Operational Safety: The Human Factor

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Introduction

The ever-increasing technical precision and sophistication of military and civilian aviation hardware has made an unprecedented contribution to the information available for analysis when things go wrong.

In this sense, the equipment is more accountable than ever. On the other hand, the human frailties of those managing this increasingly autonomous operational environment reflect all the complexities of their evolved cognitive and emotional make up. Digital information may potentially be infinitely knowable, but the vulnerabilities of the operatives will be something even they may not be aware of.

In any accident investigation, there is an imbalance between the availability and detail of contextual facts and the uncertainties associated with the complexities of human nature. Generally perceived as subjective, unstructured and difficult to measure, human factors in evaluation of risk are easily underestimated and become over-shadowed by hard facts. The appreciation that personality characteristics play a very significant part in shaping any individual's dispositions towards risk and that they can be reliably measured opens up an interesting new avenue for risk research.

The current study illustrates this point by reporting on progress in developing a framework for the evaluation of human factors in making risky decisions. Our research is generating encouraging results across a wide range of theatres and applications.

This study represents the culmination of three years of research and will be disseminated across two white papers. This first paper will report the findings of our research into the risk personalities of pilots and crew typically employed in the Helicopter Air Ambulance (HAA) industry.

The second white paper will provide a practitioner perspective on the findings reported below.

The Proposition

Two helicopter night flight accidents, with multiple fatalities, were officially attributed to "*loss of control due to disorientation from flying into IMC conditions and losing all visual reference to the horizon*". Both pilots had over 5000 hours of total flight time and were experienced with their aircraft; the newest and most capable helicopters. One was an Air Ambulance helicopter and the other an Army Blackhawk. Although limited to visual flight rules for their missions, both machines were fully equipped, in their different ways, to bring the crew back home in an emergency should they find themselves in instrument meteorological conditions (IMC). The pilots should have been able to recover their flights when they found themselves suddenly enveloped in cloud. In spite of the investigation into these incidents, some very basic questions remain unanswered:

> *Why did they take off in weather conditions that were in violation of rules, regulations, orders, or Standard Operating Procedures (SOPs)?*

How is it that they failed to draw on all their training and experience to recognize their situation and stop before going IMC?

Why, when equipped for sophisticated recovery options, had they not transitioned, as trained, to instrument flight?

Both missions went ahead even though they were below the minimum weather requirements for a VFR flight, and both pilots were aware of this before they left the ground. So how does that happen? Why would such experienced professional pilots ignore standard procedures, fail to draw on all their training and experience or fail to deploy the technology at their disposal?

Individuals, pilots and crew members accept the risks that they take in their work. If they didn't, they would not be in that business. They each have different strategies for managing their emotions and dealing with the risk in ways that work for them. When they use good communication techniques, they can better mitigate risks by utilizing the skills associated with their varying personality traits. And that is a powerful contribution to safety that technology cannot replace.

This research explores the value of risk personality profiling (Risk Type) to provide an additional perspective on pilot decision making and personal risk management. The appeal is that it provides an accessible taxonomy of risk dispositions. Although framed within the context of neurological and psychological research, it is also intuitive, personally meaningful and easily articulated.

It is of immediate benefit as a contribution to personal and team development. It's remarkable reliability indicates potential long-term benefits in terms of safety research.

Study Rationale and Objectives

Both research and personal experience testify to the fact that people vary considerably in their risk dispositions; from levels of anxiety and fearfulness that may severely restrict a person's life options, through to an oblivious self-confidence that is virtually imperturbable. Other people are characterized by their intense desire for order and predictability or, at the other extreme, by their spontaneity and need for excitement.

These are all personality characteristics that impact on an individual's view of the world and on the decisions that they make. All decisions involve some degree of risk, and risk taking is always a consequence of some kind of decision-making process. All that we know about risk and all we know about people and their individual differences crystallises at the point of when decisions are made.

"Decision-making draws on both the analytical and the emotional systems in the brain"

Walport (2014)

The concept of Risk Type reflects this precept. The two orthogonal scales that underpin the compass model interact to create a 360° spectrum of risk dispositions (see Figure 1 below). This is further segmented to accommodate intermediate positions.
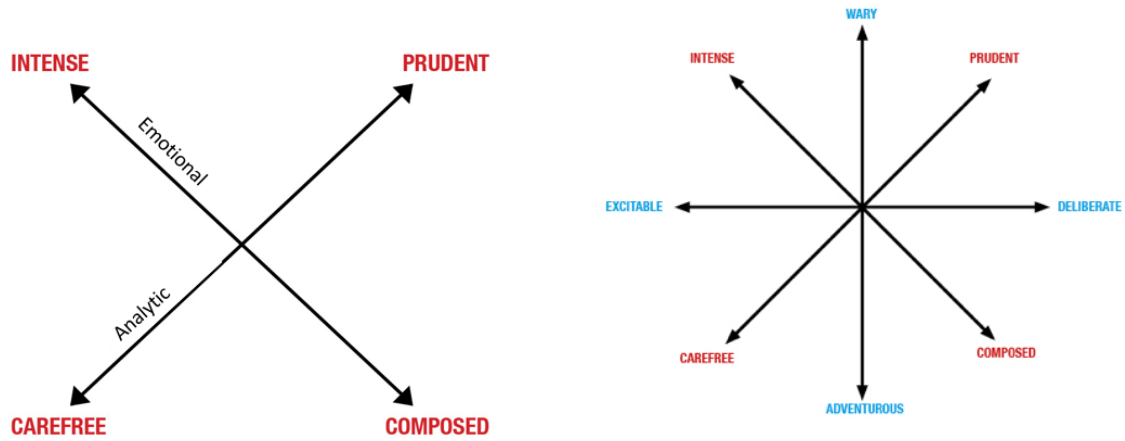
Figure 1. Underlying structure of the Risk Type Compass

These eight Risk Types provide the taxonomic framework for Human Factor Risk used in this study. Any individual completing the Risk Type Compass questionnaire is placed in one of more than 200 positions within this framework. This process is visually represented using the Compass graphic in Figure 2 below.
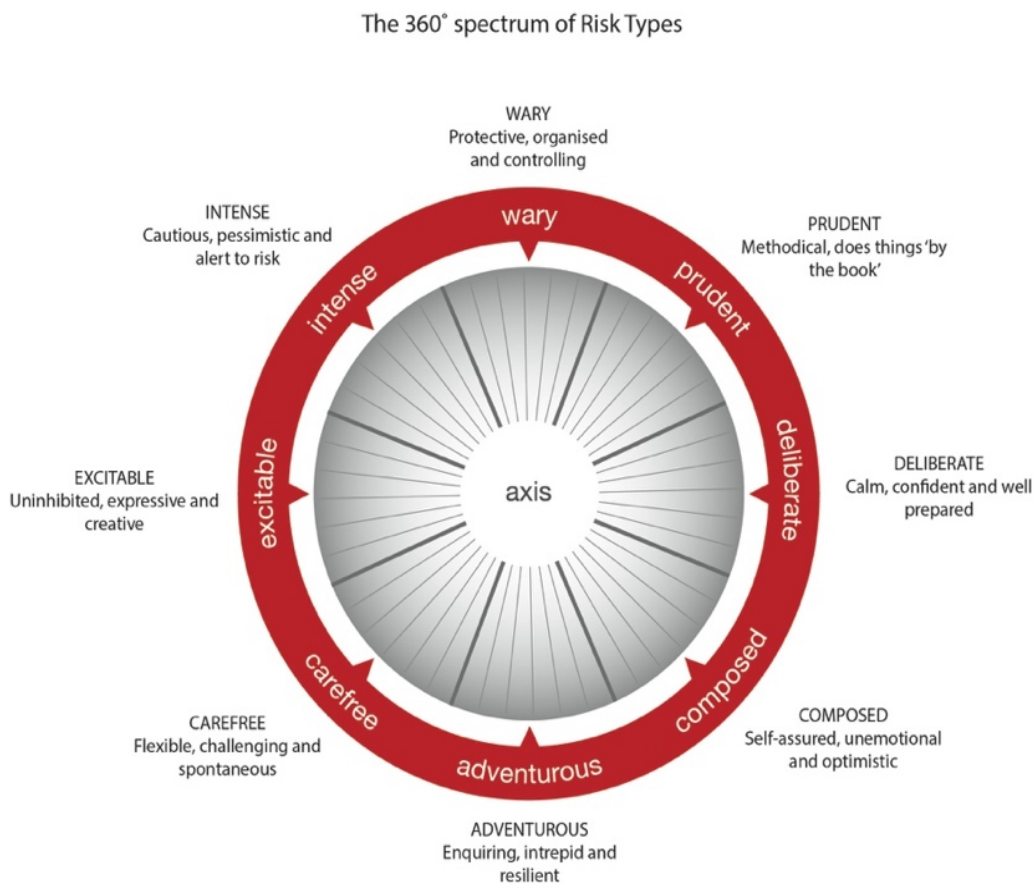

Figure 2. The Risk Type Compass

The continuous incrementation of the 360° spectrum is segmented into Risk Types for purposes of reference and communication, each Risk Type merging into its neighbouring Risk Types. The strength of Risk Type characteristics is indicated by proximity to the outer edge of the Compass. Those placed nearer the centre, will be milder in respect of their Risk Type designation. Those within the 'axial' group fall too close to the mean on both of the underpinning scales to be allocated to a Risk Type with any confidence. A more granular interpretation of test scores is derived from scores on the 18 subthemes that are encompassed by the assessment's two underlying scales.

In this study we focus on the prevalence of the eight Risk Types within a sample of pilots and crew typically employed in the HAA industry, with further pilot breakdown comparing civilian and military-trained pilots.

The Sample

The sample included Helicopter Air Ambulance (HAA) pilots, private pilots, military pilots, instructor pilots and airline pilots, and some in more specific piloting positions. The sample's 56 crew members consist almost entirely of paramedics and registered nurses who served in the HAA industry.

In addition to providing a range of details about their job roles and careers, participants completed the Risk Type Compass personality assessment.

The Risk Type Distributions of the Sample

Analysis of 11,900 RTC completions indicates that the eight Risk Types are evenly represented across the general population. This provides immediate insight when identifying the Risk Type distribution of specific samples. The Risk Type distribution of the pilots and crew members sample is presented in Figure 3 and compared against the general population sample of 11,900 (12k).
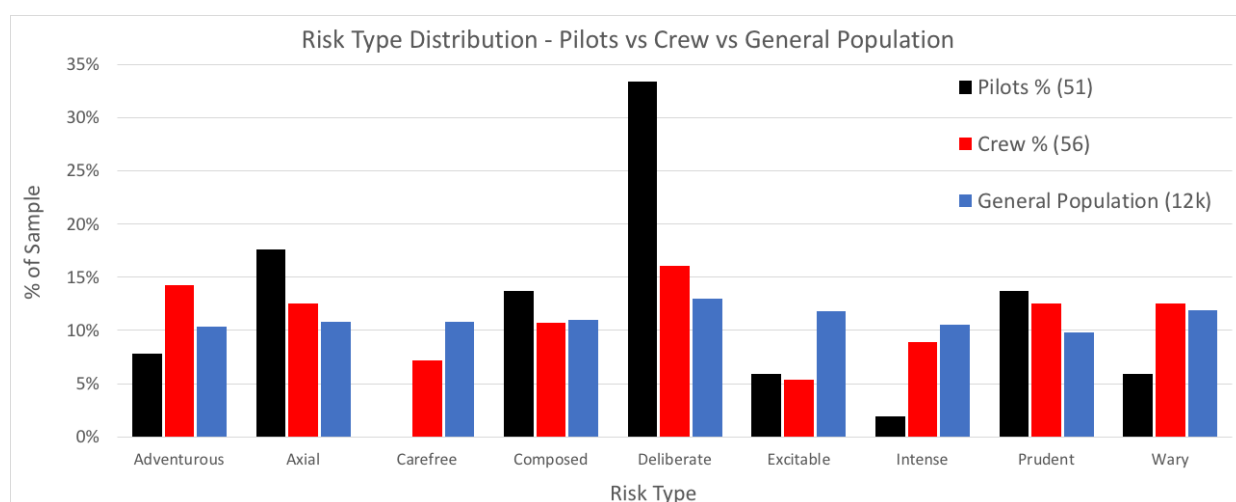

Figure 3. Risk Type distribution of the sample's pilots and crew compared against the 'general population' sample of 12k

Most notably, our sample of pilots included a far higher proportion of Deliberate Risk Types (over a third of the sample) compared to the General Population (13.8%) or Crew (16.1%) samples.

Understanding the description of Deliberate Risk Types provides greater understanding of this finding.

Deliberate Risk Type

At the root of this Risk Type are high levels of optimism and self-confidence combined with careful preparation. This Risk Type tends to be unusually calm under pressure and in situations that would worry most people. They experience little anxiety and may seem almost too accepting of risk and uncertainty. However, any concerns about them being unaware of risk should be balanced by a desire to do things in an informed, planned and systematic way. They are unlikely to walk into anything unprepared.

Also notable was the complete absence of Carefree Risk Types in the pilot sample (against 10.8% of the general population). The description of the Carefree Risk Type sheds light on this finding, and is given below:

Carefree Risk Type

At the root of this Risk Type are high levels of impulsiveness and unconventionality. These individuals dislike repetitive routine and don't really like being told what to do. Such people may seem excitement seeking and, in extreme cases, reckless. Not being good at detail or careful preparation, they may seem rather vague about their intentions and objectives. Their impatience, impulsivity and distractibility might leave them exposed to imprudent and hasty decisions.

These findings contrast with the more symmetrical and even distribution of Risk Types found within the sample of 56 crew members.

One influential view on the convergence of employee characteristics in any organisation is Schneider's (1987) 'Attraction > Selection > Attrition' model. This model recognises the role of attraction in recruitment; selection further refines the intake and attrition reflects the departure of those that prove not to be a 'good fit'. This model explains the processes by which the culture of an organisation becomes established and consolidated. The cyclical nature of this process can embed and emphasise certain traits, resulting in a workforce that reflects a particular balance of characteristics that differs in comparison to their prevalence in the general population.

Our wider research has shown clear differentiations in the prevalence of Risk Type within different organisations and professions. Our analysis of Air Traffic Controller data provides an striking example, with over 75% of the sample designated as Deliberate Risk Types.

Breakdown of the Pilots

Each participant was asked a series of questions about their careers and piloting preferences. As a result, we were able to divide pilots into civilian-trained (n=23) and military-trained (n=28). Figures 4. and 5. below illustrate the result of this breakdown.
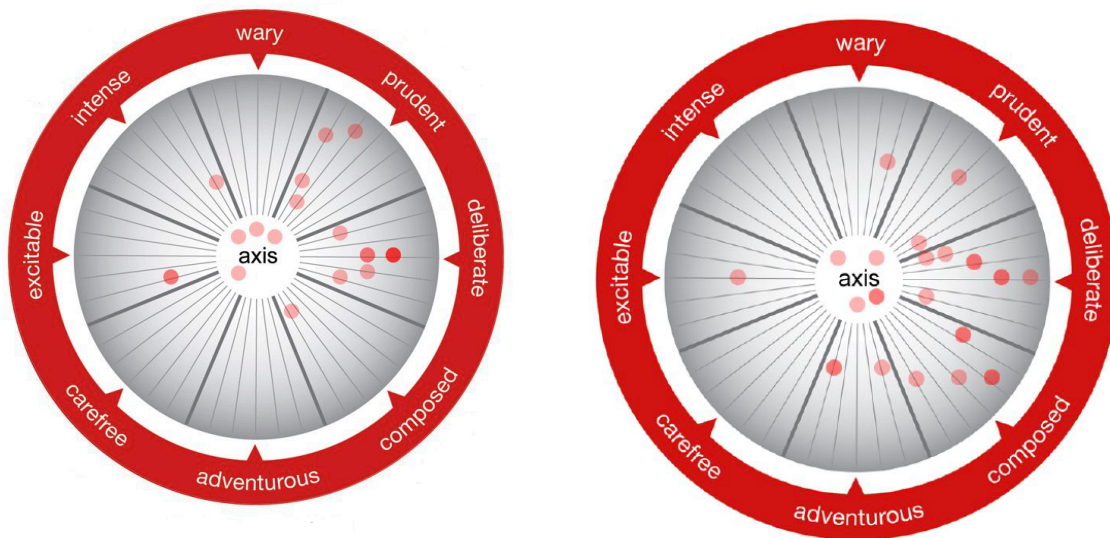
Figure 4. and 5. Risk Type distribution of Civilian-trained (n=23) and Military-trained (n=28) pilots respectively (deeper red indicates multiple participants)

Interpreting the 'scatter' within these two graphics, there is a distinct clockwise rotation from civilian trained to military trained (from NE to SE). Both samples show a clustering of participants towards the less emotional segments of the compass (Composed, Deliberate, Prudent). Greater differentiation is evident within the Composed and Adventurous segments, suggesting that military training attracts somewhat more open-minded, creative individuals who accept a degree of excitement and ambiguity in their lives. Additionally, these data indicate that neither sample includes any reckless or very impulsive individuals. This 'within group' dispersal of Risk Types will have 'real world' implications.

The RTC provides insight into how these individuals attune to, and moderate, risk in their professional experiences. Each Risk Type has its own advantages and limitations. From a personal development perspective, these insights set out a personal agenda defining where an individual's natural dispositions are likely to be of benefit and where they may present a personal challenge.

From a group or team perspective, clustering may be reflected in factions within which individuals share a common viewpoint, mutually reinforcing that perspective. Other factions will do the same, contributing to the group's dynamics and tensions. The sum of the group's risk dispositions will define their decision-making style and the degree of uncertainty or ambiguity it will tolerate. Outliers and the absence or under-representation of some Risk Types will also skew the group dynamic. The dispersal of Risk Types defines the group's orientation, its uniqueness and its idiosyncrasy. Perhaps most importantly, it provides a key to its decision-making orientation and its decision-making processes.

The Risk Type descriptions provide insightful personal narratives reflecting the interaction between each individual's emotional and rational nature, making the RTC a powerful assessment tool. At a more granular level, the Risk Type and scale scores are based on 18 distinct subthemes, and some trends emerge from this level of analysis.

What are the Subthemes driving Risk Type variations?

The Risk Type Compass's 18 four-item 'subthemes' explore various risk-related personality characteristics. Although caution should be observed due to the limited number of items in each subtheme, comparison of various subgroups within the sample of 107 participants generates some interesting findings. The following includes a brief explanations of the subthemes highlighted in this particular study. A fuller description of all 18 subthemes is available in the Technical Manual (Trickey, 2017).

Pilots vs Crew

Figure 6 presents subtheme findings in the form of T scores. This enables samples to be compared against the wider General Population sample of 11,900 participants. A score of 50 is the average against which we can meaningfully determine 'high' or 'low' subtheme scores. Figure 6 illustrates the three subthemes that show the greatest variations between the Pilot and Crew samples in comparison with the General Population sample.
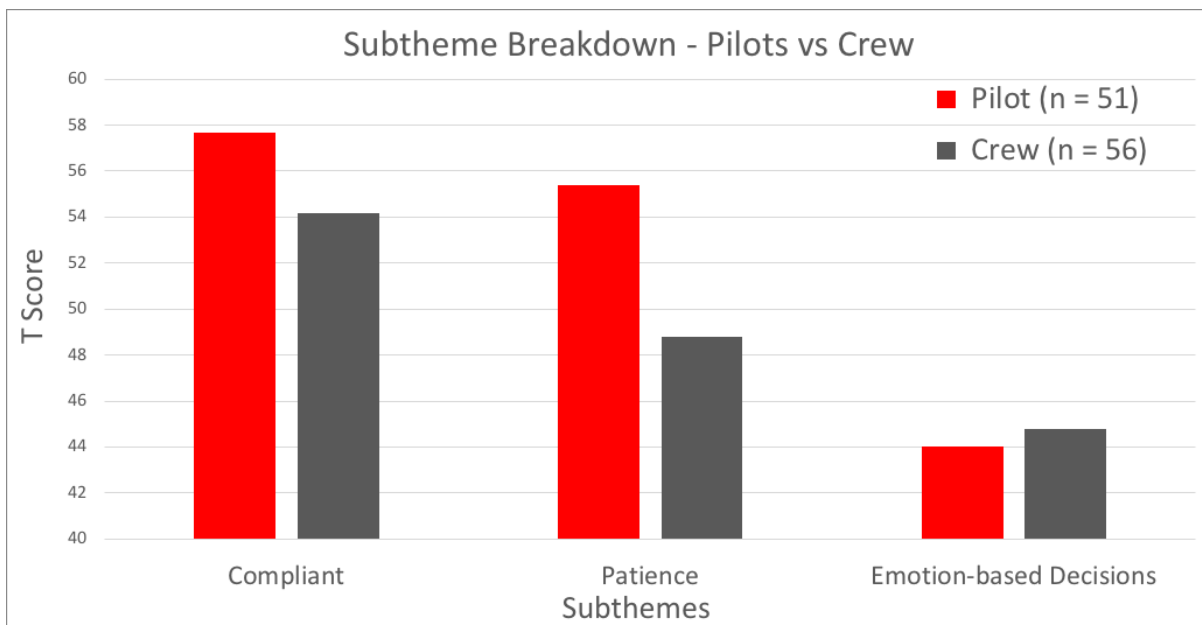

Figure 6. Subtheme breakdown of Pilots (n=51), Crew (n=56) and General Population (n=12k)

Both pilots and crew samples score higher in the *Compliant* subtheme and lower in the *Emotion-Based Decision Making* subtheme. Pilots score higher for the *Patient* subtheme compared with both the crew and general population. Descriptions of the subthemes are below:

Compliant – Higher scores distinguish those that respect rules, regulations and authority from those that are happy to bend the rules and may not feel the need to comply.

Patience – Higher scores distinguish individuals who accept that it may take time to achieve an objective, from those that may be impatient with delays and obstructions and want quick results.

Emotion-Based Decision Making – Distinguishes those that base decisions on facts and logic, rather than feelings (lower score), from those that seem easily influenced by their emotions (higher score).

Further practitioner-level insight into these findings will be provided in part two of the Operational Safety white paper.

Military-trained vs Civilian-trained Pilots
Pilots included in our analysis were further differentiated by whether they had received flight training with a civilian or military organisation. Figure 7 below presents the three subthemes reflecting the greatest differentiation between these two sub-samples.
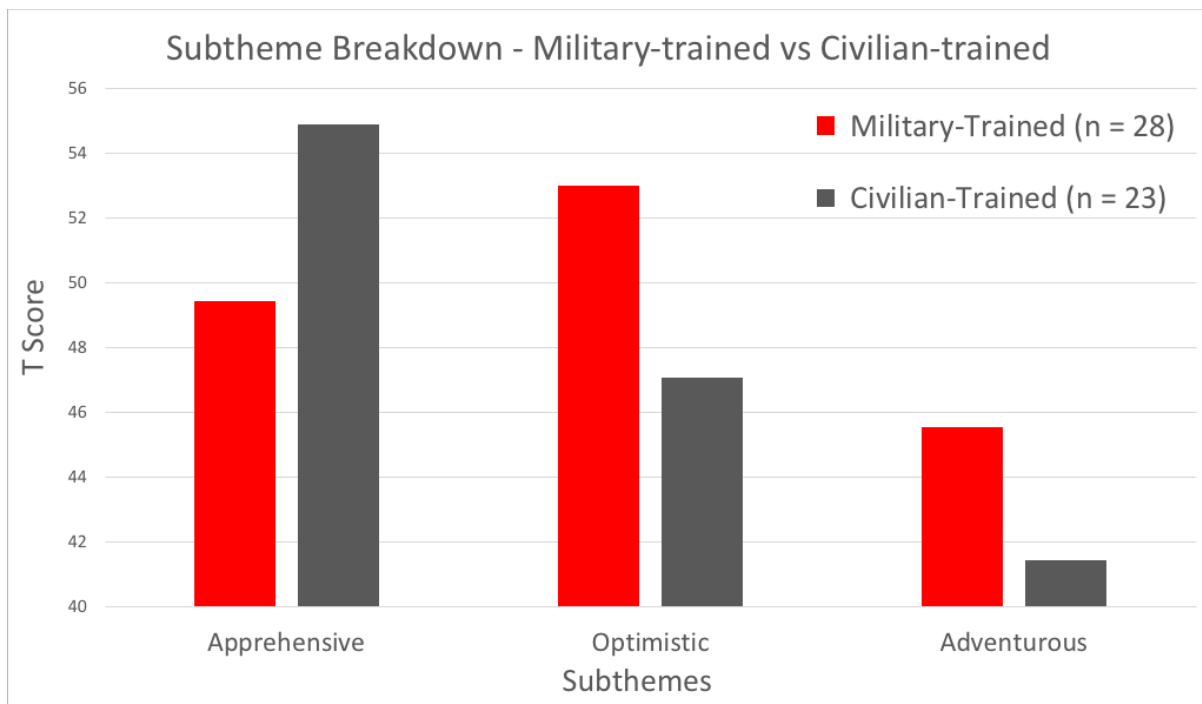

Figure 7. Subtheme breakdown of Military-trained Pilots (n=28), Civilian-trained Pilots (n=23) and General Population (n=12k)

As already evident in Figure 4, no civilian-trained pilots were designated as Adventurous Risk Types. However, at the subtheme level, both military- and civilian-trained pilots scored below average on the *Adventurous* subtheme, although inter-pilot differences reflect the Risk Type-level differences. Scores for the *Apprehensive* and *Optimistic* subthemes also differentiate, with civilian-trained pilots scoring higher on the former and lower on the latter.

Apprehensive – Distinguishes those that will rarely worry about things unnecessarily (lower score) from those that are apprehensive and need reassurance (higher score).

Optimistic – Higher scores distinguish those with a positive and upbeat approach from those that are more pessimistic, expect the worst and are more easily discouraged.

Adventurous – Distinguishes those that are conservative and prefer to stick to what they know (lower score) from those that are excited by variety, novelty and new ventures (higher score).

As with the previous subtheme-level breakdown, further practitioner insight will be provided in part two.

Do our findings align with the literature?

Despite its innovative approach to exploring the various traits that affect individuals' disposition to risk, the Risk Type Compass is deeply rooted in decades of academic research concerning the psychological study of personality. General consensus has emerged regarding the existence of five basic dimensions of personality, deemed the 'Big Five': 'Agreeableness', 'Extraversion', 'Openness to Experience', 'Conscientiousness' and 'Neuroticism'. The Risk Type Compass was developed using facets that were most relevant to risk. This enables us to contextualise the findings of our analyses alongside thousands of peer-reviewed academic research studies.

In the case of the Big Five, Neuroticism is the factor most represented in the RTC, with the Emotional scale* reflecting various facets of the trait in the subthemes it contains. The Analytic scale* relationship with the Big Five is more complex, as the subthemes it contains reflect elements of Conscientiousness, Extraversion and Openness to Experience. This gives us a basis for comparisons with the research literature, which is best understood using meta-analytic methods that combine and analyse large datasets collated from multiple studies.

One such meta-analysis was conducted into the Big Five profiles of several thousand military aviators from over 20 samples by Castaneda (2004). Findings indicated that the pilots were more likely to possess higher levels of Extraversion and lower levels of Neuroticism. The RTC represents the former in the Analytic scale (primarily in the subthemes of Adventurous and Excitement Seeking) and the latter in the Emotional scale. In the taxonomy of the RTC, the combination of these temperaments would push the individual to the lower right quadrant of the compass, and this was witnessed in the current study (see the Military pilots' positioning in Figure 5 above).

Research into the success of United States Air Force (USAF) pilots by King, Retzlaff, Barto, Ree, and Teachout (2012) used a Big Five tool to identify differences between trainees who passed (N=11,211) and those who failed (N=1,337) the USAF training programme. Failure could be attributed to one of seven reasons, including poor flying performance, self-elimination, and class rank. In line with Castaneda's (2014) findings above, comparisons between pass and fail students indicated that students who passed had higher levels of Extraversion and lower levels of Neuroticism. Findings from the study's second assessment (the 'Armstrong Laboratory Aviation Personality Survey') indicated that, compared to passing students, those who dropped on request were less aggressive, impulsive, and risk taking than trainees who passed. As with the Big Five findings, these characteristics (most notably Risk Taking) would push an individual to the lower positions of the RTC, which again aligns with the established military pilots assessed by the current study.

Finally, and in slight contrast to the military focus of the previously cited study, a study into the Big Five profiles of 165 commercial pilots by Dickens (2014) reported similar findings to the previous studies, in addition to greater levels of Conscientiousness. Larger amounts of this factor may push

individuals to the upper right quadrant of the compass due to thematic alignment with subthemes like 'Methodical' and 'Compliant', and this influence is reflected in the civilian-trained pilot graphic in Figure 4. above.

As these various studies suggest, the findings emerging from the current research align logically and consistently with previous research. In the context of pilots, the RTC's unique taxonomy provides further insight by visually representing the recurring characteristics of this group in a theoretically-validated framework. This proves helpful in understanding how the participants of this study may vary from the general population, as well as predict how specific groups of individuals may collaborate in a high-risk environment.

In the text above we have used the terms Emotional Scale and Analytic Scale for reasons of clarity and consistency. Within the Risk Type Compass Technical Manual, we use the terms 'Emotional:Calm' and 'Daring:Measured', reflecting the bi-polar nature of these scales and our factor analysis of the original research data.

Research Discussion and Conclusions

The term risk covers an amazingly wide range of phenomena. There is risk in failing to tie your shoe lace or forgetting to set your alarm clock and there is risk in global diplomacy and pandemics, and everything in between. There is one way of dividing this vast risk panorama that is essential in order to avoid infinite confusion; that is to make the distinction between *objective* risk and *subjective* risk. The former is about the risk itself; the risk out there that we need to identify, define and quantify. It is about incidents, numbers and statistical models; the world as seen through the eyes of actuaries, underwriters, risk managers, statisticians and other risk professionals. Subjective risk is about people and the way that they perceive risk, react to risk, take risks and – most importantly of all - how they make decisions. This is the world as seen through our own eyes; the eyes of individuals and personality psychologists.

Behavioural economics has made the point that human decision making can be far from rational. We know of many decision-making biases to which we are all prone, but there is a quite particular bias in all of us which is persistent and pervasive – the bias of our own risk dispositions. Neurological research tells us that decision making involves two quite separate neurological systems; one concerned with our emotions, how we feel about our world, and one concerned with the way that we analyse our world and make sense of it. These are both rooted in our nature and reflected in our personalities. Paradoxically, personality characteristics can be more easily defined and more reliably measured than risk. These are all reasons for optimism in turning our attention to decision making in operational theatres.

Our aim in this research has been to explore the possibility of adding some weight to the 'people dimension' in the appraisal and management of risk and into the explanatory aspects of risk behaviour and accident analysis. The differentiation of pilots from the general population, the coherence of their clustering within the Compass, the differentiation between military- and civilian-trained pilots, are all reassuring findings. At the individual level too, the recognition rate amongst RTC examinees is very high and this gives credibility to use in individual and team development.

Safety is an incontestable objective. There is no room for compromise on the demands for rules compliance or standards of behaviour. Those objectives are enhanced when individuals appreciate that their personal agenda is to recognise where their own dispositions align comfortably with those aims, and where additional effort or restraint is required. This in itself would be a significant contribution to accident prevention.

Answers to the questions surrounding the two helicopter incidents described at the beginning of this report may still be some way off, but there is plenty of space for improvement in our understanding of human factors; individual differences that impact on decision making and their contributions to tragedies of this sort.

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