

# Personality and behavioural outcomes in diving: current status and recommendations for future research

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## Key words

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## Abstract

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This paper provides a brief overview of the shift from studies describing the personality profiles of divers to studies exploring associations between personality variables and diving performance in terms of behavioural outcomes. The personality associations that were investigated include performance during training, panic proneness, diving injuries, susceptibility to inert gas narcosis, and the behaviour of tourist divers. The paper concludes with a number of suggested directions for further research on personality and diving that may provide tangible benefits in terms of both enhanced safety and improved performance underwater.

## Introduction

This paper aims to provide an overview of the role of personality in diving research. It briefly reviews historical work in descriptive personality profiling of divers, as well as profiling for selection purposes. It continues by reviewing more recent research into the associations of personality and a range of behavioural outcomes in diving, and concludes by positing themes to focus future research.

### Personality profiling in diving – a brief overview

Historically, a large portion of psychological research in diving was directed to the personality profiling of divers. This is not surprising, as diving in its earlier days was considered a particularly unusual and extreme activity, with much interest in the type of person who would participate in such an activity. One motivation of such profiling appeared to be an intellectual curiosity that focussed on either general personality profiling, or the description of very specific personality factors or traits.<sup>1-13</sup> A second theme was the profiling of mental health, almost exclusively done with military divers, with the likely aim to inform understanding of operational readiness.<sup>1,14-19</sup> A third motivation was profiling for the purpose of selection, stimulated by the expense of training and the costs of high drop-out rates from training programmes.<sup>20,21</sup>

Various samples were profiled over time. Military divers provided a captive target group and allowed for good scientific control. Sport diver samples often comprised college students, possibly because of their availability to the researchers. Literature on divers in the commercial sector is harder to find, sometimes buried in technical reports<sup>22</sup> rather

than found in more readily available academic publications.

### DESCRIPTIVE PERSONALITY PROFILING

A number of comprehensive personality profiles for military<sup>1,7,9,12</sup> and recreational<sup>2,13</sup> divers have been described. Such studies usually compared qualified divers to general population norms or to comparable control groups. Some of these profiles were highly context specific, and often used different measures to describe personality, which in combination restricted the generalizability of findings. While some similarities between results could be interpreted, there were limits to their comparability due to the different measures used.<sup>10</sup>

Other studies described specific individual personality factors or traits, including socialisation,<sup>5,6</sup> risk taking or sensation seeking,<sup>1,4-6,8,11</sup> locus of control (also referred to as internality-externality),<sup>4-6,12</sup> masculinity<sup>4</sup> and trait anxiety (also referred to as dispositional anxiety).<sup>3-6</sup> These studies often used comparable measures, and divers in general could thus be described as conforming to a profile of more internal locus of control, higher sensation seeking (with specific sensation-seeking profiles), greater masculine orientation (both women and men), and low trait anxiety, when compared to general population norms. In particular, two traits are regularly and consistently described across contexts, namely an adventurous or sensation-seeking propensity and lower trait anxiety.

### PERSONALITY PROFILING IN THE MENTAL HEALTH CONTEXT

Published studies profiling personality functioning of navy

diver samples from a mental health perspective used the Minnesota Multiphasic Personality Inventory (MMPI).<sup>1,15-19</sup> The use of a standardised measure allows for comparisons across samples from different navies. The reports suggest that diver profiles could be meaningfully interpreted against the context of the psychological demands of their specialised environment.<sup>19</sup> Studies further reported positive mental health profiles,<sup>15-19</sup> which may partly be due to the comprehensive medical screening during entry into navy diving.

#### PERSONALITY PROFILING FOR SELECTION

The use of psychological assessment for selection purposes has a long history, reviewed elsewhere.<sup>21</sup> Selection was usually understood as ‘selection-for-training’, and not necessarily as selection for eventual success in post training diving operations; success was generally operationalised in terms of course pass or fail. In spite of numerous studies on the roles of other psychological variables in selection, including aptitude<sup>23,24</sup> and attitude,<sup>25</sup> very few true “*personality*” variables have been found to meaningfully predict successful completion of training. Most of the earlier personality studies (reviewed above) were retrospective descriptions, often interpreted by authors as adaptive for that environment and, thus, suggestive of traits that would be desirable for selection. However, the paucity of reports on studies that actually tested the value of prospective personality measures in determining training success suggests a lack of positive findings in this field, leading to the non-reporting of such studies. In support, earlier reviews concluded that standard personality measures were only marginally useful for the selection of divers,<sup>20,26</sup> and currently there appears little robust evidence that general personality measurements have significant value in predicting success during diving training.

#### DISCUSSION

A number of limitations on the practical value of descriptive personality profiling have been highlighted:

- descriptions are often context specific (navy divers, underwater demolitions, college students, tourist divers, etc.), which does not lend itself to easy generalisation;
- profiling contributes very little to selection for training success;
- descriptions are not always helpful in improving safety or performance;
- the sharp increase in the number of certified divers resulted in such a wide spectrum of people being involved, either professionally or recreationally, that personality profiling now seems less productive.

In response, research published in the last 15 years has moved from descriptions of personality to exploring associations between personality variables and a range of behavioural outcomes in diving, which are outlined below.

#### Personality variables and behavioural outcomes in diving

##### GENERAL PERFORMANCE DURING NAVY DIVING TRAINING

A recent study from the Spanish Navy extended the prediction of training outcome beyond a dichotomous pass or fail, and found significant associations between personality traits and general scuba training performance (operationalised as ‘underwater adaptation’).<sup>27</sup> Better adaptation to underwater performance was associated with high scores on scales of emotional stability, self-control, and facilitating anxiety, and low scores on sensitivity, apprehension and tension.<sup>27-29</sup> Another study associated personality traits with risk of injury during naval diving training.<sup>30</sup> Students who sustained injuries reported higher pre-course trait anxiety scores (higher than population means and mean scores of qualified divers) and lower sensation-seeking scores than non-injured students.<sup>30</sup>

##### PANIC PRONENESS

Trait anxiety has received much interest as a possible marker of panic proneness among divers. For example, it was recognised as a possible predictor of panic in beginner diving students,<sup>31</sup> and pre-course trait anxiety mean scores effectively predicted underwater panic behaviour for beginner sport divers during training.<sup>32</sup> In a separate study, trait anxiety scores only predicted panic among experienced scuba divers when adding one standard deviation to the mean.<sup>33</sup> An earlier review of the research concluded that trait anxiety was a reliable predictor of panic proneness while using scuba.<sup>34</sup> In particular, individuals with trait anxiety scores equal to or higher than the general population had an increased risk of panic behaviour during recreational scuba training.<sup>34</sup>

##### DIVING INJURIES

Outside of the diving environment, measures of personality have shown a relationship between risk-taking behaviour and personal injury during activities like extreme sports, such as skiing and skydiving. Applying this to the diving context, in a comparison of divers with a history of decompression illness (DCI) to a control group of divers without a history of DCI using several personality measures, personality did not appear to predict DCI.<sup>35</sup> Although the DCI group reported more internal locus of control, lower levels of experience seeking, and had more driver’s licence endorsements, it was concluded that there was no clear relationship between risk-taking and personal injury among this group of sport divers.

##### INERT GAS NARCOSIS (IGN)

In spite of anecdotal accounts regarding the role of personality in the susceptibility to IGN, very little is known. A number of studies associated situational (or ‘state’) anxiety

with performance during IGN.<sup>36–39</sup> However, state anxiety is not generally considered a personality trait, due to its association with situational cognitive appraisals, rather than enduring behavioural patterns. There was suggestion that low trait anxiety is associated with better memory performance after dives under conditions of IGN.<sup>40</sup> Conversely, a recent study found no association between measures of personality and susceptibility to IGN,<sup>41</sup> although the small sample size and the use of navy divers with homogenous profiles may have limited the applicability of the results.

#### DIVING BEHAVIOUR IN TOURISM CONTEXTS

Responsible diving behaviour in the tourism context was investigated using the Five Factor Model of personality.<sup>42</sup> Tourist divers high in neuroticism were more likely to be irresponsible, for example, in damaging coral reefs and marine ecosystems,<sup>43</sup> while high scores for agreeableness, extroversion, and openness to new experiences were associated with more responsible behaviour underwater.<sup>43,44</sup>

#### Recommendations for future research

Many of the studies reported above used small samples with highly specific (either intentionally, or self-selected) participant groups, and it is not always clear whether the results can be generalised to other diver populations. However, they provide suggestions for enhancing both safety and performance during underwater activities. Thus, given the enduring interest in personality, a number of directions to focus further research are suggested.

#### PRACTICAL TESTS FOR SELECTION

Although non-personality psychological constructs, like technical aptitude or general mental ability, have shown some positive predictive value for training success, there is little robust evidence for the value of personality measures in selection. However, the financial and human resource implications of high failure rates during commercial and military diving courses continue to stimulate interest in personality and related psychological constructs. With little support to recommend continued personality testing, it may be worth considering a blend of psychometric assessment and practical tasks to elicit markers of personal psychological performance. Two practical tasks that have been used in a number of navies may provide opportunity for fruitful research:

- Platform jump: an earlier unpublished study with Royal Navy divers (Leach J, personal communication, August 2017) used a test in which each recruit had to walk to the edge of a ship's platform 12 meters above the harbour and step off into the water. The study found a highly significant negative correlation between the length of time a person hesitated at the edge before stepping off and their performance on the dive course. A similar experience was observed for South African Navy

divers using an 8-meter platform (Waters A, personal communication, August 2017).

- Night swim: another test popular in many navies to determine whether divers have the 'right stuff' is to drop recruits into deep and/or cold water at night (with the instruction to swim to a specific location), and observe how they perform.

Both these practical tests are already in use, and with formal measuring protocols, could be useful in considering selection guidelines. Many other tasks may also already be in use in diver selection, and considering their use as expression of personality may prove fruitful.

#### PERSONALITY AND SUSCEPTIBILITY TO IGN

There are significant safety-critical risks associated with narcosis, as well as risks of general performance impairment during deep dives. Understanding the role of personality may be of particular interest in a commercial deep diving context, where the ability to predict may assist to prepare individual divers better for deep excursions. If the behavioural effects of IGN are understood through the Slowed Information Processing model,<sup>45</sup> susceptibility to IGN may be influenced by central nervous system inhibitory and excitatory factors, which in turn may share a psycho-biological basis with expressions of personality. In spite of the current lack of evidence associating personality and susceptibility to IGN, further investigation into this topic, possibly following recent recommendations,<sup>41</sup> is encouraged.

#### PERSONALITY AND DIVING-ASSOCIATED INJURY

The sustained surge of interest in recreational diving<sup>46</sup> and the associated increase in both diving tourism and technical diving has changed the risk profile of diving. The original studies on personality and hyperbaric injury<sup>35</sup> could be replicated with larger numbers and possibly expanding both the measurement of personality and the definitions of injury, and differentiated across contexts (e.g., local recreational diving, tourist diving, technical diving and so forth).

#### PERSONALITY AND PANIC EXPERIENCES

From a psychological perspective, the greatest risk during underwater activity is panic. Panic is a leading cause of rapid ascents, which in turn may result in severe hyperbaric injuries.<sup>47</sup> It is further estimated to contribute to 40–60% of all scuba diving deaths.<sup>26,47–50</sup> Given the reportedly high occurrence of panic experiences among divers,<sup>48,50</sup> supplementary studies are needed to explore other possible personality correlates. Panic experiences have implications for safety-critical diving behaviours, and understanding the role of personality may assist in improved training and preparation of at-risk divers. A number of avenues of research could be considered, including exploring the most effective ways to measure trait anxiety, exploring

other personality correlates and, although strictly not in the domain of personality studies, continue to explore the best interventions to counter the effects of high trait anxiety on decision making and behaviour.<sup>31,51,52</sup>

#### RISK TAKING/SENSATION SEEKING AND TRAIT ANXIETY IN BEHAVIOURAL OUTCOMES DURING DIVING

These two personality markers have consistently been identified among divers<sup>1,3-5,8,11,32</sup> and both are associated with tolerance to physiological excitation. Both are considered to have significant safety implications, for example, the relationship of trait anxiety to injury may be mediated through its association with panic proneness and, in the case of sensation seeking, through greater risk-taking behaviour. Elucidating the relationships between physical activation, personality descriptors, and behavioural outcomes during diving may contribute considerably to the broader understanding of many manifestations of diver conduct.

#### PERSONALITY AND UNDERWATER BEHAVIOUR IN DIVING TOURISM

Diving tourism has become a multi-million dollar business, and is associated with pressure of human activity on popular reefs. Tourist divers often have little experience,<sup>44</sup> and may be at greater risk for non-intentional damage to marine ecosystems. Clarifying the relationship between personality and underwater behaviour may be important when considering ways to enhance diving experiences without compromising the sustainability of popular reef systems.

#### PERSONALITY PROFILES AND PSYCHOLOGICAL RESILIENCE

Previous attempts endeavoured to link personality traits of navy divers to measures of resilience, with the rationale that personality profiles associated with resilience may be desirable profiles for military divers. Two small studies suggested that the typical navy diver profile<sup>12</sup> might not be the most resilient profile (Bester PC, personal communication, June 2017). Researching resilient personality characteristics, specific to different contexts, may support positive long-term mental health outcomes in fields such as military deployments or civilian underwater search and recovery operations.

#### Conclusions

This paper highlights the shifting focus from describing personality profiles to exploring associations between personality variables and diving performance in terms of behavioural outcomes. A number of interesting relationships have been studied, and a number of directions for further research are suggested that may provide tangible benefits in terms of both enhanced safety and improved performance.

#### References

- 1 Biersner RJ, Cameron BJ. Betting preferences and personality characteristics of navy divers. *Aerosp Med.* 1970;41:1289-91.
- 2 Martin WS, Myrick FL. Personality and leisure time activities. *Research Quarterly: American Alliance for Health, Physical Education and Recreation.* 1976;47:246-53.
- 3 Griffiths TJ, Steel DH, Vaccaro P. Anxiety levels of beginning scuba students. *Percept Mot Skills.* 1978;47:312-4.
- 4 Heyman SR, Rose KG. Psychological variables affecting SCUBA performance. In: Nadeau CA, Halliwell WR, Newell KM, Robers GC, editors. *Psychology of motor behaviour and sport.* Champaign, Ill.: Human Kinetics; 1980.
- 5 Biersner RJ, La Rocco JM. Personality characteristics of US Navy Divers. *J Occup Organ Psychol.* 1983;56:329-34.
- 6 Biersner RJ, LaRocco JM. Personality and demographic variables related to individual responsiveness to diving stress. *Undersea Biomed Res.* 1987;14:67-73.
- 7 Beckman TJ, Johnson WB, Lall R. Salient personality characteristics among navy divers. *Mil Med.* 1996;161:717-9.
- 8 Taylor DMcD, O'Toole KS, Auble TE, Ryan CM, Sherman DR. Sensation seeking personality traits of recreational divers. *SPUMS Journal.* 2001;31:25-8.
- 9 Van Wijk C, Waters AH. Personality characteristics of South African Navy divers. *Undersea Hyperb Med.* 2001;28:25-30.
- 10 Beckman TJ. Personality characteristics of South African Navy divers. Letter. *Undersea Hyperb Med.* 2001;28:233-4.
- 11 Van Wijk, CH. Sensation-seeking personality traits of navy divers. *Diving Hyperb Med.* 2007;37:10-15.
- 12 Van Wijk CH. The resilience of naval specialists: Their sense of coherence and its relationship with measures of personality. *S Afr J Psychol.* 2008;38:737-51.
- 13 Coetzee N. Personality profiles of recreational scuba divers. *Afr J Phys Health Educ Recreat Dance.* 2010;16:568-79.
- 14 Biersner RJ, Ryman DH. Psychiatric incidence among military divers. *Mil Med.* 1974;139:633-5.
- 15 Tansy WA. The longitudinal health study: a multiphasic medical surveillance program for US Navy submarines and diving personnel. Naval Submarine Medical Research Laboratory, Groton, CT; 1974. *Report No. 786.* Available from: <http://archive.rubicon-foundation.org/8814>. [cited 2017 September 16].
- 16 Weybrew BB. Psychological screening of divers as subjects for long duration saturation experimentation. Naval Submarine Medical Research Laboratory, Groton, Connecticut; 1974. *Report no. 776.* Available from: <http://archive.rubicon-foundation.org/8804>. [cited 2017 September 16].
- 17 Dembert ML, Mooney LW, Ostfeld AM, Lacroix PG. Multiphasic health profiles of navy divers. *Undersea Biomed Res.* 1983;10:45-60.
- 18 El Sheshai A, Rashed S, Sadek M. Psychiatric and psychometric study among divers. *Egypt J Psychiatry.* 1994;17:87-93.
- 19 Van Wijk CH, Meintjes WAJ. Mental health and personality functioning of naval specialists working in extreme environments. *Mil Psychol.* Forthcoming 2017. doi: 10.1037/mil0000185
- 20 Bachrach AJ, Miller JW, Joiner J, Parks R, Stewart J, Ginzburg H. Psychological factors involved in undersea-hyperbaric exposures: selection and training of professional divers. In: Shilling CW, Beckett MW, editors. *National plan for the safety and health of divers in their quest for subsea energy.* Bethesda, MD: Undersea Medical Society; 1976. p. 5.i-5.43.
- 21 Nevo B, Breistein S. *Psychological and behavioural aspects*

- of diving. Flagstaff, AZ: Best Publishing Company; 1999.
- 22 Baddeley AD, Godden D, Moray NP, Ross HE, Synodinos NE. *Selection of diving trainees: Final Report*. London: Training Services Agency; 1978.
  - 23 Berghage TE. The use of Standard Navy Classification Test scores for the selection of Diver First Class candidates. Navy Experimental Diving Unit, Panama City, FL; 1972. *Report NEDU-RR-20-72*. Available from: <http://archive.rubicon-foundation.org/4098> [cited 2017 September 16].
  - 24 Wise DA. Aptitude selection standards for the U.S. Navy's first class diving course. Navy Experimental Diving Unit, Panama City, FL; 1963. *Report NEDU-3-63*. Available from: <http://archive.rubicon-foundation.org/3859> [cited 20107 September 16].
  - 25 Biersner RJ, Ryman DR. Prediction of scuba training performance. *J Appl Psychol*. 1974;59:519-21.
  - 26 Edmonds C, Lowry C, Pennefather J, Walker R, editors. *Diving and subaquatic medicine*, 4th ed. London: Hodder Arnold; 2002.
  - 27 Colodro-Plaza J, Garcés-de-Los-Fayos EJ, López-García JJ, Colodro-Conde L. Prediction of human adaptation and performance in underwater environments. *Psicothema*. 2014;26:336-42.
  - 28 Colodro J, Garcés de los Fayos-Ruiz E J, López-García JJ, Colodro-Conde L. Incremental validity of personality measures in predicting underwater performance and adaptation. *Span J Psychol*. 2015;18:E15.
  - 29 Colodro-Plaza J, Garcés de los Fayos-Ruiz E J, López-García JJ, Colodro-Conde L. Individual differences in diving: Intelligence, personality, and underwater adaptation. *Mil Psychol*. 2015;27:129-41. doi:10.1037/mil0000073.
  - 30 Van Wijk CH, Fourie M. Using psychological markers of sport injuries for navy diving training. *Int J Sport Exerc Psychol*. 2015. doi: 10.1080/1612197X.2015.1056903.
  - 31 Griffiths TJ, Steel DH, Vaccaro P, Allen R, Karpman M. The effects of relaxation and cognitive rehearsal on the anxiety levels and performance of scuba students. *Int J Sport Psychol*. 1985; 16:113-9.
  - 32 Morgan WP, Raglin JS, O Connor PJ. Trait anxiety predicts panic behaviour in beginning scuba students. *Int J Sports Med*. 2004;25:314-22.
  - 33 Colvard DF. Identifying anxiety and panic risk in divers. *DAN-SA diver stress and panic prevention Workshop*; 2007 September 27; Johannesburg, South Africa. [cited 2017 September 16]. Available from: <http://www.divepsych.com/articles-by-dr-colvard>.
  - 34 Raglin S, Stegner J. Psychobiological aspects of panic in SCBA and SCUBA. *International Journal of Sport and Exercise Psychology*. 2005;4:446-54.
  - 35 Harding SA, Gee P. Personality as a predisposing factor for DCI: a pilot study. *Diving Hyperb Med*. 2008;38:134-8.
  - 36 Baddeley A, Idzikowski C. Anxiety, manual dexterity and diver performance. *Ergonomics*. 1985;28:1475-82.
  - 37 Hobbs M, Kneller W. Anxiety and psychomotor performance in divers on the surface and underwater at 40m. *Aviat Space Environ Med*. 2011;82:20-5.
  - 38 Kneller W, Higham P, Hobbs M. Measuring manual dexterity and anxiety in divers using a novel task at 35–41m. *Aviat Space Environ Med*. 2012;83:54-7.
  - 39 Mears JD, Cleary PJ. Anxiety as a factor in underwater performance. *Ergonomics*. 1980;23:549-57.
  - 40 Van Wijk CH, Meintjes WAJ. Nitrogen narcosis and tactile shape memory in low visibility. *Undersea Hyperb Med*. 2014;41:371-7.
  - 41 Van Wijk CH, Martin JH, Meintjes WAJ. Diving under the influence: issues in researching personality and inert gas narcosis. *Int Marit Health*. 2017;68:52-9.
  - 42 Goldberg LR. The structure of phenotypic personality traits. *Am Psychol*. 1993;48:26-34. doi:10.1037/0003-066X.48.1.26.
  - 43 Musa G, Seng WT, Thirumoorthi T, Abessi M. The influence of scuba divers' personality, experience, and demographic profile on their underwater behaviour. *Tourism in Marine Environments*. 2011;7:1-14.
  - 44 Ong TF, Musa G. Examining the influences of experience, personality and attitude on SCUBA divers' underwater behaviour: a structural equation model. *Tourism Management*. 2012;33:1521-34.
  - 45 Fowler B, Ackles KN, Porlier G. Effects of inert gas narcosis on behaviour: a critical review. *Undersea Biomed Res*. 1985;12:369-402.
  - 46 PADI (2016). *Worldwide Corporate Statistics*. [cited 2017 September 16]. Available from: [https://www.padi.com/sites/default/files/documents/about-padi/statistics/PADI\\_2016\\_WW\\_Statistics.pdf](https://www.padi.com/sites/default/files/documents/about-padi/statistics/PADI_2016_WW_Statistics.pdf).
  - 47 Morgan WP. Anxiety and panic in recreational scuba divers. *Sports Med*. 1995;20:398-421.
  - 48 Bachrach AJ, Egstrom GH, editors. *Stress and performance in diving*. San Pedro, Ca: Best Publishing Company; 1987.
  - 49 Colvard DF, Colvard LY. A study of panic in recreational scuba divers. *The Undersea Journal*. 2003;Q1:40-4.
  - 50 Ladd G. When panic strikes. *Hangline*. 1997;2(1). Available from: <http://www.psychodiver.com> [cited 2017 September 16].
  - 51 Griffiths TJ, Steel DH, Vaccaro P, Karpman MB. The effects of relaxation techniques on anxiety and underwater performance. *Int J Sport Psychol*. 1981;12:176-82.
  - 52 Terry PC, Mayer JL, Howe, BL. Effectiveness of a mental training program for novice scuba divers. *J Appl Sport Psychol*. 1978;10:251-67.

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