HELINOTS(S)

Non-technical Skills for Search and Rescue Pilots

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Acknowledgements
The Helicopter Non-technical Skills for Search and Rescue Pilots (HeliNOTS (S)) system is a behavioural marker system developed by psychologists from the Applied Psychology and Human Factors Group of the University of Aberdeen, in association with CRM trainers and search and rescue pilots from international helicopter operators.

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Introduction

Alongside the technical aspects of pilot training, the enhancement and evaluation of pilots' non-technical skills has been a long-standing component of flight crew training and pilot licence maintenance. Fundamental variances, however, have been recognised between pilots who fly different aircraft types across a range of flight roles. Differences between helicopter and fixed-wing aircraft operation are a significant point of consideration for rotor-wing operators seeking to tailor their Crew Resource Management training, and its associated assessment methods (e.g. behavioural marker systems), to their operational needs.

Rotorcraft have a range of unique features; they possess the ability to hover, decrease airspeed without loss of altitude, and have a reduced need for ground infrastructure. This makes the helicopter an ideal aircraft for search and rescue operations, a role it is utilised for by both civilian and military operators globally. In respect to this unique aircraft functionality and its distinct operational roles, helicopter pilots have been shown to exhibit non-technical skills differently from their fixed-wing counterparts, and also adapt these skills according to specific mission parameters.

Search and rescue missions are characterised by typically unpredictable and dynamic operating environments. Risk factors associated with low altitude, hazardous terrain, weather conditions, and extraction method must be considered alongside a casualty's condition or a missing person's status. Crews comprised of pilots, winch operators, and winch paramedics, maintaining prescribed air readiness posture, must react to taskings with what information is provided, continuing to gather information on transit to a location. As such, pilots may find themselves in heightened exposure to the effects of fatigue and stress, and must utilise their non-technical skills to a heightened degree to ensure their own and their crew's safety and effectiveness.

It is essential, therefore, that operators continue to enrich non-technical skills training, specific to the domain in which the search and rescue pilot operates. To that end, the HeliNOTS (S) system is the result of a range of studies exploring in detail the non-technical skills utilised by pilots during search and rescue missions. HeliNOTS (S) has been developed to provide a structured, empirical framework in which to address these skills. It provides a common language for pilots and Crew Resource Management trainers to discuss and train non-technical skills and lays a foundation on which debriefing sessions may be structured. It is expected that such a nuanced system will be ideally placed to address the unique elements of the search and rescue pilot role and further enhance Crew Resource Management training.

What this handbook contains

This handbook contains a guide to the HeliNOTS (S) system. Part 1: Information for users outlines guidance for the use of behavioural marker systems. Parts 2: The HeliNOTS (S) system provides the full contents of the system across categorical

and elemental levels, in addition to providing behavioural markers for each element. Part 3: Use of the HeliNOTS rating scale includes a description of the rating scale, and the observation /rating form associated with HeliNOTS (S). For more information on the HeliNOTS (S) system, underpinning research, and supplementary materials, please visit the website at: **https://research.abdn.ac.uk/applied-psych-hf/**

Part 1: Information for users

What are non-technical skills?
It is accepted that whilst technical knowledge is a core component of high-level performance, non-technical skills (NTS), encompassing interpersonal (e.g. communication) and cognitive (e.g. situation awareness) skills, are a necessity for safe and efficient practitioner outcomes (Flin, O'Connor, & Crichton, 2008). Within the aviation industry, NTS have been the focus of significant attention due to a series of fatal human-error related incidents in the 1970s. One such incident in 1977, where two airline jets collided on a runway resulting in the greatest accidental loss of human life in aviation history, is still used as a case study to highlight the catastrophic impact of lapses in NTS such as loss of situation awareness, inappropriate decision-making, and poor leadership behaviours (Weick, 1990). Subsequently, over the following decades distinct generations of Crew Resource Management (CRM) training has evolved in the industry, aimed at addressing non-technical skills and ultimately mitigating human error (Helmreich, Merritt, & Wilhelm, 1999).

CRM courses involve the modular, classroom-based training of NTS by certified CRM trainers. These programmes have been adopted globally as the training of knowledge and skills relating to human performance have become a mandated component of flight training by all major air operators worldwide (ICAO, 2010). In the UK, both fixed-wing and helicopter operators are subject to CRM training regulations from the Civil Aviation Authority (CAA) which stipulate that pilots should receive training and assessment on non-technical skills (see Flin, 2019). Indeed, it is outlined that a marker of effective training is that there is a degree of role-specificity in CRM courses (CAA, 2017).

What are behavioural marker systems?
Behavioural marker systems are rating scales based on skill taxonomies and are used to identify observable, non-technical behaviours that contribute to superior or substandard performance. They consist of two parts: a skills taxonomy with examples of positive and negative behavioural markers allied to each skill, and a rating system. Behavioural marker systems are context-specific and are developed in the domain in which they are to be used, and can be utilised to structure observations, ratings and feedback, as well as to identify practitioner' training needs. They can also form the basis for NTS training. One of the earlier behavioural marker systems in the European aviation industry is NOTECHS (Flin et al., 2003), comprising four NTS categories and a five-point rating scale. Since its inception in the early 2000s, NOTECHS has been used and adapted by a number of operators (fixed and rotor-

wing) for assessing the NTS of aviators and is the only method named by the European regulator. Other operators have moved towards a competency-based approach to training and assessment through EBT (evidence-based training). In cases where a European operator has approval for an ATQP (Alternative Training and Qualification Programme) they are permitted to construct their training programmes and assessments based upon their own evidence (EASA, 2016).

Recently, a series of studies with search and rescue (SAR) and offshore transport helicopter pilots identified differences in how helicopter pilots utilise their NTS based upon mission parameters and the factors which influence these NTS (Hamlet, Irwin & McGregor, in press; Hamlet, Irwin, Flin, & Thomson, 2019; Hamlet, 2020). The research proposed the inclusion of a new skill category for SAR pilots, cognitive readiness, which encompassed the overall adaptability, preparedness, resilience and quick problem solving required for dynamic and unpredictable rescue environments. Based on these findings, the HeliNOTS (S) behavioural marker system, specific to the SAR pilot role, has been developed.

What is the HeliNOTS (S) systems?

Helicopter Non-technical Skills for Search and Rescue Pilots (HeliNOTS (S)) is a behavioural marker system developed by psychologists from the Applied Psychology and Human Factors Group of the University of Aberdeen, in association with CRM trainers, and SAR pilots from international helicopter operators. The system allows for the observation, rating, and feedback of SAR pilots' NTS performance.

HeliNOTS (S) describes the core NTS categories specific to the SAR pilot role in unpredictable and dynamic rescue environments. It has been designed for use by qualified CRM trainers in accordance with established technical aircraft knowledge in order to allow for the observation and subsequent rating of SAR pilots' NTS against a structured framework. The system is recommended for use in the simulator but may also be used as a debriefing tool post-flight.

HeliNOTS (S) has been developed on the basis that all system behaviours are directly observable or may be identified though communications between crew members. The system applies a rule of parsimony, where a broad range of NTS behaviours are described in as few distinct elements as possible, and has been designed to be in a terminology recognisable and applicable to SAR pilots and trainers.

The system is comprised of three levels, with skill categories, elements, and associated behavioural markers. HeliNOTS (S) is made up of five core NTS categories and 15 associated elements (see Table 1). Definitions of the categories and their associated elements are provided in this handbook, alongside examples of positive and negative behavioural markers for each element. These behavioural markers were developed in consultation with experienced pilots from international SAR operators and are intended to give examples of typical behaviours rather

than provide an exhaustive summary of behaviours.

Table 1. HeliNOTS (S) taxonomy v1.0

Category	Elements
Communication	– Exchanging information – Giving instructions – Providing feedback
Leadership and Teamwork	– Guiding task behaviours – Sharing task activities – Monitoring other crew members – Setting and maintaining crew atmosphere
Cognitive Readiness	– Utilising preparedness – Maintaining resilience – Applying problem-solving
Situation Awareness	– Gathering information – Comprehending informational elements – Anticipating future states
Decision-making	– Identifying and selecting options – Reviewing course of action

Using the HeliNOTS (S) system

The HeliNOTS (S) behavioural marker system is intended to be used as a rating tool to assess SAR helicopter pilots' NTS performance and give feedback in a structured manner immediately after the flight. In this regard, HeliNOTS (S) may also be utilised as debriefing tool post flight or simulator session. It is recommended that users first observe performance while taking note of any specific behaviours or omissions. Assessments should be based solely on behaviours that are observed or directly communicated. Using these observations, a rating may first be made at an element level, then at the more general category level. The associated five-point rating scale should be used to determine the level of performance achieved, with a non-applicable option for skills that could not be observed within the current situation. The HeliNOTS (S) rating form can be viewed on page 17. It is essential that users of HeliNOTS (S) receive proper instruction on observation, assessment / rating, and the application of the system prior to use.

As with other behavioural marker systems, it may require repeated use of the system for assessors to become familiar and competent with the HeliNOTS (S) system. Training and practice should help facilitate this process.

- HeliNOTS (S) assessment should not interfere with flight performance; use of the system should cease immediately should circumstances dictate.
- Formative assessment and feedback on HeliNOTS (S) should occur routinely in both in-flight and simulated environments.
- HeliNOTS (S) should be utilised primarily to structure beneficial feedback to pilots on the state of their NTS. It is therefore essential that the system is used in a non-threatening and educational manner.

User selection and training

- Training is required to learn how to rate behaviours using HeliNOTS (S). This should include an understanding of:
  - Non-technical skills, human performance and error management so that constructive, directive feedback can be given to pilots
  - Principles of using psychometric tools for rating performance
  - The contents of the HeliNOTS (S) system and how it relates to flight performance
  - Observing NTS and rating behaviours with the system
  - Providing constructive feedback.
- If HeliNOTS (S) is to be used for assessment, users should be appropriately trained and calibrated to ensure all assessors provide consistent ratings for the same behaviours.
- Regular updates may be required, so recurrent training and calibration programmes should be developed.
- It is recommended that a group of experienced CRM trainers be selected from an operator to become HeliNOTS (S) trainers/assessors.

Pilot selection and training

- Pilots should receive training on human performance and error management to support development of their NTS.
- Pilots should receive their own copy of this HeliNOTS (S) booklet.
- HeliNOTS (S) should be used appropriately for the level of experience of the pilot:
  - For junior / trainee pilots, HeliNOTS (S) can be used as a tool for discussion on NTS and their importance to safe and effective flight performance
  - For experienced pilots, HeliNOTS (S) can be used to observe, rate, and provide feedback upon NTS behaviours
  - Experienced pilots may also be trained to use HeliNOTS (S) to assess NTS in others.
- CRM trainers should explain to pilots why the structured rating of NTS are important, and why HeliNOTS (S) has been developed for this purpose.

Suggested functions for HeliNOTS (S)

- To assess pilots' NTS in accordance with operators' CRM assessment regulations.
- To guide discussions of HeliNOTS (S) and the role of NTS in flight.
- To provide a basis for debriefing discussions and to encourage less experienced crew members to participate in debriefs.
- To allow for trainers and crew members to discuss NTS in relation to case studies and CRM issues.

Practical tips and recommendations:

- Use HeliNOTS (S) in a variety of simulated flight settings as appropriate for CRM assessment.
- It is recommended new users work at an elemental level, as behaviours may be more directly observable.
- If HeliNOTS (S) is being used for assessment purposes, it is

recommended that:

- Users take notes about observations during the assessment if possible (e.g. observed or omitted expected behaviours), then make assessments based on these notes post-observation
- Users take notes about specific circumstances of observed case and pilot's experience (e.g. type of simulated flight, simulated hazards / emergency scenarios, pilot new on aircraft type)
- Pilots receive feedback and a debriefing session directly after the observation session, with element level observations / ratings to give feedback on specific skills and the categorical rating to describe general performance

- The HeliNOTS (S) system has been designed for use during CRM sessions and assessments, but focus should be applied to areas of weakness identified by the operator / CRM trainers.

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Part 2: The HeliNOTS (S) System

Communication: Exchanging task relevant information with others and ensuring information has been received and understood.

Exchanging information – Providing appropriate information to others and being receptive to information provided.

Positive behavioural markers	Negative behavioural markers
• Communicates in a clear and open / candid manner • Addresses appropriate crew members (e.g. those engaged in task) • Considers and shares intent prior to undertaking decision or action • Requests relevant information from the appropriate source/s • Uses hand signals to convey information where necessary • Promptly warns others of cues suggesting potential hazards	• Does not share information with co-pilot or technical crew • Fails to identify correct crew member for communication • Continues with verbal communication where unsuitable (e.g. interrupts busy crew member/s with inappropriate request, violates sterile cockpit rule) • Requests irrelevant, or fails to ask for, information from appropriate source/s • Ignores, or appears unaware of, crew hand signals

Giving instructions – Being clear and concise when requesting action from another crew member.

Positive behavioural markers	Negative behavioural markers
• Explains in sufficient detail what is required or expected • Seeks to ensure all relevant parties (e.g. other pilot and technical crew) are aware of new instruction (s) • Updates instructions as task / situation progresses	• Provides unclear or inconsistent information about requirements or task information • Proceeds with following new instruction without informing crew of action • Provides instruction but does not update as task / situation progresses

Providing feedback – Providing an opportunity to raise questions and seeking to address any misunderstandings in communication.

Positive behavioural markers	Negative behavioural markers
• Responds to briefs and indicates they have been understood • Uses hand signals to demonstrate recognition of communication (e.g. thumbs up) • Regularly raises opportunity for questions and takes the time to respond to the questions asked	• Fails to acknowledge or respond to brief or instructions • Acknowledges brief but carries out different task/ action • Responds negatively to questions and discourages other crew members from speaking up

Leadership and Teamwork: Taking charge of a task when needed, coordinating with other crew members, and making sure that others are managing with their tasks.

Guiding task behaviours – Taking oversight of a mission, action / series of actions, and ensuring teamwork effectiveness.

Positive behavioural markers	Negative behavioural markers
• Oversees crew activities and decision-making processes • Facilitates crew coordination • Gathers input and information from all team members • Ensures tasks have been shared appropriately	• Provides minimal or no justification of actions / decisions chosen • Undertakes command behaviours without consultation from crew members • Struggles, or shows unwillingness, to oversee crew tasks / mission • Overloads / overburdens some crew members with tasks

Monitoring other crew members – Ensuring others in crew are coping and performing appropriately.

Positive behavioural markers	Negative behavioural markers
• Catches other crew members' missed cues • Notices when crew performance seems compromised / performance has reduced • Adapts monitoring to suit team experience level • Steps in to correct actions / understanding where required	• Focuses solely on own actions and is unaware of other crew members' cues • Ignores indications of reduced performance in other crew members (e.g. lack of communication / yawning) • Assumes everyone has shared understanding of task without checking • Fails to correct actions / misunderstanding when inconsistency is found in crew

Sharing task activities – Maintaining input into team tasks and providing support to others under pressure.

Positive behavioural markers	Negative behavioural markers
• Effectively coordinates task with other crew members • Passes task responsibilities to other crew members when personally overloaded • Assists other crew members when their workload is too high • Follows instructions from other crew members accurately and promptly	• Acts in isolation without coordination to other crew members • Shows reluctance to share tasks / responsibilities when own performance becomes compromised • Does not offer assistance to other crew members despite recognition of overloaded state • Fails to follow instruction correctly, or in a timely manner

Setting and maintaining crew atmosphere – Setting the tone for an effective crew environment.

Positive behavioural markers	Negative behavioural markers
• Demonstrates a tone for other crew members to follow (e.g. facilitates flat cockpit gradient, ensures rapport) • Uses reasoning and diplomacy when interacting with other crew members and external agencies • Seeks to identify and resolve conflict within the crew • Modifies behaviours and actions to take into account current emotions and state of team (e.g. uses humour to diffuse tense situation)	• Sets inappropriate tone (e.g. shuts down other crew members, creates hostile atmosphere) • Shows signs of distress (e.g. raises voice) when interacting with crew or external agencies • Acts as a source of conflict within the team (e.g argumentative)

Cognitive Readiness: Employing mental preparation and adaptability to cope with dynamic, hazardous, and taxing rescue conditions.

Utilising preparedness – Exhibiting the mental preparation to enable action in an appropriate and effective manner.

Positive behavioural markers	Negative behavioural markers
• Shows an awareness of regulations associated with potential rescue-related task or action • Demonstrates knowledge via prompt and appropriate use of checklists or emergency procedures • Establishes contingency plans en route to rescue • Makes sure all task-relevant information is up to date	• Demonstrates an erroneous understanding of regulations related to potential rescue-related task or action • Acts without reviewing checklists or emergency procedures, or uses incorrect checklists • Shows reluctance to engage in contingency planning • Proceeds with task despite out of date information

Maintaining resilience – Effectively managing reactions to unforeseen or stressful circumstances.

Positive behavioural markers	Negative behavioural markers
• Maintains composure when exposed to surprise or startle incident • Shows ability to quickly adapt, switch tasks, and remain flexible to unforeseen circumstances • Produces measured, effective, responses to sudden changes in task requirements • Maintains focus and persists with appropriate actions during adverse conditions • Swiftly changes rescue priorities in response to new information	• Demonstrates the effects of stress / distress after surprise or startle incident • Slow to notice and react to changes in rescue conditions • Engages in rushed, disjointed or inappropriate actions in unfamiliar or high intensity rescue scenarios • Reacts negatively, and quick to give up, in adverse rescue conditions • Continues with established task focus despite new information

Applying problem solving – Generating adaptive approaches to dynamic and challenging rescue situations.

Positive behavioural markers	Negative behavioural markers
• Demonstrates an understanding of mission complexities and defines issues (e.g. potential influence of hazards, difficulties with landing locations) • Recognises uncertainties and consistently generates new potential solutions in response to changing conditions (e.g. patient status becomes more severe) • Shows ability to innovate and consider new pathways to achieving mission goal • Correctly diagnoses problems using appropriate checks and acts accordingly (e.g. applies correct checklist)	• Acts without fully understanding, or defining, mission complexities • Fails to recognise change in, or suggest potential solutions to, mission-based challenges • Follows defined responses to problems, even when ineffective • Misdiagnoses problem or applies incorrect checklist

Situation Awareness: Perceiving and monitoring one's surroundings, establishing an understanding of the environment, and projecting a picture of future events based on this understanding.

Gathering information – Establishing awareness of cues from the environment internally and externally to the helicopter.

Positive behavioural markers	Negative behavioural markers
• Monitors aircraft instrumentation / systems regularly to get relevant information and ensure awareness of warning indicators • Frequently scans external environment • Uses information from others (e.g. other crew members, tasking agencies) to gain overall picture • Refers to / checks multiple information sources relevant to mission objective • Identifies potential escape points	• Sporadically scans instrumentation, is subject to distraction, or underutilises systems when gaining awareness • Does not react to warning indicators • Fails to scan external environment • Does not request information in a timely manner, or at all • Fixates on single information source

Comprehending informational elements – Recognising the significance and meaning behind cues perceived to form a mental picture.

Positive behavioural markers	Negative behavioural markers
• Recognises erroneous information from other crew members or external sources • Exhibits a clear account of current situation and relevant task information • Shows awareness of risks inherent in each action taken • Re-briefs, suspends, or cancels action based on new risk or hazard	• Fails to recognise, or ignores, cues that information gathered is incorrect • Shows a lack of understanding of current situation and associated task information • Demonstrates an incomplete or inappropriate awareness of risk • Continues action when circumstances indicate high level of hazard to crew

Anticipating future states – Projecting understanding of situation in order to predict future events.

Positive behavioural markers	Negative behavioural markers
• Makes an effective plan of action (e.g. takes into account information gathered and comprehended) • Predicts need for corrective action • Reacts to, and acknowledges information suggesting future risk • Takes immediate actions before normal operating actions • Shows awareness of time and manages planned tasks and activities	• Fails to plan effectively despite recognition of cue/s • Does not foresee need to make corrective action despite information suggesting otherwise • Misunderstands or fails to recognise information that puts aircraft at risk • Does not manage all planned activities in a time effective manner

Decision-making: Weighing up alternatives and selecting approach to task in consideration of relative risk and confirming input of, and acceptance by, other crew members.

Identifying and selecting options – Weighing up multiple options and settling on appropriate option.

Positive behavioural markers	Negative behavioural markers
• Seeks to actively participate in group decision-making process (e.g. inputs reasoning, open to others inputs) • Estimates risk to crew and aircraft when considering options for rescue and casualty • Evaluates alternative approaches to task in order to choose the best course of action • Engages in timely decision-making in response to recognised cues	• Shies away from group decision-making and leaves other crew members to make task related decisions • Acts in a manner that puts the crew and aircraft in increased risk • Does not consider alternative approaches / courses of action before proceeding with task • Selects inappropriate or hazardous option for rescue

Reviewing course of action – Revisiting and assessing the outcomes of the decision made.

Positive behavioural markers	Negative behavioural markers
• Reads back decisions to demonstrate comprehension • Assesses whether decision has met objective • Shows willingness to revisit decision	• Fails to read back, or shows incorrect comprehension of, decision • Proceeds without investigating whether decision goal has been achieved • Indicates reluctance to revisit decision

Part 3: Use of the HeliNOTS rating scale

The HeliNOTS rating scale may be used at both the elemental and categorical levels, though it is recommended the user starts by grading elements before proceeding to assign a category score. Before making ratings, it is suggested that notes be taken on observed behaviours and any on omissions of behaviours that should have been observed, thereby reducing the possibility of missing key behaviours. All skill elements and categories should be scored using the same five-point rating scale described in Table 2. This five-point scale design was chosen in consultation with subject matter experts (CRM trainers / examiners).

The HeliNOTS (S) rating form is provided in the rear of this handbook.

Table 2. HeliNOTS System Rating Scale

Rating	Description
5 – Very good	Behaviour optimally enhances flight safety; no areas of improvements can be identified
4 – Good	Behaviour is of high standard and enhances flight safety
3 – Acceptable	Behaviour does not endanger flight safety but could be improved
2 – Marginal	Behaviour indicates cause for concern and could, in other conditions, endanger flight safety
1 – Poor / sub-standard	Behaviour was unacceptable and directly endangered flight safety; remedial action is required
N/A – Not Applicable	Skill / element was not required in this case

Ratings should only be made on observed behaviours to achieve a grade of 2 (marginal) – 5 (very good). A grade of 1 (poor / substandard) can be given based upon the observation of unacceptable behaviours or the absence of behaviours that were required.

It is important to note that not all skill elements are required or appropriate in any given scenario, therefore the rating of N/A should be made in such circumstances - this judgement is to be made by the HeliNOTS user.

HeliNOTS (S) v1.0 Rating Form

Location..... Trainer name..... Date.....

Pilot name..... Aircraft type .....

Category	Category rating	Element	Element rating	Feedback on performance / debriefing notes
Communication		Exchanging information		
		Giving instructions		
		Providing feedback		
Leadership and Teamwork		Guiding task behaviours		
		Monitoring other crew members		
		Sharing task activities		
		Setting and maintaining crew atmosphere		
Cognitive Readiness		Utilising preparedness		
		Maintaining resilience		
		Applying problem-solving		
Situation Awareness		Gathering information		
		Comprehending informational elements		
		Anticipating future states		
Decision-making		Identifying and selecting options		
		Reviewing course of action		

1 – Poor / sub-standard Behaviour was unacceptable and directly endangered flight safety; remedial action is required
2 – Marginal Behaviour indicates cause for concern and could, in other conditions, endanger flight safety
3 – Acceptable Behaviour does not endanger flight safety but could be improved
4 – Good Behaviour is of high standard and enhances flight safety
5 – Very good Behaviour optimally enhances flight safety; no areas of improvements can be identified
N/A – Not applicable Skill / element was not required in this case

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