.61	.01
Q1) Conservative vs. Radical	5.74	1.87	5.2	1.8	.24	.117	2.05	.05	.54	.192	2.81	.01
Q2) Group Dependent vs. Self-Sufficient	6.36	1.92	6.3	2.0	.86	.120	7.16	.01	.06	.208	.29	NS
Q3) Low vs. High Ability to Bind Anxiety	5.18	1.84	5.4	1.7	-.32	.116	-2.77	.01	-.22	.184	-1.19	NS
Q4) Low vs. High Free-Floating Anxiety	6.94	1.92	7.0	2.0	1.44	.120	11.99	.01	-.06	.208	-.29	NS
I Extraversion	5.1	2.03	5.2	2.0	-.40	.126	-3.17	.01	-.1	.212	-.47	NS
II Anxiety	7.1	1.8	6.8	1.9	1.6	.113	14.13	.01	.3	.197	1.52	NS
III Tough Poise	5.7	2.0	6.0	2.2	.2	.125	1.61	NS	-.3	.226	-1.33	NS
IV Independence	5.2	1.5	5.5	1.8	-.3	.097	-3.11	.01	-.3	.180	-1.66	NS

difference on eight of the sixteen factors, thus suggesting that there is a good deal of similarity betweenthose who seek services of a mental-health center and those who seek the services of a private practitioner.

Significant differences were found on the following six primary factors: B ($\underline{t}$ = -4.18), I ($\underline{t}$ = 2.88), Q1 ($\underline{t}$ = 2.81), O ($\underline{t}$ = 2.61), M ($\underline{t}$ = -2.47), and N ($\underline{t}$ = 2.33). Thus, the mental-health center group may be described as more concrete in thinking (B-), more emotionally sensitive (I+), more radical (Q1+), more guilt prone (O+), more practical (M-), and more shrewd (N+) than the private-practice group. Conversely, the private-practice group might be compared with the mental-health group as more abstract in thinking, less emotionally sensitive, more conservative, less guilt-prone, more imaginative, and more socially naive.

FOUR-POINT CODES

Four-point codes for the second-order factors were determined for the 282 subjects in this study according to Krug (1981, p. 17). This resulted in 47 different four-point codes for the sample. These codes, their ranks, frequency, and incidence (percentage) are shown in Table 2. A criterion level of 3% incidence was set for purposes of interpretation and discussion. This criterion level results in selection and description of the following nine four point codes: 2322, 2222, 1222, 1322, 2232, 2332, 1321, 1312, 2321. Interpretation of these codes is based upon Krug's (1981) formulations.

2322. Thirty-four individuals obtained this code, accounting for 12% of the sample. Code 2322 is characterized by average scores on three of the four second-order factors with an elevation on Anxiety. Krug (1981, pp. 122-123) found incidences of 6.1% for normal population and 8.2% for clinical population. Although a cursory glance at this code might suggest much similarity with an all-average code, examination of primary-factor deviations which lead to this coding suggest otherwise. Trends in the modal type for this code lie in the direction of C-, L+, O+, Q3-, and Q4+ and suggest considerable difficulty in terms of ego strength (C-), suspicion (L+), guilt (O+), the presence of free-floating anxiety (Q4+), and in the in ability to bind this anxiety (Q3+).

2222. This code is characterized by average scores on all four second-order factors. It was found for 26 subjects in this study and with an incidence of 9.2%. Krug (1981, pp. 104-105) found a higher incidence rate for this code inboth normal (13.2%) and clinical (12.6%) populations. Krug cautions against interpretation of this code and suggests that alternative methods be used to determine if the individual is truly average or is perhaps defensive, depressed, or has reading difficulties.

1222. The third code was found for 16 individuals in the mental-health center group and showed a 5.6% incidence. Incidence in Krug's (1981, pp. 50-51) findings for this code were 2.8% for normal population and 3.4% for clinical population. This code is characterized by only one deviation from normality on Extraversion. Individuals who obtain this code would probably avoid the company of others. Although schizoid features may be present, they are generally not excessive.

1322. Sixteen subjects obtained this code and also accounted for 5.6% incidence. Krug (1981, pp. 68-69) found incidences of 2.1% for normal subjects and 4.3% for clinical subjects. With average scores on Tough Poise and Independence, high score on Anxiety, and low score on Extraversion, the individual obtaining a 1322 code would probably experience much fear and tend to have little interaction with others. Common diagnoses for those having this code include personality disorder, neuroses, or narcotics addition. Depression may also be found among the 1322 codes.

2232. The present sample incidence for this code was 5.3% and was obtained by 15 individuals. Krug's (1981, pp. 110-111) incidence was 4.3% for both normal and clinical populations. Three of the second-order scales are average, and only Tough Poise is elevated. This code suggests individuals who may be insensitive and have difficulty in relating to others.

2332. This code was found for 14 of the sample and comprised 4.0% of the sample. Krug's (1981, pp. 128-129) rate of incidence was 1.8% for normal and 2.4% for clinical populations. The elevations on Anxiety and Tough Poise suggest a good deal of tension, instability, and insecurity. Aggressive behavior is possible, and an early history of poor family relationships may interfere with later development of interpersonal relationships.

1321. Twelve individuals obtained this code with an incidence of 4.2%. Krug's (1981, pp. 66-67) findings for this code were 1.6%for normal and 4.1% for clinical populations. This code is characterized by an average score only on Tough Poise, with an elevation for Anxiety and lowered scores on Extraversion and Independence. Individuals who obtain this four-point code often score high on a neuroticism scale, and a diagnosis of avoidant personality disorder is relatively common. This code is characterized by social withdrawal, low self-esteem, hypersensitivity to rejection, and need for emotional support from others. There may be a long history of unsatisfactory relationships, probably stemming from early-childhood family dysfunction.

1312. This code was found for 11 individuals in the sample and had an incidence of 3.9%. Incidence in Krug's (1981, pp. 62-63) research was 1.2% for normal and 4.6% for clinical populations. Individuals with this code often need much emotional support from others and often show dependency needs. Common diagnoses include neurosis, personality disorder, and narcotics addiction.

2321. The final code to be considered was found for 11 subjects with an incidence of 3.9%. Krug's (1981, 120-121) findings were slightly higher for a clinical population (4.1%) and lower for a normal population (2.5%). Anxiety, passivity, submissiveness, and emotional dependence tend to be evident for persons with this code.

Table 2 also includes four-point code data for a group of 131 individuals from the private-practice group described by Reuter, Wallbrown, & Wallbrown (1985). Rank, frequency, and incidence (percentage) are included with the code designations. Cursory examination of Table 2 suggests considerable similarity of four-point codes for these two groups. More specifically, the mental-health center group and the private-practice group had thirty-eight four-point codes in common. The private-practice group had three codes (3223, 1122, 3231) not found in the mental-health group. However, the incidence of these three codes was relatively small (1.5%, .8%,and .8%, respectively). Similarly, the mental-health center group had ten codes not found in theprivate-practice group. All of these ten codes had relatively small incidence (1.1% or less).

TABLE 2

COMPARISON OF FOUR-POINT CODES FOR MENTAL HEALTH GROUP AND PRIVATE PRACTICE GROUP

Four-Point	Mental Health Center Group, n=282			Private Practice Group, n=132		
Code	Rank	f	%	Rank	f	%
2322	1	34	12.0	1	12	9.0
2222	2	26	9.2	5.5	7	5.3
1222	3.5	16	5.6	7.5	4	3.0
1322	3.5	16	5.6	7.5	4	3.0
2232	4	15	5.3	5.5	7	5.3
2332	5	14	7.9	3	11	8.3
1321	6	12	4.2	6	6	4.5
1312	7.5	11	3.9	4	8	6.1
2321	7.5	11	3.9	7.5	4	3.0
1311	8.5	8	2.8	8.5	3	2.3
2312	8.5	8	2.8	9.5	2	1.5
3332	8.5	8	2.8	9.5	2	1.5
1212	9.5	7	2.5	9.5	2	1.5
2212	9.5	7	2.5	9.5	2	1.5
2221	9.5	7	2.5	8.5	3	2.3
2322	9.5	7	2.5			
1211	10.5	5	1.8	7.5	4	3.0
2122	10.5	5	1.8	9.5	2	1.5
2233	10.5	5	1.8	8.5	3	2.3
3222	10.5	5	1.8	9.5	2	1.5
3232	10.5	5	1.8	9.5	2	1.5
2223	11.5	4	1.4	10.5	1	.8
2311	11.5	4	1.4			
1223	12.5	3	1.1	10.5	1	.8
2333	12.5	3	1.1	10.5	1	.8
3122	12.5	3	1.1			
3233	12.5	3	1.1	3	10	7.6
3312	12.5	3	1.1			
3333	12.5	3	1.1	7.5	4	3.0
1232	13.5	2	.7			
2133	13.5	2	.7			
2231	13.5	2	.7	10.5	1	.8
3132	13.5	2	.7	10.5	1	.8
3221	13.5	2	.7			
3323	13.5	2	.7			
1221	14.5	1	.4	10.5	1	.8
1231	14.5	1	.4	10.5	1	.8
1233	14.5	1	.4	10.5	1	.8
2112	14.5	1	.4			
2121	14.5	1	.4			
2123	14.5	1	.4	10.5	1	.8
2132	14.5	1	.4	10.5	1	.8
2211	14.5	1	.4	10.5	1	.8
2213	14.5	1	.4	10.5	1	.8
2323	14.5	1	.4	7.5	4	3.0
2331	14.5	1	.4	8.5	3	2.3
3331	14.5	1	.4			
1323				9.5	2	1.5
2311				9.5	2	1.5
3223				9.5	2	1.5
1122				10.5	1	.8
3231				10.5	1	.8

The nine four-point codes of the mental-health center group discussed above had incidence of 3% or more. Although the ranking of these nine four-point codes for the two groups is somewhat different, only the third-ranked code (3233, 7.6%) for the private-practice group is missing in the mental-health center group. The similarity of the incidence and ranking of four-point codes for the two groups provides further evidence that individuals who seek services of a mental-health center have much in common with individuals who seek counseling/psychotherapy from a private practitioner.

The findings from the present study are instructive in that they show that clients who seek counseling/psychotherapy in a comprehensive community mental-health center show a pattern of personality characteristics which can be dinguished from normals in the 16 PF standardization sample. The most noteworthy differences (more than one sten-score point) are evident in the form of elevations on the Anxiety secondary (QII), Free-Floating Anxiety (Q4), Guilt Proneness (O), and Suspiciousness (L), along with lower scores on Ego Strength (C) and Imagination (M). One would anticipate significant differences between mental-health center clients and normals on measures of psychopathology, but the findings from the present study go beyond this truism and indicate differences on normal personality dimensions which are both significant and substantial. This finding clearly supports the need for including a measure of normal personality development as well as a measure of psychopathology in the assessment battery used with adult outpatient clients.

Some significant differences between the 16 PF scores for the present sample of mental-health center clients and the private-practice sample (Reuter, Wallbrown, & Wallbrown, 1985) were evident, but the overall pattern for the two groups shows a remarkable degree of similarity. The largest mean difference (-.78) was on B, with the mental-health center group scoring in the average range of the concrete vs. abstract reasoning dimension and the private practice group scoring above average toward the abstract end of the continuum. Both groups scored substantially above average on Guilt Proneness (O), but the mental-health center group showed even more elevated scores than the private-practice group. Both groups scored significantly lower than normals on Imagination (M), but the scores for the mental-health center group were significantly more depressed than the scores for the private-practice group. The private-practice group scored in the average range on I (Tender Minded) in comparison with the mental-health center group, who were above average in the direction of emotional sensitivity. The private-practice group was slightly below average on Shrewdness (N) in contrast with the mental-health center group, which was above average in the direction of increased social sensitivity. Finally, the private-practice group was below average on Q1 (Radicalism), and the mental-health center group was above average on this dimension.

Despite the differences between these two groups, the following pattern of 16 PF scores — QII+, Q4+, O+, L+, C-, and M- still holds and provides the basis for some interesting hypotheses about why individuals seek counseling/psychotherapy. The work of Karson and O'Dell (1976) provides a rich source for such hypotheses, and all of the group differences except M-are suggested by their clinical insights. This finding for M suggests that some minimum degree of creative imagination is necessary for coping with emotional stress. One might surmise that when M- persons encounter a traumatic event they find it difficult to restructure their lives and/or develop a new coping strategy. According to this hypothesis, one would suspect that an important aspect of counseling/psychotherapy with M- clients would involve helping them reframe traumatic events and/or develop new strategies or coping with stressful events.

Caution should be observed in interpreting the comparison between the scores reported by Reuter, Wallbrown, and Wallbrown (1985) with those for the present sample of mental-health center clients. Some of the differences between these two groups may be due to socio-economic factors. As a rule, clients seen by private practitioners tend to be from higher socio-economic strata than those from community facilities. Direct comparison between these two samples is difficult, since the clients from the Reuter, Wallbrown, and Wallbrown (1985) study were described in terms of presenting problems rather than DMS-III diagnosis.

A reasonable degree of restraint should be observed in attempting to generalize the findings from the present study to other clinical settings. As a rule, the greater the dissimilarity from the present sample, the more caution one should observe in attempting to draw generalizations. Of course, the safest basis for generalization consists of replication in a wide range of different clinical settings. Thus, the need for further research designed to replicate and refine the results from the present study is clearly indicated.

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FOOTNOTES

[1]Some portions of this article are based on a dissertation by the first author under the direction of these second author, and other portions of this article are based on a dissertation by the third author under the direction of the second author.

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ITEM ANALYSIS OF THE SUBSCALES IN THE EIGHT STATE QUESTIONNAIRE (8SQ): EXPLORATORY AND CONFIRMATORY FACTOR ANALYSES

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ABSTRACT

The Eight State Questionnaire (8SQ) is a comprehensive self-report inventory which has been used in numerous studies of multidimensional mood states. The 8SQ has been useful in clinical situations for evaluating the efficacy of various therapeutic interventions, as well as in other contexts. The instrument takes about 20-25 minutes to administer, thereby enhancing its usefulness as a quick measure of transitory, constantly fluctuating mood states. Nevertheless, examination of the congeneric factor structure of the 8SQ subscales suggests that a number of the items are complex, contributing significantly to more than one subscale dimension. Both exploratory and confirmatory factor analyses have failed to provide substantial support for the existing subscale structure. Hence, further research should be directed toward refining the 8SQ item composition, by replacing items which contribute inadequately to the respective subscales, and/or those which are factorially complex. Such "progressive rectification" (Cattell's term) should result in a more psychometrically efficient instrument, which is characterized by greater factor purity and reduced intercorrelations, than is currently evident.

INTRODUCTION

The Eight State Questionnaire (8SQ) (Curran & Cattell, 1976) is a multi-dimensional, self-report instrument which is purported to measure eight fundamental and clinically relevant emotions/mood states labeled Anxiety, Stress, Depression, Regression, Fatigue, Guilt, Extraversion, and Arousal, respectively (cf. Curran, 1968, 1974). An individual's behaviors depend not only on intra-personal characteristics such as enduring personality traits, motivational dynamics, as well as cognitive/intellectual attributes and abilities, but also on prevailing levels of several emotional/mood states. Mood-state measurement has practical importance in many research and applied psychological contexts, such as those involved in trials on the effectiveness of new drugs, monitoring treatment efficacy in clinical situations, assessing the influence of mood states on academic school learning, investigating the moods of different categories of employees in industrial and occupational settings, and so forth.

Multivariate assessment of mood states is mandated by virtue of the observed complexity of human behavior. Restriction (prematurely) of measurement to single mood-state dimensions such as anxiety or depression may inadvertently fail to reveal important mood-state interactions and interdependencies in specific situations. This issue has been addressed both by Kline (1979) and by Boyle (1985b). The situationist debate provoked by Mischel was directed at traits alone, and ignored the role of situationally sensitive mood states, as well as the Cattellian concept of state liability factors (cf. Cattell, 1979/80).

Clearly, therapeutic interventions or experimental manipulations may influence a wide range of mood states simultaneously. If measurement is confined to only certain states, elevations or depressions in other states must necessarily remain undetected. Conceivably, changes in unmeasured states may even bring about alterations in those states actually measured. The only satisfactory way of avoiding this difficulty is to utilize multidimensional state measurement. The 8SQ, along with other multidimensional self-report instruments such as the Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1971/1981) and the Differential Emotions Scale (DES-IV) (Izard, Doughtery, Bloxom, & Kotsch, 1974), was designed specifically to avoid the problems associated with the psychometrically inadequate univariate measurement of emotional/mood states.

The usefulness of the 8SQ instrument has been investigated in several applied psychological studies (e.g., Barton, Cattell, & Curran, 1973; Boyle, 1983b, 1984, 1986e, 1986f, 1987c; Boyle & Cattell, 1984; Gilliland, 1980), suggesting thereby the situational sensitivity of the eight subscales comprising the questionnaire. According to Curran and Cattell (1976, p. 4), "The eight emotional states measured by the 8SQ have been shown, by factor analyzing change scores, to be distinct but interrelated constructs . . . The present forms are based on the results of over ten separate factor-analytic studies . . . numerous item analyses were conducted in order to select maximally valid items. This research continues and refinement of some of the test items would not be unexpected in the course of time." Curran and Cattell (p. 4) further maintained that "coordinated factor analyses have repeatedly shown that substantially more than two distinct states can be found in questionnaire responses. The 8SQ has been designed to include the best defined eight among them."

Several studies have examined the higher-order factor structure of the 8SQ (Barton, 1978; Boyle, 1983c, 1985a, 1986a, 1986d, 1987a, 1987f; Dorans, 1977; Stewart & Stewart, 1976). Also, the relationships between the 8SQ and other psychological self-report inventories have been investigated (Boyle, 1986b, 1986c, 1987d, 1987e; Boyle, Stanley & Start, 1985). In general, up to four higher-order 8SQ factors have been identified, suggesting interpretations of State Neuroticism, State Extraversion, Arousal-Fatigue, and Depression/Guilt. The quantitative measurement overlap (redundancy) with other psychometric instruments has been shown to be slight. Cattell and Kline (1977), as well as Kline (1979), have concluded that the eight states measured in the 8SQ are reasonably reliable and valid (cf. Curran, 1974).

In constructing the 8SQ, an equal number of "reversed" and "nonreversed" items were included in each subscale in order to minimize the likelihood of response sets. This practice has been questioned in previous research (Boyle, 1979, 1983a, 1989; Schmitt & Stults, 1985), wherein it was shown (in the state-trait curiosity domain, for instance) that the reversed and nonreversed items were loaded by essentially orthogonal factors, rather than by single combined factors as predicted. In effect, the reverse-worded items measured something different, rather than the actual construct under investigation. Reverse-worded items therefore are potentially problematic.

The major reason for this study was to test the validity of the claimed factor structure of the 8SQ instrument. Even though the 8SQ has been shown to be useful in applied investigations, the fundamental question concerning the construct validity of the subscale structure has not been addressed adequately. Despite numerous studies by Cattell and his colleagues (cf. Cattell, 1973, 1979, 1981, 1983), separation of the eight mood-state dimensions has not yet been verified by an *independent* investigation on large samples, different from those initially utilized.

In view of these considerations, it seems germane to reexamine the item composition of each 8SQ subscale, and to ascertain whether each subscale is robust for a sample differing considerably from those employed in the initial development of the instrument. Recent research with the POMS along similar lines (Boyle, 1987b) revealed that the items, by and large, contributed to the subscales as stipulated by the test authors. A similar demonstration for the 8SQ would clearly add to the virtues of the instrument. The present paper reports such an investigation into the item-structure characteristics of the 8SQ.

METHOD

SUBJECTS AND PROCEDURE

The sample comprised a total of 1,111 Australian college students (926 females; 185 males) from several tertiary institutions located in the Melbourne metropolitan area. The mean age of the sample was 22.23 years (S.D. = 6.18 years). Participation in the study was voluntary, and subjects were free to either participate or not participate. In fact, most subjects seemed quite willing to respond to the 8SQ items, and virtually all completed the 96 items as requested. Protocols with significant numbers of unanswered items were excluded from the subsequent analyses. Most subjects were Australian-born and came from essentially middle-class socioeconomic backgrounds. All subjects were fluent readers of written English. The 8SQ was administered as part of the regular classes in which the students normally participated. In order to facilitate the students' motivation to respond to the 8SQ items, the instrument was administered in cooperation with the usual instructor in each class. This task was readily accepted by the students, who in most instances appeared to take the study seriously and to respond to the 8SQ items conscientiously.

DATA ANALYSIS AND METHODOLOGY

Item analyses for each subscale in the 8SQ were performed by subjecting the 12 x 12 intercorrelation matrix in each instance to a principal-components analysis, using the SPSSX (Edition 3) statistical package (SPSSX, 1988). For each of the eight subscales, only the first unrotated component was extracted so that the resulting loadings on the items represented the correlations between the individual items and the component representing the subscale. Hence, it was possible to determine the contribution of each item to its respective subscale. In accord with accepted practice, only items with loadings greater than 0.30 were regarded as contributing adequately to the various subscales.

The item loadings for each subscale having been determined, it was appropriate to further investigate the relationship of the items in the 8SQ to the various subscales by conducting exploratory item factor analyses of the instrument. Given the large number of items involved (a total of 96 items), only the best six items for each subscale (those items with the highest loadings) were included in the subsequent factor analyses. An iterative, maximum-likelihood procedure was employed, together with extraction of factors by the Scree test (Hakstian, Rogers, & Cattell, 1982), and rotation to direct Oblimin simple structure. In general, the factor-analytic methodology followed the recommendations of Cattell (1978), Gorsuch (1983), and Kline (1987). Both six-factor and seven-factor solutions were derived in an attempt to verify the underlying dimensionality of the 8SQ instrument, as described below.

Mood states are most often delineated using exploratory factor-analytic procedures, wherein the observed variables (mood-state items) are linked to latent constructs (subscales) as specified by the measurement model (see below). According to Hinshaw (1987), the vast majority of studies reported in the literature have employed orthogonal rotation methods (typically principal components, or iterative principal factoring, with Varimax rotation). According to Rowe and Rowe (1990), such approaches are problematic. Using exploratory (unrestricted) methods of factor analysis results in arbitrary, data-driven factor solutions which merely conflate theory. Orthogonal methods assume that the factors are independent. However, there is considerable literature pertaining to overlapping dimensions. Moreover, the Pearson product-moment correlation coefficient is often computed from responses measured on dichotomous or Likert-type ordinal scales. Yet, the underlying assumptions (normality of distribution and homogeneity of variance) are usually ignored. By using product-moment estimates for dichotomous or ordinal variables, instead of the less-biased tetrachoric/polychoric estimates, significant bias is introduced inadvertently into the subsequent analyses (cf. Jõreskog & Sõrbom, 1988). As Rowe and Rowe pointed out, failure to recognize the measurement and distributional properties of response variables amounts to "an undisciplined romp through a correlation matrix" (Hendrickson & Jones, 1987, p. 105). Hence, claims about substantive knowledge often may be prefaced largely on statistical artifact.

Accordingly, the corresponding matrix of polychoric correlation coefficients was computed via PRELIS (Jõreskog & Sõrbom, 1986), and congeneric factor analyses via SIMPLIS (which uses a two-stage least squares method of parameter estimation) — (Jõreskog & Sõrbom, 1987), and LISREL (using the maximum-likelihood estimation option) — (Jõreskog & Sõrbom, 1989) were undertaken for each 8SQ subscale with the aim of delineating more precisely the importance of each of the items in the respective subscales. Finally, an overall confirmatory factor analysis of the best 48 items for the 8SQ was carried out using the LISREL statistical package.

RESULTS AND DISCUSSION

SUBSCALE ITEM ANALYSES

The item loadings for each of the eight subscales are presented in Table 1. The item numbers correspond to those in the 8SQ instrument it self. Most items designated by the test authors as contributing to the respective subscales have held up, while only a small proportion of items have failed to exhibit adequate loadings. In refining the item content of the 8SQ, those items in Table 1 with inadequate loadings might need to be deleted from the instrument. However, cross-validational replication of findings is required before any firm conclusions are drawn regarding the adequacy of the respective items, for use in the Australian context.

The 8SQ is comprised of 96 items which require about 20 minutes of testing time. A shortening of the instrument, retaining only the best items for each subscale, might result in a more efficient and useful measure of mood states. Admittedly, mood states fluctuate momentarily in response to changes in stimulus input and other influences, including even the task of responding to the items. It is undesirable if administration of the instrument itself brings about changes in the very dimensions which it is measuring. Table 1 suggests that at least three of the items in both the Stress and Regression subscales are inadequate predictors of these respective mood-state dimensions. Two items appear to be questionable contributors to the Arousal subscale. On the other hand, for the Fatigue, Guilt, and Extraversion subscales, all items have exhibited significant relationships with the corresponding factors.

ITEM FACTOR ANALYSES

Examination of the item loadings for the eight separate subscales (see Table 1) enabled selection of the "best" six items in each instance (items exhibiting the highest subscale loadings) for inclusion in the subsequent factor analyses of the 8SQ instrument. The resulting 48 x 48 intercorrelation matrix served as the starting point for the factor analyses. Examination of the latent roots for the unrotated principal components suggested that no more than seven factors should be extracted on the basis of the Scree test. Using a maximum-likelihood procedure, convergence of communality estimates required five iterations of the initial factor matrix, with extraction of seven factors. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (an index of the observed versus partial correlations) was 0.976, indicating the correlations between variables were appropriate for an exploratory factor analysis to be conducted. The KMO is defined algebraically in Norušis (1985, p. 129). In addition, Bartlett's Test of Sphericity (see Norušis, p. 128) was 28815.218 ($P<.000001$), indicating that the correlation matrix was not an identity matrix, and therefore that it was suitable for subsequent factor analysis. The direct Oblimin factor-pattern solution

TABLE 1

ITEM LOADINGS FOR EACH 8SQ SUBSCALE

(N=1,111)

Anxiety		Stress		Depression		Regression		Fatigue		Guilt		Extraversion		Arousal	
Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading
1	-.60	2	.66	3	.70	4	.46	5	.51	6	.45	7	-.32	8	-.44
9	.76	10	-.15	11	.08	12	.01	13	-.74	14	-.33	15	.67	16	.11
17	-.24	18	.64	19	-.58	20	.54	21	.76	22	.59	23	.51	24	.36
25	-.47	26	.54	27	.50	28	.02	29	-.76	30	.56	31	.51	32	.60
33	.64	34	-.63	35	.55	36	.65	37	-.64	38	-.44	39	.60	40	.65
41	-.62	42	-.77	43	-.49	44	-.30	45	.66	46	.48	47	-.37	48	-.25
49	.70	50	.42	51	-.72	52	.61	53	.69	54	.63	55	-.65	56	-.68
57	.43	58	.22	59	-.51	60	-.58	61	-.50	62	-.60	63	-.70	64	-.32
65	-.77	66	.21	67	.62	68	-.53	69	-.41	70	.71	71	-.41	72	.74
73	-.76	74	.46	75	.55	76	-.56	77	.66	78	-.71	79	-.58	80	.48
81	.67	82	-.44	83	-.67	84	.60	85	-.68	86	-.62	87	.34	88	-.65
89	.76	90	-.45	91	.74	92	-.22	93	.77	94	-.70	95	.60	96	.39

NOTES: Loadings shown to two decimal places only. Inadequate item loadings are underlined.

converged in 73 iterations, suggesting a somewhat unstable factor resolution (the smaller the number of iterations required, the more reliable is the solution). With the SPSSX δ (delta) shift parameter set at zero, the $\pm .10$ hyperplane count for the maximum-likelihood solution was 53.3% (cf. Cattell, 1978; Gorsuch, 1983), indicating only moderate approximation to simple structure of the final rotated solution. Variation of the δ shift parameter enabled maximization of the hyperplane count with $\delta = -0.2$, wherein the degree of obliquity of the factors was reduced slightly ($\pm .10$ hyperplane count of 54.2%). This factor-pattern solution is presented in Table 2.

Table 2

Oblique Seven-Factor Pattern Solution

	Factor Number							
8SQ Item No.	1	2	3	4	5	6	7	h^2
Anxiety								
09	.37	-.04	.33	.01	.14	.06	.11	.58
49	.22	-.16	.20	.04	.09	.20	.19	.50
65	-.56	-.01	-.13	.17	-.09	-.08	-.06	.63
73	-.51	-.01	-.08	.24	-.20	-.01	-.12	.67
81	.44	-.16	.01	.03	.12	.10	.12	.48
89	.30	-.01	.36	-.04	.07	.02	.29	.63
Stress								
02	-.09	.07	.68	-.03	.09	.09	.14	.55
18	-.03	-.01	.66	-.05	-.01	.05	.08	.48
26	.12	-.09	.47	-.02	-.01	-.02	-.05	.29
34	-.52	.05	-.19	.10	.07	-.17	.00	.54
42	-.19	.03	-.51	.10	-.01	-.08	-.17	.62
74	.20	-.04	.40	.02	.06	-.06	-.09	.25
Depression								
03	-.14	-.09	-.13	.26	-.38	.02	-.22	.54
19	.07	-.09	.24	.02	.11	.12	.31	.40
51	.09	-.10	.11	.08	.33	.18	.34	.58
67	-.02	-.07	-.03	.13	-.09	-.08	-.65	.60
83	.30	-.20	.05	.08	.20	.18	.15	.52
91	-.16	.10	-.09	.35	-.38	.03	-.10	.62
Regression								
20	-.22	.13	.02	.10	-.35	-.12	.06	.40
36	-.04	.28	-.11	.35	-.01	-.14	-.16	.53
52	-.14	.03	-.02	.09	.03	-.50	-.10	.46
60	.08	-.15	.04	.08	.09	.43	.10	.40
76	.06	-.08	.31	.03	.04	.07	.48	.55
84	-.09	.15	.03	.35	.04	-.23	-.12	.40

Table 2 (Continued)

Fatigue								
13	-.08	**.61**	.07	.09	-.12	-.10	.03	.59
21	.03	**-.67**	.14	-.08	.08	.05	-.07	.65
29	.01	**.37**	-.03	**.33**	-.27	-.07	-.08	.65
53	.03	**-.45**	.07	-.20	-.08	.13	-.07	.46
85	-.04	**.40**	.00	**.45**	.05	-.07	-.03	.53
93	.13	**-.52**	.08	-.26	.05	.01	.02	.60
Guilt								
54	**.34**	-.10	.02	.22	-.03	.19	.27	.41
62	-.24	-.06	.01	.07	-.01	-.21	-.26	.33
70	.27	-.12	-.02	.27	.18	.18	**.33**	.52
78	-.19	-.05	.02	.19	-.10	-.12	**-.49**	.61
86	-.18	-.02	-.13	.14	.12	-.15	**-.41**	.45
94	-.24	-.07	-.06	.12	-.11	-.04	**-.52**	.61
Extraversion								
15	.01	.02	-.01	.09	**-.70**	-.04	.01	.57
39	.03	.04	-.05	**.46**	-.29	-.11	.05	.47
55	.06	-.01	.04	.08	**.36**	**.48**	-.06	.50
63	.07	-.04	.11	-.08	**.38**	.28	-.06	.46
79	-.04	-.17	.03	-.18	**.41**	.01	.12	.41
95	-.20	-.02	.02	.29	-.16	-.20	-.10	.43
Arousal								
32	.07	**-.58**	.10	.01	.10	.12	-.01	.55
40	.08	-.18	.07	-.03	.06	**.41**	.14	.50
56	.02	-.02	.00	.29	-.04	**-.63**	.02	.57
72	-.01	**-.38**	-.07	-.05	.16	**.35**	.12	.57
80	.04	**-.30**	-.07	.03	.22	.06	.18	.29
88	-.08	.06	-.03	**.51**	-.18	-.08	-.13	.57
Latent Root:	18.27	3.15	1.85	1.54	1.20	1.01	.96	
Percent Variance:	38.1	6.6	3.9	3.2	2.5	2.1	2.0	
Hyperplane Count (± .10):	25	29	30	27	25	24	22	

Notes. Factor loadings are reported to two decimal places only.
Factor loadings ≥ .30 are shown in bold.

Factor 1 (38.1% of the unrotated principal-components variance) represented the 8SQ dimension labeled Anxiety. No fewer than five of the six items exhibited significant (≥.30) loadings with respect to this dimension (Items 9, 65, 73, 81, and 89, respectively). In addition, one Stress item (Item 34), one Depression item (Item 83), and one Guilt item (Item 54) contributed significantly. Curran (1974) reported the results of an exploratory factor analysis of item parcels (each comprising four 8SQ items from Forms A and B together), using a sample of 155 American university students as subjects. Curran provided strong evidence for the construct validity of the Anxiety subscale, with all six item parcels (comprised of known marker variables) exhibiting significant factor loadings as predicted. Accordingly, there seems little doubt as to the validity of the Anxiety dimension, although the present findings suggest some refinement of the actual items in the subscale may be required.

As for Factor 2 (6.6% of the unrotated component variance), all six of the Fatigue items (Items 13, 21, 29, 53, 85, and 93) exhibited significant loadings as predicted, along with three of the Arousal items (Items 32, 72, and 80). This factor supported the 8SQ Fatigue subscale as a discrete mood-state construct. It is possible that the responses to the Fatigue items may have been influenced partly by the time required for administration of the instrument, although typically this involved only about 20 minutes,or so. Previously, Curran (1974) also had reported strong factor support for the Fatigue subscale items.The fact that only three of the Arousal items lined up on this factor suggests that the Arousal subscale needs refinement.

Factor 3 (3.9% of unrotated component variance) loaded predominantly on Stress items (with the exception of Item 34), as well as on two of the Anxiety items (Items 9 and 89), and one of the Regression items (Item 76). While strongly supporting the Stress subscale as defined in the 8SQ, this factor also suggested some association of stress and anxiety. Curran (1974) had reported that three of six marker variables for Stress exhibited significant loadings on Anxiety. While Curran obtained no significant loadings on the Stress factor, the present findings support the validity of this subscale. Curran used a sample of only 155 subjects (three subjects per variable), whereas the present analysis was based on a much larger sample, providing a firmer base on which to investigate the validity of the 8SQ subscale structure.

Seven items contributed significantly to Factor 4 (which accounted for 3.2% of the unrotated component variance). Perusal of the content of these particular items (Items 29, 36, 39, 84, 35, 88, and 91) suggests that this factor represented a specific mood-state dimension of Adventurousness, not delimited as such in the existing 8SQ subscale structure. This factor may represent the sensation-seeking dimension (Zuckerman, 1979). The 8SQ may benefit by addition of items intended specifically to measure the sensation-seeking emotional/mood-state dimension. This would necessitate inclusion of an additional subscale into the structure of the instrument, thereby providing a more comprehensive measurement of the mood-state domain.

Factor 5 (accounting for 2.5% of the unrotated component variance) clearly loaded on the Extraversion subscale items (only Item 95 failed to exhibit a significant loading). Three of the Depression items (Items 3, 51, and 91) also contributed to this factor, along with one Regression item (Item20). The "non-Extraversion"items which contributed significantly to this factor may need to be redefined as extraversion items. Even though the eight states measured in the 8SQ are conceptually distinct, the particular items allocated to each subscale may need some revision.

As for Factor 6 (2.1% of the unrotated component variance), significant factor loadings occurred for three Arousal items (Items 40, 56, and 72), two of the Regression items (Items 52 and 60), and one Extraversion item (Item 55). The overall interpretation of this factor suggests confusion and sluggish intellectual/cognitive functioning. This factor seems to represent the negative pole of the 8SQ Arousal dimension. The items defining the Regression subscale failed to load together as a single entity, but instead were scattered among five of the seven extracted factors. The Regression subscale is not supported by the present findings as a discrete factorial construct. Curran (1974) reported that only one of six marker variables was loaded significantly (≥.30) on the Regression dimension. Correspondingly, his marker variables exhibited significant loadings which were scattered widely across the remaining mood-state factors in his analysis. Hence, the factor analytic support for the 8SQ Regression subscale seems uncertain. The 8SQ would probably be a more efficient instrument with removal of the Regression subscale.

Factor 7 (2.0% of unrotated component variance) contrasted three of the Depression items (Items 19, 51, and 67) with four of the Guilt items (Items 70, 78, 86, and 94), thereby suggesting a Guilt/Depression interpretation. This factor loaded significantly on one Regression item (Item 76), suggesting that Guilt/Depression represents a distinct mood-state dimension. The Depression items were evenly divided between factors 5, and 7, in accord with reports of the complexity of depressive mood states (see Boyle,1985b, for a review). A number of 8SQ items contributed substantially to more than one of the eight subscale dimensions, thereby inflating the subscale intercorrelations, and also raising doubts about the purported subscale structure of the instrument.

Subscale intercorrelations tend to be rather high in the psychometric mood-state area. Not only is the 8SQ hampered by high subscale correlations (Cattell & Curran, 1976, p. 16), but also other multidimensional instruments such as the Multiple Affect Adjective Check list (MAACL-R; Zuckerman & Lubin, 1985), the POMS (McNair et al., 1981), and the DES-IV (Izard et al., 1974) demonstrate this difficulty. Such a finding is not unexpected, as mood states tend to fluctuate concurrently, in response to provocative stimuli. As Cattell (1978, p.163) stated, "Researchers in the field of psychological states have repeatedly found decidedly larger correlations among primaries in state than in trait factors, due to time-coordinated ambient situation changes. . . . the dynamics of situations often cause them to occur together."

In the present study, the intercorrelations for the seven extracted and rotated factors generally were moderate, rather than being excessively high (Table 3). However, in view of the apparent interdependence of the seven derived factors, obliquity of the final factor solution was reduced somewhat by use of the SPSSX δ shift parameter, in an attempt to achieve a greater approximation to simple structure. It might be argued that differences in the obtained factor-pattern solution as compared with that defined by the 8SQ subscales were due partly to cross-cultural influences (since Australian rather than North American subjects were used). However, a similar investigation of the POMS factor structure, using Australian college students as subjects (Boyle, 1987b), supported the groupings of items designated as contributing significantly to each factor.

Table 3

Factor Pattern Intercorrelations

Factor No.	1	2	3	4	5	6	7
1							
2	-.30						
3	.42	-.18					
4	-.22	.34	-.17				
5	.36	-.38	.22	-.38			
6	.46	-.41	.20	-.31	.43		
7	.51	-.16	.30	-.21	.31	.44	

Notes. Correlations are shown to two decimal places only.
All correlations are *statistically* significant, although only those which are not trivial (≥ .30) are shown in bold.

The present attempt to cross-validate the factor structure of the 8SQ instrument has resulted in only partial replication. Good support for the subscales labelled Anxiety, Stress, Fatigue, and Extraversion was forthcoming, while the dimension labelled Arousal combined with Fatigue and with Regression. Depression and Guilt emerged as a single dimension. A number of the 8SQ items contributed significantly to more than one subscale, thereby making the separation of some of the factors unnecessarily problematic. While the Scree test suggested seven separate factors, examination of the percentage variance accounted for by each factor, together with the significant intercorrelations observed between the factors, suggested a smaller number of factors.To test this possibility, and the appropriateness of removing the Regression subscale (since it failed to emerge from the seven-factor solution), a six-factor solution was also taken out.

The six-factor solution (Table 4) also involved an iterative maximum-likelihood method of analysis requiring five iterations of the initial factor matrix. The direct Oblimin factor pattern converged after only 47 iterations as compared with the 73 iterations required for the seven-factor solution. The total ± .10 hyperplane count associated with the six-factor solution, with the δ shift parameter set at zero, was 45.8%, suggesting a rather unsatisfactory approximation to simple structure (variation of the SPSSX δ shift parameter to reduce the obliquity of the derived factors did not result in a greater approximation to simple structure criteria). Ideally, the ± .10 hyperplane count should be at least 75% or better (Kline, 1979; Boyle, 1988).

Table 4

Oblique Six-Factor Pattern Solution

8SQ Item No.	Factor Number 1	2	3	4	5	6	h^2
Anxiety							
09	.34	.00	.38	.14	.13	.02	.58
49	.17	-.18	.24	.25	.07	.12	.50
65	-.59	.03	-.14	-.02	-.13	-.05	.64
73	-.55	.02	-.11	.04	-.26	-.10	.68
81	.41	-.14	.04	.22	.10	.02	.48
89	.27	.02	.44	.11	.06	.20	.63
Stress							
02	-.13	.06	.73	.00	.11	.12	.54
18	-.07	-.05	.70	-.03	-.02	.06	.47
26	.09	-.09	.50	-.03	-.04	-.11	.29
34	-.52	.14	-.19	-.07	.07	-.03	.53
42	-.17	.08	-.57	-.02	-.02	-.14	.61
74	.15	.00	.43	-.01	.03	-.17	.25
Depression							
03	-.17	-.08	-.18	.08	-.49	-.19	.53
19	.03	-.08	.30	.19	.10	.23	.40
51	.04	-.04	.17	.31	.33	.22	.58
67	-.06	-.07	-.13	-.12	-.13	-.59	.58
83	.25	-.18	.08	.29	.17	.05	.52
91	-.18	.17	-.13	.14	-.47	-.11	.62
Regression							
20	-.22	.16	.03	-.07	-.40	.07	.40
36	-.07	.49	-.13	.10	-.05	-.25	.53
52	-.16	.23	.02	-.21	-.05	-.25	.40
60	.06	-.25	.02	.33	.10	.13	.38
76	.02	-.04	.41	.20	.00	.35	.54
84	-.14	.40	.05	.08	-.04	-.28	.39
Fatigue							
13	-.04	.71	.07	-.12	-.08	.11	.58
21	-.03	-.77	.15	.08	.01	-.17	.64
29	.01	.52	-.04	.08	-.33	-.09	.64
53	.01	-.62	.06	-.01	.08	-.05	.47
85	-.08	.67	.02	.22	.01	-.16	.54
93	.12	-.66	.10	-.06	.03	-.01	.59

Table 4 (Continued)

Guilt							
54	.28	-.04	.06	**.39**	-.11	.15	.41
62	-.27	.01	.00	-.14	-.05	-.29	.33
70	.20	.00	.04	**.46**	.11	.16	.51
78	-.23	-.01	-.04	-.09	-.16	**-.49**	.60
86	-.19	.06	-.19	-.08	.10	**-.45**	.46
94	-.26	-.10	-.14	-.11	-.14	**-.45**	.59
Extraversion							
15	.01	-.04	-.02	-.05	**-.80**	.09	.57
39	-.03	.25	-.03	.26	**-.44**	-.11	.46
55	.05	-.11	-.01	.29	**.42**	.01	.44
63	.06	-.13	.09	.12	**.46**	.00	.44
79	-.05	-.19	.06	.00	**.47**	.07	.40
95	-.25	.14	.03	.04	-.26	-.22	.42
Arousal							
32	.01	**-.64**	.12	.19	.02	-.12	.55
40	.07	**-.33**	.06	.25	.09	.20	.48
56	-.06	**.32**	.09	-.06	-.20	-.26	.41
72	-.03	**-.52**	-.08	.25	.17	.14	.57
80	.00	-.27	-.03	.20	.19	.06	.27
88	-.15	.27	-.03	.25	**-.32**	-.28	.58

Latent Root:	18.27	3.15	1.85	1.54	1.20	1.01
Percent Variance:	38.1	6.6	3.9	3.2	2.5	2.1
Hyperplane Count (± .10):	23	21	26	22	23	17

Notes. Factor loadings are reported to two decimal places only.
Factor loadings ≥ .30 are shown in bold.

Factor 1 again represented the 8SQ Anxiety dimension, but this time both Items 49 and 89 failed to exhibit significant (≥ .30) factor loadings. However, Items 83 and 54 (Depression and Guilt items, respectively) no longer were significantly associated with the Anxiety factor. Factor 2 again supported the 8SQ Fatigue subscale, with *all* six items contributing significantly to the dimension. In addition, four of the Arousal subscale items (Items 32,40, 56, and 72) exhibited significant loadings, providing further support for collapsing the Fatigue and Arousal subscales into a single scale. Arousal and Fatigue seem to represent extremes on a bipolar dimension. Factor 3 clearly represented the 8SQ Stress dimension, and again only Item 34 failed to exhibit a significant loading. However, a Depression item (Item 19) now loaded significantly. Factor 4 comprised a few scattered significant loadings suggestive of general negative affect. It did not resemble the fourth factor from the seven-factor solution. Factor 5 again suggested an Adventurousness interpretation, while Factor 6 partially represented the Guilt dimension. The factor intercorrelations are presented in Table 5, suggesting a high level of interdependence between the six factors. Evidently, the seven-factor solution is not particularly challenged by the six-factor solution, and the latter would not appear to replicate better the findings of either Curran (1974) or Curran and Cattell (1976).

Table 5

Factor Pattern Intercorrelations

Factor No.	1	2	3	4	5	6
1						
2	**-.45**					
3	**.53**	**-.31**				
4	**.36**	-.22	.24			
5	**.46**	**-.62**	**.33**	.23		
6	**.49**	**-.31**	**.30**	.25	**.42**	

Notes. Correlations are shown to two decimal places only.
Non-trivial correlations (≥ .30) are shown in bold.

CONGENERIC AND CONFIRMATORY FACTOR ANALYSES

As congeneric and confirmatory factor analyses via SIMPLIS and LISREL (Jöreskog & Sörbom, 1986, 1987, 1989) had not been reported, and given the uncertainty surrounding the exploratory factor analytic results above, LISREL analyses of the 8SQ item intercorrelations were also carried out. Both congeneric and confirmatory factor analytic methods enable statistical model testing, unlike the traditional data-driven, exploratory factor analytic approaches (cf. Anderson, 1987; Bentler, 1985; Long, 1983; McDonald, 1980; Muthén, 1984). Separate PRELIS runs (Jöreskog & Sörbom, 1988) were carried out for subsets of 48 items (due to practical limitations of the computer hardware it was not possible to conduct a confirmatory factor analysis on the intercorrelations of all 96 8SQ items simultaneously). Use of the PRELIS program is particularly important if the variables are skewed or kurtotic. Given that the item responses were measured on a four-point Likert-type scale, computation of Pearson product-moment correlation coefficients was not justified, as such estimates have been shown to be significantly biased when the variables are ordinal (Jöreskog & Sörbom, 1989). Use of PRELIS enabled the computation of polychoric correlation coefficients. Had product-moment correlations been used, the resulting parameter estimates, as well as the various goodness of fit indices (Chi-Square or χ^2, Goodness of Fit Index or GFI, Adjusted Goodness of Fit Index or AGFI, and Root Mean square Residual or RMR)[1] would have been significantly biased (Jöreskog & Sörbom, 1986; Olsson, 1979; Poon & Lee, 1987). The resulting 48 x 48 intercorrelation matrices for each respective 8SQ subset of 48 items served as the point of departure for the subsequent confirmatory factor analyses (see below), wherein the measurement model is expressed algebraically as:

$$\mathbf{x} = \Lambda_x \xi + \delta$$

such that the observed variables/8SQ items are represented by the x's, and the latent variables are represented by the ξ's, respectively. The vector of measurement errors in the x variables is represented by δ (cf. Cuttance & Ecob, 1987).The corresponding equation for the covariance matrices reported below (Tables 8, 10, and 12), is given as:

$$\Sigma = \Lambda\Phi\Lambda' + \Theta_\delta$$

where Λ represents the matrix of loadings for the latent traits (8SQ subscales), Φ represents the matrix of covariances between the latent traits, and Θ_δ represents the matrix of error variances and covariances among the x variables (8SQ items).

A similar procedure was employed using a combination of PRELIS and LISREL in undertaking separate congeneric factor analyses of the best six items for each of the 8SQ subscales, as determined from the SIMPLIS standardized regression equations. Together with the corresponding maximum-likelihood goodness of fit estimates, the congeneric factor analytic results are shown in Table 6 for each 8SQ subscale, respectively.

Table 6
Congeneric Factor Models for 8SQ Subscales

Subscales (X Variables)	Standardized (Λ_x) LISREL Estimates (ML): Parameter Value	Standard Error	Significance of T-Value	R^2
Anxiety (ξ_1)				
Q01	0.63	0.00	<.01	0.40
Q17	0.34	0.06	<.01	0.12
Q25	0.52	0.06	<.01	0.27
Q33	-0.67	0.07	<.01	0.45
Q41	0.66	0.07	<.01	0.44
Q57	-0.47	0.06	<.01	0.23

Coefficient of Determination for X Variables = 0.742
Goodness of Fit Statistics: GFI = 0.983; AGFI = 0.961; RMR = 0.033

Subscales (X Variables)	Parameter Value	Standard Error	Significance of T-Value	R^2
Stress (ξ_2)				
Q02	0.77	0.00	<.01	0.60
Q18	0.73	0.04	<.01	0.53
Q26	0.57	0.04	<.01	0.33
Q34	-0.61	0.04	<.01	0.37
Q42	-0.82	0.04	<.01	0.67
Q74	0.50	0.04	<.01	0.25

Coefficient of Determination for X Variables = 0.835
Goodness of Fit Statistics: GFI = 0.953; AGFI = 0.890; RMR = 0.045

Subscales (X Variables)	Parameter Value	Standard Error	Significance of T-Value	R^2
Depression (ξ_3)				
Q11	0.23	0.00	<.01	0.05
Q27	-0.54	0.39	<.05	0.29
Q35	-0.62	0.43	<.05	0.38
Q43	0.56	0.40	<.05	0.32
Q59	0.50	0.36	<.05	0.25
Q75	-0.68	0.47	<.05	0.46

Coefficient of Determination for X Variables = 0.715
Goodness of Fit Statistics: GFI = 0.982; AGFI = 0.957; RMR = 0.039

Subscales (X Variables)	Parameter Value	Standard Error	Significance of T-Value	R^2
Regression (ξ_4)				
Q20	0.58	0.00	<.01	0.34
Q36	0.69	0.07	<.01	0.48
Q52	0.68	0.07	<.01	0.46
Q60	-0.61	0.07	<.01	0.37
Q76	-0.60	0.07	<.01	0.36
Q84	0.63	0.07	<.01	0.40

Coefficient of Determination for X Variables = 0.793
Goodness of Fit Statistics: GFI = 0.983; AGFI = 0.960; RMR = 0.030

Table 6 (Continued)

Fatigue (ξ_5)				
Q13	0.80	0.00	<.01	0.64
Q21	-0.82	0.03	<.01	0.68
Q29	0.80	0.03	<.01	0.64
Q53	-0.73	0.04	<.01	0.53
Q85	0.73	0.04	<.01	0.54
Q93	-0.81	0.03	<.01	0.66

Coefficient of Determination for X Variables = 0.894
Goodness of Fit Statistics: GFI = 0.953; AGFI = 0.891; RMR = 0.032

Guilt (ξ_6)				
Q06	0.65	0.00	<.01	0.42
Q14	-0.42	0.06	<.01	0.18
Q22	0.72	0.07	<.01	0.52
Q30	0.52	0.06	<.01	0.27
Q38	-0.46	0.06	<.01	0.21
Q46	0.60	0.06	<.01	0.36

Coefficient of Determination for X Variables = 0.744
Goodness of Fit Statistics: GFI = 0.978; AGFI = 0.948; RMR = 0.039

Extraversion (ξ_7)				
Q07	0.31	0.00	<.01	0.10
Q15	-0.75	0.28	<.01	0.56
Q23	-0.50	0.20	<.01	0.25
Q31	-0.56	0.22	<.01	0.31
Q71	0.42	0.18	<.01	0.18
Q79	0.68	0.25	<.01	0.47

Coefficient of Determination for X Variables = 0.750
Goodness of Fit statistics: GFI = 0.978; AGFI =0.949; RMR =0.042

Arousal (ξ_8)				
Q08	0.53	0.00	<.01	0.28
Q32	-0.59	0.08	<.01	0.35
Q40	-0.70	0.09	<.01	0.49
Q56	0.75	0.09	<.01	0.56
Q80	-0.50	0.08	<.01	0.25
Q88	0.69	0.09	<.01	0.47

Coefficient of Determination for X Variables = 0.794
Goodness of Fit Statistics: GFI = 0.966; AGFI = 0.921; RMR = 0.043

Notes. The statistical significance of a T-value refers to the significance of the ratio of the unstandardized parameter estimate to its standard error.
GFI = Goodness of Fit Index; AGFI = Adjusted Goodness of Fit Index;
RMR = Root Mean Square Residual.
Factor loadings are shown to two decimal places only.

As is evident from the congeneric factor results, the various goodness of fit indices for each of the eight subscales were all highly supportive of the construct validity of the respective 8SQ dimensions. However, *this result was obtained only by exclusion of the least-adequate six items for each subscale.* The congeneric factor results and associated goodness of fit estimates were less than satisfactory when all 12 items for each subscale were included in the analyses. It would seem desirable, therefore, that the item content of the 8SQ instrument be revised by eliminating those items which account for the least amount of shared variance associated with the respective subscales. Concomitantly, it might be necessary to include new items, in view of the congeneric factor results. The present findings suggest that the existing item content of the 8SQ instrument requires modification.

Separate maximum-likelihood confirmatory factor analyses were carried out on the sets of 48 items, consisting of the best six items from each subscale, as determined initially from the principal-component analyses reported in Table 1, and subsequently from the standardized regression coefficients produced from the congeneric factor analyses for each subscale. In addition, for purposes of comparison, a confirmatory factor analysis was also undertaken on the 48 least-adequate items, as determined from the standardized regression equations for each subscale.

Using the best 48 items as shown in Table 1 for the principal-component analyses on each 8SQ subscale (see Table 7), the GFI was found to be 0.623, the AGFI was 0.578, and the RMR was 0.214, indicating an inadequate fit of the empirical data to the purported eight-factor model of the 8SQ.

Table 7

Confirmatory Factor Analysis of Best 48 Items
(from the principal components scale analyses)

Standardized LISREL Estimates (ML)

8SQ Subscales	Factor No.								
	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	ξ_7	ξ_8	R^2
Anxiety (ξ_1)									
Q09	0.02								0.02
Q49	-0.78								0.45
Q65	0.30								0.08
Q73	-0.69								0.43
Q81	-0.75								0.51
Q89	-0.81								0.59
Stress (ξ_2)									
Q02		0.76							0.43
Q18		0.63							0.36
Q26		0.51							0.23
Q34		-0.78							0.54
Q42		-0.86							0.67
Q74		-0.85							0.65

Table 7 (Continued)

Depression (ξ_3)							
Q03	0.02						0.02
Q19	0.67						0.41
Q51	0.79						0.56
Q67	0.23						0.05
Q83	0.82						0.60
Q91	-0.79						0.56
Regression (ξ_4)							
Q20		0.69					0.39
Q36		0.78					0.55
Q52		0.66					0.40
Q60		-0.63					0.36
Q76		0.65					0.39
Q84		0.67					0.40
Fatigue (ξ_5)							
Q13			0.01				0.01
Q21			0.79				0.58
Q29			-0.86				0.69
Q53			0.75				0.52
Q85			-0.79				0.58
Q93			0.85				0.67
Guilt (ξ_6)							
Q54				0.01			0.02
Q62				0.46			0.18
Q70				0.58			0.30
Q78				-0.71			0.46
Q86				0.65			0.37
Q94				0.76			0.52
Extraversion (ξ_7)							
Q15					0.01		0.01
Q39					-0.58		0.31
Q55					0.66		0.39
Q63					-0.62		0.35
Q79					-0.82		0.61
Q95					-0.72		0.47
Arousal (ξ_8)							
Q32						0.01	0.01
Q40						-0.73	0.49
Q56						0.71	0.46
Q72						-0.42	0.16
Q80						-0.65	0.38
Q88						0.77	0.54

Notes. GFI = 0.623; AGFI = 0.578; RMR = 0.214

Factor loadings are shown to two decimal places only.

Perusal of communality estimates indicates that Items 3, 9, 13, 15, 26, 32, 54, 62, 65, and 67 account for the least amount of common factor variance for the respective 8SQ subscales.

All Λ_x factor loadings (except for Items 3, 9, 13, 15, 32, 54) are statistically significant at the 1% level or better, using univariate two-tailed tests (cf. Boyle & Langley, 1989).

As can be seen from Table 7, use of the principal-components analyses to select the "best" six items per subscale has not been particularly successful, as several of the selected items have very low communalities (<.30) associated with them. Moreover, a number of the factor loadings are trivial, suggesting that the 8SQ instrument needs considerable psychometric improvement at the item level, for optimal use in the Australian context. The covariances obtained for the eight factors are shown in Table 8. It is clear that the subscales are very highly intercorrelated, suggesting that a reduction in the number of 8SQ mood-state dimensions would seem desirable.

For the confirmatory factor analysis of the best 48 8SQ items (as determined from the two-stage least squares standardized regression equations) (Table 9), the GFI was found to be 0.738, the AGFI was 0.707, while the RMR was now 0.095. Cuttance (1987, p. 260) has pointed out that "models with an AGFI of less than 0.8 are inadequate . . . most acceptable models would appear to have an AGFI index of greater than 0.9." Accordingly, even though these goodness of fit indicators represented an improvement, they still suggested the inadequacy of the overall eight-factor model proposed by Curran and Cattell (1976) for the 8SQ instrument. The corresponding phi matrix of covariances for these items is presented in Table 10. Again,the 8SQ subscales are generally quite highly intercorrelated, suggesting that there is significant item redundancy (cf. Boyle, 1985b). This finding is further evidence that the item composition of the 8SQ subscales needs revision, at least for use in the Australian context.

Table 8

Covariances between Exogenous Latent Traits (Φ Matrix)

8SQ Subscale	AX	ST	DE	RG	FA	GI	EX	AR
AX								
ST	-0.95							
DE	-1.00	0.90						
RG	0.97	-0.83	-0.97					
FA	-0.80	0.68	0.83	-0.93				
GI	1.00	-0.95	-1.00	0.99	-0.82			
EX	-0.92	0.85	0.97	-0.98	0.77	-1.00		
AR	0.91	-0.79	-0.97	1.00	-0.90	0.95	1.00	

Notes. Covariances are shown to two decimal places only.
AX = Anxiety; ST = Stress; DE = Depression; RG = Regression; FA =Fatigue; GI = Guilt; EX = Extraversion; AR =Arousal

Table 9

Confirmatory Factor Analysis of Best 48 Items
(from the standardized regression equations)

Standardized LISREL Estimates (ML)

8SQ Subscales	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	ξ_7	ξ_8	R^2
				Factor No.					
Anxiety (ξ_1)									
Q01	0.67								0.65
Q17	0.23								0.04
Q25	0.51								0.23
Q33	-0.66								0.36
Q41	0.70								0.44
Q57	-0.43								0.18
Stress (ξ_2)									
Q02		0.73							0.66
Q18		0.66							0.50
Q26		0.52							0.30
Q34		-0.71							0.39
Q42		-0.86							0.66
Q74		0.46							0.24
Depression (ξ_3)									
Q11			0.04						0.46
Q27			-0.60						0.11
Q35			-0.56						0.14
Q43			0.56						0.16
Q59			0.57						0.44
Q75			-0.60						0.09
Regression (ξ_4)									
Q20				0.63					0.85
Q36				0.71					0.50
Q52				0.63					0.28
Q60				-0.59					0.28
Q76				-0.62					0.13
Q84				0.60					0.30
Fatigue (ξ_5)									
Q13					0.78				0.75
Q21					-0.79				0.55
Q29					0.84				0.81
Q53					-0.73				0.48
Q85					0.74				0.48
Q93					-0.81				0.61
Guilt (ξ_6)									
Q06						0.67			0.68
Q14						-0.45			0.17
Q22						0.66			0.38
Q30						0.54			0.23
Q38						-0.44			0.16
Q46						0.62			0.35

Table 9 (Continued)

Extraversion (ξ_7)			
Q07	0.01		0.21
Q15	0.69		0.13
Q23	0.52		0.10
Q31	0.59		0.11
Q71	-0.42		0.07
Q79	-0.70		0.14
Arousal (ξ_8)			
Q08		0.01	0.18
Q32		0.69	0.11
Q40		0.69	0.14
Q56		-0.65	0.10
Q80		0.50	0.07
Q88		-0.70	0.06

Notes. GFI = 0.738; AGFI = 0.707; RMR = 0.095
Factor loadings are shown to two decimal places only.
Perusal of communality estimates indicate that Items 7, 14, 15, 17, 23, 24, 25, 27, 30, 31, 35, 38, 43, 52, 57, 60, 71, 75, 76, and 79 account for little of the common factor variance for the respective 8SQ subscales.
All Λ_x factor loadings (except for Items 7, 8 and 11) are statistically significant at better than the 1% level, using univariate two-tailed tests.

Table 10
Covariances between Exogenous Latent traits (Φ Matrix)

8SQ Subscale	AX	ST	DE	RG	FA	GI	EX	AR
AX								
ST	-0.96							
DE	-0.85	0.68						
RG	1.00	-0.79	-1.00					
FA	0.68	-0.55	-0.96	0.89				
GI	-0.98	0.77	0.81	-0.93	-0.63			
EX	0.67	-0.54	-0.96	0.86	0.82	-0.60		
AR	-0.88	0.67	1.00	-1.00	-0.96	0.83	-0.89	

Notes. Covariances are shown to two decimal places only.
AX = Anxiety; ST = Stress; DE = Depression; RG = Regression; FA = Fatigue; GI = Guilt; EX = Extraversion; AR = Arousal

The goodness of fit estimates for the confirmatory factor analysis of the least-adequate 48 items (Table 11) were as follows: GFI (0.723); AGFI (0.691); and RMR (0.108), indicating again, a poor fit to the 8SQ model. The number of iterations for the maximum-likelihood analysis exceeded 250 (as was also the case for the confirmatory factor analyses reported in Tables 7 and 11), thereby indicating the extensive "measurement noise"associated with these subsets of 8SQ items. Even so, these goodness of fit estimates were slightly better than those for the analysis based on the principal components (from Table 1). Hence, the combined use of PRELIS and LISREL enabled a more accurate assessment of the adequacy and construct validity of item structure of the 8SQ instrument. As for the matrix of covariances (Table12), it is evident that there is multicollinearity (cf. Pedhazur, 1982) associated with this particular subset of 48 items, thereby pointing to the inadequacy of these items, and to the possible need for their removal from the existing instrument.

Table 11

Confirmatory Factor Analysis of Worst 48 Items
(from standardized regression equations)

Standardized LISREL Estimates (ML)

	Factor No.								
8SQ Subscales	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	ξ_7	ξ_8	R^2
Anxiety (ξ_1)									
Q01	0.59								0.35
Q17	0.25								0.06
Q25	0.54								0.29
Q33	-0.71								0.51
Q41	0.67								0.45
Q57	-0.46								0.21
Stress (ξ_2)									
Q10		0.01							0.00
Q50		0.24							0.06
Q58		0.28							0.08
Q66		0.21							0.04
Q82		-0.67							0.45
Q90		-0.57							0.32
Depression (ξ_3)									
Q11			0.01						0.00
Q27			-0.59						0.35
Q35			-0.52						0.26
Q43			0.63						0.40
Q59			0.54						0.29
Q75			-0.59						0.35

Table 11 (Continued)

Regression (ξ_4)						
Q04	0.44					0.20
Q12	0.00					0.00
Q28	0.03					0.00
Q44	-0.31					0.09
Q68	-0.56					0.31
Q92	-0.21					0.04
Fatigue (ξ_5)						
Q05		0.01				0.01
Q37		0.64				0.41
Q45		-0.74				0.54
Q61		0.52				0.27
Q69		0.52				0.27
Q77		-0.75				0.57
Guilt (ξ_6)						
Q06			0.67			0.44
Q14			-0.45			0.21
Q22			0.65			0.42
Q30			0.52			0.27
Q38			-0.44			0.20
Q46			0.64			0.41
Extraversion (ξ_7)						
Q07				0.00		0.00
Q23				0.53		0.29
Q31				0.60		0.36
Q47				-0.38		0.15
Q71				-0.41		0.17
Q87				0.42		0.18
Arousal (ξ_8)						
Q08					0.00	0.00
Q16					0.08	0.01
Q24					0.43	0.18
Q48					-0.23	0.05
Q64					-0.35	0.12
Q96					0.41	0.18

Notes. GFI = 0.723; AGFI = 0.691; RMR = 0.108

Factor loadings are shown to two decimal places only.

Perusal of the communality estimates indicates that only one-third of the subscale items (Items 1, 6, 22, 27, 31, 33, 37, 41, 43, 45, 46, 68, 75, 77, 82, and 90) have communalities which are non-trivial ($\geq$.30).

All Λ_x factor loadings (except for Items 5, 10, 11, 12, and 28) are statistically significant at the 1% level or better, using univariate two-tailed tests.

Table 12

Covariances between Exogenous Latent Traits (Φ Matrix)

8SQ Subscale	AX	ST	DE	RG	FA	GI	EX	AR
AX								
ST	-1.00							
DE	-0.84	1.00						
RG	1.00	-1.00	-1.00					
FA	0.84	-0.98	-0.98	1.00				
GI	-0.99	1.00	0.81	-0.95	-0.84			
EX	0.69	-0.88	-1.00	0.89	0.83	-0.66		
AR	-0.91	1.00	1.00	-1.00	-1.00	0.71	-1.00	

Notes. Covariances are shown to two decimal places only.
The multicollinearity among these 8SQ is clearly evident.
AX = Anxiety; ST = Stress; DE = Depression; RG = Regression; FA = Fatigue; GI = Guilt; EX = Extraversion; AR = Arousal

CONCLUSIONS

Evidently, the 8SQ is potentially a useful mood-state instrument. However, in view of the apparent factor complexity of several of the 8SQ items (contributing to more than one mood-state dimension), and given the apparent lack of construct validity of at least half of the items, it would seem desirable to remove both complex items and those with trivial (≤.30) factor loadings from the 8SQ instrument. An abbreviated version of the instrument (comprising at least 48 psychometrically sound items) should minimize effects on mood states brought about solely through the process of responding to the items. While the exploratory factor analysis (Table 7) provided partial support for the construct validity of the 8SQ subscale structure, and while the congeneric factor analyses for the best six items in each subscale also provided somewhat encouraging GFI, AGFI, and RMR estimates, the evidence from the confirmatory factor analyses based on subsets of 48 items each was somewhat discouraging for the eight-factor nomological model proposed by Curran and Cattell (1976). It is evident from the obtained results that the 8SQ instrument is affected by problems associated with multicollinearity.

Given the less-than-adequate confirmation of the eight-factor model, it may be necessary to revise the structure of the instrument by reducing the number of subscales. A shortened 8SQ would be more efficient psychometrically, enabling quicker measurement of transitory mood states. The present findings suggest that a reallocation of items to a number of the 8SQ subscales also may be needed. Such a psychometrically refined version of the instrument should enable better research to be undertaken within the mood-state area.

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FOOTNOTE

[1]The GFI and AGFI indices are independent of sample size, whereas the χ^2 is directly affected by sample size, such that virtually all models are rejected when the sample size is large, as in the present instance. The AGFI is the statistic of choice, together with the RMR (mean residual variance-covariance resulting from comparison of the obtained vs. predicted covariance matrices).

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SEX AND AGE INTERACTIONS WITH THE STRUCTURED INTERVIEW GLOBAL TYPE A BEHAVIOR PATTERN AND HOSTILITY IN THE PREDICTION OF HEALTH BEHAVIORS

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ABSTRACT

A health-behavior survey and the Type A structured Interview (SI) were administered to a general-population sample of 903 adults. Self-reports of nine health behaviors were used as dependent variables. Multivariate analyses of variance followed by two series of three-way analyses of variance were conducted by age, sex, and SI-assessed global Type A (or hostility). There were main effects and/or two-way interactions for all of the dependent variables. Global Type A behavior and hostility were positively related to higher frequency-quantity of alcohol use, more frequently exceeding the speed limit, fewer hours of sleep, and less-frequent breakfast. Three-way interactions indicated that men under the age of 60 who were classified as Type A1 reported a higher frequency-quantity of alcohol use than any other subgroup. The highest percentage of current cigarette smokers was among the high-hostility young men. Implications for behavior-change programs and research are discussed.

INTRODUCTION

The Western Collaborative Group Study (Rosenman et al, 1966) identified the global Type A behavior pattern (TABP) as a predictor of coronary heart disease (CHD) among middle-aged men who were free of CHD at the onset of the study and who volunteered to participate. The TABP was defined by such characteristics as excessive drive, competitiveness, ambition, and hostility. The structured interview (SI), developed to assess the TABP, utilized an audiotaped interview to assess speech stylistics, such as speed of speaking, explosive speech, and voice volume, and interviewer ratings of other subjective characteristics such as hostility, anger-in, anger-out, and verbal competitiveness.

Dembroski and Costa (1987) and Williams (1987) have reviewed nearly thirty years of literature which has addressed the TABP-CHD relationship. These reviews have two important modifications of the original findings: 1) the TABP-CHD relationship may be due primarily to the hostility component of the SI, rather than the entire constellation of TABP components (Dembroski & Costa, 1987), and 2) the nature of the TABP-CHD relationship is probably dependent on age as well as sex (Williams, 1987), in that the TABP appears to be predictive of CHD only for middle-aged men.

Other recent research has focused on identifying behavioral correlates of TABP. Among the many variables studied in this regard have been health behaviors such as smoking, alcohol use, sleep habits, and exercise, with the hypothesis that health behaviors serve as moderators of the TABP-CHD relationship. The literature concerning the relationship between smoking and the TABP indicates that the results have depended to a large extent on the TABP assessment method used and the nature of the sample studied. For instance, in one study in which no significant relationship was found between the TABP and smoking, the TABP was measured with a German translation of the SI administered to a volunteer group of 212 policemen (Schmidt, Undeutsch, Dembroski, Langosch, Neus, & Ruddel, 1982). In another study in which no significant relationship was found, the TABP was assessed with the Jenkins Activity Schedule (JAS) in a group of 136 volunteer women (Dearborn & Hastings, 1987). In one study reporting a significant relationship between smoking and the TABP, Kittel, Kornitzer, DeBacker, Dramaix, Sobolski, Degre,& Denolin (1983) found a weak positive correlation ($r= .06$) between the speed/impatience and hard-driving components of the JAS and the smoking behavior of 2,225 volunteer businessmen working in Belgium who were aged 40-55. Howard, Cunningham, and Rechnitzer (1976), in their study of 236 male volunteer company managers, noted that a significantly larger percentage of SI-assessed Type A1's smoked. Neither Kittle et al. (1983) nor Howard et al. (1976), however, found a difference in smoking behavior between subjects who were classified as Type A (combining the A1 and A2 classifications) and Type B (combining the B3 and B4 classifications).

The results of studies by Haynes, Levine, Scotch, Feinleib, and Kannel (1978) and Rosenman, Friedman, Straus, Wurm, Jenkins, and Messinger (1966) support the age-dependent nature of the relationship between smoking and the TABP. Haynes, analyzing data from a nonrandom subset of the Framingham study sample, found that the smoking behavior of white-collar men over the age of 65 was significantly correlated (.38) with their Framingham Type A scale score, while this relationship was not observed in any other subgroup. Rosenman et al. (1966) found that a significant relationship between SI-assessed TABP and smoking existed for men aged 39-49 in the Western Collaborative Group Study, with a higher percentage of Type A's than Type B's who reported smoking. It may be important that the earlier studies almost always found a relationship between smoking and the TABP, while later studies tended not to find this relationship. Some of the conflicting results may be due to temporally specific smoking cessation rates and the kinds of people who quit smoking.

The literature on the relationship between TABP and alcohol intake is somewhat less complicated. Folsom, Hughes, Buehler, Mittelmark, Jacobs, and Grimm (1985) analyzed data from the National Heart, Lung and Blood Institute Multiple Risk Factor Intervention Trial study (1979), in which the TABP was assessed both with the SI and the JAS in a group of men 35-57 years old. The subjects were selected from a volunteer population deemed at a high risk of heart disease, although currently free of disease. The SI was administered to over 3,000 men, while the JAS was administered to more than 12,000. Heavy drinkers (those who had more than five drinks per day) were excluded from the analyses (Shekelle, Hully, Neaton, Billings, Borhani, Gerace, Jacobs, Lasser, Mittlemark, and Stamler, 1985). Although there was no overall difference between either SI or JAS-assessed Type A's and B's in the amount of alcohol they consumed during a 24-hour period, among those who did drink Type A subjects drank more frequently than Type B subjects, but no more at each occasion. The restriction of range that occurred by excluding those who drank more than five drinks per occasion may have mitigated against finding a relationship between amount of alcohol consumed and the TABP.

Cohen and Reed (1985) found that the JAS Type A score was significantly and positively related to alcohol use as measured by a quantity-frequency index based on the number of ounces of alcohol ingested in one month's time. This sample consisted of 2,187 men aged 50-70 who had come in for their second checkup for the longitudinal Honolulu Heart Program in 1970. The total sample of men (N = 8,000) was randomly selected from the population of men born between 1900 and 1919.

By contrast, Glynn et al. (1988), in a study of 1,556 men, found no significant relationship between the TABP and average alcohol consumption in the last year, problem drinking, or problems associated with drinking. This study differed from those cited previously in both sample selection and methodology. An alcohol frequency-quantity index was not utilized to measure alcohol intake, and the sample consisted of volunteer, nontransient, male workers who were screened on the basis of health. Respondents who had cirrhosis, as well as other diseases such as heart disease and hypertension, were excluded. Dearborn and Hastings (1987) also did not find a relationship between JAS-assessed TABP and alcohol intake. Their sample consisted of 136 volunteer women.

The relationship of the TABP with two other health behaviors, sleep and exercise, has not been studied extensively. Dearborn and Hastings (1987) measured the amount of regular exercise reported by 136 volunteer women and found no relationship between exercise and JAS-assessed TABP. Hicks, Pellegrini, Martin, Garbesi, Elliott, and Hawkins (1979) found a significant relationship between sleep duration and the JAS-assessed TABP in a study of 361 college students. Type A subjects reported less sleep than Type B subjects.

The purpose of the present study was to determine the extent of the relationships, within sex and age subgroups, between health behaviors and the SI-assessed global TABP and the SI-assessed hostility component, using a randomly selected population sample. The hypothesis was that younger and middle-aged men with higher scores on the hostility component and the global TABP would exhibit less healthful behavior, thereby providing at least a partial explanation for the findings that the TABP-CHD relationship is observed only among middle-aged men.

METHODS

Sample. A sample of Washtenaw County, Michigan, households was selected using multistage probability sampling procedures. To be eligible, respondents has to be 18 years old or older and not residing in the county primarily for the purpose of attending a college or university. Respondents were interviewed in their homes twice: the first time by a trained survey interviewer collecting data on a variety of sociological, psychological, sociodemographic, and health-related topics, and the second time by an interviewer trained in the administration of the structured Type A interview. These interviews were conducted independently because the expertise and approach required by each are different. The survey interviews ranged from one-half hour to three and one-half hours in length, with a median interviewing time of one hour and fifteen minutes, and the Type A interview averaged fifteen minutes. Of a total of 1,429 eligible respondents, 963 (66.9%) primary respondents completed the survey interview. Of these primary respondents, 903 (93.8% of those completing the interview) also completed the structured Type A interview. The 60 nonrespondents at this stage of interviewing either could not be relocated or refused the structured interview. Details of the sample selection, response rates, interviewer training, and quality-control procedures have been published (Moss et al., 1986).

Measures. The survey interview data discussed in this paper consisted of respondents' self-reports of the frequency of various health-related behaviors. All of the dependent variables except alcohol use were measured using single items with a higher score indicating a higher frequency of engaging in that activity. The alcohol frequency-quantity index was created by first multiplying each substance specific (beer, wine, liquor) frequency and quantity items together, then summing these three scores. This created a total alcohol frequency-quantity index summed across substances.

Subsequent to the completion of the Type A structured interview, a tape of the structured interview was rated for global Type A behavior using a sixteen-point scale. For the purposes of analysis, the global Type A measure was recoded to a four-point scale (A1, A2, X, and B). The hostility component of the Type A structured interview was scored on a five-point scale, with a higher score indicating a higher level of hostility. For the purposes of analysis, the hostility measure was recoded to a three-point scale (low, medium, high) to achieve more even distributions. These two measures, along with sex and age, were used as independent variables.

Analyses Two series of nine three-way analyses of variance were conducted to determine the main and interactive effects of SI-assessed global TABP (in one series of analyses) or hostility (in the second series), sex, and age on each of the nine health-behavior variables. In one series, the three-way analyses of variance were conducted using each of the nine health-behavior variables as dependent variables and SI-assessed global TABP, sex, and age as independent variables. In the second series of analyses of variance, the SI-assessed hostility score was used as an independent variable instead of the global TABP score. When significant F-ratios involving more than two groups were noted, the significance of differences among pairs of group means was assessed with the Scheffé test. Also due to the fact that analyses were being conducted on multiple dependent variables, the extent of the linear relationship among all independent and dependent variables was determined by calculating the Pearson product-moment correlations among all variables, and two multivariate analyses of variance were conducted, using sex, age, and the global TABP independent variables in one analysis and sex, age, and hostility in the other.

RESULTS

The sample size, score ranges, grand means,and standard deviations are presented in Table 1 for each independent and dependent variable. This table shows that the sample was 58% female and the mean age of the respondents was 40.61 years. The mean SI-assessed global TABP score was 2.37 (between X and A^2), and the mean SI-assessed hostility score was 2.05 on the three-point scale. The dependent variable means and standard deviations show that the mean reported frequency of working outside and eating breakfast were high (3.54 and 3.84, respectively, on the five-point scale), while reports of engaging in active sports and hiking/jogging were lower. The mean hours of sleep per night were 7.06. The mean score on frequency of exceeding the speed limit was 2.22 on the four-point scale (where a score of 2.0 indicated"sometimes"and a score of 3.0 indicated "almost always"). Of the 903 respondents, 52% reported ever having smoked cigarettes regularly, and 28% reported being current cigarette smokers. The mean alcohol frequency-quantity index score was 7.73.

Table 2 shows the correlations among all variables used in the analyses. The results reported below reflect, in part, the fact that the analyses employed correlated dependent variables as well as two correlated independent variables that were used in separate analyses. The primary overlapping dependent variables were found in the cluster including the alcohol-use variable, the two smoking variables, breakfast frequency, and exceeding the speed limit. Additional correlations that reached the .05 level of significance with this large sample, but were less than .20 in absolute value, included: positive correlations between breakfast frequency and hours of sleep; positive correlations among alcohol use, active sports participation, and hiking/jogging; a negative correlation between alcohol use and working outside; negative correlations between the

TABLE 1

VARIABLE DESCRIPTION, SCORE RANGES, N's, MEANS, AND STANDARD DEVIATIONS

Item	Range	N	Mean	SD
Age of Respondent	18 to 80	903	40.61	16.24
Sex of Respondent	1=Male 2=Female	903	1.58	.49
SI Score	1=B 2=X 3=A2 4=A1	903	2.37	.93
Hostility Score	1=low 2=Medium 3=High	889	2.05	.79
How often do you eat breakfast	1=Never 5=Every Day	902	3.84	1.32
How often do you engage in active sports	1=Never 5=Every Day	903	2.24	1.22
How often do you hike or jog	1=Never 5=Every Day	903	1.79	1.14
How often do you work outside	1=Never 5=Every Day	902	3.54	1.31
How many hours of sleep do you usually get a night	2-12 hours	902	7.06	1.26
Have you ever smoked cigarettes regularly	1=No 2=Yes	903	1.52	.50
Do you smoke cigarettes now	1=No 2=Yes	903	1.28	.45
How often do you exceed the speed limit when driving	1=Never 4=Always	840	2.22	.74
Total frequency/quantity of alcohol	0=None 100	899	7.73	9.36

two smoking variables and the hiking/jogging and the hours-of-sleep variables, and the negative relationships of exceeding the speed limit with hours of sleep and working outside. The only significant correlation among the variables used as independent variables in the study was that of.42 between the hostility score and the global TABP score.

The multivariate analyses of variance by sex, age, and the global TABP score indicated significance of all main and interaction effects except for the sex by age interaction. The multivariate analysis of variance by sex, age, and hostility indicated the significance of all main effects and a significant sex by hostility interaction. These results indicated the need to conduct separate analyses of variance on the single dependent variables to determine the differential effects for each of the dependent variables.

The results of the two series of three-way analyses of variance on the single dependent variables are summarized in Table 3. As shown in Table 3, the main effect of age was significant for eight of the health behaviors, the main effect of sex was significant for six, the main effect of the global TABP score was significant for four, and the main effect of hostility was significant for five of the health behaviors. The main effects of age indicate that the older group reported eating breakfast more frequently than the younger group; the younger group reported participating in active sports and hiking and jogging more often than did older respondents; and the older group reported working outside more often. Additionally, the middle-aged group, those between 30 and 55, reported fewer hours of sleep than the older and younger age groups, and a greater proportion of the older group reported current cigarette smoking. The younger group reported exceeding the speed limit more often and a higher frequency-quantity of alcohol use.

The main effects of sex were due to men reporting active sports participation, hiking and jogging more often than women; women reporting a greater frequency of working outside; and men reporting having ever smoked, exceeding the speed limit, and using alcohol more than women.

Of the four significant main effects of SI-assessed global TABP, the subjects classified as Type A1 reported eating breakfast least frequently, and those classified as Type B reported eating breakfast most frequently. The same relationship held for reports of exceeding the speed limit, with Type A1 subjects reporting speeding most often and Type B subjects reporting speeding least often. The opposite result was found for hours of sleep per night, with Type B subjects reporting the most hours of sleep and Type A1 subjects reporting the fewest hours of sleep per night. Type A1 subjects reported the highest frequency-quantity of alcohol use with a mean of 11.2, while the Type A2, X, and B subjects' means ranged between 7.0 and 7.2.

The significant main effects of the hostility measure closely paralleled the results regarding the main effects of the global Type A score. The respondents in the highest hostility category more often reported having ever smoked, eating breakfast less frequently, sleeping fewer hours, exceeding the speed limit more often, and a higher frequency-quantity of alcohol use than the other two hostility groups.

TABLE 2

CORRELATIONS AMONG ALL VARIABLES

(N=903)

	Breakfast frequency	Active sports	Hike or jog	Work outside	Hours of sleep	Ever smoke	Smoke now	Exceed speed limit	Total alcohol freq/quan	R's sex	R's age	4pt SI Score
Active sports	0.00											
Hike of jog	0.05	0.36										
Work outside	0.03	-0.02	0.01									
Hours of sleep	0.10	0.02	0.00	0.00								
Ever smoke	-0.21	-0.03	-0.09	0.02	-0.10							
Smoke now	-0.32	-0.05	-0.13	-0.02	-0.08	0.60						
Exceed speed limit	-0.13	0.10	0.05	-0.16	-0.08	0.07	0.06					
Total alcohol frequency/quantity	-0.24	0.08	0.08	-0.09	-0.03	0.19	0.23	0.17				
R's sex	0.06	-0.15	-0.14	0.13	0.02	-0.09	-0.04	-0.21	-0.29			
R's age	0.24	-0.30	-0.20	0.18	-0.04	0.01	-0.13	-0.25	-0.25	0.05		
4pt SI score	-0.09	0.01	0.01	0.06	-0.11	0.05	0.01	0.11	0.09	-0.02	0.07	
3pt Hostility	-0.11	0.06	-0.02	-0.04	-0.10	0.12	0.07	0.11	0.13	-0.05	-0.02	0.42

NOTE: Correlations of .07 or greater are significant at the p <.05 level;
Correlations of .09 or greater are significant at the p <.01 level.

As shown in Table 3, there were seven significant two-way interactions: two sex by hostility, two sex by global Type A score, one age by global Type A score, and two sex by age interactions. One of the sex by hostility interactions was for the dependent variable of the frequency-quantity of alcohol use measure. Among females, the mean frequency-quantity of alcohol use increased with increasing hostility scores (4.88, 5.30, 6.07) but were relatively low compared to the means for the males. The means for the low- and medium-hostility males (9.02, 9.10), while higher than those of the low- and medium-hostility females, were virtually identical to each other, while the high-hostility males' mean frequency-quantity of alcohol use was significantly higher (13.72) than any other sex-hostility subgroup.

The second sex by hostility interaction was noted for breakfast frequency. Among both men and women, reports of breakfast frequency were lower for the high-hostility group. Among men, the reported breakfast frequency was significantly lower for the high-hostility group ($\overline{X}$ = 3.53) than for the medium-hositility ($\overline{X}$ = 3.98) or low-hostility ($\overline{X}$ = 3.82) groups. Among women, there was little difference in reported frequency of breakfast by the high ($\overline{X}$ = 3.78) and medium ($\overline{X}$ = 3.80) hostility groups, while the low-hostility group reported the highest breakfast frequency ($\overline{X}$ = 4.17).

One sex by global TABP interaction occurred in the analysis of the hiking and jogging variable. Among women, the mean reported frequency of hiking or jogging was significantly higher for those classified as Type X ($\overline{X}$ = 1.79) than for the other three groups (B = 1.59, A2 = 1.55, A1 = 1.56). Among men, the mean reported frequency of hiking or jogging was higher for those classified as A2 ($\overline{X}$ = 2.18) than for the other three groups (B = 1.86, X = 1.92, A1 = 1.92). A significant sex by global TABP score interaction was also noted for the reported frequency-quantity of alcohol use. Again, the males' means were significantly higher than the females' means. Among women, there was little difference in the reported frequency-quantity of alcohol use by global TABP scores (B = 5.68, X = 5.00, A2 = 5.64, A1 = 5.76). Among the men, the mean reported frequency-quantity of alcohol use by those classified as A1 (16.10) was significantly higher than the other three subgroup means (B = 9.36, X = 10.59, A2 = 9.51).

The only age by global TABP score interaction was found for reported frequency of exceeding the speed limit. Among those under 30 years of age, the respondents who were classified as A1 reported a significantly greater frequency of exceeding the speed limit ($\overline{X}$ = 2.92) than the other global TABP groups (B = 2.37, X = 2.34, A2 = 2.30). Among those 30 to 59 years of age, there was a linear increase in reports of exceeding the speed limit with no difference between those classified as A1 and A2 (B = 2.04, X = 2.17, A2 = 2.34, A1 = 2.35). Among those 60 years of age and over,the respondents classified as Type X reported exceeding the speed limit more frequently ($\overline{X}$ = 1.90) than the other three global TABP groups (B = 1.58, A2 = 1.66, A1 = 1.71).

The final two-way interactions to be discussed are the sex by age interactions. The results are a reflection of changing health behaviors over the past fifty years. For the "have you ever smoked cigarettes" item, the percentage of men who reported having ever smoked cigarettes increased from 41% among those under

TABLE 3

RESULTS OF THREE-WAY ANALYSES OF VARIANCE

SERIES ONE: Sex by Age by Hostility Score (Low, Medium, High)
SERIES TWO: Sex by Age by Global Type A Score (B, X, A2, A1)

Dependent Variable	Significant Main Effects	P	Eta^2	Two-Way Interactions	P	Eta^2	Three-Way Interactions	P	Eta^2
Beakfast	Age	.001	.07	Sex x Hostility	.06	.02			
	Hostility	.05	.01						
	SI Score	.05	.01						
Active Sports	Sex	.001	.02				Sex x Age X SI	.01	.14
	Age	.001	.09						
Hike or Jog	Sex	.001	.02	Sex x SI	.05	.03			
	Age	.001	.05						
Work Outside	Sex	.001	.02				Sex x Age x SI	.05	.08
	Age	.001	.03						
Hours of Sleep	Age	.01	.0003						
	Hostility	.05	.01						
	SI Score	.05	.01						
Ever Smoke Cigarettes	Sex	.05	.01	Sex x Age	.001	.03			
	Hostility	.01	.02						
Smoke Cigarettes Now	Age	.001	.03	Sex x Age	.001	.03	Sex x Age x Host	.05	.05
Exceed Speed Limit	Sex	.001	.04	Age x SI	.01	.12			
	Age	.001	.02						
	Hostility	.01	.01						
	SI Score	.01	.01						
Alcohol Use	Sex	.001	.08	Sex x Hostility	.05	.11	Sex x Age x SI	.05	.15
	Age	.001	.03	Sex x SI	.01	.11			
	Hostility	.001	.02						
	SI Score	.001	.02						

30 years of age to 63% among those aged 30 to 59, and 73% among those 60 years of age or older. Among women, the trend was reversed, with 49% among those under 30 years of age reporting having ever smoked cigarettes, compared with 51% of those aged 30 to 59, and 34% among those 60 years of age or older. The other interaction between sex and age was found for the current-smoking item, which showed a different pattern of results than the "ever smoked" item. Among male respondents, 33% of those under 30 years of age reported current smoking compared with 34% among those 30 to 59 years old, and 8% of those over 59 years of age. Among the female respondents, 31% of the youngest age group reported current smoking compared with 28% of the middle-aged group and 15% of the oldest subgroup.

A significant three-way interaction was found for four of the health-behavior variables. A significant sex by age by global TABP interaction was found for the variables of working outside, active sports, and frequency-quantity of alcohol use variables. A significant sex by age by hostility interaction was found for the current-cigarette-smoking variable. In Table 4, the means, standard deviations, and cell sizes are shown for the sex by age by global TABP three-way interaction in the analysis of reports of frequency of active sports participation. Among the younger two subgroups of men, there was very little difference in the reports of active sports participation accounted for by the global TABP classification, while among the oldest subgroup of men those classified as Type A1 reported significantly less participation in sports than the other global TABP subgroups. Among women, there was very little difference in reports of participation in active sports due to global TABP classification within any age group.

The means, standard deviations, and cell sizes for the sex by age by global TABP interaction involving the frequency of working outside are presented in Table 5. In the youngest age group, the reports of frequency of working outside were consistently low across all global TABP classifications for men. Among the men 30 to 59 years of age, the means were higher than those of the younger subgroup, but very little difference in the frequency of outside work reported was due to the global TABP classification. Among men 60 years of age and over, the means were higher than for the other two age groups, and there was a linear increase in the amount of outside work reported with increasing global TABP scores. Among the younger women, the reports of outside work were low for those with global TABP classifications of B and A1, and the Type X and A2 young females reported moderate amounts of outside work. Among women 30 to 59 years of age, there was an increase in reports of the frequency of outside work with increasing global TABP scores, with no differences between those classified as A1 and A2. Among the older group of women, all global TABP groups reported high frequencies of outside work, with the exception of the moderate amount reported by the women over 60 classified as Type A2.

The cell sizes, means, and standard deviations for the sex by age by global TABP interaction for the frequency-quantity of alcohol use index are presented in Table 6. As discussed previously, both the sex and age main effects were significant for this variable. Among men under 30 years of age, as well as those 30 to 59 years of age, the reported frequency-quantity of alcohol use was significantly higher in the subgroups with a global TABP classification of A1 than in the other

TABLE 4

CELL SIZES, MEANS AND STANDARD DEVIATIONS

Sex by Age by Global TABP Classification Interaction
Frequency of Participation in Active Sports

	Men						Women					
	<30		30-59		60+		<30		30-59		60+	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
SI Group												
B	3.03	1.20	2.33	1.20	1.50	1.17	2.06	1.07	2.47	1.32	1.30	1.80
n	31		36		12		36		36		20	
X	2.51	1.20	2.38	1.17	2.17	1.25	2.63	1.17	2.04	1.11	1.18	.73
n	43		74		18		68		104		38	
A2	3.15	1.35	2.42	1.27	2.00	1.54	2.63	1.07	2.03	1.04	1.56	1.21
n	27		69		12		41		89		34	
A1	3.00	1.56	2.34	1.26	1.00	.0	2.27	.90	2.26	1.05	1.44	1.01
n	15		38		7		11		34		9	
Total	2.86	1.30	2.38	1.21	1.80	1.26	2.47	1.12	2.13	1.11	1.36	.95
n	116		217		49		156		263		101	

global TABP subgroups. Among men 60 years of age and older, the reported frequency-quantity of alcohol use showed a linear increase with global TABP classification through the A2 subgroup, with a sharp decrease in reports of the frequency-quantity of alcohol use in the A1 subgroup. Among women, there was little variation in reports of the frequency-quantity of alcohol use due to global TABP classification within any of the age subgroups.

The only sex by age by hostility interaction was noted in the analysis of reports of current cigarette smoking. Table 7 shows the cell sizes, means, and standard deviations for this analysis. The pattern of results on the current-smoking variable shows that among younger men 46% of the high-hostility and 19% of the medium-hostility subjects were current smokers, compared with 33% to 37% among the middle-aged group at all levels of hostility, as well as the low-hostility younger men. Among the older men, a maximum of 17% were current smokers. Among the women, 25% to 32% were current smokers in all subgroups except the low-hostility middle-aged group (17%), the low-hostility older group (16%), and the medium-hostility older group (4%).

TABLE 5

CELL SIZES, MEANS AND STANDARD DEVIATIONS

Sex by Age by Global TABP Classification Interaction
Frequency of Working Outside

	Men						Women					
	<30		30-59		60+		<30		30-59		60+	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
SI Group												
B	3.13	1.20	3.31	1.26	3.42	1.62	3.17	1.42	3.11	1.43	4.25	.85
n	31		36		12		36		36		20	
X	3.10	1.23	3.53	1.33	3.78	1.40	3.50	1.25	3.57	1.32	4.29	1.25
n	42		74		18		68		104		38	
A2	3.04	1.26	3.22	1.22	4.17	1.27	3.68	1.21	3.90	1.16	3.74	1.62
n	28		69		12		41		89		34	
A1	3.00	1.36	3.29	1.33	4.57	.53	3.09	1.22	3.94	1.04	4.33	1.00
n	15		38		7		11		34		9	
Total	3.08	1.23	3.35	1.28	3.90	1.36	3.44	1.29	3.67	1.27	4.10	1.32
n	116		217		49		156		263		101	

DISCUSSION

The findings that subjects with high global TABP and hostility scores reported fewer hours of sleep, a greater frequency of exceeding the speed limit, a higher frequency-quantity of alcohol use, and a lower frequency of eating breakfast are consistent with the early characterization of the Type A individual as one who tries to do more in less time, and thus lend support to the construct validity of the TABP. The finding of a positive relationship between the Type A classification and the positive (participation in active sports, hiking, jogging, and working outside) as well as negative (smoking, alcohol use, speeding) health behaviors also suggests a general high-drive personality "type" related to doing more of everything faster.

The analyses reported in this paper were also conducted substituting the other TABP components measured in this study (voice volume, voice emphasis, response latency, verbal competitiveness, and speed of speaking), for hostility or the global TABP rating as an independent variable in the three-way analyses of

TABLE 6

CELL SIZES, MEANS AND STANDARD DEVIATIONS

Sex by Age by Global TABP Classification Interaction
Frequency-Quantity of Alcohol Use Index

	Men						Women					
	<30		30-59		60+		<30		30-59		60+	
SI Group	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
B	10.55	11.47	9.34	12.16	6.33	9.39	6.50	5.28	5.50	4.70	4.55	10.98
n	31		35		12		36		36		20	
X	11.16	10.09	10.37	9.43	10.11	13.94	7.47	5.63	4.53	4.69	1.81	2.76
n	43		73		18		68		104		37	
A2	10.86	7.81	8.46	8.10	12.42	15.05	6.55	6.54	6.51	6.69	2.32	3.51
n	28		69		12		40		89		34	
A1	22.00	26.55	15.89	14.39	4.57	5.74	6.64	5.28	6.12	6.32	3.33	2.78
n	15		38		7		11		34		9	
Total	12.32	13.57	10.57	10.81	8.96	12.38	6.95	5.74	5.54	5.69	2.67	5.63
n	117		215		49		155		263		100	

variance. The significant results noted for the global TABP and hostility scores were not found for these other components. The results of these analyses thus support the hypothesis that hostility is the important component in the relationship with the health behaviors employed in this study. The implication of these results for behavior-change programs is that dealing with hostility and the associated behavioral manifestations is an important component for programs directed at reducing Type A behavior. The inclusion of such a component could also be beneficial in smoking-cessation programs as well as programs for treatment of alcohol problems.

The most striking finding in these results is that of the higher frequency-quantity of reported alcohol use among young and middle-aged male respondents classified as Type A1. There are implications in this finding for prevention and behavior-change programs as well as for future research. The findings suggest that programs directed at the modification of Type A behavior may benefit from screening men for alcohol use and appropriate referral when alcohol problems are noted. Conversely, programs for the treatment of alcohol problems might

TABLE 7

CELL SIZES, MEANS AND STANDARD DEVIATIONS

Sex by Age by Global TABP Classification Interaction
Current Cigarette Smoking

	Men						Women					
	<30		30-59		60+		<30		30-59		60+	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Hostility Group												
Low	1.37	.49	1.37	.49	1.01	.05	1.30	.47	1.17	.38	1.16	.37
n	35		49		16		46		66		45	
Medium	1.19	.39	1.34	.48	1.17	.38	1.32	.47	1.32	.47	1.04	.19
n	43		77		18		65		98		27	
High	1.46	.51	1.33	.47	1.08	.27	1.31	.47	1.32	.47	1.25	.44
n	37		86		14		42		97		28	
Total	1.33	.47	1.34	.47	1.07	.28	1.31	.47	1.28	.45	1.15	.36
n	115		212		48		153		261		100	

benefit from screening men for Type A characteristics and the introduction of relaxation training and hostility reduction forthose classified as Type A1 or high hostility. The implication for prevention programming is that relaxation training might be a useful component of alcohol-misuse prevention programs for adolescents. This presumes that the relationship between alcohol use and Type A behavior stems from an attempt by Type A subjects to find a chemical means for reducing tension. It is, however, equally likely that increased use of alcohol induces tension. Additional longitudinal research is necessary to determine the temporal sequence in the relationship.

The findings that the negative health behaviors are positively related to the TABP primarily among younger and middle-aged men, while among older men the relationship between the TABP and negative health behaviors is negative, are congruent with recent findings by Dembroski and Costa(1987) and Williams (1987) that the positive relationship between the TABP and CHD is found only among men under the age of 60, while among men over 60 years of age the TABP-CHD relationship is negative. Longitudinal studies are also required to determine the factors responsible for the age-related change in the relationships among the TABP, health behaviors, and CHD.

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THE 16 PF: PERSONALITY IN DEPTH

Heather B. Cattell
(1989)
Champaign IL: Institute for Personality and Ability Testing.
354 pp. $19.95 (paperback)

Review by
Fred H. Wallbrown
Kent State University

In my opinion, *The 16 PF: Personality in Depth* represents the culmination of the first phase of providing clinicians with access to R. B. Cattell's contributions to psychology. This book was obviously written by a brilliant clinician with a profound knowledge of Cattell's personality theory. She writes in a language that clinicians can understand, and, at the same time, presents R. B. Cattell's formulations with flawless precision. It is a truism to assert that the major problem with Cattell's contributions is that they have not been accessible in a form that is intelligible to most practitioners. The landmarks in the process of dissemination are clearly discernible beginning with the publication of the *Handbook for the 16 PF* (Cattell, Eber, & Tatsuoka, 1970) and extending through the publication of *A Guide to the Clinical use of the 16 PF* (Karson & O'Dell, 1976) and *Functional Psychological Testing: Principles and Instruments* (Cattell & Johnson, 1986). All of these earlier works provide valuable tools for familiarizing students and colleagues with Cattell's work. However, none of the books are serious rivals for Heather B. Cattell's The *16 PF: Personality in Depth* insofar as either scope or depth are concerned. This book is clearly the definitive work on the clinical interpretation of the 16 PF.

My assertion that this book represents the culmination of the first phase in the dissemination of Cattell's ideas is not meant to imply that H. B. Cattell's ideas are complete and cannot be expanded or improved upon. Quite the contrary. In fact, she herself frequently acknowledges that many of her ideas are tentative and based on case histories, interview data, and clinical impressions rather than "hard data" from multivariate research. There is plenty of room for researchers and clinicians to refine, enhance, and modify the insights suggested in this work. This assertion is rooted in different grounds.

Adequate resources are now available so that instructors can do a good job of introducing the clinical interpretation of the 16 PF to their students. Practitioners with a reasonable degree of initiative will also find that the clinical interpretation of the 16 PF is within their grasp. Yet, this is only one part of the picture. Hopefully, the second phase in the dissemination of R. B. Cattell's contributions will involve familiarizing clinicians with the use of the Clinical Analysis Questionnaire (CAQ) (Krug, Cattell, & IPAT Staff, 1980), which not only includes all the primary and secondary factors from the 16 PF, but also provides scores for twelve dimensions of psychopathology and four additional secondaries. The measurement of psychopathology is a must for clinicians in many settings. It is not likely that the CAQ will receive the attention that it deserves until clinicians are provided with more specific instructions about how it can be used in differential diagnosis, planning intervention programs, and monitoring the progress of counseling/psychotherapy. Clearly, the second phase in the dissemination of R.B. Cattell's work should include a series of works devoted to the clinical interpretation of the CAQ.

There are those who believe that Cattell's motivational theory represents his most brilliant contribution to psychology. The assessment procedures generated from his motivational theory are available in the form of the Motivational Analysis Test (MAT) (Cattell, Horn, Sweeney, & Radcliffe, 1964) for adults and the School Motivational Analysis Test (SMAT) (Krug, Cattell, & Sweeney, 1976) for adolescents. Both of these tests warrant much more attention than they have received from either researchers or clinicians. Hopefully, the second phase in the dissemination of Cattell's contributions will include works devoted to the clinical interpretation of the MAT and SMAT.

Looking at this work from another perspective, it is well worth noting that its subtitle, "Personality in Depth," does a useful job of conveying its essence. The depth of H.B. Cattell's insights about the clinical interpretation of the 16 PF go much beyond what is available elsewhere. The guts of this book are to be found in chapters 2-17, which are devoted to explaining and interpreting the sixteen dimensions of normal personality development measured by the 16 PF. The first chapter, entitled "Introduction," provides a very brief overview of the 16 PF along with the author's description of her experience with this test and the sample that she used in developing her ideas and insights. The last chapter, "The Second-Order Factors: The Underlying Organizers of Temperament," contains some worthwhile ideas that will be of interest to practitioners. In comparison with other available sources, however, the material on the interpretation of the secondaries in chapter 18 is not so distinctly superior as the material presented in the chapters devoted to describing the primaries. In fairness, one must acknowledge that this chapter would come across as being longer as well as stronger if the author confined all of her ideas and insights about the secondaries to Chapter 18. She chose to do otherwise, however. Some of the author's best insights about the secondaries are scattered through the earlier chapters.

The format for chapters 2-17 is relatively uniform. Each chapter begins with a description of the personality dimension described in that chapter. What makes the subtitle, "Personality in Depth," appropriate for this book is the richness of H.B. Cattell's clinical insights about what the 16 PF primaries are measuring. Each chapter begins with a description of R. B. Cattell's ideas about what the dimension is measuring. The ideas of other 16 PF authorities (e.g., Karson & O'Dell, 1976) are also brought forth and given full consideration and fair treatment. But what makes this book truly outstanding is the bridging which

H.B. Cattell achieves between R.B. Cattell's work and that of "mainline" clinicians and clinical theorists. The main bridging thrust is toward Freud (e.g., 1946, 1961) and his followers (e.g., Hartman, 1939; A. Freud, 1936; Winnicott, 1964; and Erickson, 1968) along with Jung (1928), but the ideas of others are sometimes considered (e.g., Adler, 1957; Witkin, 1962; and Shapiro, 1965). The author not only bridges, but she does so with skill and fluency. This is clearly one of the features of this book that justifies the subtitle, "Personality in Depth."

The chapter format also includes discussions of heritability, sex differences, and developmental changes across the life span. This information is useful, but it is neither so impressive nor so unique as H.B. Cattell's descriptions of high and low scores on each of the primaries. She offers a wide range of creative ideas about the dynamics and etiology involved in high and low scores on the different 16 PF primaries. Here H.B. Cattell is definitely at her best as she draws on interview data and clinical experience to generate promising ideas, insights, and hypotheses. In numerous cases, she offers several alternative hypotheses for use in interpreting high and low scores. All of the sixteen chapters on the primaries contain sections devoted to the "clinical relevance" of both high and low scores. The chapters are organized quite well, with the general information about the construct presented first followed by separate sections devoted to the understanding and interpretation of high and low scores. This, of course, means that the clinical relevance of high and low scores is covered in separate subsections of the chapter. The material covered in the "clinical relevance" subsections varies from treatment suggestions and ideas for differential diagnosis through suggestions for care management and predictions concerning emotional adjustment/behavioral problems.

Another distinct feature of this book which warrants the subtitle, "Personality in Depth," is to be found in the author's care in showing how scores on one primary personality dimension can interact with scores on one or more other dimensions to refine and enhance the interpretation of all of the primaries involved. An excellent example of this is to be found in the author's discussion of the "clinical relevance" of O+ (Guilt-Prone) scores in the chapter devoted to that primary (pp. 228-231). Here H. B. Cattell discusses five score configurations that can combine with O+ scores to alter the meaning of that score. Another excellent example of this type of configurational analysis is to be found in the chapter on E (Dominance), where the author (pp.82-86) describes five patterns resulting from the interaction of E-scores with other 16 PF primaries. These are but two instances pulled out to illustrate a trend that is evident throughout all sixteen chapters devoted to the primary personality dimensions. Such consistent use of configurational interpretation of the 16 PF primaries brings that test to a new level of clinical sophistication that has been attained by few personality tests.

Still another commendable feature of H.B. Cattell's *The 16 PF: Personality in Depth* is that it comes in paperback and carries a reasonable price, which puts it within the reach of graduate students as well as practitioners. I have no hesitation whatsoever in recommending this book for clinicians and advanced graduate students who are reasonably familiar with the 16 PF and Cattell's personality theory. *A Guide to the Clinical Use of the 16 PF* by Karson and O'Dell (1976) is still my preference for rank beginners who are not already familiar with the 16 PF. These two books are quite different and should not be regarded as competitors. As I see it, the H. B. Cattell text takes up where Karson and O'Dell (1976) left off. These two books are complementary and should be on the shelf of any psychologist who practices or teaches in the area of personality assessment. Needless to say, both books have their place in graduate training programs for counseling psychologists and clinical psychologists. Persons in related areas such as counselor education will find this book invaluable in their work.

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