An Investigation of Canadian Forces Selection Measures as Potential Indices of Recruit Quality

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In face of contemporary threats of the new world security environment, the Canadian Forces (CF) are undergoing transformation. One overall goal of CF transformation is to ensure the CF remains a relevant and effective military capable of responding quickly to domestic and international threats. This is only achievable if the CF has the right people with the right skill sets ready to deploy where needed. Similarly, General Natynczyk, chief of Defence Staff stated that: "*Rebuilding the Forces into a first-class, modern military means recruiting the 'best and the brightest' that Canadian communities have to offer*" (Anonymous, 2012). While recruiting quality people is intrinsically fundamental for CF transformation, the CF/Department of National Defence currently does not have a formal definition of a 'quality recruit'. In response to this issue, the Director General of Military Personnel (DGMP) requested the services of Director General Military Personnel Research and Analysis (DGMPRA) to conduct a three-phase project on recruit quality. The goal of Phase 2 of the project, which is the subject of the current research, was to examine various CF selection measures as potential indices of recruit quality.

Literature Review

Recruit Quality Indices in Organizational Research

Organizational research shows that applicant quality matters, as applicants with higher credentials and higher selection scores are more likely to have higher post-hire performance evaluations, promotion rates, and salaries than their counterparts (Gaugler, Rosental, Thornton & Bentsen, 1987). To properly measure applicant quality, it is important that an organization defines the various elements (e.g., the applicant has the knowledge, skills, and abilities to successfully perform the job; the applicant's values align with the organization's values) that are thought to bring success to the organization or to a specific job (Snell & Lermusiaux, 2004, Volcker, 1990). While there is no simple universal method to assess applicant quality, there are best practices that can guide an organization in developing their own applicant quality definition (Snell & Lermusiaux, 2004 ; Walvoord, 2010).

For instance, most organizations measure applicant quality with indicators that have been found to predict job performance (Osedach, Belau, & Gill, 2008). In fact, predictor scores on selection instruments are the most prevalent index of applicant quality (Cofer *et al.*, 2001 ; Crewson, 1995). Score on a biodata questionnaire derived from educational and work-related questions, for example, is a prevalent applicant quality index (Kirnan, Farley & Geisinger, 1989 ; McManus & Ferguson, 2003). Dimensions of a

selection interview that have been found to predict job success are often averaged to create an applicant quality index. For example, the following dimensions of a selection interview were combined to create an index of recruit quality: relevant work experience, job related training or education, attitude, job interest, appearance, communication skills and overall job qualification (Griffeth, Hom, Lawrence & Cohen, 1997). Finally, grade point average, a well-recognized predictor of graduate school performance, is commonly used for assessing applicant quality in a student population (Isharani, Litch, Romberg, Wells & Rutkauskas, 2006).

US Military Recruit Quality Indices

The U. S. Department of Defense (DoD) defines recruit quality in terms of two indicators: completion of high school and above-average score on the Armed Forces Qualifying Test (AFQT), an enlistment test that measures cognitive ability. Research conducted for DoD demonstrates that recruits who scored at or above average on AFQT show higher training and on-the-job performance compared to those who scored lower (Guilroy, 2010; McCloy, Hogan & Smith, 1999). Recruits with a high school diploma are more likely to complete their initial enlistment term (Buddin, 2005; Guilroy, 2010).

In line with both the organizational research and the US DoD, the present research investigates the predictive validity of two CF selection instruments (the Canadian Forces Aptitude Test [CFAT] and the Military Potential [MP] score) and education levels in relation to initial occupational training (Qualification Level3 [QL3]) performance among non-commissioned members (NCM). It is our hope that the results of this work will be useful to the development of a recruit quality definition specific to the CF. The evidence concerning the predictive validity of CF selection measures relevant to the purpose of this research is described below.

Predictive Validity of CF Selection Measures

The CFAT and MP scores are both used to assess candidates' suitability for enrolment in the CF.[1] The CFAT was implemented in 1997 and assesses three types of cognitive aptitude: verbal skills, problem solving skills and spatial ability. Research has consistently shown that the CFAT is a moderate to strong predictor of QL3 training performance across a variety of NCM occupations, including Vehicle Technician, Army Communications and Information Systems Specialist, Steward, Military Police and Geomatics Technician (Girard, 2004a ; Hodgson, 2005 ; O'Keefe & Smith, 2007 ; Piassentin, 2010b; Scholtz, 2004; Woycheshin, 1999).

The MP score is derived from a semi-structured interview that assesses personality and person-environment fit. The rating scale, as well as the method of assigning MP ratings, was modified in 2006 to overcome shortcomings of the original MP rating score (Grandmaison & Cotton, 1994). To date, no CF studies have examined the ability of the new MP score to predict QL3 training performance.

[1] Suitability is also assessed with a medical examination and an enhanced reliability check.

Also of interest to this research are the education requirements for enrolment in the CF. The minimum education level required for NCM candidates is less than high school that is, grade 10 in most Canadian provinces or Secondaire III in Quebec. However, some NCM military occupations may have more stringent education requirements, such as a college level education.

Two studies have explored the relative importance of CF selection predictors (Girard, 2004b; Otis, 2011). In the first study, Girard (2004b) examined the relation between cognitive ability, previous military experience, and education in predicting QL3 training performance among Resource Management Services (RMS) clerks. The analyses performed on less experienced candidates (i.e., 3 or less years of experience) indicated that education and cognitive ability (CFAT scores) were strongly associated with QL3 performance, whereas experience was moderately associated with QL3 performance. Regression results further suggest that education is a more important predictor than cognitive ability. Indeed, whether cognitive ability added significantly to the prediction of QL3 performance varied depending on when it was added in the regression equation whereas education always accounted for unique variance in QL3 performance.

The second study examined the relative role of the CFAT, MP scores, and education levels as predictors of basic training completion on first attempt, the first stage of training in which recruits learn basic core skills and knowledge common to all trades (Otis, 2011). Results for NCM recruits showed that CFAT scores and having a high school diploma or greater were positively associated with basic training completion even after controlling for age and gender. A positive relation was also found between the MP score and basic training completion for NCM recruits, but this relationship was no longer practically significant when controlling for gender and age.

Aim

While there is substantial evidence for the predictive validity of the CFAT, few studies have examined the role of MP score or of education level in the prediction of training performance. Therefore, this paper examines the incremental validity of the MP score and education levels over that of the CFAT in predicting QL3 training performance, with the ultimate aim of being able to recommend the set of measures that demonstrates the greatest potential to assess the quality of CF recruits.

This research is divided in three studies, each bearing on a given NCM occupation. The first used results from two different training courses within the same occupation, and was subdivided.

Studies 1a and 1b were conducted with the Aviation Systems Technician (AVN TECH) occupation, which is part of the Mechanical job family and the Air Force. The minimum education level required for AVN TECH is grade 10 or Secondaire III in Quebec.

Study 2 focused on the Boatswain (BOSN) occupation, which is part of the General Military job family and the Navy. The minimum education level required for BOSN is grade 10 or Secondaire III in Quebec.

Finally, ***Study 3*** was conducted with the Military Police occupation, which is part of the General Military job family. Military Police can belong to the Navy, Army or Air Force. The minimum education level required for the Military Police occupation is a technical school or college diploma/certificate.[2]

Although the selection of NCM occupations for this paper was limited to data availability, the selected occupations represent useful groups for the investigation of recruit quality indicators because they differ in terms of their environment (Navy, Army or Air Force) and education requirements. Further, the validity of the CFAT for indicating future success in these occupations has already been examined (Ebel-Lam & Carter, 2011; Hodgson, 2005; Piassentin, 2010a; Piassentin & Carter, 2010).

Study 1a: Aviation Systems Technician QL3 Phase 1 Training

Method

Sample and Procedure

Training data from 201 NCMs who completed Aviation Technician QL3 Phase 1 training in one of 21 course sessions offered between September 2008 and May 2009 were available. This study used the same dataset as in a previous study by Piassentin (2010a). CF members' Service Number was used to link this dataset to data on CFAT scores, MP scores, and educational levels, which were taken from the applicant and recruit database held at DGMPRA. Due to incomplete information, the resulting aggregate dataset included 141 NCMs (132 males, 9 females; M_{age} = 24.22 years; SD = 5.40) of whom 83 completed the training in English and 58 completed the training in French.

Measures

Predictor Variables

a) Canadian Forces Aptitude Test (CFAT)

The CFAT is a timed test composed of 60 multiple-choice items divided into three subscales: verbal skills (VS: 15 items), spatial ability (SA: 15 items) and problem solving ability (PS: 30 items). The CFAT exists in both English and French versions. Results on the CFAT can be presented in raw scores or in percentile ranks.[3] Percentiles are based on norms that were established separately for NCMs and officers and for English and French test takers. Raw CFAT scores for each subscale were used in the present analyses. Total CFAT was calculated as the sum of all subscales.

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[2] A technical school or college diploma/certificate is the entry standard for civilian applicants with no former military service and for component transfer (any other MOSID). For OT/civilian applicants (with former service as Reg F MP or ARAF MP) and for component transfer (same MOSID), a high school diploma is acceptable for entry but some college/university level courses are ideal.

[3] A percentile rank is the percentage of scores that fall below a given score. For instance, a candidate achieving a 60 percentile rank did better than 60% of the candidates who took the test.

b) Military Potential Score (MP)

The MP score employs a 90-point scale with 35 as the cut-off for most NCM occupations and with 40 for officer positions. High scores on the MP are indicative of stronger candidates. The 90-point scale is divided up as follow: a) Fifteen possible points for academic achievement (based on highest level of education attained and grades); b) Fifteen possible points for cognitive ability (based on CFAT scores); c) Thirty possible points for the six structured interview questions that assess the following personality dimensions: Degree of work ethic, organizational citizenship, openness to novel experiences, dependability, achievement striving and stress management; and d) Thirty possible points for the four structured interview questions that assess the following domains of person-environment fit: Occupational-related skills, knowledge of targeted occupation, interest congruency, and realistic expectations.

c) Educational Levels

Educational level represents the highest level of education attained at enrolment. Educational level was grouped into four categories: 1) no high school diploma, 2) graduated from high school, 3) completed some college or university courses but did not attain a diploma or degree, and 4) graduated from either college or university.

d) Criterion Variable: Air Technician QL3 Phase 1 Training Performance

Air Technician QL3 Phase 1 training course is one of many courses AVN TECHs need to successfully complete to graduate from Basic Occupational Qualification Training (BMOT). At the end of this course, AVN TECHs receive a letter grade and an academic score which represents the average percentage obtained across all performance objectives. In this study, only the academic score was used to measure performance on this course.

Analysis Strategy

Because the English and the French versions of the CFAT differ in terms of content, all analyses were done separately for anglophone NCMs and francophone NCMs.[4]

Prior to testing for the incremental validity of the MP score and educational levels beyond the CFAT, preliminary analyses were conducted. First, descriptive statistics were calculated for all continuous variables and frequencies were calculated for the categorical variable. Second, bivariate correlations were calculated to examine relationship among the continuous variables. Third, a one-way analysis of variance was conducted to examine the impact of the categorical variable (educational levels) on academic scores.

The customary and recommended statistical tool for examining the incremental validity of a predictor is the hierarchical multiple regression (Hunsley & Meyer, 2003). Therefore, a hierarchical regression analysis was conducted in which the three CFAT subscales were entered in the first step and educational levels were entered in the second step. Finally, the MP score was entered in the last step. This ordering of variables was based on recommendations that the measure for which evidence of predictive validity

[4] Those who completed the CFAT in one language also completed their training in it.

already exists should be entered first, followed by demographic variables such as educational levels, and finally by any other psychological measures (Hunsley & Meyer, 2003). Educational levels were dummy-coded. Because there were very few AVN TECHs that had acquired "some college or university" education, this category was collapsed in with the category representing those who had "completed college or university" education. Therefore, two dummy variables were created. The first dummy variable (C1) compared the means of NCMs with no high school diploma with those who had a high school diploma. The second dummy variable (C2) compared the means of NCMs with no high school diploma with those of NCMs who had taken some college or university courses or had graduated. The squared semi-partial correlation (Sr^2) was reported as a measure of the proportion of academic scores variance uniquely accounted for by a single predictor.

Descriptive Statistics and Bivariate Correlations

The range, means, standard deviations, and correlations among all continuous variables are presented for the anglophone and francophone samples in Tables 1 and 2, respectively. The data for both samples were normally distributed, with skewness and kurtosis coefficients for both the criterion and the predictor variables being close to zero. For the anglophone sample, academic score correlated most highly with Total CFAT, the VS subscale, and the MP score; secondarily with the PS subscale; and non-significantly with the SA subscale. The correlation between MP score and academic score was small and non-significant when the effects of Total CFAT (rp = .16, p = .14) were partialled out, while it remained significant when the effects of the VS subscale (rp = .23, p < .05) were partialled out. For the francophone sample, academic score correlated most highly with the VS subscale and the MP score; less with the Total CFAT; and non-significantly with the SA and PS subscales. The correlation between MP score and academic remained significant when the effects of Total CFAT (rp = .35, p < .01), the VS subscale (rp = .38, p < .01), and the PS subscale (rp = .42, p < .01) were partialled out.

Table 1: *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables (Study 1a : Anglophone Sample)*

	Range	Mean	SD	Skewness	Kurtosis	2.	3.	4.	5.	6.
1.Total CFAT	26-56	38.35	6.57	.46	-.33	.53**	.47**	.85**	.52**	.28**
2.CFAT VS	3-14	8.41	2.70	.08	-.60	—	.06	.14**	.23**	.27**
3.CFAT SA	4-15	10.94	2.11	-.83	.81		—	.18	.34**	.05
4.CFAT PS	9-29	18.99	4.85	.21	-.67			—	.43**	.20*
5.MP	39.60-70.80	55.05	6.58	-.03	-.23				—	.28**
6.Academic Score	70.00-97.00	83.13	5.35	-.17	.52					—

Note. *N* = 83; * p < .05; ** p < .01.

Table 2: *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables (Study 1a: Francophone Sample)*

	Range	Mean	SD	Skewness	Kurtosis	2.	3.	4.	5.	6.
1.Total CFAT	30-54	43.17	5.32	.00	-.46	.56**	.45**	.81**	.49**	.38**
2.CFAT VS	5-14	10.36	2.22	-.34	-.40	—	.15	.12	.32*	.45**
3.CFAT SA	8-14	11.41	1.91	-.43	-.83		—	.04	.24	.02
4.CFAT PS	12-30	21.40	3.96	-.24	-.30			—	.36**	.25
5. MP	36.00-67.50	53.03	6.59	-.19	.20				—	.47**
6.Academic Score	72.00-92.30	81.81	4.86	-.21	-.29					—

Note. N = 58; * p < .05; ** p < .01.

The number and percentage of NCMs who achieved different levels of education is presented in Table 3. For both the anglophone and francophone samples, most NCMs had a high school diploma as their highest level of education.

Table 3 Frequency of Education Levels (Study 1a)

Education Level	Anglophone (N = 83)	Francophone (N = 58)
No high school diploma	14 (16.9%)	10 (17.2%)
High school diploma	48 (57.8%)	24 (41.4%)
Some college/university	6 (7.2%)	13 (22.4%)
Completed college/university	15 (18.1%)	11 (19%)

Analysis of Variance

The mean academic score as a function of educational levels is presented in Table 4. In general, higher educational levels were associated with slightly higher academic scores. However, one-way ANOVAs with educational level (three levels: no high school diploma, high school diploma, and some college or university courses combined with completion of college or university)[5] as the independent variable and academic score as the dependent variable indicated that these mean differences were not significant (anglophone sample: F (2, 82) = 2.33, p = .10 and francophone sample: F (2, 58) = 2.73, p = .07).

Table 4: *Mean Academic Score by Education Level (Study 1a)*

	Anglophone (N = 82)		Francophone (N = 58)	
Education Level	**Mean (SD)**	***n***	**Mean (SD)**	***n***
No high school diploma	80.71 (4.14)	14	79.57 (4.98)	10
High school diploma	84.06 (5.49)	48	81.14 (5.33)	24
College/university	82.62 (4.66)	21	83.40 3.88)	24

[5] Because there were very few NCMs with "some college or university education", this category was collapsed with the category "completed college or university".

Hierarchical Multiple Regression Analysis

The results of hierarchical multiple regression analyses are presented in Table 5. For the anglophone sample, results at Step 1 showed that the VS subscale was a significant predictor of academic score, $F (3, 82) = 2.90$, $p < .05$; $R^2 = .07$, accounting for 7 % of the variance. Results at Steps 2 and 3 revealed that educational level and the MP score did not improve the amount of variance explained in the academic score $\Delta F (5, 82) = 2.57$, $p = .15$; $\Delta R^2 = .04$; and $\Delta F (1, 82) = 2.67$, $p = .10$; $\Delta R^2 = .03$, respectively.

For the francophone sample, results at Step 1 showed that the VS subscale was a significant predictor of academic score, $F (3, 57) = 5.86$, $p < .01$; $R^2 = .20$, accounting for 20% of the variance. The addition of educational levels in Step 2 failed to increase the variance explained in academic score, $\Delta F (5, 57) = 4.69$, $p = .45$; $\Delta R^2 = .02$. At Step 3, the MP score was added as a predictor and the percentage of variance accounted for in academic score increased by 9%, $\Delta F (6, 57) = 4.70$, $p < .05$; $\Delta R^2 = .09$.

Summary

The results were obtained using a subsample of participants from Piassentin's (2010a) study which revealed the importance of the CFAT VS subscale as a predictor of Phase 1 training performance for the AVN TECH occupation. The present study extends this finding by providing evidence for the incremental validity of the MP score over and above the CFAT VS subscale as a predictor for the francophone sample but not for the anglophone sample. The present analyses failed to show that educational level predicts academic performance over and above the CFAT VS subscale as a predictor.

Table 5 Hierarchical Regression Predicting Academic Score with CFAT Scores, MP Scores, and Educational Levels (Study 1a)

	Anglophone (*N* = 82)				**Francophone (*N* = 58)**			
Predictor	**B**	**Sr^2**	**R^2**	**ΔR^2**	**B**	**Sr^2**	**R^2**	**ΔR^2**
Step 1			.07*				.20**	
CFAT VS	.24*	.06			.44**	.18		
CFAT SA	.00	.00			-.06	.00		
CFAT PS	.17	.03			.20	.04		.02
Step 2			.09	.04			.20**	
CFAT VS	.22	.04			.45**	.14		
CFAT SA	-.02	.00			-.06	.00		
CFAT PS	.18	.00			.19	.04		
C1	.27	.04			-.15	.01		
C2	.11	.01			.00	.00		.09**

Step 3			.11	.05				
CFAT VS	.19	.03			.40**	.11	.28**	
CFAT SA	-.08	.01			-.14	.02		
CFAT PS	.11	.01			.10	.00		
C1	.25	.03			-.19	.01		
C2	.05	.00			-.11	.00		
MP	.22	.03			.35*	.09		

Note. B = Standardized regression coefficient ; Sr^2 = Squared semi-partial correlation ; * p < .05 ; ** p < .01.

Study 1b: Aviation Systems Technician Apprentice Level Training

Method

Sample and Procedure

Training data from 472 NCMs who completed AVN TECH QL3 Apprentice Level training in one of 48 courses between April 2004 and May 2009 were available. This study used the same dataset as in the previous study by Piassentin (2010a). CF members' Service Number was used to link this dataset to data on CFAT scores, MP scores, and educational levels, which were taken from the applicant and recruit database held at DGMPRA. Due to incomplete information, the resulting aggregate dataset included 126 NCMs (112 men, 14 women ; M_{age} = 26.01 years ; SD = 6.45) 89 of whom completed the training in English and 37 completed the training in French.

Measures

Predictor Variables: CFAT, MP and Educational Levels

The present study used the same predictor measures as in Study 1a (see section on measure for description of the CFAT, MP and educational level measures).

Criterion Variable: Aviation Technician Apprentice Level Training Performance

Once AVN TECHs have completed the Air Technician Phase 1 training, they must also successfully complete the AVN TECH Apprentice Level training course as part as their BMOT training. At the end of this course, AVN TECHs receive a letter grade and an academic score which represents the average percentage obtained across all performance objectives. In this study, only the academic score was used to measure performance on this course.

Analysis Strategy

The present study used the same analysis strategy as in Study 1a.

Results

Descriptive Statistics and Bivariate Correlations

The range, means, standard deviations, and correlations among all continuous variables are presented for the anglophone and francophone samples in Tables 6 and 7, respectively. While the data for both the anglophone and francophone samples were generally normally distributed, the score distributions associated with Total CFAT in the francophone sample were slightly positively skewed, indicating a higher percentage of low scores. For the anglophone sample, academic score only correlated marginally with the Total CFAT and the VS subscale. For the francophone sample, academic score correlated significantly with the VS subscale.

Table 6: *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables – Study 1b Anglophone Sample (N = 89)*

	Range	**Mean**	**SD**	**Skewness**	**Kurtosis**	**2.**	**3.**	**4.**	**5.**	**6.**
1.Total CFAT	22-54	37.74	6.50	.52	-.15	.65**	.38**	.87**	.52**	.20†
2.CFAT VS	3-14	8.38	2.90	.27	-.67	—	-.08	.35**	.46**	.20†
3.CFAT SA	5-15	10.80	2.18	-.35	.07		—	.12	.16	-.05
4.CFAT PS	9-27	18.56	4.37	.36	-.90			—	.39**	.19
5. MP	39.00-78.00	55.85	7.67	.41	-.40				—	.08
6.Academic Score	77.20-96.20	86.25	4.35	.21	-.49					—

Note.* p < .05 ; † p = .06.

Table 7 : *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables – Study 1b French Sample (N = 37)*

	Range	**Mean**	**SD**	**Skewness**	**Kurtosis**	**2.**	**3.**	**4.**	**5.**	**6.**
1.Total CFAT	36-56	41.76	5.17	1.00	.45	.34*	.55**	.84**	.46**	.20
2.CFAT VS	6-15	10.95	2.32	-.17	-.69	—	-.03	-.07	.35*	.51**
3.CFAT SA	6-14	10.54	2.17	-.39	-.64		—	.22	.09	.02
4.CFAT PS	11-30	20.27	4.22	.29	.31			—	.36*	-.01
5.MP	40.50-68.00	55.08	6.32	-.04	-.18				—	.26
6.Academic Score	76.80-91.20	85.76	3.79	-.33	-.63					—

Note.* p < .05; ** p < .01.

The number and percentage of NCMs who achieved different levels of education is presented in Table 8. For both the anglophone and francophone samples, most NCMs had a high school diploma.

Table 8: *Frequency of Education Levels (Study1b)*

Education Level	**Anglophone (*N* = 89)**	**Francophone (*N* = 37)**
No high school diploma	20 (22.5%)	12 (32.4%)
High school diploma	52 (58.4%)	16 (42.1%)
Some college/university	7 (7.9%)	7 (18.9%)
Completed college/university	10 (11.2%)	2 (5.4%)

Analysis of Variance

The mean academic score as a function of educational levels is presented in Table 9. One-way ANOVAs revealed no statistically significant difference in academic scores across the different educational levels: anglophone sample, $F (2, 89) = .62$, $p = .54$; francophone sample, $F (2, 37) = .40$, $p = .67$.

Table 9 : *Mean Academic Score by Education Levels (Study 1b)*

	Anglophone (*N* = 89)		**Francophone (*N* = 37)**	
Education Levels	**Mean (SD)**	***n***	**Mean (SD)**	***n***
No high school diploma	85.50 (4.67)	20	86.32 (3.78)	12
High school diploma	86.25 (4.11)	52	85.03 (4.32)	16
College/university[6]	87.10 (4.81)	17	85.33 (2.92)	9

Hierarchical Multiple Regressions

A hierarchical multiple regression was performed with the three CFAT subscales entered in the first step, education levels entered in the second step, and MP score in the third step. For the anglophone sample, results at Step 1 revealed that none of the CFAT subscales were significant predictors of academic score, $F (3, 88) = 1.83$, $p = .15$; $R^2 = .03$. Steps 2 and 3 also failed to increase the variance explained in academic score, $\Delta F (5, 88) = 1.10$, $p = .94$; $\Delta R^2 = .00$ and $\Delta F (6, 88) = .93$, $p = .70$; $\Delta R^2 = .00$, respectively.

For the francophone sample (Table 10), the VS subscale was a significant predictor of academic score, $F (3, 37) = 3.83$, $p < .05$; $R^2 = .19$, accounting for 19 % of the variance. The subsequent addition of educational level led to a marginal increase in R^2 (11 % additional variance accounted for) ; $\Delta F (5, 37) = 3.68$, $p = .08$; $\Delta R^2 = .11$, indicating that NCMs with no high school diploma achieved higher academic scores than those who had taken some college or university courses or who had completed college or university. Adding the MP score to the equation did not significantly increase the prediction of

[6] Because there were very few AVN TECHs who had taken some college or university courses, this category was collapsed with the category representing those who had completed college or university.

academic score; ΔF (6, 37) = 3.56, p =.15; ΔR^2 = .04. The squared semipartial correlations, Sr^2, suggest that the VS subscale had a stronger unique relationship with academic scores than educational level did.

Table 10: *Hierarchical Regression Predicting Academic Score with CFAT Scores, MP Scores, and Education Level (Study 1b)*

	Francophone (*N* = 37)			
Predictors	**B**	**Sr^2**	**R^2**	**ΔR^2**
Step 1			.19*	
CFAT VS	.48**	.22		
CFAT SA	-.07	.00		
CFAT PS	-.09	.01		
Step 2			.27*	.11†
CFAT VS	.62**	.32		
CFAT SA	-.03	.00		
CFAT PS	-.10	.00		
C1	-.27	.05		
C2	-.42*	.11		
Step 3			.30*	.05
CFAT VS	.54**			
CFAT SA	-.04	.20		
CFAT PS	-.20	.00		
C1	-.30	.03		
C2	-.45*	.06		
MP	.25	.12		

Note : B = Standardized regression coefficient; Sr^2 = Squared semi-partial correlation;
* p < .05 ; ** p < .01; † = .08.

Summary

The present study was conducted using a subsample of participants from Piassentin's (2010a) study. The results of the present study for the anglophone sample differ from those previously obtained by Piassentin. Indeed, the validity of the CFAT against AVN TECH Apprentice Level training was not supported for the anglophone sample. The MP score and education levels also did not emerge as significant predictors. This finding may be due to differences in sample size. Piassentin conducted the analyses on a larger sample which allowed the detection of relatively small R^2 (R^2= .13). Our small sample size, coupled with the number of independent variables in our model, made any small effect difficult to detect.[7]

The validity of the CFAT against AVN TECH Apprentice Level training was supported for the francophone sample. Similar to Piassentin's (2010a) study, the VS

[7] For example, with five independent variables and a sample size of 50, the minimum R^2 that can be detected is of 23%.

subscale in the present study was found to be a significant predictor of academic performance and explained 19% of variance. Our analyses also suggested (marginal effect) that education levels predict academic performance over and above the CFAT. NCMs who had taken some college or university courses or had completed their post-secondary education achieved lower academic scores than NCMs without a high school diploma. A look at the mean academic score by education levels suggests however, that the practical significance of this difference is quasi-null. This finding should be interpreted with caution because of the small number of francophone candidates and may not be generalizable to the population.

Study 2: Boatswains (BOSNs)

Method

Sample and Procedure

Training data from 151 NCMs who completed BOSN QL3 training in one of 18 courses between April 2006 and January 2009 were available. This study used the same dataset as in a previous study by Piassentin and Carter (2010). CF members' Service Number was used to link this dataset to data on CFAT scores, MP scores, and education levels, which were taken from the applicant and recruit database held at DGMPRA. Due to incomplete information, the resulting aggregate dataset included 51 NCMs (43 men, 8 women; M_{age} = 22.92 years, SD = 4.98) who all completed both the CFAT and the training in English.

Measures

Predictor Variables : CFAT, MP and Education Levels

The present study used the same predictor measures as in Study 1a (see section on Measure for description of the CFAT, MP and Education Levels measures.)

Criterion Variable : Boatswain QL 3 Training Performance

BOSNs need to successfully complete the BOSN QL3 training course to graduate from BMOT. At the end of this course, BOSNs receive a letter grade and an academic score which represents the average percentage obtained across all performance objectives. In this study, only the academic score was used to measure performance on this course.

Analysis Strategy

All analyses were conducted on NCMs who completed both the CFAT and their training in English. None of the NCMs completed both the CFAT and their training in French. The present study used the same analysis strategy as in Study 1a. Because they were also very few BOSNs with some college or university education this category was collapsed with the category representing those with completed college or university education. Therefore, this study used the same dummy variables for education levels as in Study 1a.

Results

Descriptive Statistics and Bivariate Correlations

The range, means, standard deviations, and correlations among all continuous variables are reported in Table 11. While the data were generally normally distributed, the score distributions associated with CFAT PS were slightly positively skewed, indicating a higher percentage of low scores. All the predictor variables positively correlated with academic score. The predictors that correlated most strongly with academic score were: Total CFAT, the PS subscale, and MP score. The correlation between MP score and academic score was small when the effects of Total CFAT (r_p = .14, p = .32) and PS subscale (r_p = .23, p = .11) were partialled out, while it remained significant when the effects of the VS subscale (r_p = .29, p < .05) and the SA subscale (r_p = .31, p < .05) were partialled out.

Table 11: *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables (Study 2)*

	Range	**Mean**	**SD**	**Skewness**	**Kurtosis**	**2.**	**3.**	**4.**	**5.**	**6.**
1.Total CFAT	20-57	30.84	8.37	.98	.57	.72**	.71**	.89**	.67**	.46**
2.CFAT VS	1-15	7.69	2.98	.04	-.31	__	.29*	.46**	.45**	.36**
3.CFAT SA	3-14	8.43	2.81	-.07	-.81		__	.47**	.59**	.29*
4.CFAT PS	9-30	14.73	4.77	1.17	.95			__	.55**	.42**
5. MP	36.00-70.00	51.06	7.49	.49	-.27				__	.40**
6.Academic Score	81.90-99.10	92.63	4.45	-.61	-.30					__

Note : N = 51 ; * p < .05 ; ** p < .01.

The number and percentage of NCMs who achieved different levels of education is presented in Table 12. Almost three-quarters of NCMs had a high school diploma as their highest level of education.

Table 12: *Frequency of Education Levels (Study 2)*

Education Level	***N* = 51**
No high school diploma	9 (17.6%)
High school diploma	38 (74.5%)
Some college/university	1 (2%)
Completed college/university	3 (5.9%)

Analysis of Variance

The mean academic score as a function of education level is presented in Table 13. In general, higher education levels were associated with slightly higher academic scores. Given that the present education groups were very unequal and small, it was inappropriate to run ANOVA analyses (Todman & Dugard, 2001).

Table 13: *Mean Academic Score by Educational Levels (Study 2)*

	***N* = 51**	
Education Level	**Mean (SD)**	***N***
No high school diploma	91.22 (3.37)	9
High school diploma	92.64 (4.64)	38
College/university[8]	95.78 (3.76)	4

Hierarchical Multiple Regressions

A hierarchical multiple regression analysis was conducted in which academic score was predicted by CFAT scores at Step 1, education level at Step 2, and by MP score at Step 3 (Table 14). Results at Step 1 revealed that the overall model was significant, F (3, 51) = 4.39, p< .01; R^2= .17, but the PS subscale was the only borderline significant predictor for academic score (p = .08). Steps 2 and 3 failed to increase the variance explained in academic score, ΔF (5, 51) = 2.76, p = .63 ; ΔR^2 = .02 and ΔF (6, 51) = 2.51, p =.28, ΔR^2 = .02, respectively. Therefore these steps are not reported below.

Table 14: *Hierarchical Regression Predicting Academic Score with CFAT Scores, MP Scores, and Education Level (Study 2)*

Predictor	**B**	**Sr^2**	**R^2**	**ΔR^2**
Step 1			.17**	
CFAT VS	.20	.03		
CFAT SA	.10	.01		
CFAT PS	.28†	.05		

Note : B = Standardized regression coefficient ; Sr^2 = Squared semi-partial correlation;
** p < .01; † = .08.

Summary

Using a subsample of participants from the Piassentin and Carter (2010) study, the present study was able the replicate their findings regarding the incremental validity of the PS subscale (albeit only marginally significant). However, the present study failed to show that either the MP score or education level added to what the PS subscale offered. Partial correlation analyses suggest that the association the MP score shares with academic performance is completely accounted for by Total CFAT and PS subscale.

[8] Because only a few BOSNs had some college or university education, this category was collapsed with the category representing those with had completed their college or university education.

Study 3 : Military Police

Method

Sample and Procedure

Training data from 408 NCMs who completed Military Police QL3 training on one of 18 courses between September 2006 and August 2008 were available. This study used the same dataset as in a previous study by Ebel-Lam and Carter (2011). CF members' Service Number was used to link this dataset to data on CFAT scores, MP scores, and education levels, which were taken from the applicant and recruit database held at DGMPRA. Due to incomplete information, the resulting aggregate dataset included 155 NCMs[9] (131 men, 24 women; M_{age} = 24.92 years; SD = 4.41), of whom 142 completed the training in English and 13 completed the training in French.

Measures

Predictor Variables: CFAT, MP and Educational Levels

The present study used the same predictor measures as in Study 1a (see section on measure for description of the CFAT, MP score and Education Level measures.)

Criterion Variable: Military Police QL3 Training Performance

To graduate from BMOT, Military Police candidates need to successfully complete the Military Police QL3 training course. At the end of this course, the candidates receive a critical individual GPA, which represents the average percentage obtained across eight enabling and performance checks that are assigned a percentage grade. In this study, only the scores on this index were used to measure training performance. Enabling and performance checks that were graded on a pass/fail basis were not considered. Note that the minimum passing grade for percentage-based enabling checks is generally high (75 or 80%).

Analysis Strategy

All analyses were conducted on NCMs who completed both the CFAT and their training in English. The number of NCMs who completed both the CFAT and their training in French was too small to allow statistical analysis. The present study used the same analysis strategy as in Study 1a.

Because very few Military Police candidates had no high school diploma, this category was collapsed with the category representing those with a high school diploma. Therefore, this study used different dummy variables for education levels than in Study 1a. In this study, two dummy variables were created to represent three levels of education. The first dummy variable (C1) compared the means of NCMs with a high school diploma or less with those with some college or university. The second dummy variable (C2) compared the means of NCMs with a high school diploma or less with those with completed college or university.

[9] See Ebel-Lam & Carter (2010) and 198 cases with missing or old MP score.

Results

Descriptive Statistics and Bivariate Correlations

The range, means, standard deviations, and correlations among all continuous variables are reported in Table 15. The data were normally distributed, with skewness and kurtosis coefficients for both the criterion and predictor variables close to zero. Academic score correlated most highly with the MP score; secondarily with Total CFAT and the VS and PS subscales; and non-significantly with the SA subscale. The correlation between MP score and academic score remained significant when the effects of Total CFAT (r_p = .27, p < .01), VS subscale (r_p = .30, p < .01), PS subscale (r_p = .28, p < .01), and SA subscale (r_p = .33, p < .01) were partialled out.

Table 15: *Descriptive Statistics and Bivariate Correlations Among All Continuous Variables (Study 3)*

	Range	Mean	SD	Skewness	Kurtosis	2.	3.	4.	5.	6.
1.Total CFAT	19-58	35.96	8.64	.19	-.55	.56**	.66**	.91**	.37**	.25**
2.CFAT VS	2-15	8.85	2.80	.20	.40	—	.09	.31**	.22**	.23**
3.CFAT SA	2-15	9.74	2.77	-.37	.40		—	.46**	.28**	.07
4.CFAT PS	4-30	17.37	5.75	-.76	-.48			—	.31**	.23**
5. MP	50.50-79.50	63.80	5.93	.11	.32				—	.33**
6.Academic Score	79.33-97.29	90.33	3.66	-.38	-.51					—

Note : ** p < .01.

The number and percentage of Military Police candidates who achieved different levels of education is presented in Table 16. Most Military Police candidates had completed college or university.

Table 16 : *Frequency of Education Levels (Study 3)*

Education Level	***N* = 142**
No high school diploma	9 (6.3%)
High school diploma	35 (24.6%)
Some college/university	16 (11.3%)
Completed college/university	82 (57.7%)

Analysis of Variance

The mean academic score as a function of education level is presented in Table 17. One-way ANOVAs revealed no statistically significant difference in academic scores across the different education levels, F (2, 142) = 1.67, p = .19.

Table 17 : *Mean Academic Score by Educational Levels (Study 3)*

	***N* = 142**	
Education Level	**Mean (SD)**	***n***
No high school diploma/ high school[10]	91.16 (3.39)	44
Some college/university	89.87 (4.14)	16
Completed college/university	89.97 (3.67)	82

Hierarchical Multiple Regressions

A hierarchical multiple regression analysis was conducted in which academic score was predicted by CFAT scores at Step 1, education level at Step 2, and by MP score at Step 3 (Table 18). Results at Step 1 revealed that the VS and PS subscales were significant predictors of academic performance, accounting for 6% of the variance, F (3, 141) = 4.16, p = < .01 ; R^2= .06. Step 2 failed to increase the variance explained in academic score, ΔF (5, 141) = 3.54, p = .09 ; ΔR^2= .03. When the MP score was added at Step 3, the percentage of variance accounted for in the academic score increased by 5%, ΔF (6, 141) = 4.58, p < .01 ; ΔR^2 =.05; R^2= .13. However, the PS subscale was no longer significant and the VS subscale was only marginally significant. Instead, a significant coefficient for the MP score emerged, suggesting that the MP score might be accounting for overlapping variance with the two CFAT subscales as well as adding to the incremental change.[11]

Table 18 : *Hierarchical Regression Predicting Academic Score with CFAT Scores, MP Scores, and Education Levels (Study 3)*

Predictors	**B**	**Sr^2**	**R^2**	**ΔR^2**
Step 1			.06**	
CFAT VS	.17*	.03		
CFAT SA	-.04	.00		
CFAT PS	.20*	.04		
Predictors	**B**	**Sr^2**	**R^2**	**ΔR^2**
Step 2			.08**	.03
CFAT VS	.21*	.02		
CFAT SA	-.03	.00		
CFAT PS	.17	.01		
C1	-.12	.01		
C2	-.20	.03		

[10] Because only a very few Military Police candidates had no high school diploma, this category was collapsed with the category representing those who had a high school diploma.

[11] In hierarchical multiple regression, any shared variance between two variables is credited to the first variable entered in the equation, which in this case are the CFAT subscales. Given the present results, an additional hierarchical regression was conducted in which the MP score was first entered, then the additional variance accounted for by the CFAT subscales was tested. The MP score was a significant predictor of academic score, accounting for 11% of variance, F (1, 141) = 17.56, p< .01. At Step 2, none of the CFAT subscales accounted for unique variance, Δ F (4, 141) = 2.23, p= .09 ; ΔR^2= .04.

Step 3			.13**	.05**
CFAT VS	.17†	.02		
CFAT SA	-.08	.00		
CFAT PS	.13	.01		
C1	-.07	.00		
C2	-.15	.02		
MP	.26**	.05		

Note : *B* = Standardized regression coefficient ; Sr^2 = Squared semi-partial Correlation ; * p < .05; ** p < .01; † = .05.

Summary

The results were obtained using a subsample of participants from Ebel-Lam and Carter's (2011) study which revealed the importance of the CFAT VS and PS subscales as predictors of Military Police QL3 training performance. The present analyses also found positive associations between both the CFAT VS and PS subscales and Military Police QL3 training performance. However, both CFAT subscales did not account for a significant amount of the variance in training performance after controlling for the MP score. Thus, Military Police recruits' training performance appeared to be related to their MP score (which is based on their CFAT scores but also takes into account their educational achievement and their performance on the selection interview) rather than solely on their CFAT scores. The present analyses failed to show that education levels explained added variance in training performance above that contributed by the CFAT and the MP score.

Discussion

Summary of Findings

The present research examined the appropriateness of using CF selection measures as indices of recruit quality. In light of past research results showing that the CFAT is a good predictor of training performance, this research examined the incremental validity of MP scores and education levels over the CFAT in predicting QL3 training performance. Three studies were conducted with three different NCM occupations: AVN TECH, BOSN, and Military Police. A summary of hierarchical regression results across studies is presented in Table 19.

Concerning the predictive validity of the CFAT, the present findings were generally in line with past studies (Ebel-Lam & Carter, 2011; Piassentin, 2010a; Piassentin & Carter, 2010). QL3 training performance was best predicted by the CFAT VS subscale for AVN TECHs and by the CFAT PS subscale for BOSNs. Moreover, the CFAT VS and PS subscales, but not the SA subscale, were positively associated with QL3 training performance for the Military Police occupation.

The incremental validity of the MP score is unclear, as the results were mixed. In the case of the francophone AVN TECHs after the first BMOT course, the MP score accounted for an additional 9% of the variance in QL3 training performance beyond the

20% attributable to CFAT scores. Apart from this finding, the MP score did not add to the prediction of AVN TECH and BOSN QL3 training performance above what can be predicted by the CFAT.

Table 19 : *Summary of Hierarchical Regression Results Across Studies*

Study	*N*	Significant Predictors	R^2
Study 1a :			
AVN TECH QL3 Phase 1 Training Course			
Anglophone	82	CFAT VS	.07
Francophone	58	CFAT VS and MP	.28
Study 1b:			
AVN TECH Apprentice Level Training Course			
Anglophone	89	No significant predictors	
Francophone	37	CFAT VS and educational levels[12]	.30
Study 2			
BOSN QL3 training course			
Anglophone	51	CFAT PS	.17
Study 3			
Military Police QL3 training course			
Anglophone	142	CFAT VS[13] and MP	.13

In the same way, the pattern of partial correlations generally suggested that association between the MP score and QL3 training performance was totally accounted by the CFAT. As already mentioned, the MP score is made up of three assessment components : CFAT scores, academic achievement (based on highest level of education attained and grades), and an interview that assesses personality and person-environment fit. The results indicated that the effectiveness of the MP score as a predictor of performance in the AVN TECH and BOSN occupations generally depends on the influence of its CFAT assessment component. Given that the findings differed by language, it would be important to determine in future studies whether the MP score differentially predict training performance in francophones and anglophones or the findings are unique to our sample.

For the Military Police occupation, the MP score not only predicted QL3 training performance (as assessed by critical individual GPAs) but was found to have the greatest incremental predictive power. Indeed, correlations showed that the positive association

[12] Education levels had a marginal relationship with training performance. This finding regarding education levels should be interpreted with caution because of the small number of francophone candidates and because a closer examination revealed that the differences in academic scores between education levels had no practical significance.

[13] The CFAT VS subscale had a marginal relationship with training performance.

between the MP score and QL3 training performance remained significant after controlling for CFAT scores. Results from hierarchical multiple regression analyses showed that only the MP score contributed unique information to the prediction of QL3 training performance beyond that offered by CFAT scores and education level. In contrast with the results for the AVN TECH and BOSN occupations, the results for the Military Police occupation imply that the effect of the MP score depends on more than its CFAT and education components. Future studies could examine how the two other MP score assessment components (grades and the personality interview) contribute to the prediction of QL3 training performance.

Two explanations may explain why the impact of the MP score was different for the Military Police occupation. First, police officers are an occupational group for which the importance of personality measures for predicting training performance has been consistently demonstrated (Varela, Boccaccini, Scogin, Stump & Caputo, 2004). Second, the Military Police occupation has higher education requirements than the AVN TECH and BOSN occupations. More than two-thirds of the present Military Police sample had a college diploma. It could be that past grades, which are captured by the MP score, are especially determinant of how well Military Police candidates do in their QL3 training courses. Future research could verify whether Military Police candidates who achieved higher grades in college are also the ones with higher grades in QL3 training courses.

The results failed to demonstrate the incremental validity of education level for all three occupations. The current findings contrast with prior findings, in which CF recruits with a high school diploma or more education were more likely to complete basic training on their first attempt[14] than those without a high school diploma (Otis, 2011). U.S. military recruits with a high school diploma were also more likely to complete their initial enlistment term (Guilroy, 2010). A possible reason for this finding is that previous research has used attrition as the criterion whereas this study used training performance as a criterion. Failure to complete high school may reflect a lack of persistence and a lack of motivation in the face of adversity that better explain subsequent failure to complete basic training than grades obtained on QL3 training courses.

Limitations

The present findings need to be interpreted in the context of a number of limitations. First, most of the studies had small sample sizes, which has a direct and sizable impact on the statistical power of the significance testing. Most of the sample sizes were only powerful enough to detect strong relationships. Second, sample size also limits the generalizability of the results. Future studies are needed to verify whether the present findings hold with a larger sample and for other NCM occupations. The third limitation concerns the restriction of the range of grades assigned: they ranged in average from 70 to 97 for AVN TECHs and from 80 to 99 for BOSNs and the Military Police. Coupled with

[14] Most prevalent reasons for failing the complete the course was release requests (recruits who voluntary left basic training).

this is the range restriction in predictor scores, as samples in the present studies were limited to recruits who achieved the minimum cut-off scores for the CFAT and the MP score assessment and had successfully completed basic training.[15] Restriction of range for both the predictor and criterion has likely contributed to the underestimation of the true size of the correlations between candidates' test scores and QL3 training performance (Shultz & Whitney, 2005).

The Present Research in the Context of the Recruit Quality Project

The present research was conducted in the larger context of Phase 2 of the Recruit Quality Project which examined CF selection measures as potential indices of recruit quality. The first paper (Otis, 2011) used completion of basic training on first attempt as an early attrition criterion while this paper used QL3, or initial occupational training, as a training performance criterion. The combined findings from the two papers suggest that: a) the CFAT is good predictor of both attrition and training performance among NCM recruits; b) the MP score is a weak predictor of attrition and good predictor for training performance for one of the three NCM occupations examined (Military Police) ; c) Education is a good predictor of attrition but not of training performance among NCM recruits.

These findings provide initial empirical data in support of CF use of CFAT scores and educational levels as indices of NCM recruit quality. Similar to the US DoD, combining cognitive aptitude and educational levels could allow the identification of recruits who are more trainable and more likely to stay. Before any recommendations can be made regarding the use of the MP score as a potential indicator of NCM recruit quality, additional research need to examine the incremental validity of the interview and grade components of the MP score with QL3 training performance for other NCM occupations with different education requirements.

In conclusion, this is the first series of studies that has evaluated the relative predictive validity of CF selection measures. The results highlight the complexities of developing a set of indicators to assess the quality of CF recruits and illustrate the need for more research on the relationships between CF selection measures and a comprehensive array of training/job performance and attrition criteria for a representative sample of NCM occupations.

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[15] Note that Military Police candidates must also be assessed by the Military Police Assessment Centre, which further reduces the range restriction for this occupation.

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