Performance and coping under stress in security settings: Workshop report

FULL REPORT

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This report summarises themes discussed at an invitation-only event to share latest cross-disciplinary academic research and practical experiences of performance and coping under extreme stress and discuss the implications for security. The workshop was held in London in July 2018, was sponsored by CREST and organised by researchers at the University of Manchester.

Over a day and a half, academic researchers and people with extensive experience in extreme environments shared their knowledge with a practitioner-focused audience. Presentations focused on the nature and impact of extreme stress, and lessons learned from experience and research. Rather than give a description of every presentation, we have structured this report around the key themes that arose (sometimes in multiple presentations). We have indicated (in brackets) the speakers who provided detail on each topic and provided suggestions for further reading at the end of each section.

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1. CONTEXT

Defence, security and law-enforcement personnel may be required to operate in extreme environments, including in war zones and other dangerous settings (Barrett). These environments are typically characterised by intense environmental (e.g., extreme temperature, low resource), psychological (e.g., high threat, monotony, boredom) and interpersonal stressors (e.g., social tension).

Security personnel entering challenging and demanding contexts can be broadly grouped into two categories. The first is those who do it as part of a job and have been selected and trained:

- Military (Special Forces).
- Civilian governmental and private sector security workers.
- Undercover law enforcement officers.

The second category is individuals who choose to enter or find themselves in extreme contexts without in-depth training and preparation:

- Informants.
- Terrorists.
- Hostages.

We can learn about the performance and resilience of people involved in security activities by examining the responses of analogous groups operating under similar extreme and high-pressure conditions (Barrett).

At the start of the workshop, we introduced the model of Adaptation to Isolated, Confined and Extreme Environments (ICEE; Sandal et al., 2006). The ICEE model can be used to understand how the operating conditions might impact upon adaptation, and the safety, performance and health of personnel (Smith; see Appendix 1). According to this specific model, the physical features of the environment (e.g., temperature, weather), the habitat (e.g., confinement, isolation), the characteristics of those involved (e.g., composition of group, personality), and the task demands (e.g., repetitiveness, threat of danger) will impact upon how

a person adapts over time, their cognitive performance, feelings of health and wellbeing, and how they function in a group. Although there are many different models for understanding stress, adaptation and coping, this particular framework is relevant to the unique demands faced by people operating in extreme and unusual conditions.

1.1 FURTHER READING

Barrett, E. C., & Martin, P. (2014). *Extreme: Why Some People Thrive at the Limits*. Oxford University Press.

Grace, E. (2018). A dangerous science: psychology in Al Qaeda's words, *Dynamics of Asymmetric Conflict*. DOI: 10.1080/17467586.2018.1428762

Kowalczyk, D., & Sharps, M. J. (2017). Consequences of Undercover Operations in Law Enforcement: A Review of Challenges and Best Practices. *Journal of Police and Criminal Psychology*, 32, 197-202.

Sandal, G. M., Leon, G., & Palinkas, L. (2006). Human challenges in polar and space environments. *Environmental Science and Biotechnology, 5*, 281-296.

2. PRE-DEPLOYMENT

2.1 SELECTION

The purpose of selection is to identify people who are suitable for the job and the demands that are unique to a specific role. In extreme contexts, this usually reflects their capacity to maintain function under conditions of pressure/stress (Beattie; Morgan; Sarkar). To identify suitable candidates, it is beneficial to conduct a Knowledge, Skills, Abilities, and Other-characteristics (KSAOs) analysis:

- **Knowledge:** awareness of relevant technical concepts, facts, procedures and processes relevant to the job
- **Skills:** developed or trained proficiency in the use of equipment, tools, machinery that are needed for the job
- **Abilities:** capacity to learn and acquire the knowledge and skills required to complete the job to an acceptable level of proficiency
- **Other personal characteristics:** interests, motivations, temperament and personality characteristics needed for the job

After identifying KSAOs that are relevant to the job/mission, you can work backwards to identify the job person-specification that will inform selection (Morgan).

There has been a long history of studying individual difference factors, such as personality, in extreme and challenging settings. In military Special Forces and NASA astronauts, personality traits have been linked to passing selection and overall suitability for the job. In general, research suggests that the following personality traits are likely to be adaptive for coping in high stress environments:

- Higher than average levels of openness.
- Higher than average levels of extraversion.
- High agreeableness (the capacity to cooperate).
- Low neuroticism (emotionally stable).

- High conscientiousness (engage in goal-directed behaviour).

2.2 TRAINING

Training programmes are designed to equip individuals with the skills they need to complete the job or task. In addition to technical and tactical skills, there are a range of psychosocial competencies that can aid performance and health in extreme environments and when operating under stress/pressure (Beattie; Bessone). Astronauts/cosmonauts selected for the International Space Station are trained in the following competency areas:

- **Self-care/Self-management:** this is about individuals taking responsibility for and monitoring and managing their own performance and health (Hadow identified this as a priority for solo expeditions)
- **Leadership:** in high-performing teams individuals need to be able to transition between leadership and followership positions
- **Situational awareness:** having an awareness of the operating conditions, as well as understanding the physical and emotional state of yourself and others
- **Communication:** being able to deliver and receive information in a clear and concise way. This include clarifying and confirming others have understood when communicating information
- **Cross-cultural understanding:** being aware of and having an understanding of cross-cultural differences when interacting with people from different backgrounds
- **Teamwork:** this includes taking actions to improve team effectiveness and working cooperatively and collaboratively with other people
- **Problem-solving/decision-making:** being proactive at dealing with problems and being comfortable making decisions both independently and as part of a team
- **Conflict management:** understanding how to effectively avoid and resolve conflict in order to maintain group function

Practitioners who have developed and delivered training have focused on experiential learning and maintaining optimal levels of challenge (Aston; Bessone; Hadow). Examples include simulating stress by doing progressively more difficult activities in a remote UK setting, astronaut training in Sardinian caves, and up-skilling novice expeditioners in Arctic environments in Norway and Iceland.

Consistent across academic and practitioner perspectives was that training has to have some kind of consequence to make it relevant and invoke a meaningful response that results in learning (Beattie; Bessone; Hadow; Morgan; Sarkar). For example, building adversity into training increases the stakes for those taking part. Training consequences could include small punishments for mistakes or being exposed to managed levels risk, such as cold-exposure, which will create a more memorable learning experience.

Part of delivering quality training is about creating the right culture and learning environment. People are more likely to progress when they are in a high challenge, high support environment (Sarkar). If the environment that surrounds a person (whether from a leader or their peers) is lacking in challenge and/or support, they are less likely to maximise their true potential.
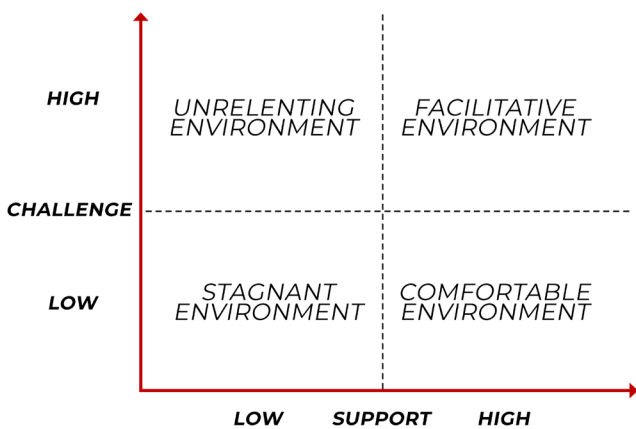

Figure 1: Challenge-support matrix for developing resilience (from Fletcher & Sarkar, 2016)

An important feature of developing a high challenge, high support environment is the feeling of psychological safety. In a psychologically safe environment, individuals are more likely to learn from their mistakes and see failures or adversity as an opportunity for development.

Signs of psychological safety:

- Can I tell someone they are doing a great job?
- Can I tell someone they are messing up?
- Can I raise worries or concerns?
- Can I ask for help without fear of judgement?
- Can I take a risk and feel supported?
- Can I genuinely listen to feedback from others?

There is likely to be an individualised aspect to effective training, which may be more important when personnel selection has not been possible – especially when working with difficult characters (Beattie).

Three formal training programmes were discussed (see 'further reading' for details): mental-fortitude training (Sarkar), which focuses on how to develop systematic training for high-performing populations; punishment and reward sensitivity training (Beattie), using consequences to develop mental toughness in performance sport; and the European Space Agency (ESA) Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills (CAVES) programme that involves training astronauts and cosmonauts in psychological and behavioural competencies that are needed to fly in space.

2.3 TAKE-HOME MESSAGES

When selecting personnel, it is typical to begin with a job analysis to identify the psychological traits and competencies that are relevant to the role (Morgan).

Individual difference factors, such as personality, will influence whether a person can meet the demands of the task and perform to the level required (Morgan).

Identifying core psychosocial competencies, like those included within the International Space Station Human Behaviour Performance model, can be used to inform the design of training programmes (Bessone).

Training should be comparable to the performance environment and simulate the conditions faced – there should be appropriate consequences (Beattie).

A typical training evolution will be progressive and move from classroom seminars/workshops, to simulations, in to field exercises (Bessone).

Ensuring psychological safety during training is critical for individuals to be open to learning from their mistakes and see pressure situations as a challenge rather than threat (Sarkar).

2.4 FURTHER READING

Beattie, S, Alqallaf, A & Hardy, L 2017, 'The effects of Punishment and Reward Sensitivities on Mental Toughness and Performance in Swimming' *International Journal of Sport Psychology*. *DOI: 10.7352/IJSP.2017.48.246*

Bessone et al., (2008). *International Space Station (ISS) Human Behavior & Performance Competency Model Volume I*. Accessible at: *https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080018552.pdf*

Morgan, C., Doran, A., Steffian, G., Hazlett, G., and Southwick, S. (2006). Stress-induced deficits in working memory and Visuo-constructive abilities in special operations soldiers. *Biological Psychiatry*. 60, 722–729.

Morgan, C, A, III., Russell, B., McNeil, J., et al. (2011). Baseline burnout symptoms predict visuospatial executive function during survival school training in Special Operations military personnel. *Journal of the International Neuropsychological Society,* 17, 494-501.

Fletcher, D., & Sarkar, M. (2016). Mental-fortitude training: An evidence-based approach to developing psychological resilience for sustained success. *Journal of Sport Psychology in Action*, 7, 135-157.

3. DEPLOYMENT

3.1 STRESS & COPING

Stress has a physiological and biological basis. In challenging training environments, such as during military Survive Evade Resist and Escape (SERE) training, elevated markers of cortisol indicate that people find the experience challenging (Morgan). A range of physical, psychological and interpersonal stressors were discussed by practitioners operating in expedition and extreme contexts. Stressors that were discussed multiple times included: individual psychological factors, such as sleep deprivation, monotony, boredom and uncertainty; and social psychological factors, including issues to do with how the team was working and challenges associated with working/interacting with people from different cultural backgrounds (Aston; Evans; Hadow; O'Dowd).

The extent to which the stressors faced in an extreme setting have a positive or negative impact upon performance and health is related to the interpretation (sometimes referred to as appraisal) or perception of stress (Beattie, Morgan, Sarkar, Smith). When a person interprets the stressor as something they can control, they are more likely to respond positively. For example, an individual who has a lot of experience operating in an extreme setting is more likely to retain a sense of control, and find the experience as less stressful, than someone who has never been into that same setting. The interpretation of stress and impact upon performance and health is also likely to shaped by a person's physical and psychological state. For example, someone who is sleep deprived, fatigued, carrying an injury and feeling frustrated, is less likely to interpret stress as controllable, than when they are well-rested, feeling energised and positive.

Different people will find different things stressful. The key is helping individuals identify the features of the situation that are interpreted as stressful (i.e., less controllable) and exploring ways to reduce the impact of those stressors (i.e., help develop a sense of control).

People use coping strategies to minimise the impact of stressors by mitigating their effects and helping instil a sense of control. In extreme environments, individuals tend to rely on a range of problem- and emotion-focused strategies and flexibility in being able to draw on these strategies is really important. Although problem and approach-focused coping strategies are deemed adaptive in daily life, there are often limits to which you can change an extreme context (many aspects are unchangeable). Therefore, acquiring emotion-focused methods that help reframe or re-appraise stressors in a more adaptive way are helpful (Smith).

Many examples were shared by practitioners in relation to coping with stress. These include:

- Doing 'what if' scenario planning (Aston).
- Focusing on the process (within personal control; Hadow).
- Embracing cultural diversity as value-adding (Evans).
- Learning from historical examples of how people have coped previously (Evans).
- Visualisation (Aston).
- Rational thinking (Aston).

Data collected from expeditioners in the field suggest that experiencing multiple stressors in combination, or cumulatively, is likely to be more detrimental to performance and well-being than each of the individual stressors alone. If coping resources are overwhelmed more serious impairment in functioning is likely to occur. Monitoring combinations of stressors is critical for keeping people healthy in extreme settings; ups and downs are normal but continual decline is likely to be indicative of something more serious (Smith).

3.2 RESILIENCE & MENTAL TOUGHNESS

The capacity to maintain function in the face of demands or stressors is critical to those exposed to extreme environments. Beyond coping, there are various theories and approaches to building capacity and optimising performance under pressure. During the workshop, two strengths-based concepts were

discussed; resilience and mental toughness (Beattie; Sarkar).

Resilience has traditionally been viewed as the capacity for an individual to bounce back after adversity. In recent years, developments in the study of resilience have resulted in new conceptualisations of what it means to be 'resilient'. According to contemporary approaches, resilience refers to the personal qualities a person uses to withstand and maintain functioning (both performance and wellbeing) under pressure. As a process, resilience reflects the dynamic interactions between an individual and the environment.

Resilience is:

- Not a rare or special quality.
- Not a fixed trait.
- Not found only within a person; can be facilitated by the social environment that surrounds a person (see challenge-support matrix above).
- Not about suppressing or not feeling emotions.
- Not necessarily transferred across contexts.

Similar to resilience, mental toughness (MT) is an encompassing term that reflects both trait and state characteristics. There are many definitions, but MT can broadly be thought of as the "ability to achieve personal goals in the face of pressure from a wide range of different stressors" (Beattie). Observational measurements of mentally tough behaviour offer an alternative to self-reports and may prove useful for monitoring how a person is coping and functioning in high-pressure environments (see Hardy et al., 2014 paper below).

3.3 GROUP DYNAMICS

The social and interpersonal aspects of living and working in extreme settings have regularly been cited as the greatest source of stress (Bessone; Smith). Where personnel are working together for long-durations, compatibility becomes more important (Bessone). There a range of interpersonal factors that can result in difficulties including diversity in personalities, needs, cultures and experience (Aston, Bessone).

Practitioners highlighted that team dynamics can make or break an expedition. It is possible to put up

with most people for a week or two, but for longer expeditions there is a much greater need for effective team working (O'Dowd). Examples of poor social relationships were shared from expeditions, including instances of the formation of cliques, romantic relationships, and exercises in dominance. Challenges related to merging teams were also discussed and how groups adapt to incoming team members (Bessone; O'Dowd). Thoughts were shared on how to maintain group function. This included:

- **Debriefing**: which can helpful but needs to be framed in a way that is productive for it to have purpose.
- **Communication planning:** deciding how you are going to communicate with each other before getting into the environment e.g., being able to openly discuss irritations/tensions to avoid conflict
- **Conflict resolution:** being tolerant of individual tendencies and avoiding conflict unless it is having a significant impact on task performance – choosing the right time to bring up issues (perhaps not in front of the whole group)
- **Using peer-support:** identifying when to share difficulties with other team members who may also be finding this situation challenging – not to overburden or overshare with other people as this can add stress
- **Planning for the 'what-ifs':** helps develop consensus around team decision-making and how problems will be addressed when they occur in the environment

Relevant to security work, culture plays a central role in how a group functions (Aston; Evans). When preparing teams to operate in Middle Eastern environments, uncertainty and prolonged timescales for decision-making were identified as challenging (Evans). Expeditioners spoke of difficulties in identifying the people who did/did not have the authority to make decisions, which impacted upon their ability to secure permits for travel through different regions. Receiving confirmation for travel/transit often came at the last minute, making planning and preparation difficult. Planning early and building flexibility into the expedition objectives and travel routes was important for making sure the journeys happened.

In the Middle East the focus on culture and tradition is deep-rooted and needs to be understood for effective relationships to occur. In-country, different tribes and regions are likely to have their own unique traditions. Understanding the rituals and traditions that are specific to certain groups can help when interacting and trying to build relationships with the local community. On expeditions, challenges related to cultural differences were identified, particularly in relation to the slaughtering of animals for food and the lack of privacy that you get when travelling as a group through the desert (Evans). There was also difficulties related to the use of language (for instance swearing) and the process of making decisions in mixed-culture teams (Aston).

Despite some of the issues, cultural differences can also be a positive when harnessed and used in the right way (Evans). For example, being open to new rituals and traditions can provide diversity in the experience of operating in difficult environments. People from different backgrounds can often identify different solutions to problems that are being faced. Additionally, learning about other peoples' culture can give you something meaningful to do and provide a topic of conversation when you are stuck with the same people for long periods of time.

A contemporary issue raised by practitioners was the use of social media. Access to internet and social media platforms means that it is harder to detach from what is happening at home. One solution was to allow outgoing communications only. There needs to be a balance between effective psychosocial support without burdening the person with what is happening back home (O'Dowd; Aston).

3.4 FACILITATIVE ENVIRONMENTS

Creating a facilitative environment was discussed at multiple points throughout the workshop (Beattie; Evans; Hadow; Sarkar). The social environment that surrounds a person is relevant to pre-, during- and post-deployment phases. Thoughts on creating a facilitative environment centred on:

- Providing supportive challenge towards goals.
- Finding balance between challenge and support.

- Allowing individuals to have input and take ownership over decisions.
- Encouraging initiative-taking.
- Promoting the value of constructive feedback.
- Maintaining a positive and agreeable relationship.
- Emphasising psychological safety.

Although not discussed at length, lessons might be learnt from examining coach-athlete dyads in high-performance sport.

During solo activities, an individual is responsible for creating their own facilitative environment (Aston; Hadow). Expeditioners talked about ways that they tried to motivate themselves and improve performance, which included:

- Setting small but progressive goals.
- Using motivational self-talk or mantras.
- Using imagery to run through different scenarios in their mind.
- Regulating arousal (trying to get pumped up for the next stage).
- Trying to maintain a grip on reality – despite have unusual sensed-presence experiences.

3.5 TAKE-HOME MESSAGES

Stress has a biological and physiological basis, but it is how the stressor and stress response is perceived that is critical for maintenance of performance and health (Morgan).

Understanding the situational or day-to-day experience of an individual is important in order to mitigate against the impact of stress (Smith).

When multiple stressors are experienced in combination, or cumulatively, there is an increased risk to performance and health (Smith).

Coping strategies are methods that people use to try and maintain a sense of personal control (Morgan; Smith).

Other strengths-based psychological approaches can inform how to maintain and enhance function under pressure; Sarkar's grounded theory of resilience

and Beattie's work on mentally-tough behaviour are two candidate areas that could be used to support to performance and health of people in extreme environments.

Social aspects of extreme deployments pose significant challenges for personnel (Smith).

In extreme settings, culture, poor preparation, inadequate leadership and diversity of team members can all lead to tension (Aston, Evans, O'Dowd).

Creating a facilitative environment helps maintain a sense of challenge and support – doing so via remote interactions where contact may be limited needs to be explored further (Sarkar).

3.6 FURTHER READING

Arthur, C. A., Hardy, L., Beattie, S., Fitzwater, J., & Bell, J. (2015). Development and Validation of a Military Training Mental Toughness Inventory. *Military Psychology*, 27, 232-241.

Cockell, C. (2002). Mars is an awful place to live. *Interdisciplinary science reviews,* 27, 32-38.

Fletcher, D., & Sarkar, M. (2013). Psychological resilience: a review and critique of definitions, concepts, and theory. *European Psychologist*, 18, 12-23.

Kagge, E. (2006). *Philosophy for polar explorers: What they don't teach you in school.* Pushkin Press.

Owen, J. (2008). *Tribal business school: Lessons in Business Survival and Success from the Ultimate Survivors.* John Wiley & Sons.

Smith, N., Barrett, E. C., & Sandal, G. M. (2018). Monitoring daily events, coping strategies, and emotion during a desert expedition in the Middle East. Stress & Health. *DOI: 10.1002/smi.2814*

4. POST-DEPLOYMENT

4.1 TRANSITIONS

The post-return transition can be a difficult phase for people returning from extreme settings. Many expeditioners talk about the feeling of 'post-expedition blues' (Barrett), which is also common among high-performing athletes. Despite the more challenging aspects of transitioning and reintegrating, others have highlighted the benefits of being exposed to adversity and what can be learnt as a result (Sarkar).

During the final session of the workshop, initial exploratory research was presented detailing some of the experiences of people doing 'expeditions' in adventurous and extreme environments (Barrett). A number of themes were discussed and many of the practitioners (and other delegates) in the room agreed on having experienced those responses at some point during their expedition endeavours. The key themes relevant to transition are:

- Feelings of going from simplicity to complexity upon return.
- Complications with other people:
    - People 'back home' only having a superficial interest.
    - Home life has not changed despite the returning individual feeling different.
    - Other people not understanding.
- Unreality and memories fading quickly.
- Lacking cohesion after being in a highly cohesive team.
- Reliving the expedition/missing the expedition.
- Lacking purpose.

People shared insights on how to deal with the transition process. Suggestions include:

- Decompression.
- Staying social.
- Redefining 'success/failure'.
- Finding purpose.
- Active remembering.

During discussions, reference was made to research on post-Olympic blues and what might be learnt (see further reading). There is not an abundance of research in this area (beyond studies on PTSD) and therefore exploring literatures is likely to be of value.

4.2 TAKE-HOME MESSAGES

The transition out of challenging environments can be difficult as a person readjusts to their home setting (Barrett).

There are likely to be a range of both positive and negative feelings linked to how a person perceives themselves, others and their purpose in life (Barrett).

Lessons might be learnt by analysing experiences of people in other high-performance/pressure environments and what it is like upon return e.g., professional athletes (Sarkar).

There is limited research on this area despite being relevant for organisations that have to regularly deploy people to challenging settings.

4.3 FURTHER READING

Brown, C. J., Well, T. L., Robinson, M. A., & Cotgreave, R. (2018). Athletes' experiences of social support during their transition out of elite sport: An interpretive phenomenological analysis. *Psychology of Sport & Exercise*, 36, 71-80.

Howells, K., & Lucassen, M. (2018). 'Post-Olympic blues' – The diminution of celebrity in Olympic athletes. *Psychology of Sport & Exercise*, 37, 67-78.

5. SPEAKER BIOGRAPHIES

Professor Emma Barrett
University of Manchester
Emma.barrett@manchester.ac.uk

Emma is Professor of Psychology, Security and Trust at University of Manchester. Her role involves leading and coordinating security-relevant research, and her research interests include terrorist and criminal behaviour; decision-making; betrayal, deception, and interpersonal manipulation; and human performance in extreme and challenging conditions.

From 2003-2015, Emma led a UK Government inter-departmental research unit of 25 specialist staff and contractors that developed and applied behavioural, psychological and social science research to a range of security and defence issues. Emma is the co-author of Extreme: Why some people thrive at the limits (Oxford University Press, 2014) and is currently engaged in a range of research on extreme environments, including on youth mental health, transitions, and team cohesion.

Dr Nathan Smith
University of Manchester
Nathan.smith@manchester.ac.uk

Nathan is a researcher interested in the psychology of performance and health in challenging and demanding settings. He conducts both theoretical and applied research on topics related to individual differences and selection, performance and health monitoring, and post-return adjustment and reintegration. He has worked with many different extreme environment populations including expeditioners in desert, polar and mountain environments, Antarctic scientists, space simulation participants, military personnel and extreme medics.

Shortly, Nathan will join the University of Manchester as a Research Associate in Psychology and Security. He previously worked as a Senior Research Scientist at the UK Ministry of Defence Science and Technology Laboratory (Dstl). Nathan helped establish the psychological module on the Extreme Medicine MSc programme at the University of Exeter and co-designed the programme for the World Extreme Medicine

WEMSKI course in Livigno, Italy. He is a Fellow of the Royal Geographical Society, Associate of the Alpine Club and Honorary Lecturer at the University of Exeter's Medical School.

Professor Charles A. Morgan III
University of New Haven

Professor Charles A. Morgan III MD, MA, is a Board Certified Forensic Psychiatrist, and tenured Professor in the Department of National Security, Henry C. Lee College of Criminal Justice and Forensic Sciences, University of New Haven. He received his medical degree from Loma Linda University School of Medicine in 1986 and completed his residency training in psychiatry at Yale University in 1990.

Dr. Morgan joined the faculty of medicine at Yale University in 1990 where he taught for 25 years. During his time at Yale, Dr. Morgan received numerous grants and published over 100 peer reviewed scientific papers on stress, detecting deception and on cognitive performance in Special Operations forces. He is an internationally recognized expert in eyewitness memory, human performance under stress, and in detecting deception. For his work Dr. Morgan has been awarded the US Army Award for Patriotic Service in 2008 and the 2010 Sir Henry Welcome Medal and Prize for his development of interventions to buffer the negative impact of stress on human cognition, memory, learning and operational performance.

Dr. Morgan served as an intelligence officer (2003-2010) with the Central Intelligence Agency. He has served as a Subject Matter Expert to the US Government Department of Defense in areas of Operational Psychology, Advanced Interviewing and in Neuroscience. The products developed from his research with the U.S Department of Defense have been validated in both domestic and operational environments.

Pen Hadow

Pen is the only person to have trekked solo, and without resupply, across the sea ice from Canada to the North Geographic Pole (75 days/770km). He is also the first Briton to have trekked, without resupply, to both the North and South Geographic Poles from the respective continental coastlines of North America and Antarctica. He previously had set up the world's first guide service

to the North Pole, leading a range of pioneering private, charitable and television expeditions and organising the first all-women expedition (22 women) from Canada to the Pole in 1997.

Pen led the multi-award-winning £6.5m international research programme, Catlin Arctic Survey (2007-2012) which operated a research base and remote field teams investigating sea-ice volume, ocean acidification and ocean circulation, and involved a 50-strong team of scientists, field guides, Inuit assistants, technical and logistical staff, and a wide range of in-house and embedded media personnel.

In summer 2017, Pen led Arctic Mission, which became the first boat expedition without icebreakers to sail into the ice-free international waters surrounding the North Geographic Pole. Its pioneering research into the wildlife, ecosystem, and marine pollution of these waters was undertaken by the University of Exeter. Its marine pollution work was cited by Senator Sheldon Whitehouse in the US Senate in Autumn 2017 to help recover all the recently withdrawn funding for NOAA's marine debris research programme during a 'Save Our Seas Act' debate.

Over the last 25 years he has spent more than 10,000 hours travelling on the Arctic Ocean's sea ice.

Dr Mustafa Sarkar
Nottingham Trent University

Mustafa is a Senior Lecturer in Sport and Exercise Psychology and teaches across the undergraduate and postgraduate degree programmes. He holds a PhD from Loughborough University, investigating the assessment of psychological resilience in sport performers. Before joining NTU, Mustafa was a Research Fellow in Sport, Exercise, and Wellbeing at the University of Gloucestershire. His research focuses on the psychology of sporting excellence and its application to other high-performance domains (e.g., business). His work addresses how high achievers thrive on pressure and deliver sustained success, and clusters around the following themes: psychological, team, and organisational resilience; growth and thriving; and sport psychology consultancy. Mustafa has worked closely with sport organisations on creating environments and cultures to develop resilience, including the Premier League, the Netherlands Olympic Committee, Hockey Wales, Cricket Scotland, and Agility Team GB.

Mark Evans MBE

Based in Muscat, Oman, Mark Evans is an experienced desert and polar explorer and guide, writer, speaker and wilderness advocate. He acts as a consultant in the fields of expedition logistics and risk mitigation. Twenty-two years spent living and travelling extensively in Arabia, backed up by 80-day camel expeditions, a 55-day 1,700 km solo kayak journey from UAE to Yemen, and remote 4×4 journeys throughout Saudi Arabia and Oman, give Mark an unrivalled knowledge of the area.

Mark has written four books, and was recognised as a Pioneer to the Life of the Nation at Buckingham Palace in 2003 for his creativity in the field of outdoor education and youth development. In 2004, to address the polarisation of cultures, Mark established the Connecting Cultures initiative, later recognised by the United Nations Alliance of Civilisations as one of the world's leading civil society initiatives. In 2011 he received an MBE for services to intercultural understanding. Mark is Patron of The Andrew Croft Memorial Fund, and, with two Arab companions recently completed a 49-day, 1700km crossing, on foot and by camel, of the largest sand desert on earth, the Empty Quarter of Arabia.

Dr Stuart Beattie
Bangor University

Stuart is Senior Lecturer in the School of Sport and Exercise Sciences at Bangor University where he obtained his PhD. He is also a co-director of the Institute for the Psychology of Elite Performance based within the School. Stuart's main research interests are in the areas of Stress and Performance, Performance Psychology, Mental Toughness, and Self-efficacy. His current projects include profiling high level cricketers from the English and Welsh Cricket Board to implementing psychological strategies in trainee RAF pilots. He has also published/publishing research in relation to the Armed Forces.

Felicity Aston MBE

Felicity is an author, speaker, expedition leader and former Antarctic scientist. In 2012 she became the first woman to ski alone across Antarctica. It was a journey of 1744km that took 59 days to complete. She trained as a Meteorologist, and has spent a continuous period of two and a half years (including two consecutive winters) at Rothera Research Station on the Antarctic Peninsula to monitor climate and ozone.

Felicity went on to organise and lead numerous expeditions to remote places around the world, but particularly to the Polar Regions. Her expeditions have included the first British Women's crossing of Greenland, a 6000km drive to the South Pole, a 36,000km drive to the Pole of Cold, and leading the largest and most international team of women ever to ski to the South Pole. Felicity has been elected Fellow of both the Royal Geographical Society in London and The Explorers Club in New York. In 2015 she was awarded The Queen's Polar Medal - one of very few women to have received this special honour – and was appointed MBE for services to polar exploration.

Loredana Bessone
European Space Agency

Loredana is Head of Analogue Field Testing and Exploration Training Unit at the European Space Agency. She is leading the ESA CAVES and PANGAEA projects, where leading European field scientists and explorers help prepare international astronauts and cosmonauts to become effective team members in scientific expeditions in space analogue environments, including caves.

Loredana has designed and leads behavioural training for astronauts, space station ground control personnel and overwinter teams of the Concordia Antarctic station based on the International Space Station (ISS) Long Duration Spaceflight competency model, which she also co-developed. In the past, she has been leading human Mars mission design studies within the ESA Aurora exploration programme, and she helped design and conduct the ESA Extra Vehicular Activity (spacewalk) training programme, and the ESA astronaut survival training.

Loredana holds an Ms in Information Science and an Ms in Space System Engineering. She is a speleologist and has been a diving instructor.
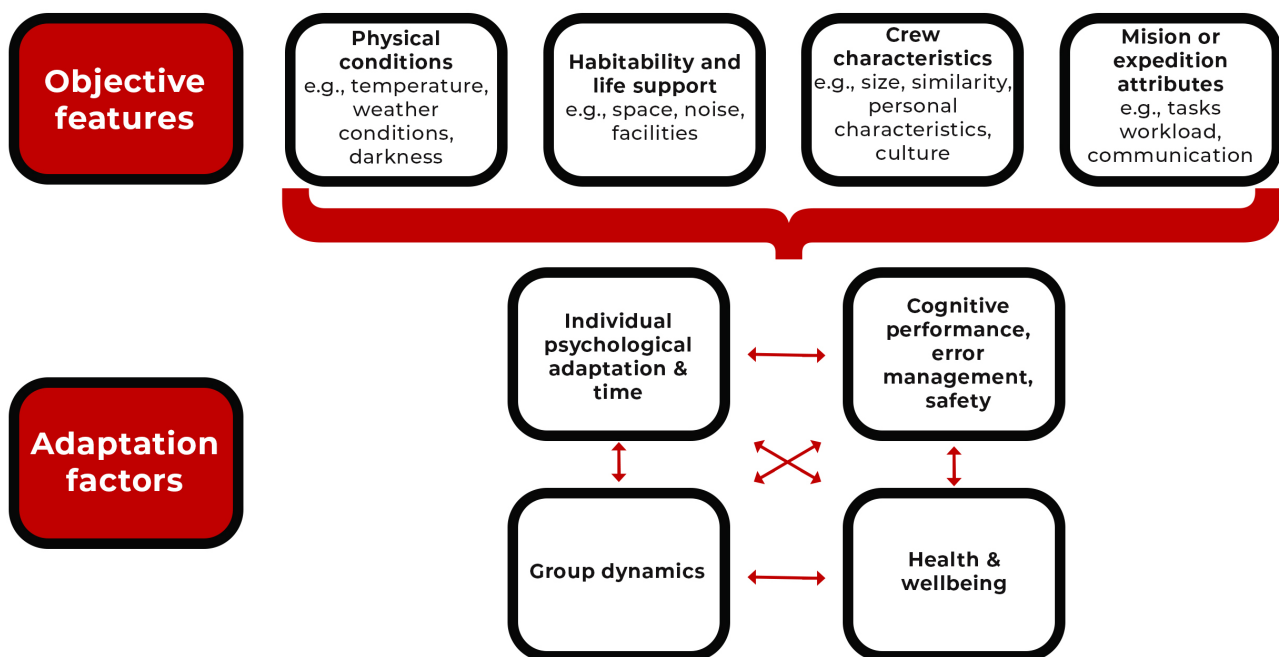
Cathy O'Dowd

Cathy O'Dowd is the first woman to climb Mount Everest, the world's highest mountain, from both its north and south sides. Her career has given her rich insights about individuals and teams under intense

stress in the face of overwhelming challenge: She has been on Everest as the last minute 'token woman' team-member, and as an expedition leader. She has worked in partnership with a wide range of international teams forced to co-operate on popular routes, and has climbed on a team attempting a new route, the only expedition on the entire east face. She has faced the 'worst storm in the history of Everest' and the giant avalanches of the Kangshung face, and she has faced warring team members as ego ran rampant. She has experienced both the thrill of the summit and the reality of failure, and has paid the ultimate price with the loss of fellow climbers.

Cathy remains an active adventurer. She was part of the team that achieved the first ascent of Nanga Parbat via the Mazeno ridge and her most recent expedition was a ski-mountaineering ascent of Mount Logan, the second highest peak in North America.

APPENDIX 1

Objective features

Physical conditions
e.g., temperature, weather conditions, darkness

Habitability and life support
e.g., space, noise, facilities

Crew characteristics
e.g., size, similarity, personal characteristics, culture

Mision or expedition attributes
e.g., tasks workload, communication

Adaptation factors

Individual psychological adaptation & time

Cognitive performance, error management, safety

Group dynamics

Health & wellbeing

Model of Adaptation to Isolated, Confined and Extreme Environments

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