*Scientia Militaria*
*2025, VOL. 53, NO. 2, 25-46*
*DOI 10.5787/53-2-1496*

# Submarine Psychology: A South African Perspective on Assessing Readiness after Adversity

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## Abstract

Psychological readiness is a critical component for the success of the mission of the South African Navy, as well as the wellbeing of their personnel. The study on which this article reports, explored psychological readiness within the unique and demanding context of submarine duty. Key psychological factors for readiness include good clinical mental health, adaptability, and effective interfacing with support systems. From the 1970s, SA military psychologists have been involved in the selection of submariners, focusing on traits, such as motivation, intelligence, interpersonal skills, and personality. More recently, positive psychological constructs, such as sense of coherence, psychological hardiness, and mental toughness, were also identified as important for coping with the isolation and stress inherent in submarine operations. The current research specifically examined the aftermath of the SAS *Manthatisi* accident of September 2023, highlighting the psychological resilience of submariners and risk and protective factors associated with their post-accident adaptation. Initial screenings showed the presence of adjustment difficulties and other mental health challenges, but by seven months, most submariners had returned to their baseline mental health, demonstrating resilience and effective coping strategies. The importance of thorough pre-service selection, regular psychological screening, and timely interventions were emphasised as key to maintaining operational readiness. Insights from the accident furthermore underlined the need for resilient personnel who can withstand adverse events and speedily return to duty. The study concluded that ongoing availability of psychological support and the cultivation of resilience and adaptability are essential for maintaining the readiness and effectiveness of submariners.

**Keywords:** Adaptability, Coping, Mental Health, Psychological Readiness, Resilience, Submarine Operations.

## Introduction

In September 2023, the South African Navy (SAN) submarine SAS *Manthatisi* tragically lost three sailors during a training exercise. In light of the emotional impact on the submarine squadron, the incident led to a reconsideration of the local understanding of readiness of sailors in general to continue with operations after adverse events. The aim of this article is to offer a South African (SA) perspective on the psychological readiness for submarine operations, set against the backdrop of the tragic events of September 2023.

The above aim will be pursued as follows: the article starts with a brief discussion of the concept "psychological readiness", and then provides a brief overview of the involvement of psychologists with the SAN submarine service in order to discuss evolving

understandings of readiness in this context. This overview will be twofold. Firstly, it will touch on historical selection and psychological characterisation of submariners as pertaining to personal readiness; and secondly, it will describe the current involvement of the Institute for Maritime Medicine (IMM) with regard to the psychological wellbeing (and thus readiness) of SAN submariners.

The events of September 2023 and the post-accident psychological adaptation of the submarine squadron are reported as a case study, and discussed within the framework of psychological readiness for submarine operations after adverse incidents. Risk and protective factors – both short-term (seven weeks) and medium-term (seven months) – are presented in the context of adaptation and return to readiness after adverse occupation-specific events. The article concludes with insights gained and lessons for practical implementation.

## Psychological Readiness for Duty

"Fitness for duty" – medically speaking – refers to a state of health relative to employment demands.[1] More formally, being (medically) fit for duty means that an employee's physical, emotional, and mental condition would allow them to perform essential job duties in a proper, safe, and competent manner.[2] This locates "fitness for duty" within the context of workplace health and safety. In the common use of language in armed forces, the term "fitness" is however more often associated with physical conditioning (e.g. how many push-ups someone can do or how far they can run), and thus does not easily fit into psychological nomenclature.

In the context of military operations, the term "psychological readiness" is sometimes offered as an appropriate alternative. "Psychological readiness" refers to a composite set of mental attributes and capacities that enable sailors, medical personnel, aircrews and soldiers to meet the environmental, interpersonal, and operational challenges inherent to military service. In essence, it captures the mental state and preparedness of service members to function effectively under stress and uncertainty – whether during active combat, long deployments, or routine military life. Psychological readiness is multifaceted and comprises several key components:

- *Conation* – the mental energy and focus required to carry out a task to completion.[3] While this may overlap with motivation, "conation" refers to the neuropsychological capacity to apply consistent and purposeful mental effort over time.[4] It reflects the drive and determination to stay engaged, particularly in monotonous or taxing circumstances – a critical trait in the highly structured and high-pressure environment of submarine duty.
- *Emotional stability* – the ability to maintain predictable and balanced emotional responses, even when confronted with trauma, stress, or a crisis.[5] Emotional stability is marked by the absence of mood volatility and extreme emotional reactions. In practice, this often correlates with the absence of diagnosable psychiatric conditions, and indicates a high degree of psychological self-regulation.

- *Adaptability* – the ability to adjust quickly and effectively to changing circumstances, environments or roles.[6] Adaptability is supported by several resilience-related attributes, such as:
  - *Psychological resilience* – the ability to bounce back from adversity, trauma, or stress, and to maintain psychological wellbeing. This involves flexible thinking, emotional regulation, and the capacity to respond positively to internal and external stressors.[7] A number of factors contribute to how well people adapt to adversities, predominant among them:
    - the ways in which individuals view and engage with the world (also called "life orientation");
    - the availability of specific coping strategies; and
    - the availability and quality of social resources.
  - *Mental toughness* – the capacity to persevere in the face of adversity, hardship, and uncertainty. Sometimes also called "grit", mental toughness entails working strenuously to overcome challenges and maintaining effort and interest over time[1] despite failures, adversities, and plateaus in progress.[8] Mental toughness has been associated with performance success in military settings,[9] including SAN surface ships and submarines.[10]
- *Coping skills* – the availability of and confidence in techniques and strategies to manage stress, anxiety, and other emotional challenges. This is often associated with psychological self-regulation.
- *Support systems* – access to resources, such as family and/or peer support, mental health services, and leadership support, to help service members cope with psychological stressors. Reference to support systems also refers to the quality of such resources.

Other organisational and operational factors may also contribute to readiness, although they typically fall outside the scope of the individual or personal psychological dimensions of this article.

"Mission readiness", for instance, refers to a person's confidence in their training, experience, and equipment. Related concepts, such as "unit cohesion", or the "collective will to fight", also play a role. These elements belong to the domain of industrial and organisational psychology, but remain deeply intertwined with individual mental readiness.

In the context of the SAN submarine service, psychological readiness takes on a heightened significance due to the unique stressors of the undersea environment – including extreme confinement, isolation, sensory monotony, and reliance on a small crew for extended periods. The IMM in Simon's Town, South Africa, is contracted to provide medical and associated health services to the SAN submarine service. At the IMM, readiness for submarine duty is framed through the following psychological considerations:

[1] "Grit" refers to a personality construct, and is different from "conation", which refers to a neuropsychological or biological construct.

- *Clinical mental health* – individuals need to be free from any psychopathology that could impair functioning in a confined, high-stakes environment. This incorporates measures of conation and emotional stability, ensuring that individuals can maintain focus and regulate their emotions under pressure.
- *General adaptability*, which includes:
  - A resilient life orientation, indicating a generally optimistic and adaptable worldview;
  - An adaptive personality, that can facilitate the mobilisation of coping strategies; and
  - The capacity to activate appropriate coping skills and resources.
- *Interfacing with support systems*, which in turn need to be responsive, meaningful, and enduring.

These indicators are evaluated routinely by means of the IMM biennial Maritime Specialist Psychological Screening (MSPS), which is described later in this article. Broad organisational factors, for example perceived organisational support, belief in leadership, and confidence in equipment; or aspects, such as group cohesion and the collective will to fight, fall under the scope of industrial and organisational psychology, and are not assessed at the IMM, whose mandate is to operate from a health promotion position.

## South African Submarine Service and the Discipline of Psychology

The understanding of psychological readiness for submarine duty has evolved over time alongside the historical involvement of the discipline of psychology within the submarine service. Initially, psychological readiness was understood through the lens of selection, and terms, such as "suitability" of candidates, were used to reflect this. The more recent understanding is described within the current involvement of the IMM Mental Health Clinic. This will be described later in the article.

### *Selection during the Daphne Period (1966–2000)*

During the early second half of the twentieth century, in line with international experience, psychological readiness was closely associated with the selection of suitable submariners. In 1966, the SAN therefore commenced with the selection of naval officers and ratings for the then newly created submarine service. Earlier studies were done by psychologists from the National Institute for Personnel Research and South African Defence Force,[11] and have been summarised in an earlier article.[12] During the period 1970 to 1990, psychological selection mainly focused on five aspects, namely motivation, intelligence or academic ability, interpersonal relations, personality, and technical aptitude, which – in combination – were understood to reflect psychological readiness. Reports from that time noted that *realistic expectations* strongly predicted good adaptation to submarine service[13] – an issue that remains a challenge in modern-day selection.

While the above psychological assessments used standard protocols, one unusual test was developed specifically to simulate the operational demands of a submarine environment. The Climate Room Tension Test was intended to assess performance under conditions of

continuous physical discomfort and tension.[14] This test worked as follows: a small group of candidates were placed in a room where environmental conditions were controlled from the outside. Temperature was maintained at 30 °C, humidity at between 88 per cent and 90 per cent, and speakers fed a recording of compression hammers at 88 decibels into the room. Candidates had to complete tasks that were dependent on group cooperation and interaction, while a panel of observers rated their cooperation, response to tension and frustration, leadership, and acceptance by the group through a one-way mirror. While a novel approach to assess readiness, the test was time-consuming and labour-intensive, and there is no record that it was used after 1970.

Psychological selection for submarine duty was suspended in the 1990s, with mental health assessment continuing as part of the Comprehensive Submarine Medical Assessment at IMM.

### *Overview of Earlier Descriptions of Psychological Characteristics of SAN Submariners*

Over time, several psychometric analyses that explored the characteristics of active-duty submariners advanced the evolution of understanding of psychological readiness by the IMM. Reports describing the adaptive characteristics of submariners considered constructs, such as personality, mental health and psychological functioning, as well as constructs from positive psychology, such as resilience, sense of coherence, and mental toughness. These reports on SAN submariners are in the public domain, and are summarised here to demonstrate how they informed current perspectives on psychological readiness.

### *Personality*

There is some debate on the usefulness of including personality as part of psychological readiness deliberations.[15] Environmental demand theories however describe people with particular personality characteristics to gravitate towards particular occupational environments.[16] Personality thus indirectly shapes psychological readiness, as specific configurations of personality traits may underpin adaptability-in-context. The presence of four personally traits have been demonstrated to support individual readiness for submarine duty,[17] namely:

- *Adventurousness*. Often perceived as a blend of emotional toughness and readiness to roll up one's sleeves and get to work, adventurousness is particularly appropriate for submariners in two ways. Firstly, it presents a largely constitutional predisposition to low physiological reactivity to threat,[18] which would enable good performance and wellbeing, despite submarine sailors' understanding of the inherent dangers of submarine duties. Secondly, adventurousness fosters resilience in interpersonal contexts, enabling submariners to cope with the emotional strain of long-term, close-quarters living under stressful conditions.[19]
- *Dispositional confidence*. This trait reflects a stable sense of self-assurance, calmness, and importantly, a strong sense of self-agency – that inner belief that people can influence outcomes in their environment through personal effort.

- *Group orientation*. This trait is associated with good cooperation within groups, and with sufficient sensitivity in social interaction – a critical requirement for adjusting to the close-knit social structure of life on board submarines and the constant exposure to the social interaction that is prevalent.[20]
- *Precision and exactitude*. This trait involves self-discipline, meticulous attention to detail, and even a degree of compulsiveness.[21] The demands of submarine duty may require an exceptionally high degree of precision, and training and sea duty further ingrain the meticulous checking of equipment and adherence to operating procedures – all vital requirements for situations where small errors could have catastrophic consequences.

Further, a seminal analysis, using data of submariners according to the Minnesota Multiphasic Personality Inventory-2, confirmed that effective submariners score within adaptive ranges for both mental health and personality functioning.[22]

### *Constructs from Positive Psychology*

The Institute for Maritime Medicine (IMM) has a long history of using constructs from positive psychology in their work with submariners.[23] Constructs, such as sense of coherence, psychological hardiness, and mental toughness, offer complementary insights into the readiness of submariners for sea duty.

- *Sense of coherence* (SoC) refers to an enduring dispositional orientation that views life as understandable, manageable, and meaningful, which in turn enables individuals to mobilise effective coping resources in the face of tension.[24] Enhanced SoC has been associated with high adaptive coping in military contexts,[25] and with certain adaptive personality traits common to SAN submariners.[26] A high SoC appears to enable submariners to mobilise those resources in their environment that would support adaptive personal coping and, by extension, psychological readiness.
- *Psychological hardiness* comprises three interrelated components, namely commitment, control, and challenge. Hardy individuals view difficult situations as opportunities for growth rather than threats, and are especially resistant to the adverse effects of personal and environmental stress.[27] Well-adapted submariners scored high on measures of hardiness, and tended to display an associated personality profile characterised by high agreeableness, high conscientiousness, and low neuroticism, which have been associated with enhanced readiness for submarine duty.[28]
- *Mental toughness* is related to hardiness, and comprises four components, namely commitment, control, challenge, and confidence, and is strongly associated with perseverance,[29] known colloquially as *vasbyt* (to hang on). Again, individuals who score high on measures of mental toughness share the same personality traits as those high in hardiness,[30] reinforcing the consistency of the personality profile supporting psychological readiness for submarine operations.

### *Emotional disposition*

Emotional disposition refers essentially to one's typical emotional state or "trait emotions", and has proved to be predictive of psychological adaptation in submariners. Originally derived from the Trait-State Personality Inventory, emotional disposition allows for a forward-looking assessment of psychological readiness, especially when predicting how individuals may fare during future deployments or stressful assignments. Submariners who display positive emotional dispositions also report positive mental toughness,[31] which illustrates the interplay between affective traits and overall resilience in determining psychological readiness.

### *Coping strategies*

Globally, both problem-focused coping strategies and interpersonal sensitivity have been associated with superior coping during submarine missions.[32] Submariners from the SAN reflect this trend, reporting problem-solving approaches (e.g. planning, taking action) as their preferred styles. They also use cognitive coping approaches (e.g. positive reframing, religion) effectively as additional coping styles. This is particularly useful in situations where they might not be able to change their external environment. Equally interesting are the coping styles they do not endorse, namely behavioural disengagement (e.g. giving up, not persevering), as well as denial of their situation.[33]

While these tendencies represent dispositional coping styles – in other words, the way in which they would typically cope – across different situations, real-time adaptations to the submarine environment suggest dynamic flexibility. Over long deployments, SAN submariners increasingly rely on cognitive coping tools, such as humour, acceptance, and positive reframing. As the duration of deployment stretches, self-distraction also becomes a prominent coping strategy, allowing individuals to shift focus away from internal stressors, and find temporary mental relief.[34] This shift in coping strategies reflects an essential element of psychological readiness: adaptability across time and circumstance.

Two specific coping styles stand out as especially relevant within SAN submarine culture, and are reflected in other submarine services as well:[35]

- *Dispositional confidence* was discussed earlier in this article, and refers to a person's sense of agency, a belief that their own actions might influence outcomes in their environment.[36] Such a disposition acts as critical coping resource to sustain constructive psychological performance and wellbeing during submarine operations.
- *Rational denial* refers to the unspoken consensus among submariners that openly discussing the risks of disaster is unhelpful.[37] This is not a denial of danger but rather a selective suppression of such awareness in day-to-day consciousness. Submariners appear to acknowledge the hazards of their profession, but consciously choose not to dwell on them, adopting a mind-set of "light fatalism" – acceptance of risk without fixation. While this mechanism supports functional coping during routine operations, it can be disrupted in the wake of real-world incidents – such as the SAS *Manthatisi* accident – when threats may become too immediate or tangible to ignore. Both these coping

characteristics are strongly associated with enhanced psychological readiness for submarine operations.

### *Recurrent social stressors*

Social stressors may occur irrespective of individual coping styles or self-efficacy, and are generally not directly germane to psychological readiness. When individuals have difficulty resolving such stressors appropriately, its reoccurrence may however compromise long-term adjustment. Such stressors are referred to as "recurrent social stressors" (RSS), and their presence suggests difficulty in mobilising appropriate coping resources, leading to failure to manage or resolve concerns adequately. Unlike acute or isolated stressors, RSS reflect persistent interpersonal issues that fail to resolve over time, and which may resurface under strain.

An analysis of SAN submariner data from 2015–2017 showed that 60 per cent of sailors removed from active duty due to poor adjustment had unresolved RSS.[38] Moreover, all additionally flagged cases during that period also involved RSS as a contributing factor. This finding suggests that repeated failures to navigate social stressors may be indicative of broader limitations in abilities to activate and mobilise coping strategies and resources, which should be considered when determining psychological readiness for submarine operations.

### *Overview of Current Involvement of the IMM Mental Health Clinic*

The IMM in Simon's Town provides medical and related health support for submariners.[39] The psychologists at the IMM mental health clinic have a threefold engagement with the submarine service, namely:

- Mental health screening during the initial comprehensive submarine-specific medical assessment;
- The MSPS incorporated into the routine biennial comprehensive submarine-specific medical assessments; and
- Ad hoc psychotherapeutic interventions throughout the careers of submarine personnel, when requested.

### *Initial Comprehensive Submarine-Specific Medical Assessment*

New candidate submariners are required to undergo a comprehensive submarine-specific medical assessment to obtain an "S" medical classification[2] when joining the submarine branch, with a repeat "submarine medical" every two years until they reach 40, and thereafter annually for the rest of their career. The initial assessment includes a mental health screening component, which has as its main purpose the identification of major mental health challenges, prior to candidates' deployment to the submarine squadron, and to advise the confirming medical authority accordingly. This evaluation mainly assesses for risk of psychiatric syndromes, although personality factors incompatible with submarine operations would, in theory, also raise concern. As there is currently no mechanism to exclude such candidates, this is, however, generally not considered.

[2] In the SAN, an "S" medical classification refers to medical fitness for submarine duty.

### *Biennial Maritime Specialist Psychological Screening*

The biennial Maritime Specialist Psychological Screening (MSPS) is used to identify current mental health challenges in order to facilitate their resolution and promote adaptive coping in general, and to advise the confirming medical authority accordingly. Where appropriate, identified submariners are referred for a psychotherapeutic intervention, in order to maintain their active-duty status. As far as could be ascertained, the IMM is the only facility in sub-Saharan Africa where MSPS is offered. The overarching screening is prescribed in part by occupational health and safety legislation, and the MSPS is seen as part of occupational mental health monitoring and promotion. The MSPS is thus guided by occupational mental health sensibilities, and attempts to answer the question whether "this person is able to do this work at this time", and without undue risk to the health and safety of self or others (within a military operational context).

The focus of the MSPS is twofold: to consider psychiatric symptomatology, which is generally not expected, and then to follow a salutogenic (or health-promoting) approach to facilitate continuous good adaptation. A salutogenic approach entails a focus on what keeps individuals mentally healthy. This is typically done by the individual exploring their strengths and resources, and developing their skills to mobilise those resources.[40] The exact psychometric protocol used for mental health monitoring has changed over the years, with emotional disposition featuring strongly in the period 2000 to 2020, and clinical symptomatology moving to centre stage from about 2017–2018 onwards. This happened as part of a requirement to integrate various forms of occupational mental health monitoring and military mission readiness assessments more closely.

### *Ad Hoc Psychotherapeutic Interventions*

Throughout a submariner's career, their psychological readiness can be supported through formal psychotherapeutic intervention. Such interventions may be in response to referral through their divisional system, from a medical officer, from a psychologist (typically after an MSPS), or – most often – self-referral. Interventions are tailored to individual needs, and form part of the regular outpatient service at IMM.[41]

Through all three mechanisms – entry, routine, and ad hoc interventions – psychological readiness for submarine operations is determined by a relative absence of clinically debilitating psychopathology (i.e. good emotional stability), the presence of adaptive functioning-in-context, and the ability to mobilise personal and social coping resources when required.

## Submarine Accident of September 2023 and its Aftermath: A Case Study on the Assessment of Readiness after Adversity

As an extension of the routine involvement of the IMM mental health clinic, the events of September 2023 and their psychological impact are reported as a case study, to highlight risk and protective factors associated with adaptation and return to readiness after adverse occupation-specific events.

## *Background*

On 20 September 2023, the South African Navy Type 209 diesel-electric submarine, SAS *Manthatisi* (S101), conducted a vertical replenishment (VERTREP) exercise while underway off the west coast of the Cape Peninsula, amidst strong winds and heavy seas. During the course of the afternoon, three senior sailors died of injuries sustained after being washed overboard during the exercise, while another five submariners (including a rescue swimmer deployed by helicopter) spent many hours in the water before being rescued by the National Sea Rescue Institute (NSRI). All five eventually made a good physical recovery. The deceased were the executive officer (Lt Cdr Hector), Chief of the Boat (Master Warrant Officer Mathipa), and the chief of the boat under training (Warrant Officer Mojela).[42] The boat returned to her home port of Simon's Town the next day.

This incident bore resemblance to an event in December 2006 where four crew members of the USS *Minneapolis–Saint Paul* (SSN-708) were washed overboard by heavy seas in Plymouth Sound, England. Here, too, the Chief of the Boat was one of two fatalities. Similar anecdotal accounts of sailors being washed overboard from SAN submarines in heavy seas during operational deployments have been circulating going back to the Daphne era (although without fatalities).

In the week following their return to Simon's Town, voluntary psychological debriefings for affected submariners took place, and addressed those members who were identified, or who identified themselves, as in need of such interventions.[43] A mass memorial service was held a week after the incident, with various members of the submarine squadron participating. Formal funeral services were also held for the three deceased submariners, with full military honours, in their respective home communities. The submarine squadron was intimately involved in these arrangements, and participated in large numbers during each event.

Seven weeks after the incident, a psychometric screening was conducted to determine the readiness of submariners to return to active operational duty, and to, where appropriate, make recommendations to facilitate this. As a result, a number of individuals were offered further psychological counselling. A second and final psychometric screening was conducted about seven months after the accident.[44] In accordance with routine practice at IMM, the psychometric data were analysed to understand post-accident psychological stress responses and subsequent psychological readiness of the submariners better. The findings below describe short- and medium-term risk and protective factors, as well as the course of adaptation and return to readiness after this adverse occupational-specific event.

## *Methodology*

All members of the submarine squadron who were available at the time, participated in the screening. The data for the current analysis came from three sources, and were accessed for this study with the participants' written consent. To protect the privacy of the participants, no source data are presented, only the outcomes of the analysis. Ethics permission for the analysis was provided by Stellenbosch University Health Research Ethics Committee (N20/07/078, dd 29 January 2024).

First, IMM maintains an archive of MSPS records, which were used to place the participating submariners' current experiences into their personal historical context. Data included:

- History of RSS (unrelated to submarine service) or other family–work interface concerns (i.e. previous family issues that interfered with work performance);
- History of multiple and/or recent losses (defined as the loss of a family member or close friend within the preceding three months, or the loss of multiple family members or close friends during the preceding year);
- History of previous psychological trauma (in preceding three years; although not clear what qualified as "trauma"); and
- Scores on the Connor–Davidson Resilience Scale-10 collected during their previous MSPS cycle.[45]

Second, quantitative data were available from the psychometric survey during week 7.[46] The assessment included a composite clinical screener to identify maladaptive psychological stress responses (namely adjustment disorder, major depressive disorder, and post-traumatic stress disorder [PTSD]), as well as clinical interviews.

Third, quantitative data were available from the psychometric survey administered at seven months.[47] The battery included the same composite clinical screener to identify maladaptive psychological stress responses, as well as the Coping Self-efficacy Scale[48] that measures an individual's confidence in their coping strategies when it comes to handling challenges and stressors. Positive associations between coping self-efficacy and physical and mental health outcomes have previously been reported in military samples.[49]

The IBM SPSS 29 was used for statistical analysis, which comprised descriptive, chi-square, and regression analyses to determine associations with risk and protective factors, and likelihood ratios.

### *Psychological Responses to Collective Traumatic Events*

Before describing the psychological stress responses after the submarine accident, a brief consideration of psychological responses to collective traumatic events (e.g. mass tragedies, disasters) in general, may be helpful.

Individuals may present with widely different responses to collective traumatic experiences. In spite of this, for the majority of people there appears to be a typical course of psychological symptoms after disasters, namely that post-disaster symptoms of mental health problems are reported soon after such events, but are also resolved relatively soon thereafter.[50] For smaller segments of society, symptoms may persist for some time, or for others, these may be delayed and only present later. Table 1 below lists a range of different trajectories (of psychological adaptation) following exposure to severe stress.[51] The SAN estimates are discussed in the section 'Course of Post-Incident Mental Health' later in this article.

| Descriptive name | Nature of trajectory | General population estimates[52] | SAN submarine accident 2023 estimates (after seven months) |
|---|---|---|---|
| Resistance | No or mild stable symptoms | 54% | 75,0% |
| Resilience | Initially moderate or severe, followed by sharp decrease | 10% | 22,5% |
| Recovery | Initially moderate or severe, followed by gradual decrease | 9% | 0% |
| Chronic dysfunction | Moderate or severe and stable symptoms | 13% | 2,5% |
| Delayed dysfunction | Initially mild symptoms, becoming severe only after a period of time | 14% | 0% |

*Table 1: Different trajectories of psychological adaptation after exposure to severe stress*

The prevalence of psychological symptoms after disasters depends on many factors, including the degree of exposure and availability of post-disaster social support.[53] Historically, low rates of PTSD and other clinical disorders have been reported from French, Norwegian, and US submariners following submarine-specific accidents.[54] Analyses showed that previous and subsequent traumatic life events tend to exacerbate the severity of post-traumatic stress responses to a single-accident submarine event.[55] The low rates of long-term adverse reactions are regularly attributed to the fact that submariners volunteer for this service.[56]

### *Risk and Protective Factors for Psychological Readiness at Seven Weeks*

Based on the standardised psychometric screening algorithms, a number of submariners met criteria for acute stress reactions (e.g. adjustment disorders, PTSD) and were offered further psychological counselling.[57] In only half of the cases counselling focused primarily on submarine-related concerns; the other half primarily focused on unrelated personal life management difficulties (i.e. RSS) triggered by the incident. By about eleven weeks after the incident, only a small number were still receiving continuing support (for reasons not directly related to submarines), with the rest managing their concerns appropriately. Individual processing of grief – for the entire submarine community – continued.

Psychological responses after the incident were moderated by several factors.[58] For example, chi-square analysis revealed that difficult short-term adjustment was significantly associated with:

- A history of pre-incident difficulties (existing adjustment challenges unrelated to submarines, most typically RSS);
- A history of multiple and/or recent losses;
- A history of previous trauma in the preceding three years; and/or

- Co-occurrence of other significant phase-of-life adjustments (e.g. new parenting).

Given the known risk posed by previous traumatic experiences,[59] it was noteworthy that almost a quarter of the submariners who participated in the screening reported a history of trauma in their personal life in the preceding three years – a figure comparable to SA population statistics.[60] Statistical analysis also indicated that previous trauma significantly increased the likelihood of submariners screening positive for an adjustment disorder, but not for other psychological disorders.

Submariners who reported a history of family crises that interfered with performance at work in the preceding three years were also at significantly increased risk of adjustment disorder. In contrast, higher scores on the resilience scale (collected previously) were associated with a significantly smaller likelihood of adjustment disorder.[61] The risk of poor post-incident adjustment posed by family concerns point to the critical role that military social workers can play by proactively supporting submariners and their families in their adjustment throughout life.

### *Risk and Protective Factors for Psychological Readiness at Seven Months*

Seven months after the incident, all cases of PTSD had been resolved, and only a small number of the participating submariners still experienced adjustment difficulties. These figures are fairly typical for similar groups,[62] and the mental health profile of the squadron could be considered to have returned to its original pre-incident status. Positive mental health outcomes were associated with enrolment into psychological counselling.[63]

The submarine sample mean score on the Coping Self-Efficacy Scale[64] was significantly higher than any available international or SA civilian samples,[65] indicating a high sense of coping efficacy among the submariners. Further, lower scores on the coping self-efficacy scale were associated with a significantly higher likelihood of adjustment disorder.[66]

At seven months after the incident, only one risk factor was still statistically associated with adjustment difficulties, namely a history of pre-incident difficulties. Any remaining concerns about the longer-term psychological readiness thus represented RSS that were unrelated to submarine duty.

### *Course of Post-Incident Mental Health*

Table 1 above presented the general population estimates for the course of psychological adaptation after exposure to severe stress. Based on the same criteria used for the general population,[67] it was estimated that the majority of the squadron displayed either a "Resistance" or "Resilience" profile. Encouragingly, no "Delayed dysfunction" profiles were observed by seven months after the incident. The SAN estimates presented in Table 1 are only that – estimates calculated using probability statistics, and are included in the table to illustrate the relative distribution of profiles.

Compared to general population expectations, the SAN estimates in Table 1 suggest a positive collective mental health status seven months after the incident. This could be attributed to a number of factors. As noted earlier, SAN submariners are resilient individuals,[68] and the resilience scores from their most recent MSPS before the incident were significantly higher than the average for general civilian populations.[69] Resilience, per definition, refers to the ability to "bounce back" after adversity, and this was clearly demonstrated in this group. Further, submariners participate in a biennial MSPS, which would have facilitated good premorbid adaptive functioning. High group cohesion (associated with the tight-knit submarine squadron), and substantial post-incident support from the Fleet and their own families, were identified from their screening responses as instrumental in their adjustment after the incident. Lastly, intensive psychological intervention to those in need supported their good recovery.

## Current Issues Regarding Psychological Readiness for Submarine Operations

Against the background of the case study, a number of insights regarding psychological readiness for submarine operations came to the fore.

### *Current state of Readiness*

At the time of the incident, members of the submarine squadron were certified as medically fit, and thus presumably possessed adaptive personality configurations, resilient life orientations, and good mental health. A more detailed view of the collective status of the squadron at seven weeks emerged however when assessed against the three criteria for psychological readiness: clinical mental health, general adaptability, and responsive support systems. Several cases of concern were identified, although most had been resolved by seven months.[70]

By seven months, the situation had stabilised considerably. Clinical mental health levels were within normal range, and submariners reported effective mobilisation of their personal and social support systems.[71] This resulted in adaptive functioning and high confidence in their coping strategies, and indicated good psychological readiness for operational duty. That so few cases of concern – out of the whole squadron – remained by seven months is a testament to the ability of members of the squadron to mobilise their coping resources – both individually and collectively – to recover from their shared tragedy.

### *Take-Home Insights and Lessons*

A number of insights were gained from the experience following the submarine incident:

- The collective state of psychological readiness of any ship or submarine is contingent on the timing of such assessment. In the above example, screening at seven weeks did not offer a convincing estimate of the longer-term psychological readiness of the squadron. In contrast, screening at seven months provided a more accurate indication of long-term adjustment than at seven weeks. The seven-week screening was however crucial in identifying

individuals in need of targeted support, which in turn facilitated the eventual positive outcome. The optimal time to assess psychological readiness may depend on many circumstances, including the severity of the collective adverse experience, the availability of both post-incident personal family support and formal mental health assistance, the degree of organisational recognition of the incident, and the time-sensitive nature of operational responsibilities.

- Targeted selection remains vital to ensure appropriate baseline personality and other psychological configurations that would promote psychological readiness for submarine operations. Appointing individuals with the prerequisite personality traits adaptive to the context of submarine operations, as well as with a resilient orientation to life, is critical. This would support both the continuing mental wellbeing and the psychological readiness of submariners to continue their operational duty competently and safely.
- An appropriately structured and resourced biennial MSPS remains critical to maintain continuous wellbeing and psychological readiness. The MSPS supports timeous identification and referral of cases requiring intervention, and salutogenically facilitates effective coping and enhancing adjustment throughout submariners' careers.
- The apparent protection – against more severe forms of poor mental health outcomes – offered by higher resilience has two practical implications. Firstly, it emphasises the importance of evaluating psychological resilience and directing sailors with lower resilience towards appropriate service providers to assist in strengthening their resilience. Secondly, the protection offered by resilience provides motivation for resourcing initiatives to develop resilience in group settings, for example through coping skills and resource activation training. In addition, the involvement of military social workers in assisting submariners to develop both family resilience and other support systems outside of their immediate workgroups, remains a priority.
- The role of previous traumatic experiences as risk factor for poor mental health outcomes was confirmed in the SAN submariner sample.[72] The confirmation of this risk factor has two practical implications. Firstly, it highlights the importance of the biennial MSPS to screen for the existence of recent traumatic experiences, and then to direct such sailors to the appropriate support services. Secondly, it suggests the need for close monitoring of such individuals after adverse occupational-specific events to ensure early identification and management of maladaptive psychological responses.
- The presence of RSS was again associated with poor adjustment in this sample. This can also be viewed as an indicator of poor psychological readiness in general. Timeous management of RSS by military social workers could both reduce the risk of poor post-adverse incident outcomes, and enhance the general reliability of personal readiness.
- Screening after traumatic or adverse occupational-specific incidents typically focuses on PTSD as the main indicator of psychological outcomes, also in submarine accidents.[73] It may however be productive to broaden such screening

to include other maladaptive outcomes, such as adjustment disorder (and others), which may offer a more accurate reflection of the actual mental health status of the group than PTSD alone.

- Optimal psychological intervention after adverse incidents – as in this example – requires early and sustained professional involvement. This in turn requires substantial resources, which may not always be available, but the outcome after seven months does suggest that such expenditure of resources is worthwhile.

### *Future Research Directions*

Future research could explore the synergy between clinical and organisational psychology in the SAN. For example, the MSPS promotes psychological resilience, which in turn enhances team cohesion, morale, and operational continuity. These qualities indirectly support leadership and role performance, suggesting that clinical interventions may benefit broader organisational stability. Examining the interaction between individual mental health and unit efficacy, as well as its effect on overall organisational performance, presents a valuable direction for future studies.

## Conclusion

Psychological readiness for operations at sea is a crucial aspect of the ability of submarine personnel to perform their duties effectively and ensure mission success, while safeguarding their own mental wellbeing. At IMM, three criteria are used to assess this. Firstly, good clinical mental health – visible in the absence of psychopathology that would interfere with performance on a submarine – is imperative. Secondly, good adaptability – reflected in a resilient life orientation, adaptive personality configuration, and the capacity to mobilise coping skills and resources – remains vital. Thirdly, the presence of responsive support systems continues to be indispensable.

This article presented risk and protective factors that contributed to the adaptation and return to readiness of submarine personnel after an adverse occupation-specific event. Early risk factors (seven weeks after the event) included a history of pre-incident RSS, multiple or recent losses, previous trauma exposure, and the co-occurrence of other phase-of-life adjustments. Higher scores on a resilience measure emerged as a protective factor. By seven months after the event, a history of pre-incident RSS remained a risk factor to psychological readiness, while coping self-efficacy, and enrolment into psychological counselling were associated with good adjustment.

The collective psychological status of the SAN submarine squadron seven months after a tragic incident displayed a remarkable level of resilience, and reflected a readiness to continue operational duties. Against this background, the recent submarine incident underscored the necessity of timely psychological assessments and the value of a supportive infrastructure to facilitate mental health resilience. The SA perspective on psychological readiness for submarine operations highlights the complexity and importance of mental health and other psychological constructs in demanding military environments. Lessons learned include the need for targeted selection, ongoing mental health screenings, and robust support systems.

## Acknowledgements

### *Funding*

The author received no financial support for the research, authorship, and/or publication of this article.

### *Competing interests*

The author declares that there were no financial or personal relationships that might have inappropriately influenced the writing of this article.

### *Disclaimer*

The views and opinions expressed in the article are those of the author and do not necessarily reflect an official policy or position of any affiliated agency of the author.

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[1] G Kew, 'Medical Fitness to Work: An All-inclusive Decision', Presentation at SASOM Conference, 23 November 2019. <https://sasom.org/wp-content/uploads/2020/05/Dr-Greg-Kew_Fit-or-Not-Fit-to-Work_An-all-inclusive-decision.pdf> [Accessed on 06 January 2025].

[2] T Taylor, 'Fitness for Duty', American College of Occupational and Enviromental Medicine, 2019. <https://ohguides.acoem.org/04-fitness-for-duty-introduction/#:~:text=Being%20fit%20for%20duty%20means,standards%2C%20regardless%20of%20the%20reason> [Accessed on 21 September 2024].

[3] RM Reitan & D Wolfson, 'Conation: A Neglected Aspect of Neuropsychological Functioning', *Archives of Clinical Neuropsychology*, 15, 5 (2000), 443–453.

[4] Reitan & Wolfson, 'Conation: A Neglected Aspect of Neuropsychological Functioning'.

[5] American Psychological Association, 'Emotional Stability', 2018. <https://dictionary.apa.org/emotional-stability> [Accessed on 21 September 2024].

[6] American Psychological Association, 'Adaptability', 2018. <https://dictionary.apa.org/adaptability> [Accessed on 21 September 2024].

[7] American Psychological Association, 'Psychological Resilience', 2018. <https://dictionary.apa.org/resilience> [Accessed on 21 September 2024].

[8] American Psychological Association, 'Grit', 2018. <https://dictionary.apa.org/grit> [Accessed on 21 September 2024].

[9] R Godlewski & T Kline, 'A Model of Voluntary Turnover in Male Canadian Forces Recruits', *Military Psychology*, 24, (2012), 251–269. https://doi/10.1080/08995605.2012.678229; DF Gucciardi, RLJ Lines, KJ Ducker, P Peeling, MT Chapman & P Temby, 'Mental Toughness as a Psychological Determinant of Behavioral Perseverance in Special Forces Selection', *Sport, Exercise, and Performance Psychology, 10,* 1 (2021), 164–175. https://doi.org/10.1037/spy0000208.

[10] CH van Wijk, 'Dispositional Resilience Predicts Psychological Adaptation of Seafarers During and After Maritime Operations', *International Maritime Health*, 74, 1 (2023), 45–53. https://doi.org/10.5603/IMH.2023.0005; C van Wijk, 'Psychological Profiles of Resilience in Extreme Environments: Correlating Measures of Personality and Coping and Resilience', *Scientia Militaria*, 50, 1 (2022), 1–18. https://doi.org/10.5787/50-1-1256.

[11] RD Griesel, *Preliminary Assessment of a Simulated Stress Situation for the Selection of Personnel for Submarine Service* (Johannesburg: National Institute for Personnel Research, 1970); M MacKay, *Selection of Submarine Crews for the SA Navy: Progress Report and Preliminary Follow-up Study* (Johannesburg: National Institute for Personnel Research, 1972); BD Murdoch, *The Recording of EEG's in the SADF: Selection of Divers, Submariners, Pilots and Candidates for South African Airways* (Johannesburg: National Institute for Personnel Research, 1981); MP Spagnoletti, *Selection of Submarine Crew for the SA Navy: Validation of the NIPR Submarine Selection Battery* (Johannesburg: National Institute for Personnel Research, 1974); DJM Vorster, 'Die Sielkundige Keuring van Duikbootpersoneel in die SAW' [The Psychological Selection of Submarine Personnel in the South African Defence Force], *South African Psychologist*, 2, 2 (1972), 21–32.

[12] CH van Wijk, 'A Historical Perspective on Submariner Selection in the SA Navy', *South African Journal of Psychology*, 37, 4 (2007), 878–892. https://doi.org/10.1177/008124630703700413

13 Van Wijk, 'A Historical Perspective on Submariner Selection in the SA Navy'.

14 Griesel, *Preliminary Assessment of a Simulated Stress Situation*.

15 CD Nye, LA White, F Drasgow, J Prasad, OS Chernyshenko & S Stark, 'Examining Personality for the Selection and Classification of Soldiers: Validity and Differential Validity Across Jobs', *Military Psychology*, 32, 1 (2020), 60–70. https://doi.org/10.1080/08995605.2019.1652482

16 SA Woods, F Lievens, F De Fruyt & B Wille, 'Personality Across Working Life: The Longitudinal and Reciprocal Influences of Personality on Work', *Journal of Organizational Behavior*, 34 (2013), S7–S25. http://dx.doi.org/10.1002/job.1863

17 CH van Wijk, 'The Resilience of Naval Specialists: Their Sense of Coherence and its Relationship with Measures of Personality', *South African Journal of Psychology*, 38, 4 (2008), 737–751; CH van Wijk & AH Waters, 'Personality Characteristics of South African Navy Submarine Personnel', *Military Medicine*, 165, 9 (2000), 656–658.

18 RB Cattell, HW Eber & MM Tatsuoka, *Handbook for the 16PF* (Champaign: Institute of Personality and Ability Testing, 1992), 91.

19 Cattell *et al.*, *Handbook for the 16PF*, 91; Van Wijk & Waters, 'Personality Characteristics of South African Navy Submarine Personnel'.

20 Van Wijk & Waters, 'Personality Characteristics of South African Navy Submarine Personnel'.

21 Cattell *et al.*, *Handbook for the 16PF*, 106.

22 CH van Wijk & WAJ Meintjes, 'Mental Health and Personality Functioning of Naval Specialists Working in Extreme Environments', *Military Psychology*, 29, 6 (2017), 601–614. https://psycnet.apa.org/doi/10.1037/mil0000185

23 CH van Wijk & AH Waters, 'A Salutogenic Approach to the Annual Psychological Assessment of Navy Specialists Involved in High Risk Operations', *Revue internationale des services de santé des forces armées*, 76, 4 (2003), 211–221; CH van Wijk & AH Waters, 'Positive Psychology Made Practical: A Case Study with Naval Specialists', *Military Medicine*, 173, 5 (2008), 488–492.

24 A Antonovsky, *Unravelling the Mystery of Health: How People Manage Stress and Stay Well* (San Francisco: Jossey-Bass, 1987).

25 C Wallenius, G Larsson & CR Johansson, 'Military Observers' Reactions and Performances When Facing Danger', *Military Psychology*, 16 (2004), 211–229.

26 Van Wijk, 'The Resilience of Naval Specialists'.

27 PT Bartone, RR Roland, JJ Picano & TJ Williams, 'Psychological Hardiness Predicts Success in U.S. Army Special Forces Candidates', *International Journal of Selection and Assessment, 16,* 1 (2008), 78–81. https://doi.org/10.1111/j.1468-2389.2008.00412.x

28 Van Wijk, 'Psychological Profiles of Resilience in Extreme Environments'.

29 PJ Clough, K Earle & D Sewell, 'Mental Toughness: The Concept and Its Measurement', in I Cockerill (ed.), *Solutions in Sport Psychology* (London: Thomson, 2002), 32–43

30 Van Wijk, 'Psychological Profiles of Resilience in Extreme Environments'.

31 Van Wijk, 'Psychological Profiles of Resilience in Extreme Environments'.

32 GM Sandal, IM Endresen, R Vaernes & H Ursin, 'Personality and Coping Strategies During Submarine Missions', *Human Performance in Extreme Environments*, 7, 1 (2003), 29–42.

33 CH van Wijk, 'Coping in Context: Dispositional and Situational Coping of Navy Divers and Submariners', *Journal of Human Performance in Extreme Environments*, 13, 1 (2017), Article 7. http://docs.lib.purdue.edu/jhpee/vol13/iss1/7

34 Van Wijk, 'Coping in Context'.

35 S Kimhi, 'Understanding Good Coping: A Submarine Crew Coping with Extreme Environmental

Conditions', *Psychology*, 2, 9 (2011), 961–967. http://dx.doi.org/10.4236/psych.2011.29145. GS Moes, R Lall & WB Johnson, 'Personality Characteristics of Successful Navy Submarine Personnel', *Military Medicine*, 161, 4 (1996), 239-242.

36 JW Moore, 'What Is the Sense of Agency and Why Does it Matter?', *Frontiers in Psychology*, 7 (2016), Article 1272. https://doi.org/10.3389/fpsyg.2016.01272

37 Kimhi, 'Understanding Good Coping'.

38 Institute for Maritime Medicine, *Perspectives on the Contemporary Mental Health & Well-being of South African Navy Submariners*, Technical Report 27 (Simon's Town: Institute for Maritime Medicine, 2017).

39 Institute for Maritime Medicine, 'IMM Services: Submarine Medicine'. <https://www.imm-st.co.za/services> [Accessed on 6 January 2025].

40 Van Wijk & Waters, 'Positive Psychology Made Practical'.

41 Institute for Maritime Medicine, 'IMM Services: Submarine Medicine', n.d. <https://www.imm-st.co.za/services> [Accessed on 6 January 2025].

42 N Sibiya, 'Kommetjie Submarine Tragedy: "Mother Nature Had the Final Word," Says SA's Navy Chief', *News24*, 6 September 2024. <https://www.news24.com/news24/southafrica/news/kommetjie-submarine-tragedy-mother-nature-had-the-final-word-says-sas-navy-chief-20240906> [Accessed on 06 January 2025]; K Swartz, 'Navy Inquiry Finds Mother Nature Cause of Tragic Accident that Killed Three Submariners Last Year', *Times Live*, 6 September 2024. <https://www.timeslive.co.za/news/south-africa/2024-09-06-navy-inquiry-finds-mother-nature-cause-of-tragic-accident-that-killed-three-submariners-last-year/> [Accessed on 06 January 2025].

43 R-L Francke, 'South African Navy Sets up Inquiry to Probe Submarine Tragedy', *IOL*, 21 September 2023. <https://iol.co.za/news/south-africa/western-cape/2023-09-21-south-african-navy-sets-up-inquiry-to-probe-submarine-tragedy/> [Accessed on 6 January 2025].

44 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN After SAS MANTHATISI Accident September 2023'. PowerPoint Presentation at Combined SOSM-OC IMM Feedback Meeting, Simon's Town, 17 May 2024.

45 L Campbell-Sills & MB Stein, 'Psychometric Analysis and Refinement of the Connor-Davidson Resilience Scale (CD-RISC): Validation of a 10-item Measure of Resilience', *Journal of Traumatic Stress*, 20, 6 (2007), 1019–1028. https://doi.org/10.1002/jts.20271

46 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

47 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

48 MA Chesney, TB Neilands, DB Chambers, JM Taylor & S Folkman, 'A Validity and Reliability Study of the Coping Self-Efficacy Scale', *British Journal of Health Psychology*, 11, 3 (2006), 421–37.

49 CA Cunningham, RJ Cramer, S Cacace, M Franks & SL Desmarais, 'The Coping Self-Efficacy Scale: Psychometric Properties in an Outpatient Sample of Active-duty Military Personnel', *Military Psychology*, 32, 3 (2020), 261–272. https://doi.org/10.1080/08995605.2020.1730683

50 E Goldmann & S Galea, 'Mental Health Consequences of Disasters', *Annual Review of Public Health*, 35 (2014), 169–183. https://doi.org/10.1146/annurev-publhealth-032013-182435

51 FH Norris, M Tracy & S Galea, 'Looking for Resilience: Understanding the Longitudinal Trajectories of Responses to Stress', *Social Science & Medicine*, 68, 12 (2009), 2190–2198. https://doi.org/10.1016/j.socscimed.2009.03.043

52 Norris *et al.*, 'Looking for Resilience'.

53 Goldman & Galea, 'Mental Health Consequences of Disasters'.

54 P Baert, M Trousselard & P Clervoy, 'Post-traumatic Stress Disorder After a Submarine Accident', *Aviation, Space, and Environmental Medicine*, 82, 6 (2009), 643–647. https://doi.org/10.3357/asem.2953.2011; JS Berg, TA Grieger & JL Spira, 'Psychiatric Symptoms and Cognitive Appraisal Following the Near Sinking of a Research Submarine', *Military Medicine*, 170, 1 (2005), 44–47. https://doi.org/10.7205/milmed.170.1.44; J Eid & BH Johnsen, 'Acute Stress Reactions After Submarine Accidents', *Military Medicine*, 167, 5 (2002), 427–431.

55 Berg *et al.*, 'Psychiatric Symptoms and Cognitive Appraisal'.

56 Berg *et al.*, 'Psychiatric Symptoms and Cognitive Appraisal'.

57 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

58 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

59 Berg *et al.*, 'Psychiatric Symptoms and Cognitive Appraisal'.

60 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'; N Matamela, G Wyatt & CD Johnson, 'Trauma Exposure as a Predictor of General Health Outcomes and Trauma-related Beliefs Among Older Adults Living in an Adverse Environment'. *Aging & Mental Health*, Advance online publication, (2025), 1–11. https://doi.org/10.1080/13607863.2025.2541192.

61 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

62 CH van Wijk, 'Prevalence Estimate for Adjustment Disorders in the South African Navy', *Clinical Practice & Epidemiology in Mental Health, 20 (*2024), Article E17450179301661. http://dx.doi.org/10.2174/0117450179301661240528064329

63 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

64 Namely CSES mean score = 197,7.

65 Chesney *et al*., 'A Validity and Reliability Study of the Coping Self-Efficacy Scale'; SR Melato, C van Eeden, S Rothmann & E Bothma, 'Coping Self-efficacy and Psychosocial Well-being of Marginalised South African Youth', *Journal of Psychology in Africa*, 27, 4 (2017), 338–344. https://psycnet.apa.org/doi/10.1080/14330237.2017.1347755.

66 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

67 Norris *et al.*, 'Looking for Resilience'.

68 Van Wijk, 'The Resilience of Naval Specialists'; Van Wijk, 'Psychological Profiles of Resilience in Extreme Environments'.

69 Namely CD-RISC-10 = 31,6 ±4,4 and MTQ-18 = 71,6 ±8,4.

70 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

71 Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

72 Berg *et al.*, 'Psychiatric Symptoms and Cognitive Appraisal'; Institute for Maritime Medicine, 'Psychological Readiness of SSK SQN'.

73 Baert, 'Post-traumatic Stress Disorder After a Submarine Accident'; Berg *et al.*, 'Psychiatric Symptoms and Cognitive Appraisal'; Eid & Johnsen, 'Acute Stress Reactions After Submarine Accidents'