DOT/FAA/AM-03/14

Office of Aerospace Medicine
Washington, DC 20591

Personality Characteristics of Air Traffic Control Specialists as Predictors of Disability Retirement

Carolyn Dollar
Dana Broach
David J. Schroeder
Civil Aerospace Medical Institute
Federal Aviation Administration
Oklahoma City, OK 73125

October 2003

Final Report

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

BEST AVAILABLE COPY

U.S. Department of Transportation
Federal Aviation Administration

20040713 057

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents thereof.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/AM-03/14		

4. Title and Subtitle	5. Report Date
Personality Characteristics of Air Traffic Control Specialists as Predictors of Disability Retirement	October 2003
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Dollar C, Broach D, Schroeder D	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
FAA Civil Aerospace Medical Institute P.O. Box 25082 Oklahoma City, OK 73125	11. Contract or Grant No.
12. Sponsoring Agency name and Address	13. Type of Report and Period Covered
Office of Aerospace Medicine Federal Aviation Administration 800 Independence Ave., S.W. Washington, DC 20591	14. Sponsoring Agency Code

15. Supplemental Notes

Work was accomplished under approved task AM-B-03-523.

16. Abstract

INTRODUCTION. Previous research has demonstrated that psychological factors may play a role in disability retirements. The purpose of this study was to investigate whether psychological factors such as personality were related to disability retirements from the air traffic control specialist (ATCS) occupation. METHOD. Fifty-two cases of controllers retiring on disability between October 1995 and September 2001 were matched exactly on four characteristics with 104 active controllers: (a) age at entry; (b) gender; (c) race; (d) air traffic option. About half of the cases were also matched exactly with controls on aptitude test score; the remainder was matched within a narrow range of scores. Personality had been assessed at entry with Cattell's 16 Personality Factor (16PF) test. On average, the 16PF was administered about 12 years before the disability date (range 6 to 24 years). Multivariate discriminant analysis between groups (retired cases versus active controllers) was conducted using the 16PF standardized scale scores.

RESULTS. Overall, a discriminant function based on three of the 16 scales correctly classified 69.2% of subjects (Wilk's lambda = .807, chi-square(3) = 32.8, $p < .001$): Sensitivity (standardized discriminant coefficient = .386); Suspiciousness (-.313); and Tension (.340).

DISCUSSION. The analysis found that controllers taking disability retirement were less suspicious, more sensitive, and more tense than active controllers. These results are consistent with previous research in other occupations showing that psychological factors are related to disability retirements (Rogers, 1998). However, the relatively low proportion of variance accounted for by the discriminant function suggests that factors other than personality may also be related to disability retirements in the ATCS occupation. Future research should focus on identifying and describing the interactions between individual controller characteristics, working conditions, and task demands to better understand the etiology of disability retirements.

17. Key Words	18. Distribution Statement
Personality, Predicting Disability Retirement, 16PF Characteristics, Air Traffic Control Specialist	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	10	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Personality Characteristics of Air Traffic Control Specialists as Predictors of Disability Retirement

INTRODUCTION

The number of U. S. workers leaving employment for reasons of disability has increased over the past decade. Between 1990 and 1999, the number of persons receiving Social Security disability benefits grew from 3,011,000 to 4,879,000 (U. S. Census Bureau, 2001). During the same years, 54,359 civilian government employees took disability retirements (OPM, 2002), representing 12.5% of all civilian retirements from the federal workforce. Because disability has an obvious adverse impact on the retiree and increases costs to employers in monetary monthly payouts and medical benefits, recent literature has focused on measures to better understand the factors involved in disability retirements.

Review of Recent Research to Understand Factors Involved in Disability Retirements

Previous research has focused on worker's compensation claims and psychological factors (see, for examples, Hui, Arvey, Butler, & Nutting, 2001; Butcher & Harlow, 1987). As worker's compensation claims may precede a disability retirement, researchers have hypothesized that psychological factors (e.g., personality) may also be related to disability retirement. Rosen, Frymoyer and Clements (1980) found that the Hypochondriasis and Hysteria scales from the Minnesota Multiphasic Personality Inventory (MMPI) were significant predictors of disability in patients with lower back pain.

Fore (1998) found that two psychological scales, Locus of Control Scale (LOC) and the Safety Locus of Control (SLOC), predicted on-the-job injuries. The LOC was also a significant predictor of whether or not an injured worker filed a claim for worker's compensation. Krause et al. (1997) found that a variety of factors were significantly associated with disability retirements. These included among others: (1) physical factors such as heaviness of workload; (2) environmental influences such as having to work in an uncomfortable position for an extended period of time; and (3) psychological aspects such as mental strain or job dissatisfaction. Furthermore, Haldorsen, Indahl, and Ursin (1998) studied employees for whom interventions had been taken to correct low back pain. A discriminant analysis of scores from several psychological tests resulted in correctly classifying 72% of the nonreturners versus returners to work. The dominant factor in determining group membership in that analysis was the Internal Health Locus of Control measure. A subsequent discriminant analysis in the same study using medical, work ability, psychological, and other variables resulted in a correct classification of 77% of the members, and the same locus of control measure continued to be a major contributor.

In an exploration of early retirements among male ambulance personnel versus other health care staff, Rodgers (1998) found musculoskeletal, circulatory, and mental disorders (a large proportion of which were related to alcohol problems) to be the chief causal factors. Thus, even with studies in which physical disability was the primary focus, scientists in several countries have employed a variety of psychological tests to investigate the role of those factors in on-the-job injuries, workman's compensation claims, and eventual claims for disability retirement.

There are several reasons that the current study was conducted. First, as with all federal agencies, the Federal Aviation Administration (FAA) has recently been tasked with becoming more efficient with Congressional funding. Second, about one-third of the agency's employees are air traffic control specialists (ATCSs), who represent comparatively high costs in training until they reach a fully proficient performance level. Finally, disability retirement under the federal system can only occur when an agency has exhausted all reasonable attempts to retain that employee in a productive capacity through accommodation or re-assignment. Since the ATCS occupation is one that requires special skills, opportunities for job transfers are limited. Hence, it would be financially beneficial for the agency to identify factors related to ATCS disabilities so that interventions might be designed to reduce those kinds of retirements.

The FAA has used Cattell's 16 Personality Factor Test ("16PF," 1949) as part of the medical exam for individuals entering the agency as ATCSs since the early 1960s. Historically, the test (Forms A and B) was first used to identify/protect controllers who might experience "burn out" or other stress effects later in their careers (Holbrook, 1974). Eventually it was used as a screen to help the agency locate potential employees with profiles requiring a more in-depth psychological evaluation (Convey, 1984).

Scores on the 16PF were used in this study to determine personality characteristics that might be associated with disability retirements from the controller workforce. In view of the stability asserted for personality traits (Costa & McCrae, 1980; Soldz & Vaillant, 1999) and the previous research, we hypothesized that personality traits measured

at entry into the ATCS occupation might differentiate between controllers that leave the occupation on the basis of a disability retirement and those that remain active and employed in the occupation.

METHOD

Sample

A search of data extracted from the FAA's Consolidated Personnel Management Information System (CPMIS) identified records for 55 disability retirees from the terminal and en route ATCS workforce between October 1995 and September 2001. These cases were matched with records for currently active controllers on: (a) age at entry; (b) gender; (c) race; (d) air traffic option; and (e) scores on the competitive OPM ATCS aptitude test battery (TMC). Three disabled subjects were eventually excluded due to missing data, resulting in a sample of 52 disability retirees and 104 active controllers.

Cases and controls were matched first on age, gender, race, and option, then on aptitude. Because of the variability in TMC scores, just over half of the disability retirees were matched exactly on TMC by two control cases. When an identical TMC score could not be found, control subjects were drawn randomly from a pool with scores within about ±5 points on a 70 to 100 point scale. As indicated before, Cattell's 16PF test had been collected for the subjects and controls as part of the pre-hire medical examination. Thus, the 16PF scores were available for all subjects who were retained in the study. On average, the 16PF had been administered 12 years prior to the year of the disability retirement (range 6 to 24 years) for the cases in the study. Characteristics of the controllers in the active and disability retiree groups are shown in Table 1.

Measures/procedure

As already stated, Cattell's 16 PF has been administered as a pre-screen for ATCS candidates for over 30 years. Each of the two forms (A and B) of the test is comprised of 187 items that have two opposite response choices (i.e., "always" or "never") and a "neutral" choice (i.e., "sometimes"). Scale scores were computed from item responses and converted into sten scores in accordance with Cattell, Eber, and Tatsuoka, (1970). Appendix A provides a brief description of the 16 factors and characteristics of persons with either low or high scores on each factor. A stepwise multivariate discriminant analysis was performed using SPSS version 10.0 (SPSS, 2002) on the data.

RESULTS

Descriptive Statistics

Table 1 shows that the TMC scores were highly similar (M=91.9, SD=4.9 versus 91.7, SD=4.9) for the disability retirees, compared with the non-disabled group

Table 1. Characteristics of ATCS active controllers and disability retirees.

	Group*	
Variable	Active Controllers (N=104)	Disability Retirees (N=52)
Gender – Males	68	34
Females	36	18
Ethnic – Black	6	3
White	98	49
Option – Terminal	44	22
Enroute	60	30
Age at entry* – Mean	26.15	26.15
SD	2.9	2.9
Minimum	19	19
Maximum	31	31
TMC – Mean	91.7	91.9
SD	4.9	4.9
Minimum	71.3	76.1
Maximum	100.0	100.0

* Note: Current mean age for the disability retiree group =37, SD=3.8, range=28-46 yrs.

respectively. Not shown, the retirement age (37 versus 49) and length of tenure before leaving (12 versus 17 years) for the disabled ATCSs were both much lower than that for the average federal disability retiree (OPM, 2002). This was expected, however, since ATCS employees are younger on average than most other federal occupations and retire with disabilities earlier than the non-controller FAA workforce (Holbrook, 1974). Figure 1 shows the mean sten scores on each of the 16 factors for the active ATCSs versus the disability retirement group.

Visual inspection of the means and the graphed 16PF data suggested that there were no remarkable differences between the groups. (See Figure 1). The goal of our analysis was to determine which personality factors distinguished between active and disabled subjects. Therefore, univariate tests for differences, factor by factor, were not appropriate. Instead, multivariate discriminant analysis was employed to determine the unique contribution of each personality factor and to construct a statistical function for distinguishing between groups.

Discriminant Analysis

Results of the stepwise discriminant analyses showed that the best predictor variables of group membership were Sensitivity (I), Suspiciousness (L), and Tension (Q4). However, these three variables accounted for only about 20% of the variance (Wilk's $\Lambda = .807$, $\chi^2(3) = 32.8$, $p < .001$). Overall, 69.2% of the cases were correctly classified. The function coefficients that were generated by the analysis are shown in Table 2. The discriminant function was:

$$D = -8.10 + .386\,(I\text{-}Sten) - .313\,(L_Sten) + .340\,(Q4_Sten),$$

indicating that disabled ATCSs are less suspicious but more sensitive and tense than those in the control group.

DISCUSSION

This study replicates the findings of previous research in that psychological factors may be helpful in predicting negative work-related outcomes such as disability retirement. For example, personality and locus-of-control measures have been shown to differentiate between groups with and without negative work-related health outcomes (Fore, 1998). Similar levels of predictability were found across the current study and the Haldorsen et al. 1998 study (over 69% of the ATCSs, compared to from 72% to 77% of subjects in the latter study, respectively, were correctly classified). As in the Krause et al. 1997 study, information in this study was collected prior to the onset of the disability. However, the current study was unique in that the data were gathered prior to the ATCSs entry on duty.

Controllers on disability retirement, when compared with active controllers, were found to be less suspicious, more sensitive and insecure, and generally more tense and frustrated. A difficulty in interpreting these findings is that while the average score on the tension measure for the disability retirees revealed greater tension than that of the active controllers, the average was still below that of the normative group on the 16PF. For the other two personality dimensions, Sensitivity and Suspiciousness,

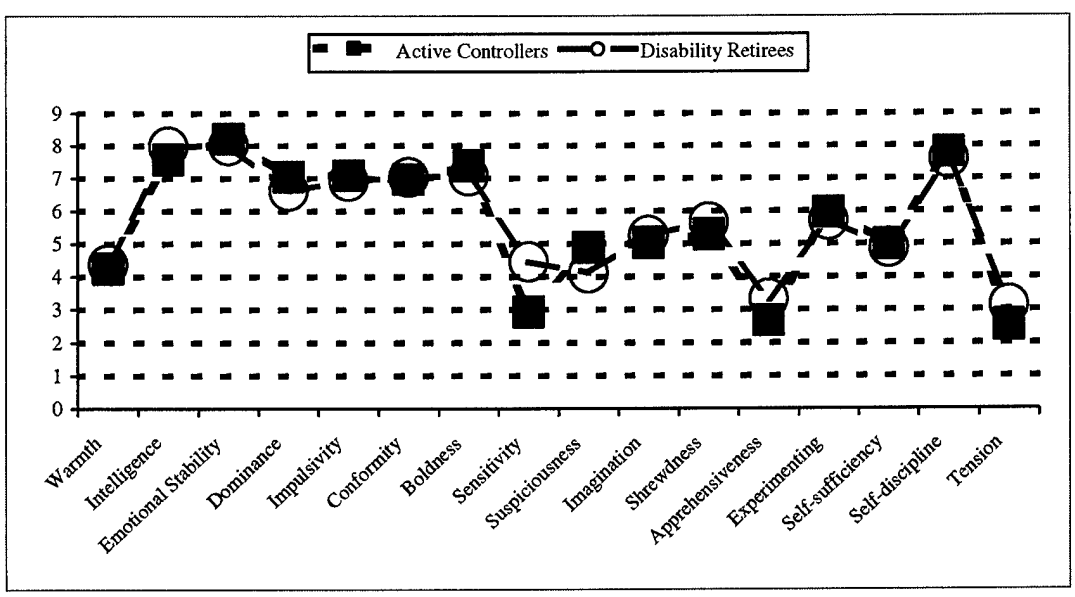

Figure 1. 16PF profiles for currently active ATCSs versus those retired with a disability.

Table 2. Discriminant Function Coefficients

Variable	Group* Not Disabled	Disabled	β
I-STEN (sensitivity)	1.066	1.0464	β_1 .386
L_STEN (suspiciousness)	1.520	1.197	β_2 -.313
Q4_STEN (tension)	.117	.468	β_3 .340
(Constant)	-5.854	-7.56	β_0 -8.10

disability retirees were in the average range. Thus, while the comparisons reveal a difference on certain personality dimensions for active controllers versus disability retirees, the overall profile for the group of disability retirees was comparable to that of other individuals entering into the ATCS profession. They evidenced an above- average level of intelligence; high self-reported emotional stability and self-sufficiency; and were generally venturesome, assertive, and conscientious. These findings suggest that upon entry on duty as an ATCS, the disability retirees present themselves, on the basis of their responses to the 16PF, in ways that are similar to that of other controllers.

The magnitude of the effects of psychological factors in the current study suggests that other factors may play a more prominent role in shorter job tenure. Stressors such as the tasks inherent in the job itself, variable work shifts, other job-related factors, or the match between the individual abilities and the demands of the job might very well contribute more reliably toward the identification of persons who leave employment with disability retirements. In addition, there are indicators that experiences outside the work environment contribute to how people feel about their work. Thus, we need to enlarge our search to identify the other situational, interactive and both work and non-work-related factors that may contribute more substantially to the incidence of medically disabling conditions within the ATCS workforce.

REFERENCES

Butcher, J.N. & Harlow, T.C. (1987). Personality assessment in personal injury cases. In I.B. Weiner & A.K. Hess (Eds.) *Handbook of forensic psychology* (pp. 128–54). New York: Wiley.

Cattell, RB. (1949). *The Sixteen P.F. Questionnaire* (1st ed.). Champaign, IL: Institute for Personality and Ability Testing, Champaign, IL.

Cattell, R., Eber, H. and Tatsuoka, M. (1970). *Handbook for the Sixteen P.F. Questionnaire* (1st ed.). Institute for Personality and Ability Testing, Champaign, IL.

Convey, J.J. (1984). Personality assessment of ATC applicants. In S.B. Sells, J.T. Dailey, and G.W. Pickrell (Eds.) *Selection of Air Traffic Controllers, 1984.* (DOT/FAA/(DOT/FAA/AM-84/2). Washington, DC: Federal Aviation Administration Office of Aviation Medicine.[1]

Costa, P.T. Jr., & McCrae, R.R. (1980). Still stable after all these years: Personality as a key to some issues in adulthood and old age. In P.B. Baltes & O.G. Brim, Jr. (Eds.) *Life span development and behavior* (Vol. 3, pp. 65–102). New York: Academic Press.

Fore, T.A. (1998). Predicting workers' compensation claims and on-the-job injuries using four psychological measures. (Doctoral dissertation, University of North Texas, 1998). UMI number 9841419. *Dissertation Abstracts International, 59* (7A), 2601.

Holbrook, H., (1974). *Civil Aviation Medicine in the Bureaucracy*, Bethesda, Maryland.

Haldorsen, *E.*, Indahl, A., and Ursin, H, (1998). Patients with low back pain not returning to work. *Spine,* 23(11), 1202-8.

Hui, L., Arvey, R.D., Butler, R.J., & Nutting, S.M. (2001). Correlates of work injury frequency and duration among firefighters. *Journal of Occupational Health Psychology, 6,* 229–42.

[1]This publication and all Office of Aerospace Medicine technical reports are available in full-text from the Civil Aerospace Medical Institute's publications Web site: http://www.cami.jccbi.gov/aam-400A/index.html

Krause, N., Lynch, J., Kaplan, G., Cohen, R.D., Goldberg, D.E., and Salonen, J.T. (1997). Predictors of disability retirement. *Scandinavian Journal of Work Environment Health*; 23, 403-13.

Office of Personnel Management (2002). *Retirement Statistics.* Washington, DC: Author.

Rodgers, L. (1998). A five-year study comparing early retirements on medical grounds in ambulance personnel with those in other groups of health service staff. Part II: Causes of retirements. *Occupational Medicine;*48(2) 119-32.

Rosen, J., Frymoyer, J. Clements, J. (1980). A further look at validity of the MMPI with low back patients. *Journal of Clinical Psychology*, 36(4), 994-1000.

Rotter, J. (1966). Generalized expectancies for internal versus external control reinforcement. *Psychological Monographs*, 80: 1-28 (1, Whole No. 609).

Schroeder, D., Broach, D. and Farmer, W. (1998). Current controller workforce demographics, future requirements, and research questions. In D. Broach (Ed.) *Recovery of the FAA Air Specialist Workforce, 1981-1992.* (DOT/FAA/AM-98/23). Washington, DC: Federal Aviation Administration Office of Aviation Medicine.[1]

Soldz, S. & Vaillant, G.E. (1999). The Big Five personality traits and the life course: A 45-year longitudinal study. *Journal of Research in Personality, 33,* 208–32.

SPSS, Inc. *SPSS version 9.0.* Chicago, IL. Author.

Stevens, J. (1986). *Applied Multivariate Statistics for the Social Sciences.* Hilsdale, NJ: Erlbaum.

U. S. Census Bureau, (2001). *Statistical Abstract of the United States.* Washington, DC: Author.

Wallston, K, Wallston, B., and DeVilles, R. (1978). Development of the multidimensional health locus of control scales. *Health-Education Monograph,* 6: 161-70.

APPENDIX A

FACTOR A (WARMTH)

LOW SCORE	HIGH SCORE
RESERVED, DETACHED, FORMAL	OUTGOING, WARMHEARTED
CRITICAL, RIGID	EASYGOING, LIKES PEOPLE
COOL, ALOOF	PARTICIPATING, ADAPTABLE

FACTOR B (INTELLIGENCE)

LOW SCORE	HIGH SCORE
LESS INTELLIGENT	MORE INTELLIGENT, BRIGHT
CONCRETE THINKING	ABSTRACT THINKING

FACTOR C (EMOTIONAL STABILITY)

LOW SCORE	HIGH SCORE
AFFECTED BY FEELINGS	EMOTIONALLY STABLE
EMOTIONALLY LESS STABLE	FACES REALITY
EASILY UPSET	CALM, UNRUFFLED
WORRYING	MATURE

FACTOR E (DOMINANCE)

LOW SCORE	HIGH SCORE
HUMBLE	ASSERTIVE
MILD	AGGRESSIVE
ACCOMMODATING, CONFORMING	STUBBORN, HEADSTRONG
EASILY LED, OBEDIENT	COMPETITIVE
SUBMISSIVE	BOSSY, DOMINANT

FACTOR F (IMPULSIVITY)

LOW SCORE	HIGH SCORE
SOBER, SERIOUS	HAPPY-GO-LUCKY
PRUDENT, RESTRAINED	IMPULSIVELY LIVELY
TACITURN	ENTHUSIASTIC
SILENT, INTROSPECTIVE	EXPRESSIVE, TALKATIVE

FACTOR G (CONFORMITY)

LOW SCORE	HIGH SCORE
EXPEDIENT, UNDEPENDABLE	CONSCIENTIOUS, RULE BOUND
DISREGARDS RULES	PERSEVERING
FEELS FEW OBLIGATIONS	STAID
SELF-INDULGENT	MORALISTIC

FACTOR H (BOLDNESS)

LOW SCORE	HIGH SCORE
SHY, TIMID	VENTURESOME, UNINHIBITED
RESTRAINED	SOCIALLY BOLD
THREAT-SENSITIVE	SPONTANEOUS
HESITANT	RESPONSIVE

FACTOR I (SENSITIVITY)

LOW SCORE	HIGH SCORE
TOUGH-MINDED	TENDER-MINDED
SELF-RELIANT	CLINGING, INSECURE
REALISTIC	OVER-PROTECTED
NO-NONSENSE	SENSITIVE
HARD	KINDLY, GENTLE

FACTOR L (SUSPICIOUSNESS)

LOW SCORE	HIGH SCORE
TRUSTING	SUSPICIOUS
ADAPTABLE	SELF-OPINIONATED
FREE OF JEALOUSY	HARD TO FOOL
EASY TO GET ALONG WITH	SKEPTICAL
PLIANT TO CHANGES	DISTRUSTFUL

APPENDIX A (CONTINUED)

FACTOR M (IMAGINATION)

LOW SCORE	HIGH SCORE
PRACTICAL,	IMAGINATIVE, BOHEMIAN
CONVENTIONAL	WRAPPED UP IN URGENCIES
REGULATED BY EXTERNAL REALITIES	CARELESS OF PRACTICAL MATTERS
CAREFUL	ABSENT-MINDED
DOWN-TO-EARTH" CONCERNS	UNCONVENTIONAL
PROPER	

FACTOR N (SHREWDNESS)

LOW SCORE	HIGH SCORE
FORTHRIGHT	SHREWD
NATURAL, ARTLESS	CALCULATING
UNPRETENTIOUS, GENUINE	WORLDLY
OPEN	PENETRATING
SPONTANEOUS	SOCIALLY AWARE
	POLISHED

FACTOR O (INSECURITY)

LOW SCORE	HIGH SCORE
SELF-ASSURED	APPREHENSIVE
CONFIDENT	SELF-REPROACHING
SERENE, COMPLACENT	WORRYING
FREE OF GUILT	TROUBLED, LONELY
SECURE	BROODING
	GUILT-PRONE

FACTOR Q1 (RADICALISM)

LOW SCORE	HIGH SCORE
CONSERVATIVE	EXPERIMENTING
RESPECTING ESTABLISHED IDEAS	LIBERAL
TOLERANT OF TRADITIONAL DIFFICULTIES	ANALYTICAL
	FREE-THINKING
	REBELLIOUS
	OPEN TO CHANGE

FACTOR Q2 (SELF-SUFFICIENCY)

LOW SCORE	HIGH SCORE
GROUP-DEPENDENT	SELF-SUFFICIENT
A "JOINER" AND SOUND FOLLOWER	PREFERS OWN DECISIONS
LISTENS TO OTHERS	RESOURCEFUL

FACTOR Q3 (SELF-DISCIPLINE)

LOW SCORE	HIGH SCORE
UNDISCIPLINED SELF-CONFLICT	CONTROLLED
FOLLOWS OWN URGES	FOLLOWING SELF-IMAGE
CARELESS OF PROTOCOL, LAX	COMPULSIVE
UNCONTROLLED	SOCIALLY PRECISE

FACTOR Q4 (TENSION)

LOW SCORE	HIGH SCORE
RELAXED, TRANQUIL	TENSE, OVERWROUGHT
UNFRUSTRATED	FRUSTRATED, FRETFUL
COMPOSED	DRIVEN

Descriptive information for the factors was taken from the 16PF test profile (1967),Karson and O'Dell (1976), and the Administrator's manual for the 16PF (1986).