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Personality profiling of pilots: traits and cognitive style

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We present a profile of male pilots having extensive flying experience, all of whom had been trained in the military. They completed the Eysenck Personality Questionnaire-Revised, short version, and the Sensation Seeking Scale (SSS), Form V; they then completed the Group Embedded Figures Task. On comparing the data of the pilots to both population norms and to previous data collected from participants who had military training, the pilots were found to be markedly better on the GEFT, indicating field independence, they scored lower on Neuroticism, and they scored higher on Experience Seeking. We thus present a distinctive profile for military pilots relative to others who had served in combat units in the military; in addition, we present a distinctive profile for these pilots when compared to population norms. These data might be put to good use in pilot selection and assessment.

Keywords: sensation seeking, neuroticism, field dependence-independence, pilots

Even though commercial flights are considered to be an extremely safe form of transportation, many people shudder on hearing that something has gone mishap. If one rules out mechanical or electronic failure of the system, and if one reserves the spectre of terrorist activity to those cases where this might be of critical concern, then one might focus on the pilots, their personality and their mental health (Bor, Field, & Scragg, 2002). Admittedly, this might well be yet another example of an attribution error (Langdridge & Butt, 2004; Miller, Jones, & Hinkle, 1981). Yet, we speculate that this focus of attention might be of critical importance with respect to *civilian* pilots who were <u>not</u> trained to be pilots in the military. Israel's national airline EL AL, for example, until recently used "to recruit its pilots exclusively from the military" (Klein, 1999, p. 59). Our present sample comprises male pilots trained in the Israeli Air Force, a number of whom are still in the military, and a number of whom fly civilian. The profile of this group should have value for those civil flying agencies who are interested in selecting and screening potential pilots for their courses and subsequently for their airlines.

Types of pilots and their personality profiles

The distinction between military pilots and civilian pilots is well illustrated in remarks made to the second author, who conducted an interview with a fighter pilot and with a military transport pilot in the study that we report in this paper, concerning the different skills required of each, within the military. Here in brief are the insights of each pilot. The fighter pilot is trained to deal with the unexpected; the pilot has to react quickly to a fast-changing combat situation, in a multitasking environment. Very fast, educated decisions have to be taken, because otherwise an air-to-air or air-to-ground combat situation might be lost. The pilot has to function in a very flexible manner–to improvise, if need be–while fulfilling the mission. The pilot is the commander of the plane and of the flight, even if a navigator is also present. The transport pilot, in contrast, is trained to function in a very organized and 'by the book' work environment. There are checklists and predefined protocols that cover the majority of the scenarios, which might be encountered during the flight. Most cockpit decisions are taken in collaboration with the co-pilot, though the final decision rests within the Captain's discretion.

The two groups are characterized by a clearly different emphasis in personality makeup, with that of the transport pilot being well summarized by Hörmann and Maschke (1996, p. 177): "sociability, well-balanced self-assertiveness, and orientation toward actions and activity are characteristics of successful airline pilots." The portrayal of the fighter pilot agrees with a conclusion made by Gray (1978, p. 18) in his report of the Israeli Air Force (IAF), that "the IAF stresses the ability to cope with the unexpected on all missions." According to Campbell, Castaneda, and Pulos (2009, p.104), such an ability is more likely to be observed in "extroverted, emotionally stable individuals." Piedmont (1998) described such individuals as having a strong sense of well-being, being hardy, adaptive, and looking forward to what life has to offer. King, Retzlaff, and McGlohn (1997) gave a similar description of the "right stuff" military aviator prototype, as being courageous, confident, uninhibited, and bold.

Importantly for present concerns, our study focuses on the common profile of the male, military pilot (both fighter and transport), having extensive flying experience in the military, and sometimes also in civilian life. These are not participants who are still in flight training–these are all experienced pilots. Hence, their profile represents the actual

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"right stuff" of pilots (Wolfe, 1979), and not those who in the end failed flight school. These pilots are not concerned with how they present themselves when completing personality questionnaires, given that the screening, selection, and training phases of their flight career are matters of the distant past for them, hence social desirability related to personality assessment (Furnham, 1986; Smith & Ellingson, 2002) is tempered.

The personality of pilots, or trainee pilots, has been looked at in terms of the Eysenckian three-dimensional model of personality (Eysenck & Eysenck, 1985): Extraversion (E), Neuroticism (N), and Psychoticism (P). Relevant studies performed with the Big Five (Costa & McCrae, 1995) framework in mind are Boyd, Patterson, and Thompson (2005), Callister, King, Retzlaff, and Marsh (1999), and Chappelle, Novy, Sowin, and Thompson (2010). As would be expected, N "is negatively related to flying success … Flying can obviously be stressful, with a single mistake proving fatal" (Furnham, 1992, p. 74). Indeed, as Callister et al. (1999, p. 885) conclude, "highly anxious, hostile, or impulsive people probably should not control aircraft." In light of this, one would expect that the military would weed out candidates scoring high on P, in early stages of selection. And yet, as part of a focus on tapping the "right stuff" of pilots (Retzlaff & Gilbertini, 1987; Wolfe, 1979), conceivably some P+ trainees would stay in the system. Regarding E, there seems to be even less consensus. Bartram and Dale (1982) reported that successful military pilots scored higher on E "than the general population" (p. 293), a finding confirmed more recently by Callister et al. (1999). But, Jessup and Jessup (1971) reported that the failure rate for trainee pilots was the lowest among stable introverts (i.e., E-, N-).

We further consider the role that Sensation Seeking can play in pinpointing this "right stuff" of pilots (Retzlaff & Gilbertini, 1987). If it is "the low sensation seekers who find it difficult to 'chew gum and walk at the same time'" (Zuckerman, 1994, pp. 356-357), then they surely will not be able to handle the task of flying. Is the pilot necessarily a high sensation seeker? Trainee pilots score indeed higher on Sensation (or, Novelty) Seeking than a normative sample (Lambirth, Dolgin, Rentmeister-Bryant, & Moore, 2003, p. 420), but this might not be an asset, "necessary or even desirable for airline pilots" (Damos, 1996, p. 205). As Flin and Slaven (1995, p. 113), for example, comment, "the 'right stuff' for a single pilot fighter jet was precisely the 'wrong stuff' when he became the captain of a three man crew on the flight deck of a commercial airline." Indeed, not only is there "right stuff"–a particular personality profile, especially for pilots trained in the military, which we show in this paper–but also "wrong stuff" and "no stuff" (Musson, Sandal, & Helmreich, 2004)–which we will not be able to address given the nature of our sample of pilots. We believe that our sample of pilots trained in the military, some of whom also serve as pilots in civilian life, can provide a useful personality profile for civilian agencies to consider.

It is important for pilots to have excellent spatial skills. In this respect, we consider the cognitive style of Field Dependence-Independence (FDI) to be of particular importance for pilots (cf. Glicksohn & Bozna, 2000; Glicksohn & Rechtman, 2011). Spatial skills such as those involved in tasks assessing FDI, are crucial for the effective functioning of a pilot in terms of spatial orientation (Bednarek, Truszczynski, & Wutke, 2013), navigation (Verde et al., 2013), and so forth. In fact, FDI measures have been used in the past (or, have been considered for use) in the military as part of their selection process (Carretta, 1987). Pilots are selected for intelligence–a tradition going back seventy years (Revelle, Wilt, & Condon, 2011, p. 11)–and intelligence is correlated with the performance measure that we use in this study, namely the number of correct detections on the Group Embedded Figures Test (MacLeod, Jackson, & Palmer, 1986). Yet, it is hard to imagine an FD trainee pilot in the military–especially one assessed using the Rod-and-Frame Test (RFT)–who actually completes flight training (Long, 1975). In any event, our prediction here is that our military pilots should be markedly Field-Independent (FI).

Comparison groups

For the profiling of the military pilot it is important that use is made of comparison groups, such as non-pilots, civilian pilots, or other groups of interest. Damos (1996, p. 202), for example, complains that "…the vast majority of the military performance measurement effort has focused on the fighter pilot; little is available concerning transport pilots." More recently, Damos (2014, p. 2) has stressed that this situation has somewhat improved. In this paper, we look at the personality profile of the military pilot, in comparison to both population norms and various groups of ex-military professionals.

Previous studies in which such personality profiles were compared involved, for example, military pilots versus civilian controls (Bartram, 1995; Bartram & Dale, 1982; Retzlaff & Gilbertini, 1987), and civil pilots versus population norms (Cuevas, 2003). Other studies in which profiles of military pilots were compared to controls or norms without a military background are Callister et al. (1999), Chappelle et al. (2010), and Lambirth et al. (2003). An issue with many of these studies is that findings are influenced by self-selection. According to Bartram (1995), individuals "seeking places on flying training courses differ markedly from the general population. Their profile looks remarkably similar to that of experienced airline pilots" (p. 232).

In the present study, we investigate to what degree the personality profiles of the pilots match those of other groups of individuals *all having military training*. For example, as we have previously written (Glicksohn & Bozna, 2000, p. 86), "Cooper (1982) found that bomb-disposal experts tended to prefer working alone and with equipment, rather than with others. They are flexible and unconventional (as is required by the different situations which they have to resolve), while being able to maintain a detached mode of operation and social isolation." Does this statement resonate with that made by the fighter pilot, noted above? If both pilots and bomb-disposal experts are FI, then, apart from an assumed difference in their IQ, itself correlated with scores on the task employed here for indicating FI, is there a difference in personality between the two groups? Or, consider the standing of sensation seeking within the personality profile of the pilot, which should

be viewed with reference to its standing in the profile of others who served in the military in combat units (such as our comparison groups, and especially with respect to those who subsequently served in an anti-terror unit of the police). Is high sensation seeking simply predictive of interest in serving in a combat unit (not necessarily as a pilot), or is there a specific combination of the sensation-seeking scales, that has predictive validity for the pilot?

The present study

In this study, we make use of four comparison groups whose profiles we have previously published (Glicksohn & Bozna, 2000; Glicksohn & Rechtman, 2011), namely VIP bodyguards (Israeli dignitary protection) and ex-military controls (Glicksohn & Rechtman, 2011), and bomb-disposal and anti-terror units (Glicksohn & Bozna, 2000).

One goal of the present study is to attempt to differentiate the profile of the pilot from those of these four groups of ex-military personnel. We employ *discriminant analysis*, with the two "standard" questions (Huberty, 1984, p. 157) in mind, involving (1) estimates of separate group and total-group percentages of correct classifications (these are the hit rates); and (2) an evaluation of the hit rates against those expected by chance.

Discriminant analysis has been used in the past to differentiate pilots screened for Special Operations from other pilots (with a 66 % overall rate of accuracy in classification), revealing that the target group "showed an accentuation of some of the basic personality characteristics usually cited to differentiate pilots from non-pilots" (Caldwell, O'Hara, Caldwell, Stephens, & Krueger, 1990, pp. 196-197). The selection of pilots, comparing those who passed and those who failed a flight-screening program, has also been evaluated using discriminant analysis (Maroco & Bártolo-Ribeiro, 2013). These authors reported an overall hit rate of 74 per cent When only two groups are compared, depending on how well defined these two groups are, a hit rate of 74 per cent would be well above the 50 per cent chance level of correct classification. As Huberty (1984, p. 169) comments, "a high degree of classification accuracy might support a finding of little overlap among the groups in a sort of 'descriptive' sense."

The task for this study, to differentiate our pilots from four other groups of ex-military personnel, whose personality profile might be somewhat similar, is a tougher question. When Gomà-i-Freixanet (1995) tried to differentiate among antisocial risk takers, sportsmen engaging in risky sports, prosocial risk takers, and controls not engaged in risky activity, she could report an overall hit rate of only 48.8 per cent. If one ignores, for the moment, the fact that her samples were uneven in size, it is still the case that a roughly 50 per cent hit rate is well above the 25 per cent chance level of correct classification given four groups. Nevertheless, a 50 percent accuracy level is by far much lower than the 74 percent accuracy level reported in the previously mentioned study. To what degree will we be able to report an accuracy level much higher than 20 per cent, when comparing our pilot group to four other groups?

METHOD

Participants

A total of 46 male pilots, ranging in age between 22 and 54 (M = 36.7 years, SD = 9.24), participated in the study. Of these, 19 were fighter pilots and 27 were transport pilots. This n was chosen to be comparable to those used in our previous studies (42-45), which would enable simple group comparisons. Recruitment of the pilots was done using a snowball sampling method. All participants were trained in the Israeli Air Force, and they had extensive flying experience (between 250 and 15,000-20,000 flight hours). Of the total group of 46 pilots, 44 were still flying in the military, for the main (68 %) in the reserves.

The four comparison groups were taken from two published studies. These were 43 male bodyguards (Israeli dignitary protection) who had completed professional training in this vocation, and 44 male controls, having comparable military experience to the bodyguards, ranging in age then between 22 and 41 years (Glicksohn & Rechtman, 2011), and 42 male bomb-disposal experts and 45 anti-terror operatives, all serving with the police after their military service, ranging in age then between 23 and 35 years (Glicksohn & Bozna, 2000). In addition, we compare our data to those of population norms (Glicksohn & Abulafia, 1998), looking at the norms for males ranging in age between 21 and 50.[1]

Measurements

Personality assessment

All participants completed two personality questionnaires in Hebrew (Glicksohn & Abulafia, 1998). One was the Eysenck Personality Questionnaire-Revised, short version (EPQ-R-S; Eysenck, Eysenck, & Barrett, 1985), comprising 48 items assessing Extraversion (E), Neuroticism (N) and Psychoticism (P), as well as a Lie Scale (L). All items have a yes/no format; scale values (sum scores) range from 0 to 12. The reliabilities for these scales, as reported in Glicksohn and Abulafia (1998, p. 1088) are .80, .80, .56, and .71, respectively. In the present study, the reliabilities for these scales in our sample of pilots were .76, .58, .41, and .69, respectively. The other was the Sensation Seeking Scale (SSS), Form V (Zuckerman, 1994), comprising 40 items assessing Thrill and Adventure Seeking (TAS), Experience Seeking (ES), Disinhibition (Dis), and Boredom Susceptibility (BS). All items have a forced-choice format (between two alternatives); scale values (sum scores) range from 0 to 10. The reliabilities for these scales, as reported in Glicksohn and Abulafia (1998, p. 1088) are .80, .59, .68, and .54, respectively. In the present study, the reliabilities for these scales in our sample of pilots were .76, .45, .68, and .47, respectively. These two instruments were used to enable a comparison of the pilots to our control groups, who completed the same questionnaires in studies following a similar protocol to that of the present.

[1] These norms appear in Table 3, p. 1090, of that article.

Table 1. *Mean ± SD of the nine measures computed for the pilots and with reference to the four groups taken from Glicksohn and Rechtman (2011) and Glicksohn and Bozna (2000)*

	pilots	VIP bodyguards	controls	bomb disposal	anti-terror	*F* (4, 214)	*p*	*Norms*
	M ± SD (*n = 46*)	*M ± SD* (*n = 43*)	*M ± SD* (*n = 43*)	*M ± SD* (*n = 42*)	*M ± SD* (*n = 45*)			*M* (*n =246*)
Psychoticism (P)	2.67 ± 1.59	2.21 ± 1.44	2.23 ± 1.86	2.07 ± 1.44	1.67 ± 1.13	2.60	.0370	2.80
Extraversion (E)	8.48 ± 2.61	10.02 ± 2.06	9.47 ± 2.44	8.50 ± 2.54	9.27 ± 2.32	3.29	.0121	9.03
Neuroticism (N)	1.94 ± 1.82	1.81 ± 2.31	3.00 ± 2.74	1.57 ± 2.00	1.91 ± 2.16	2.64	.0348	4.77
Lie Scale (L)	7.16 ± 2.59	5.28 ± 3.19	4.91 ± 2.98	6.48 ± 2.63	7.09 ± 2.60	5.98	< .0001*	4.73
TAS	7.91 ± 2.19	8.14 ± 1.90	7.23 ± 2.72	6.71 ± 2.39	8.40 ± 1.80	4.20	.0027*	6.48
ES	5.98 ± 1.69	4.84 ± 1.95	5.40 ± 2.07	4.55 ± 1.84	4.07 ± 1.42	7.65	< .0001*	5.21
Dis	5.85 ± 2.30	5.12 ± 2.17	4.91 ± 2.59	3.86 ± 2.00	4.62 ± 2.47	4.30	.0023*	4.51
BS	2.94 ± 1.84	2.33 ± 1.57	3.00 ± 1.98	2.12 ± 1.38	2.00 ± 1.37	3.50	.0086	3.52
GEFT	15.41 ± 3.02	15.12 ± 3.21	13.11 ± 4.28	14.41 ± 3.51	9.80 ± 4.78	15.93	< .0001*	

Note: TAS = Thrill and Adventure Seeking, ES = Experience Seeking, Dis = Disinhibition, BS = Boredom Susceptibility; GEFT= Group Embedded Figures Task

Cognitive style

The Group Embedded Figures Task (GEFT) comprises 7 practice figures and 18 test figures (Witkin, Oltman, Raskin, & Karp, 1971). The total number of correct answers on sections B and C (ranging between 0 and 18) served as the performance measure.[2]

Procedure

All participants completed the two personality questionnaires in alternative orders, in a group setting with the second author or a research assistant, with up to seven participants in each group. They were then administered the GEFT, which was followed by an open question to each participant regarding the strategy he had adopted to solve the GEFT tasks.

Data analysis

Data analysis was done in three stages. First, we compared the data of the pilots to normative data. Second, group comparisons were conducted for all nine scores, using analysis of variance (ANOVA), to investigate both differences and similarities in components of the personality and cognitive style profile. Third, stepwise discriminant analysis using all nine scores was run, to see which of the measures differentiating between groups in the ANOVAs would survive in this multivariate analysis.

Complementing these analyses, we refined the nine ANOVAs by decomposing the main effect for Group, using four orthogonal contrasts. First, we compared the VIP bodyguards to the controls (Glicksohn & Rechtman, 2011); second, we compared the bomb-disposal and the anti-terror units (Glicksohn & Bozna, 1998). In our third contrast, we compared the combined data of the VIP bodyguards and the controls to the combined data of the bomb-disposal and anti-terror units–a comparison which is not of much interest, but is nevertheless a viable contrast. More importantly, our fourth contrast was the comparison of the data of the pilots to the combined data from the four other groups. This latter contrast would provide us with a distinctive profile for pilots, relative to others, all of whom had military experience in combat units.

RESULTS

Personality profile of the pilots

In comparing the pilots[3] to the age-relevant norms for the Israeli population (Glicksohn & Abulafia, 1998, p. 1090), focusing on the norm means presented in the last column of Table 1, the pilots turned out to be markedly N- (as were the other high-risk, prosocial professionals[4]), TAS+, ES+ and Dis+. Using a *t* test to evaluate for each to what degree the pilots significantly deviated from those population norms, and adopting the Bonferroni-corrected *p* value of .005 (9 measures), the test-wise results were as follows: N- (t = -10.6, p < .0001), L+ (t = 6.3, p < .0001), TAS+ (t =4.4, p < .0001), ES+ (t =3.1, p < .005), Dis+ (t =3.9, p < .0005), and GEFT (t =7.7, p < .0001).

The pilots differed from the other four groups (see Table 1) in four respects, indicating their particular personality profile: (1) they scored the highest on the GEFT, indicating FI[5]; (2) they scored the highest on ES; (3) they scored the highest on Dis; and (4) they scored the highest on L. Juxtaposing the results of these two analyses–one with respect to population norms, the other with respect to the four ex-military groups–the following distinctive profile of the military pilot emerged: L+, ES+, Dis+, FI.

[2] The task requires the participant to locate as quickly as possible a simple target figure (any of 8, appearing on a separate sheet at the end of the booklet) which is embedded within a complex figure. This is done by outlining the target figure within the complex figure. Section A of the GEFT comprises 7 practice figures, and is not scored; sections B and C each comprise 9 disembedding tasks of varying degrees of difficulty. The time allocated for each of sections B and C is 5 minutes.

[3] A preliminary analysis indicated that the two groups of pilots (fighter and transport) did not differ in personality or in performance on the GEFT. This finding seems to match what is reported in the literature, using other personality questionnaires (e.g., Chappelle et al., 2010).

[4] Such individuals as our bomb-disposal experts, anti-terror operatives, and VIP bodyguards, but also firefighters, medics, and others, all being engaged in work that is conducted for the benefit of society, and entailing calculated risk-taking and physical risk.

[5] This group mean for performance on the GEFT includes four pilots who were found to have what we view as being aberrant scores of 7 (transport), 7 (transport), 10 (transport) and 5 (fighter pilot in the past, aged 54, not currently flying). Whether these scores accurately portray their cognitive style, or perhaps some momentary stress, they are not indicative of the type of score that one would assume to underlie proficiency at flying. Nevertheless, both in a recent report (Bednarek et al., 2013), and in an earlier one (Atchley, 1991), it was noted (somewhat in passing) that their samples included FD pilots.

Table 2. Summary of the results of the series of contrast analyses; each cell shows the respective *p* value for the contrast

Orthogonal Contrasts	P	E	N	L	TAS	ES	Dis	BS	GEFT
1. controls vs. VIP bodyguards	.9556	.2437	.0155	.5392	.0984	.2521	.5701	.0452	.0208
2. anti-terror vs. bomb-disposal units	.2150	.1403	.4778	.3099	.0005	.2158	.1252	.7375	.0001
3. controls/VIP bodyguards vs. anti-terror/bomb-disposal units	.1238	.0259	.0330	.0001	.6945	.0044	.0332	.0192	.0006
4. pilots vs other 4 groups	.0140	.0421	.6402	.0101	.4366	.0001*	.0017*	.0373	.0004*
d	.42	.35	.06	.43	.13	.71	.53	.35	.62

Note: P = Psychoticism, E = Extraversion, N = Neuroticism, L = Lie Scale; TAS = Thrill and Adventure Seeking, ES = Experience Seeking, Dis = Disinhibition, BS = Boredom Susceptibility; GEFT= Group Embedded Figures Task.

Table 3. Classification matrix for the results of the discriminant analysis

		Predicted Group					
Actual Group	*N*	1	2	3	4	5	Hit Rate
1. controls	42	15*	9	5	3	10	36 %
2. VIP bodyguards	41	8	15*	4	5	9	37 %
3. anti-terror unit	45	3	7	29*	2	4	64 %
4. bomb-disposal unit	42	4	10	5	13*	10	31 %
5. pilots	45	3	4	5	9	24*	53 %

Note: The diagonal cells (marked with an asterisk) indicate the *n* used to compute the group classification hit rate (correctly classified *n*/actual group *N*)

A more refined analysis was achieved by decomposing the main effect for Group, using the four orthogonal contrasts. Table 2 summarizes the results of these analyses, indicating that the pilots differed from all the other participants on ES, on Dis and on the GEFT (contrast 4).[6] From Table 1, it can be seen that the pilots had relatively elevated scores on both P and Dis. This suggests a somewhat interesting addition to the expected profile of the pilot, whom one would conventionally view as being a *non-impulsive*, prosocial sensation seeker. These data should be of interest to civil aviation agencies for screening purposes, given that a number of our pilots, trained in the military, made the transition to civil aviation.

Discriminant analysis

A discriminant analysis was done using all nine predictors appearing in Table 1, and with respect to all five groups. The analysis was conducted in a forward, stepwise manner, and terminated as Step 4 [$F(4, 207) = 2.71$, Wilks' $\lambda = .57$, $p < .05$]. At Step 1, the GEFT score entered the equation ($\lambda = .77$); at Step 2, L was entered ($\lambda = .69$); at Step 3, ES was entered ($\lambda = .62$), followed by TAS, at Step 4 ($\lambda = .57$). In Glicksohn and Bozna (2000), GEFT, TAS and ES, in this order, entered the equation when we contrasted two of these groups (contrast 2, Table 2). For the contrast of two of the other groups (contrast 1, Table 2) in Glicksohn and Rechtman (2011), it was N followed by GEFT. In short, in comparing all five groups in the present analysis, L replaced N as predictor.

Our hit rate in the present study, that is correct classification, was as follows: Controls (36 %), VIP bodyguards (37 %), anti-terror unit (64 %), bomb-disposal unit (31 %), and pilots (53 %). The results of this analysis are given in Table 3, in the form of a classification matrix. We can report an overall 44 per cent hit rate, indicating that it is hard to correctly place these various non-impulsive, prosocial sensation seekers, given their common profile (see Table 1). Interestingly, as noted in the introduction, similar hit rates were reported by Gomà-i-Freixanet (1995), with an overall hit rate of 48.8 per cent in her study comparing four groups, including prosocial and antisocial individuals, and a control group, and with individual hit rates ranging between 39.5 and 75.8 per cent for these specific groups. Nevertheless, given that the hit rate for the pilots is 53 per cent which is by far in excess of the 20 per cent chance level of correct classification, given five groups, the measures used here for discriminant analysis are worthy of research attention in screening procedures.

Table 3 further indicates that four of the pilots (9 %) were misclassified as belonging to the VIP bodyguard group, while nine of the VIP bodyguards (22 %) were misclassified as belonging to the pilot group. As Table 1 indicates, these two groups are quite similar with respect to TAS and GEFT scores, both of which are predictors in the discriminant function.

DISCUSSION

Two recent papers have suggested that one needs to consider the role of personality as part of the assessment of pilot aptitude (Carretta et al., 2014; King et al., 2013). If the profile of the impulsive, antisocial sensation seeker is P+, N+,TAS+, ES+, Dis+, BS+ (Herrero & Colom, 2008), then the profile of the non-impulsive, prosocial sensation seeker should be P-, N-, TAS+, ES-, Dis-, BS- (Glicksohn & Bozna, 2000; Glicksohn & Rechtman, 2011; Gomà-i-Freixanet & Wismeijer, 2002). We wanted to find out whether this is also the case for our pilots. Furthermore, to what degree are the pilots markedly FI, and how do they compare to both VIP bodyguards and bomb-disposal ex-

[6] For the contrast of the pilots and the combined data of the other 4 groups, we provide the effect size (*d*) based on a comparable *t* test, using the mean square error (MSE) of the *F* test (see Table 1) as pooled sample variance in the following equation: $d = |M_{pilots} - M_{others}|/\mathrm{sqrt}(MSE)$.

perts, previously reported to be markedly FI (Glicksohn & Bozna, 2000; Glicksohn & Rechtman, 2011)?

When compared to our population norms, the pilot profile is N-, L+, TAS+, ES+, Dis+, FI. Note that being high relative to the norms on three of the four subscales of sensation seeking comes in support of previous findings indicating such a trend for sensation seeking among pilot candidates (Lambirth et al., 2003, p. 420). In light of the present data, we note two major discrepancies between observed and expected profiles: the pilots were Dis+ and not Dis-, and they were also ES+ and not ES-. One unpublished study in the literature (Hallman et al., 1990) reported that trainee pilots were higher than army recruits on both TAS and Dis (Zuckerman, 2007, p. 102). Nevertheless, we would suggest that the elevated scores for TAS and Dis probably reflect more the general profile of the combat soldier (here: officer), than of something that is of particular importance to the combat pilot. Indeed, high TAS is characteristic of those individuals who are engaged in physically risky activities (Gomà-i-Freixanet, 1995; Gomà-i-Freixanet & Wismeijer, 2002), and high Dis may well be characteristic of those individuals who are engaged in "winning the game", as Gomà-i-Freixanet (2004) has suggested.

The fact that the pilots are high on ES is intriguing. Previous results have indicated that high-risk, prosocial individuals are usually ES- (Gomà-i-Freixanet, 1995). At the same time, other studies have indicated that experienced mountaineers have high scores on both TAS and ES, the latter indicating the pleasurable experience (including that of "flow") while they are engaged in their high-risk activity (Pomfret, 2006). Conceivably, the experienced pilot enjoys what he or she is doing. When compared to the other groups of individuals who had served in combat units in the army, the distinctive profile of the pilots was ES+, Dis+, FI. In light of the comment made by Butcher (2002, p. 171) that, with respect to civil aviation, there is "no single necessary or desirable 'personality pattern' for airline pilots", we would argue that this personality profile of ES+, Dis+, FI should be of interest to civil aviation agencies for screening purposes.

The hit rate for classifying the pilots of 53 per cent and our overall hit rate of 44 per cent are both far in excess of the 20 per cent chance level of correct classification given the five groups. How do these hit rates compare with those reported in other studies having five groups? When five adolescent gambling groups were contrasted by Langhinrichsen-Rohling, Rohde, Seeley, and Rohling (2004), an overall hit rate of 43 per cent was reported. When five groups of women differing in degree of sexual victimization were contrasted (Koss & Dinero, 1989), an overall hit rate of 47 per cent was reported. In contrast, when five cognitive schemas underlying personality disorders were contrasted, the authors reported an overall hit rate of 61 per cent (Petrocelli, Glaser, Calhoun, & Campbell, 2001). Given these data for comparison, the present results certainly look promising, though are not exceptionally high. Presumably, this is due to the fact that we deliberately chose to compare our pilots to other groups having military training (especially combat service), thereby making for a much harder discrimination among groups.

Nevertheless, the hit rate of 53 per cent for the pilots suggests that the use of personality measures should be of use for civilian (and military) agencies interested in screening their pilot candidates, and quite possibly in screening for remote piloting of unmanned aircraft, given the current interest in that domain (Barron, Carretta, & Rose, 2016; Rose, Barron, Carretta, Arnold, & Howse, 2014). Furthermore, even though we reported on an all-male sample of military pilots (and all-male comparison groups), female military pilots will presumably have the same type of personality profile. Indeed, as Cuevas (2003, p. 1094) writes, "the pilot personality profile was found to transcend gender differences … that is, both male and female pilots exhibited a similar pattern of personality characteristics and significantly differed from their respective male and female counterparts in the general population." We thus disagree with the conclusion drawn by Callister et al. (1999, p. 885), that "personality characteristics seem to be fairly poor predictors of training outcome," and rather side with Bartram (1995, pp. 234-235), who writes: "In conclusion, the results of this study provide further support for the role of personality measures in predicting flying training outcome. While the effects found are relatively small, they are consistent with expectations and earlier research. Even quite small increments in validity (of r = .10-.20) will result in very substantial cost-benefits in flying training, and in subsequent operational flying. Personality variance is relatively independent of that which is otherwise assessed during selection (primarily ability and motivation). As a result, measures of personality can potentially yield useful increases in the overall validity of the selection process for flying training."

We adopt Bartram's conclusion as an adequate conclusion for the present findings. Hopefully, others will take interest in pursuing further the use of the personality measures such as employed in the present study for pilot assessment and selection, especially for civil flying agencies who are interested in selecting and screening potential pilots for their courses and subsequently for their airlines.

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