

The Human Factor in Maritime Transport: Personality and Aggression Levels of Master Mariners and Navigation Students

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ABSTRACT

The current study sought to identify groups of navigation students and master mariners (captains) characterized by different constellations of the Big Five personality traits and aggression levels. We hypothesized that master mariners would exhibit the resilient personality type and that navigation students would additionally exhibit personality types other than the resilient (e.g., over- or under-controlled). A sample of 108 navigation students (men, in their second or third year of naval school, all active athletes) and 76 master mariners took part in the study and completed the Polish version of the NEO Five-Factor Inventory (Costa & McCrae, 1992; Zawadzki et al., 1998) and the Aggression Questionnaire (Buss & Perry, 1992; Tucholska, 1998). The hypothesis about the resilient personality type among master mariners was confirmed. The second hypothesis about personality types other than the resilient among navigation students was also confirmed: 33% of the students exhibited the overcontrolling personality type. The article also highlights the need to include psychological assessment in naval school enrolment procedures.

KEYWORDS

maritime personnel
personality
aggression
students of navigation
master mariners
training

INTRODUCTION

The human factor is responsible for over 80% of accidents at sea and is recognized as relevant and inherent in such risk factors as fatigue, navigation errors, distraction from additional tasks, a sense of safety due to the automatization of the navigation process, excessive routine, inability to cooperate with other crew members, and susceptibility to stress (Berg, 2013; Chauvin, 2011; Chauvin et al., 2013; Herdzik, 2016; Marine Accident Investigation Branch 2004; Matos et al., 2020; Mokhtari & Khodadadi, 2013; Plopa, 1996; Tzannatos & Kokotos, 2009; Walker et al., 2014).

Due to the fact that these human-related risk factors are closely linked to psychological functioning, it is expected that mariners with longer experience in the maritime service should be more aware of how these factors may affect them and their job tasks. It is also expected that experienced maritime captains, who both have had professional training and are subject to strict screening and selection procedures before each promotion along their career path, should exhibit a wide range of both technical skills and interpersonal competences which facilitate

effective managing of the cruise and the crew, and minimize the risk of the occurrence of such human errors.

Longitudinal research by Plopa (1996, 1997, 2015), carried out over a span of six months, pointed out the key importance of the captains' and officers' interpersonal competences for efficient leadership in the conditions of long-term maritime isolation. The results of these studies showed that the ability to function well in various social groups, facilitated by high levels of openness, spontaneity, responsibility, and sensitivity, were of particular importance in long-term, difficult conditions of maritime cruises, where the probability of risk is high, and the probability of its avoidance is low. High social competence was particularly evident in the captains' and officers' abilities to modify their perception of stressful situations so as to make them understandable/meaningful

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and acceptable. Captains and officers with high social competence were relationship-oriented, held prosocial values, and focused not only on the perception of possible risks, but were also able to create an appropriate organizational climate which facilitated a task-oriented engagement of the entire crew in agreeable cooperation necessary for the ship's safety (Plopa, 1997, 2005).

The results of these longitudinal studies also underscore the importance of job experience. Older and more experienced officers exhibited lower stress levels and better competence for neutralizing the crew's aggressive tendencies. On the other hand, novice sailors, who were exposed to maritime isolation of long duration for the first time, exhibited elevated levels of anxiety, loneliness, irritability, and aggressiveness, as well as decreased levels of agreeableness.

These findings suggest that further research on personal and emotional factors is warranted, as cognitive factors alone are not sufficient predictors of leadership competence in master mariners (Plopa, 2005, 2015).

Most studies which investigated the role of mariners' personality for cruise and/or navigation safety usually employed the Big Five personality model and the NEO Five-Factor Inventory (NEO-FFI) by Costa and McCrae (1992, 2001; see also Allik & McCrae, 2004; Skuzińska et al., 2020; Strelau, 2014) to measure personality traits. In one such study, Saus et al. (2012) tested 36 first-year students at the Royal Norwegian Navy Officer Candidate School during a simulator-based navigation training and reported significant positive correlations between neuroticism and the number of errors in the simulator ($r = .44, p < .05$) together with negative correlations between conscientiousness and the number of errors ($r = -.54, p < .001$). Multiple regression analyses revealed that the combination of neuroticism, extraversion, and conscientiousness explained 26% of the variance of the errors. Also, a personality type was identified—labelled as the resilient personality type—characterized by low neuroticism, and high extraversion and conscientiousness. It predicted both subjective and observer-rated situation awareness, defined as “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future” (Endsley, 1988). The participants with high situation awareness were also demonstrated to be able to modulate their heart rate variability (HRV). Thus, the potential applications of this research include the possibility of using personality assessment as a tool in selecting navigators and the use of HRV as an objective index of adaptability to environmental demands (see, e.g., Van Wijk & Meintjes, 2017; Van Wijk & Water, 2000).

Studies on representative and varied samples in contexts other than maritime cruises also point towards the validity of considering various individual factors, which are significant predictors of optimal leadership at various organizational levels. This is confirmed by, for example, a longitudinal study by Judge et al. (1999), which examined the relationships between the Big Five personality traits (tested from childhood on) and subjective (job satisfaction) and objective (income and occupational prestige) measures of professional success. The results revealed that (a) conscientiousness, openness, and low neuroticism best

predicted subjective job satisfaction, (b) conscientiousness, openness, and low neuroticism also predicted the social status of the participants' jobs; and (c) extraversion, conscientiousness, and low neuroticism predicted the participants' income. These results demonstrated that personality assessment performed at the age of 12-14 can predict job success at the age of 53-62. However, other authors suggest that high conscientiousness is related to the intrinsic motivation for career success, whereas low neuroticism, agreeableness, and extraversion, as well as high conscientiousness correlate with the external motivation for career success (Görner et al., 2019; Kusnierz et al., 2017, 2020).

Studies which showed the relationships between the quality of leadership and certain personality profiles bear implications for optimal functioning in the position of the cruise/ship captain. A number of empirical studies sought to identify personality profiles which would allow for selecting individuals based on the effectiveness of their functioning in various organization types. Longitudinal studies are particularly notable in this context (Asendorpf et al., 2001; Block, 1961; Block & Block, 1980; Robins et al., 1996; Schnabel et al., 2002). These have identified three personality types: the resilient type (low neuroticism, high conscientiousness, above-average extraversion, average agreeableness and openness), the overcontrolled type (high neuroticism and introversion, average levels of other basic personality traits), and the undercontrolled type (low conscientiousness, below-average agreeableness, and average or above-average levels of other Big Five traits). The resilient type is characterized by optimal social adaptation and emotional balance. The overcontrolled type is related to introverted tendencies, shyness, and withdrawal, as well as low self-esteem and uncertainty in social situations. The undercontrolled type involves extraverted tendencies, frequent antisocial behaviors, impulsivity, and relational difficulties.

Long-term isolation at sea involves the deprivation of many needs (see Plopa, 2015) and is experienced as challenging by many sailors. It can be expected that these conditions might facilitate aggression, which can negatively impact the organizational climate and crew cooperation. In line with these predictions, the studies by Plopa (1996, 1997, 2015), carried out during a long-distance sea voyage emphasized the important role of aggression as a variable contributing to the quality of interpersonal functioning in mariners. During a sea voyage, aggression levels can vary intraindividually among individual crewmembers, including the officer staff.

The current study aimed to contribute to the body of research on how to optimize sailors' functioning, particularly of those in leadership positions, who have to take responsibility for the safety and integrity of the cruise in complex and high-risk circumstances generated by weather conditions, geographic, economic, and other factors.

From the psychological perspective, the optimal selection of individuals to perform specific activities in complex and highly unpredictable maritime conditions should involve identification of personality profiles which provide higher chances for the most responsible performance. Individual differences in personality translate into variance in psychological functioning and job performance through the impact they have on job-related stress and aggression.

The current study involved a sample of master mariners—ship captains who achieved the best results in terms of work effectiveness and safety—as well as navigation students, who will seek to assume leadership positions in the future. Psychological factors are virtually absent from consideration during admission procedures in naval schools. Thus, it seems pertinent to compare the personality profiles of master mariners and candidates for officers in terms of their psychological leadership competences in the context of maritime cruises.

The Current Study

The above considerations, especially the results of studies by Block and Block (1980), Plopa (2005, 2015), and Makarowski et al. (2020), led to the formulation of the following research question:

Which personality types (i.e., constellations of basic personality traits, measured by the NEO-FFI, and aggression levels) are exhibited by experienced master mariners and navigation students?

It can be expected that captains, and elite captains in particular, will exhibit more optimal personality profiles (from the perspective of leadership in difficult maritime conditions) compared to navigation students, who are not subjected to psychological assessment during admissions to naval schools. Thus, the following hypotheses were put forward:

H1: Captains will mainly exhibit the resilient personality type (low neuroticism, high conscientiousness, extraversion, agreeableness, and openness to experience, low aggression).

H2: Navigation students will exhibit different personality types, both the resilient, as well as the undercontrolled and overcontrolled type (high neuroticism, impulsiveness, low agreeableness and conscientiousness, higher level of aggression).

METHODS

Participants

The study involved 108 men, second- and third-year navigation students at Maritime University ($M_{age} = 21.42$, $SD = 1.12$) and 76 master mariners ($M_{age} = 55.07$, $SD = 9.19$). All navigation students were active athletes and practiced swimming at the university's sports club.

The master mariners' average seniority as captains of large ships was 20.50 years (minimum = 7 years, maximum 41 years, $SD = 7.37$, $Mdn. = 19.50$). All captains had completed specialized higher education. They also received the highest notes in assessments by their employers.

Measures

PERSONALITY

Personality was measured by the Polish adaptation of the NEO-FFI (Costa & McCrae, 1992; Zawadzki et al., 1998). The NEO-FFI comprises 60 items measuring five personality traits: neuroticism, extra-

version, openness, agreeableness, and conscientiousness. Reliability was estimated using the Cronbach's α . Its values for each factor were: neuroticism = .80, extraversion = .77, openness = .68, agreeableness = .68, and conscientiousness = .82. The manual for the Polish version contains sten scores for various age groups.

AGGRESSION

Aggression levels were measured by the Polish adaptation of the Aggression Questionnaire (AQ, Buss & Perry, 1992; Tucholska, 1998; Valdivia-Peralta et al., 2014). The questionnaire consists of 29 items measuring the level of physical and verbal aggression (the behavioral aspect), hostility, and anger (the cognitive and emotional aspect) on a five-point Likert-type scale (1 = *never or hardly applies to me*, 5 = *very often applies to me*). The Cronbach's α values of the Polish adaptation of the AQ were .82 for physical and .75 for verbal aggression, .80 for hostility, and .85 for anger, which makes them similar to the values in the original AQ study (Buss & Perry, 1992).

RESULTS

Navigation students' and master mariners' results were compared first. It was expected that master mariners would exhibit different personality factor (neuroticism, extraversion, openness to experience, conscientiousness, and agreeableness) and aggression (physical aggression, verbal aggression, anger, and hostility) levels, which would justify further analyses in order to verify the above hypotheses. Levene's test showed that the variances between the samples are not equal. Thus, in order to analyze intergroup differences on the measured variables, the Cochran-Cox test was used. Results are shown in Table 1.

The data in Table 1 shows that no statistically significant differences in extraversion, openness to experience, verbal aggression, and anger were found between the groups. However, neuroticism, physical aggression, and hostility were significantly lower among the captains. Additionally, the analysis suggests that, compared to navigation students, captains exhibited higher conscientiousness and agreeableness. The above results confirm the hypothesis that captains exhibit a more optimal personality profile compared to navigation students (from the perspective of maritime cruise leadership).

In order to verify the two hypotheses on the personality profiles of navigation students and master mariners, a case-based *k*-means cluster analysis was carried out separately for the two samples (captains and students)¹. The results are shown in Table 2 and Figure 1.

The data analysis shows that two clusters, suggesting the presence of different personality profiles, were identified in each group. Navigation students can be divided into the resilient type (67%) and the type similar to the overcontrolled type (33%). The captains were classified into two clusters chiefly on the basis of conscientiousness. Elevated conscientiousness scores were exhibited by 41% of the captains in the sample, while the remaining 59% exhibited results fitting the resilient personality profile (low neuroticism, low aggression, high conscientiousness and agreeableness).

TABLE 1.Comparison of the Level of Selected Personality Traits and Aggression in Students ($n = 108$) and Master Mariners ($n = 76$)

Variable	Students			Master mariners			Cochran-Cox test	two-way p
	M	SD	Sten score	M	SD	Sten score		
Neuroticism	15.26	8.90	4	12.07	5.85	3	2.873	***
Extraversion	28.20	7.77	6	26.54	7.92	6	1.316	.193
Openness	27.70	5.91	5	27.79	5.43	7	-0.101	.952
Conscientiousness	32.37	6.58	7	36.32	6.22	7	-3.898	***
Agreeableness	28.26	5.91	6	33.61	4.47	7	-6.745	***
Physical aggression	20.94	6.47		18.26	5.39		2.497	**
Verbal aggression	15.58	4.15		13.79	4.99		1.986	.052
Anger	13.75	4.87		13.68	4.80		0.072	.940
Hostility	18.55	5.44		14.32	5.18		4.273	***

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$ **TABLE 2.**

Analysis of differences between variables in various clusters among navigation students and master mariners (the Mann-Whitney U test)

Variable	Navigation students								Master mariners								
	Cluster 1			Cluster 2			Z test		Cluster 3			Cluster 4			Z test		p
	M	Sten score	SD	M	Sten score	SD	M	Sten score	SD	M	Sten score	SD	M	Sten score	SD		
Neuroticism	23.47	6	7.76	11.11	3	5.71	-6.947	***	12	3	6.88	10.38	2	3.42	0.236	.816	
Extraversion	22.42	4	7.01	31.33	7	5.42	5.764	***	32.17	8	4.84	28.85	6	6.65	0.738	.466	
Conscientiousness	26.89	5	4.48	35.54	6	5.26	6.680	***	38.17	8	7.18	37.85	7	4.65	0.738	.466	
Agreeableness	26.06	4	5.81	29.38	3	5.84	2.457	***	38.11	10	2.08	32.69	7	3.28	4.381	***	
Physical aggression	24.39		5.83	19.22		6.11	-3.923	***	14.67		4.56	19.92		4.89	-2.873	***	
Anger	17.11		3.72	12.07		4.52	-4.911	***	8.17		1.61	16.23		3.36	-4.883	***	
Hostility	22		4.38	16.82		5.11	-4.888	***	9		4.33	16.77		3.32	-4.506	***	

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

DISCUSSION

The main aim of the current study was to identify the personality profiles composed of the Big Five traits and aggression levels in two samples: master mariners (captains who receive the highest notes from their supervisors), and navigation students (not subjected to psychological assessment during recruitment). The analyses carried out confirmed the first hypothesis stating that captains exhibit the resilient personality type. Although the cluster analysis distinguished two groups of captains, their personality profiles fit the paradigm of the resilient personality. Part of the captain sample (41%) exhibited high conscientiousness scores, which can suggest increased perfectionism, or even pedantism, in confrontation with the task of managing the cruise and the crew in various difficult situations (see. Görner et al., 2019; Kusnierz et al., 2017, 2020).

Hypothesis 2, stating that navigation students will comprise both resilient (having high interpersonal competences characteristic for elite leader) as well as other personality types, has also been confirmed. Two clusters were distinguished in the student sample, the resilient type (67%) as well as the overcontrolled type with the tendency towards

aggressive behaviors (33%). The constellation of personality factors characteristic for this type is maladaptive from the perspective of safely managing a maritime cruise and the crew. Despite the average scores in all the other Big Five personality factors, higher neuroticism and aggression levels characteristic for this group of students may eliminate them from the group of future captains.

The resilient type shows a high level of impulse control, assertiveness in relations with employees, openness to others' arguments, and a tendency to compromise if they consider these arguments valid. In difficult situations, they manage their emotions and maintain focus on good, even perfect task performance. They can act decisively, but do not show a tendency towards aggression in every interpersonal as well as in task focus situations (Saus et al., 2012).

A part of the navigation student sample (33%) exhibited a personality type close to the one described in the literature as over- or undercontrolled. These students are characterized by a tendency towards competitive behaviors based on a lack of trust and aggression towards those who behave differently in social or workplace situations. The overcontrolled type might stimulate inappropriate decision-making

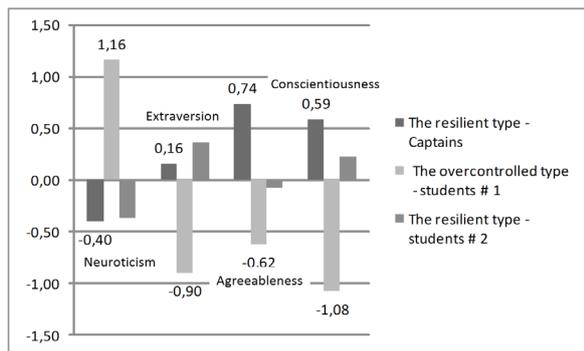


FIGURE 2.

Comparison of average standardized values of the severity of personality traits between distinguished groups representing two personality types.

due to a focus on “playing the role of the good leader,” lowering effectiveness in specific, complex situations. It can also be expected that individuals characterized by this personality type are unable to optimally cooperate with coworkers and to motivate them towards full engagement in various specific tasks related to a long-term maritime cruise (see, e.g., Van Wijk & Meintjes, 2017; Van Wijk & Water, 2000).

It is worth noting that in the current study, the navigation students have already had two training cruises on the “Dar Młodzieży” full-rigged sail training ship. The current results show that these likely did not have a significant effect on shaping their personality traits in directions beneficial for leadership. Thus, longitudinal studies tracking possible changes in personality profiles of navigation students, from the period of beginning naval school to assuming the position of a crew officer, are warranted (see Plopa, 2005, 2015). On the other hand, the current results seem to have a clear applied use. They justify including psychological criteria into the recruitment process, which would bring greater focus on individuals exhibiting the resilient personality type, characteristic for elite captains.

An analysis by Tzannatos (2010) shows that the human factor is responsible for over 75% of maritime accidents. Captains are responsible for around 80% of collisions and groundings (Berg, 2013; Chauvin, 2011; Chauvin et al., 2013; Herdzyk, 2016; Marine Accident Investigation Branch 2004; Matos et al., 2020; Mokhtari & Khodadadi, 2013; Plopa, 1996; Tzannatos & Kokotos, 2009; Walker et al., 2014). The responsibility of engineering and bridge officers in these accidents is low (around 10%).

Communication between the captain and the watch officers is vital in maritime transport, as it has a significant impact on the ship's safety. Risk management also involves the so-called interpersonal element, which concerns problems with precise communication. The results of the current study suggest that an increased risk of losing control of the ship can occur when a captain exhibits a personality type other than the resilient type, as well as when a “resilient” captain has to cooperate with “undercontrolled” officers. Lack of agreement between key crew members often generates a risk of collision or accident. Due to his leadership position, an overly self-confident captain, even when cooperating with a resilient officer, can generate tension and force through his

strategy of action without considering the officers' opinions. A belief in one's infallibility, together with aggression towards other crewmembers, creates discomfort and suboptimal functioning in the entire crew. The mechanism of this maladaptive behavior has also been observed in airline flights, all too often ending in catastrophes (Smolicz et al., 2020). The current study confirmed that taking into account the psychological factor is warranted in the context of preparing students for serving at various leadership positions on maritime vessels. The majority of the students exhibited desirable leadership traits (the resilient personality type). Nevertheless, 33 per cent of the students displayed the undesirable (from the point of view of effective crew leadership at sea during various difficult and complex circumstances) personality type. The results of the current study can be used in designing selection procedures for naval schools (no such research is being currently carried out) or promotion procedures for the position of captain. Naturally, the current results (or at least the results concerning the relationship between conscientiousness and other traits) should be replicated on other student samples as well as officer samples. The presented literature review and the results of the current study testify to the validity of this proposition.

FOOTNOTES

¹ A cluster analysis is most often used when there are no a priori hypotheses and when a study is still in its exploratory phase. We used Statistica's Generalized EM and k-Means Cluster Analysis module, including cross-validation to determine the number of clusters. This method is considered to be the best by some of the recognized authorities in statistics (Guidici, 2003). After standardizing the means, the analysis grouped cases such as to maximize the distance between the clusters. Choosing two clusters for the analysis was based on an earlier agglomeration schedule (hierarchical method) carried out using Ward's method and Euclidean distance. The cut-off point created on the basis of the stages on the distance graph distinguished two clusters. Additionally, cross-validation was used during the k-means cluster analysis, which also distinguished two clusters in the sample of captains and navigation students.

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