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Dispositional resilience predicts psychological adaptation of seafarers during and after maritime operations

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ABSTRACT

Background: *Seafarers, whether on cargo, fishery, or naval ships, may be exposed to unique and unusual psychological demands related to the often isolated, confined, and extreme environments associated with ocean-going vessels. This necessitates optimal psychological adaptation to maintain individual well-being during the mission and afterwards. This study set out to explore whether psychometric measures could predict psychological adaptation of seafarers, specifically navy sailors, during and after maritime operations. It used emotional regulation as marker of adaptation, and examined the role of psychometric measures of dispositional resilience and emotional regulation to predict psychological adaptation at subsequent time-points.*

Materials and methods: *A total of 168 sailors completed the Brief Sailor Resiliency Scale, Dispositional Resilience Scale 15, and Mental Toughness Questionnaire 18 prior to departing for sea, as well as the Brunel Mood Scale at 5 time points over a 12-month operational cycle.*

Results: *Higher resilience scores were consistently associated with more adaptive emotional regulation. Multiple linear regressions indicated that the Brief Sailor Resiliency Scale predicted emotional regulation over the shorter term, while the Mental Toughness Questionnaire 18 predicted emotional regulation over the longer term. Further, mid-mission emotional regulation also predicted emotional regulation at the end of deployments.*

Conclusions: *The findings support several practical applications. Firstly, formal organizational initiatives to promote resilience could be useful to enhance adaptation during and after missions. Secondly, measuring seafarers' dispositional resilience could allow the streaming of vulnerable individuals towards appropriate mental health support services. Thirdly, past indicators of adaptation could be useful to enhance decision-making regarding subsequent utilisation. This may be applicable to seafarers in both naval services and commercial shipping, and to personnel in remote weather stations or other isolated and inaccessible research facilities.*

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Key words: dispositional resilience, emotional regulation, isolated, confined, and extreme environments, MTQ-18, navy deployments, psychological adaptation, seafarers

INTRODUCTION

Maritime operations can be demanding, and maintaining optimal psychological adaptation is necessary for both the success of the mission and the well-being of individual seafarers during the mission and afterwards. This study set out to explore whether dispositional resilience — measured

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through various scales — could predict psychological adaptation of seafarers, specifically navy sailors, during and after maritime operations.

It has previously been suggested that personal disposition may influence the psychological adaptation of individuals working in unusual environments. For example, specific personality configurations have been shown to support the adjustment of individuals in so-called isolated, confined, and extreme (ICE) environments [1, 2], and recent research suggested that a brief dispositional resiliency scale could predict adjustment during naval deployments [3].

DISPOSITIONAL RESILIENCE IN MILITARY AND ICE ENVIRONMENTS

Isolated, confined, and extreme environments refer to settings that are characterised by isolation and confinement, often due to hostile external conditions, and are associated with a range of context-specific physical, mental, and social stressors [4].

Dispositional resilience refers to that personal quality that allows people to overcome hardships and even thrive in the face of it [5, 6]. It is usually considered an internal trait, which allows an individual to constructively work though life's adversities, and is further considered a predictor of adaptation to stress/trauma, as well as mental health [7, 8]. Such resilience constructs, which includes for example hardiness, mental toughness, and sense of coherence, are thought of as dispositional, in that they are approaches or orientations towards life that individuals develop over time.

Hardiness is a psychological orientation associated with people who remain healthy and continue to perform well in a range of stressful conditions [9, 10]. Hardiness is a psychological construct with three facets, namely commitment, control, and challenge [11]. Hardiness has been shown to influence outcomes among soldiers in training, combat duty and peacekeeping, across various national contexts [12–16]. There is evidence that hardier soldiers are less likely to develop posttraumatic stress disorder and other mental health conditions after exposure to combat [13, 17–20] and may adapt better both during and after operational deployments [21].

Mental toughness is a psychological orientation particularly associated with perseverance [22, 23]. It is partially derived from the theoretical foundations of hardiness, with a fourth facet included, namely confidence [24]. Mental toughness is associated with both mental health and coping strategies [25–30], as well as performance in military contexts [31–33]. Mental toughness has recently been associated with good adaptation during military diving and submarine operations [34].

PSYCHOLOGICAL ADAPTATION

Psychological adaptation generally refers to "an individual's ability to adjust to changes in their environment, to optimise personal functioning" (The technical definition refers to the "ongoing process, anchored in the emotions and intellect, by which humans sustain a balance in their mental and emotional states of being and in their interactions with their social and cultural environments". Miller-Keane Encyclopaedia and Dictionary of Medicine, Nursing, and Allied Health, 7th ed. Saunders, Elsevier, Inc. 2003). Within the so-called ICE environments (including naval ships at sea), three broad domain markers are often used to indicate adaptation, namely quality of work output, quality of interpersonal interaction, and emotional regulation [1, 35–37].

Emotional regulation (ER) refers to a "set of automatic and controlled processes involved in the initiation, maintenance, and modification (i.e., 'regulation') of the occurrence, intensity, and duration of feeling states" [38–41]. Emotional regulation underpins personal performance across many aspects of daily life, including family, work, and sport [39]. As such it can be used to operationalise psychological adaptation [4], in that individuals with more adaptive ER would be expected to effectively manage their personal performance across work output, social interactions, and affective states, especially under the psychologically rigorous demands found in ICE environments. In contrast, individuals with less adaptive ER could be expected to have difficulty managing their personal performance across these three indicators.

One way of describing ER would be through using Brunel Mood State Scale profiles (BRUMS; described in detail later). The BRUMS is sensitive to changes in affective states and could indicate compromised emotional regulation. Scale profiles and/or changes in specific contexts may therefore reflect either good or poor psychological adjustment to that context [4]. Psychological adaptation in ICE environments can be predicted by a number of situational factors [2, 42], which raises the question of the extent to which dispositional factors [1] may also influence this.

PSYCHOLOGICAL DEMANDS ON OCEAN GOING SEAFARERS

Ocean going vessels (e.g., cargo, fishery, military) may be examples of ICE environments: Once at sea, crewmembers may be isolated from the outside world, for example through limited communication with home for prolonged periods of time. They face confinement inside the hull or superstructure, particularly in ships with citadel designs, where they have to contend with the overlap of workspace and living quarters, and the associated social stress of high-density

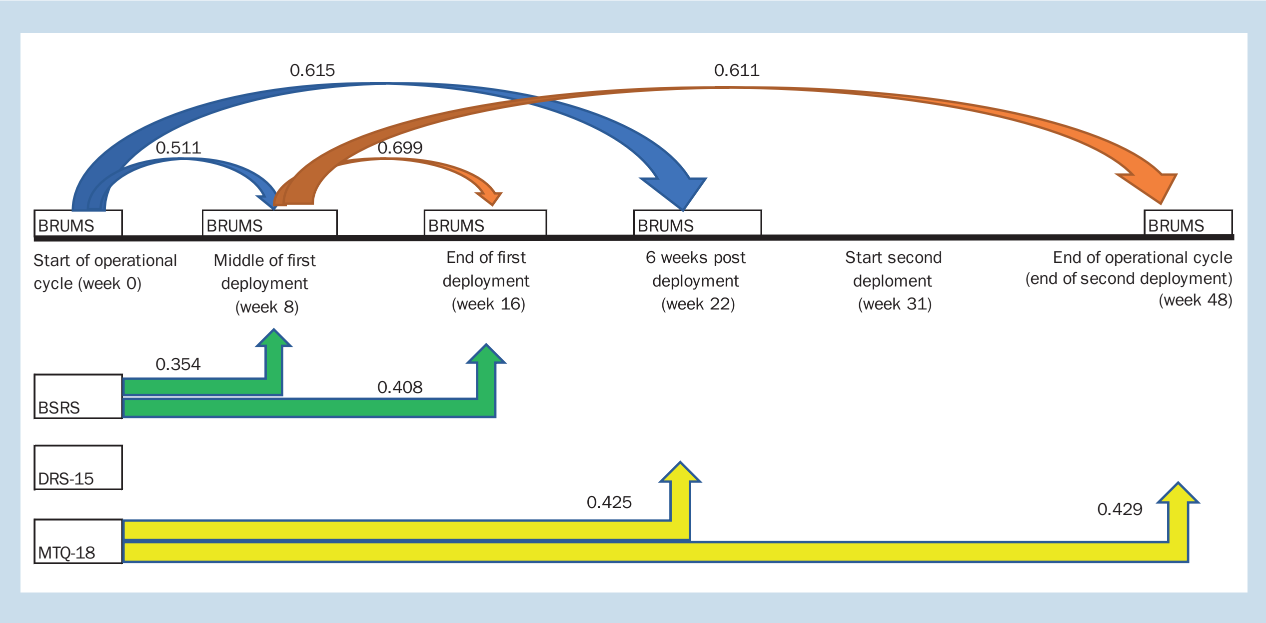

Figure 1. Significant beta coefficients predicting psychological adaptation across the deployment cycle. Numbers refer to standardised beta values; BRUMS — Brunel Mood Scale; BSRS — Brief Sailor Resiliency Scale; DRS-15 — Dispositional Resilience Scale 15; MTQ-18 — Mental Toughness Questionnaire 18

living spaces, lack of privacy, and social monotony (i.e., confinement with the same set of individuals for an extended period). They also have to endure the effects of extreme weather conditions (e.g., during rough seas) on their personal wellbeing and ability to maintain task performance. In this regard there has been a remarkable consistency in the reported psychological demands and stress across seagoing contexts [43–49]. Additionally, naval ships, and their crews, are exposed to often unique, and at times dangerous, operational demands, also deploy for extended periods of time, and face a high risk for adverse experiences associated with the operational nature of their mission (e.g., injuries during maritime interdiction operations). All of this reflects both specific demands on ocean going vessels as ICE environments, as well as the requirement to adapt effectively to this environment in order to maintain quality work output and complete the mission.

AIMS AND OBJECTIVES

As discussed earlier, psychological adaptation in ICE environments is often conceptualised across three domains, namely work-ability, sociability, and emotional regulation. This paper focuses on one indicator of psychological adaptation, namely ER. This study's primary aim was to explore the role of dispositional resilience scales in predicting ER at four different time points during and after naval deployments. This secondary aim was to explore the utility of any time-point measure of ER to predict ER at subsequent time-points during and after operational deployments.

MATERIALS AND METHODS

OVERVIEW OF STUDY

South African Navy (SAN) sailors completed psychological measures at five different time-points during a 12-month cycle of operational deployments. Figure 1 offers a graphic representation. This was done as part of the SAN occupational health surveillance programme administered by the Institute for Maritime Medicine in Simon's Town, South Africa. File data were available for sailors on a naval vessel that completed two 4-month deployments over their 12-month deployment cycle, and was accessed for this study by means of a retrospective file review. The study was conducted according the principles set out in the Declaration of Helsinki (2013), and Institutional Review Board approval was obtained for the use of psychological data.

PARTICIPANTS

A total of 168 sailors consented to their information being included in this study. The sample had a mean age of 31.3 years (standard deviation [SD]: 6.4, range 21–59), and 22.9% were women. Occupational specialities are presented in Table 1; categories comprising less than 2% of the total sample were collapsed into an 'Other' category. The sample reflected the general population of sea-going SAN personnel. Not all sailors completed all the measures at each administration, and cases were included if more than one dispositional and one ER measure were completed.

Table 1. Descriptive data for the sample and dispositional scales

Mustering	Per cent	Scale	N	Mean	SD	Range	α
Admin	7.0	BSRS	160	39.07	6.2	26–54	0.857
Catering	7.9	DRS-15	168	34.49	5.5	18–45	0.738
Combat officers	14.9	MTQ-18	168	68.96	8.2	45–90	0.774
Communications	5.3	BRUMS (week 0)	137	–8.85	6.0	–16, 14	
Engineering/technical	22.3	BRUMS (week 8)	100	–5.75	9.7	–16, 50	
Weapons operators	10.5	BRUMS (week 16)	112	–5.62	8.1	–16, 25	
Radar operators	3.0	BRUSM (week 22)	71	–8.93	7.2	–16, 24	
Other	15.0	BRUMS (week 48)	168	–3.43	10.0	–16, 31	0.799

BRUMS — Brunel Mood State Scale; BSRS — Brief Sailor Resiliency Scale; DRS-15 — Dispositional Resilience Scale 15; MTQ-18 — Mental Toughness Questionnaire 18; SD — standard deviation

MEASURES AND VARIABLES

Socio-demographic data (namely age, gender, naval speciality) was available, and used to describe the sample profile.

Emotional regulation was measured at five time points, namely immediately prior to the first deployment (week 0), mid-way through the first deployment (week 8), at the end of the first deployment (week 16), and 6 weeks after returning from the first deployment (week 22). A further measurement was done at the end of the second deployment (week 48).

Emotional regulation was measured using the Brunel Mood State Scale (BRUMS). The BRUMS is a 24-item self-report inventory that measures six transient affective mood states [50]. It has been used extensively, and a substantial body of literature exists on its use in many domains — from sport performance [51] to sleeping patterns [52] to academic achievement [53], as well as a marker of mental health [54]. Pertinent to naval seafarers, the BRUMS has reportedly been able to predict post-traumatic stress symptoms after maritime interdiction operations [55]. Good concurrent and criterion validity has been reported [50]. A total mood state score (range: 16 to 80) can be calculated and was used for this study. While lower total scores typically represent more adaptive ER, certain score profiles, and/or large changes in scores, could be indicative of risk for poor psychological adaptation. The BRUMS total score reflects the outcome of ER (not the process of ER), and as such was used here as indicator of psychological adaptation.

The dispositional variables were measured by three instruments, who all purport to assess aspects of personal resilience. By definition they were assumed to be stable constructs that would not change substantially over the period of about 12 months. For all three instruments, higher scores represent greater psychological resilience. All dispositional data was collected immediately prior to the start of the first deployment.

The Brief Sailor Resiliency Scale (BSRS) has been validated previously in South African military settings [3, 56], and measures dispositional resiliency across four domains, namely mental, physical, social, and spiritual. A comprehensive sailor resiliency score can also be calculated, ranging from 0 to 60, and which was used in the analysis below. A Cronbach alpha of 0.86 was calculated for the current sample.

The Dispositional Resilience Scale 15 (DRS-15) [57], has been extensively used to measure hardiness in military and non-military samples [21]. Good psychometric properties and criterion-related validity across multiple international samples have been reported [13, 58–61]. A previous South African study found acceptable internal reliability, but could not replicate the original factor structure [62]. Scores range from 0 to 45, with a Cronbach alpha of 0.74 calculated for the current sample.

Mental toughness is an extension of the hardiness construct, and is aggregated over six dimensions [24]. The Mental Toughness Questionnaire 18 (MTQ-18) provides an overall score for mental toughness [24]. A previous South African study found high internal reliability [62]. Scores range from 18 to 90, with a Cronbach alpha of 0.77 calculated for the current sample.

DATA MANAGEMENT AND STATISTICAL ANALYSES

The scales were administered in their standard format, and the respective total scores were calculated according to standard procedures. Only total scale scores were used in this study. The data were first analysed using Pearson's correlation coefficients, with significance set at $p < 0.05$. The association of dispositional factors and time-point ER measures were explored through calculating correlation coefficients for the BSRS, DRS-15, MTQ-18 and five BRUMS administrations.

Thereafter multiple linear regressions were conducted for each outcome variable, namely ER at 8, 16, 22,

Table 2. Correlations between dispositional resilience scales and psychological adaptation at five time points

Psychological adaptation	Scale	N	r	P
BRUMS (week 0)	BSRS	136	−0.391	< 0.001**
	DRS-15	87	−0.256	0.017*
	MTQ-18	87	−0.273	0.010*
BRUMS (week 8)	BSRS	94	−0.356	< 0.001**
	DRS-15	62	−0.167	0.196
	MTQ-18	62	−0.274	0.031*
	ER (week 0)	81	0.511	< 0.001**
BRUMS (week 16)	BSRS	101	−0.250	0.012*
	DRS-15	71	−0.305	0.010*
	MTQ-18	71	−0.297	0.012*
	ER (week 0)	86	0.385	< 0.001**
	ER (week 8)	87	0.641	< 0.001**
BRUMS (week 22)	BSRS	66	−0.287	0.019*
	DRS-15	54	−0.414	0.002**
	MTQ-18	54	−0.403	0.003**
	ER (week 0)	54	0.488	< 0.001**
	ER (week 8)	53	0.382	0.005**
	ER (week 16)	59	0.289	0.026*
BRUMS (week 48)	BSRS	106	−0.129	0.186
	DRS-15	168	−0.322	< 0.001**
	MTQ-18	168	−0.389	< 0.001**
	ER (week 0)	87	0.279	0.009**
	ER (week 8)	62	0.391	0.002**
	ER (week 16)	71	0.432	< 0.001**
	ER (week 22)	54	0.374	0.005**

*p < 0.05, **p < 0.01; BRUMS — Brunel Mood State Scale; BSRS — Brief Sailor Resiliency Scale; DRS-15 — Dispositional Resilience Scale 15; ER – emotional regulation; MTQ-18 — Mental Toughness Questionnaire 18

and 48 weeks. The role of dispositional factors in predicting ER was examined through entering BSRS, DRS-15, and MTQ-18 scores as predictors for each of the four ER time points. Similarly, the utility of using earlier time-point measures of ER to predict ER at subsequent time points during and after deployment was examined through entering all BRUMS scores from earlier time-points as predictors for each of the four outcome variables. All statistical analyses were conducted using SPSS-27.

RESULTS

Descriptive data for the dispositional scales can be found in Table 1. Mean scores, as well as Cronbach alphas, closely followed available normative data for local samples.

The correlations between the three dispositional scales and ER measured at five time points are presented in Table 2. Of the measures, the DRS-15 and BSRS were significantly correlated to ER at three time points, and the MTQ-18 at all five time points. Higher scores on these measures of dispositional resilience were associated with more adaptive ER. Further, each time-point measure of ER was significantly correlated to ER at each subsequent time point during and after the deployments.

Multiple linear regression analyses were performed to assess the ability of dispositional resilience measures, as well as earlier measurements of ER, to predict ER at the four subsequent time points. The predictor variables were entered stepwise, backward, and forward, and the results were the same across the three methods. The results are shown in Table 3 and graphically represented in Figure 1.

Pre-deployment ER scores predicted ER during mid-mission (week 8) and during the maintenance cycle (week 22), while mid-mission ER (week 8) predicted ER at end of 1st and 2nd deployments (weeks 16 and 48). The BSRS

Table 3. Results for linear regression analysis for four time-point measures of emotional regulation

Outcome	Adjusted R^2	ANOVA	Predictor	Standardised β	P
Week 48	34.5%	F = 13.310	BRUMS week 8	0.611	0.002
			MTQ-18	0.429	< 0.001
Week 22	35.9%	F = 20.079	BRUMS week 0	0.615	< 0.001
			MTQ-18	0.425	0.002
Week 16	45.5%	F = 57.461	BRUMS week 8	0.679	< 0.001
			BSRS	0.408	0.001
Week 8	25.2%	F = 27.901	BRUMS week 0	0.511	< 0.001
			BSRS	0.354	0.006

BRUMS — Brunel Mood State Scale; BSRS — Brief Sailor Resiliency Scale; MTQ-18 — Mental Toughness Questionnaire 18

predicted ER over the shorter term (8 to 16 weeks), while the MTQ-18 predicted ER over the longer term (22 to 48 weeks). The DRS-15 did not meaningfully add to any predictive model.

DISCUSSION

This study aimed, firstly, to explore the role of dispositional resilience scales in predicting ER during and after naval deployments, and some of the measures did appear useful in predicting ER across time. The study aimed, secondly, to explore the utility of earlier measurements of ER to predict ER at subsequent time-points, and again some of the ER time-point measurements appeared useful in predicting subsequent ER in the same context.

PREDICTION OF EMOTIONAL REGULATION

Two of the dispositional resilience scales showed promise in predicting ER during and after naval deployments, with the BSRS predicting adaptation over the shorter term, and the MTQ-18 predicting adaptation over the longer term. The BSRS has previously been associated with adjustment during short-duration maritime deployments [3]. However, its failure to predict longer term ER scores in the present study may suggest a temporal limit on the utility of such measures. The BSRS was first administered about 11 months before the final ER measure, and the passing of time may have resulted in the original BSRS score no longer reflecting sailors' current life situation. Once-off measurements of psychological characteristics may have a limited 'shelf-life', and for it to be used to dynamically predict performance in ICE environments (or elsewhere) may require repeated measurements across longer periods of time.

In contrast to the BSRS, the MTQ-18 scores offered strong predictions over longer time periods, and the consistency of the MTQ-18's correlations with ER across all time points mark it as a useful scale to explore in future research. Mental toughness has been associated with behavioural perseverance [22, 23], also in military contexts [31–33], as well as with greater emotional stability during stressful events [63]. Such a personal strength would therefore be a benefit in ICE environments when adverse conditions are encountered, as it would facilitate an individual's ability to handle pressure and remain focussed in stressful situations [64], which would in turn be visible in the maintenance of adaptive emotional regulation. Additionally, mental toughness has also been associated with more problem-solving coping and less avoidant coping [27, 30], which may be considered as generally desirable approaches in ICE environments.

The failure of DRS-15 to predict ER — despite previously being associated with adaptation during and after military operations [21] — may point to poor scale validity in the South African context, consistent with what was previously reported [62]. Of practical relevance, the maritime industry includes people from all races and cultures, and caution would be necessary when using internationally available scales that have not yet been validated for local cultural-linguistic groups. Psychological measures are only suitable for use if context-appropriate validation has been confirmed.

In spite of significant correlations, not all time-point measurements of ER predicted subsequent ER scores in this ICE context. Of particular interest was the observation that mid-mission scores predicted end-of-mission scores (for both deployments), suggesting that measurements representing similar contexts of situational adaptation (i.e., while immersed in ICE environment) may be particularly useful in predicting subsequent adaptation. The theory of behavioural consistency posits that past behaviour is the best predictor of future behaviour [65–67]. The consistency of the ER scores across time emphasises the value of considering past adaptation when making decisions on future utilisation of personnel, particularly where circumstances are comparable. This may be particular pertinent in the context of maintaining a high operational tempo through repeated deployments.

PRACTICAL APPLICATION

The application of these findings may be three-fold. Firstly, if it is possible to predict psychological adaptation, then it is also possible to promote psychological adaptation. If better resilience predicts better psychological adaptation, then enhancing resilience as a formal objective of military preparation needs to be emphasised. This can be done through facilitating formal developmental experiences (military training courses; graded exposure to operational demands), and/or through specific deployment preparation programmes for ships' companies.

Secondly, if better resilience predicts better psychological adaptation, there may be value in measuring resilience, with the aim of identifying potentially vulnerable individuals, in order to stream them towards support services (e.g., social work services, chaplaincy) that could assist them in developing greater resilience for subsequent deployments. In this regard the BSRS was reportedly sensitive to the development of resiliency through either specific life experiences or formal interventions [3], and may remain useful to guide the development of resilience in preparation of shorter-term missions.

Thirdly, if psychological adaptation during and after deployments can be predicted by previous measures of psychological adaptation in similar contexts, then the inclusion of available measures of psychological adaptation in any decision-making processes for subsequent deployments needs to be emphasised. However, for this to be practically useful, more inclusive measures of psychological adaptation may need to be developed, to more closely reflect the components of the original Antarctic Triarchy, in particular, measures of work-ability and sociability.

The above initiatives, namely 1) formal organisational intervention to promote resilience, 2) screening to identify the need for further individual intervention to develop resilience, and 3) using existing data on adaptation to guide future utilisation — could possibly be implemented not only in the naval context, but in other ICE environments too, from commercial shipping (whether cargo or fisheries), remote weather stations or polar outposts, to other isolated and inaccessible research facilities.

LIMITATIONS AND FUTURE DIRECTIONS

This study used a small sample in a very specific setting. The findings may thus be context bound, and possibly only applicable to psychological adaptation in similar or at least comparable settings. Further research is required to replicate the findings in the expanded settings of other ICE environments, for example commercial ocean-going vessels or remote weather or research outposts. As psychological demands across ICE environments appear remarkable consistent, the need for a resilient disposition to maintain and enhance psychological adaptation might be considered similar across industries. Additional research will be required to determine the effects of different situational factors, such as varying lengths of tours of duty, or environmental demands, or workload, on the role of resilience.

Further, all the significant predictors only explained a relatively small proportion of variance (see low Adjusted R^2 in Table 3). ER offers a single representation of psychological adaptation, and as mentioned, a wider range of markers would be necessary to confirm the principle that dispositional resilience truly predicts psychological adaptation — across quality of work output, interpersonal interaction, and emotional regulation — in ICE contexts. It would remain important to ensure that participants are exposed to the same or at least similar stressors, to demonstrate that differences between individuals reflect their resilience rather than their exposure to stressors.

Although the resilience concepts used in this study were constructed as dispositional, true personality traits not were measured. Some resilience constructs appear to be associated with, for example, the Big Five factors [28, 63, 68], as are ER [69], which leaves the possibility that any association between resilience and ER may be mediated by personality traits. For example, personality traits like negative affectivity have been reported to influence the appraisal of situations and subsequent emotional regulatory responses [27, 70]. Future research may need to include measures of personality to clarify the relationship between resilience and ER. And finally, it may be particularly productive for future studies to use the subscales of the BRUMS, not just the total score, when considering the association of dispositional reliance and psychological adaptation.

CONCLUSIONS

Measures of dispositional resilience, in particular the BSRS and MTQ-18, appeared useful in predicted psychological adaptation during and after maritime deployments. Similarly, measures of ER predicted subsequent measurements of ER, providing evidence of psychological consistency that could be constructively used in supporting seafarers to enhance their personal adaptation during and after maritime operations.

Conflict of interest: None declared

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