HumanFactors

Getting the most out of Non Technical Skills (NTS) Assessment

UniSA

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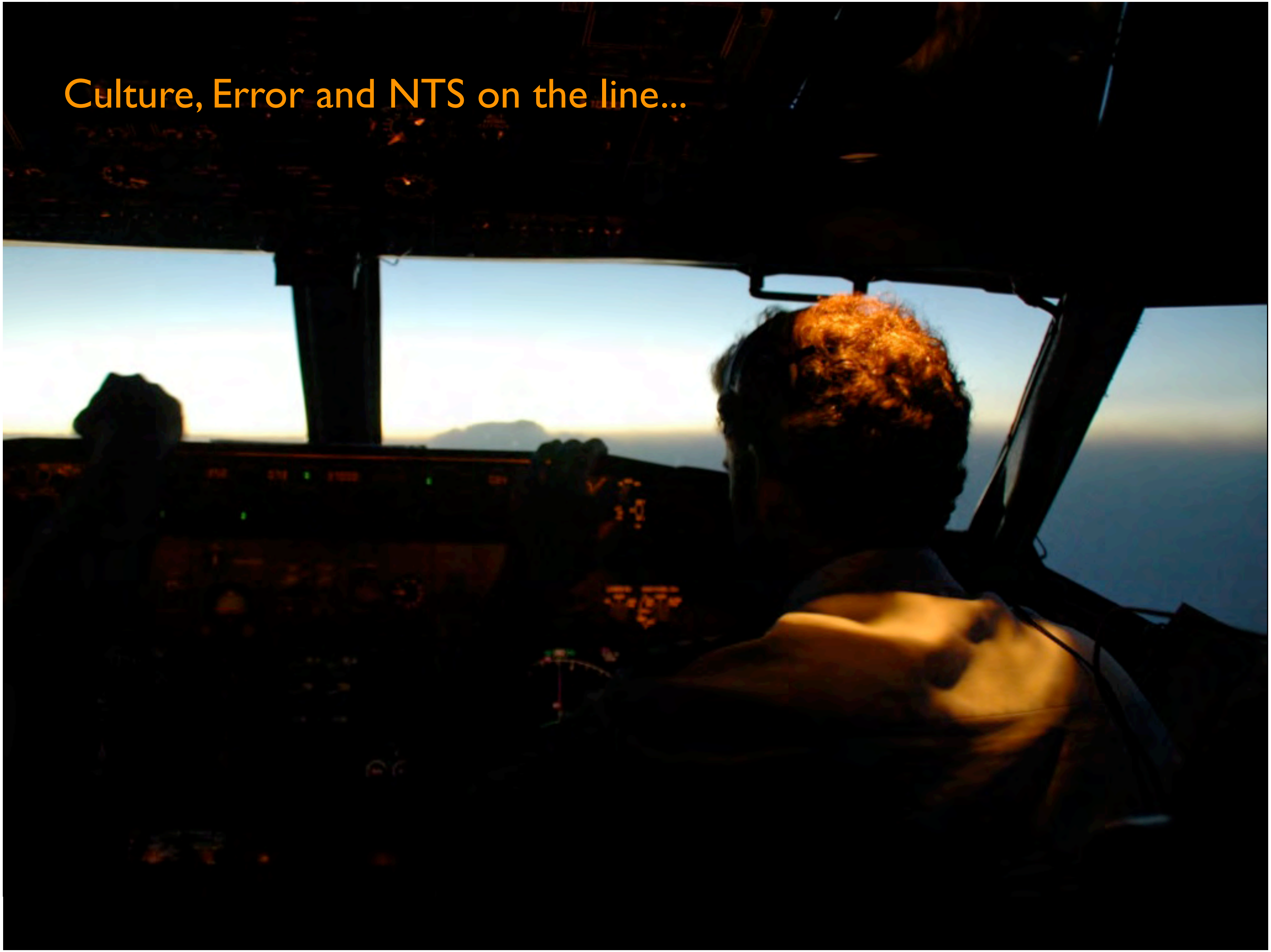
Kia Ora


UniSA
Adelaide

Research Context

Culture, Error and NTS on the line...



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Predictors of Threat and Error Management: Identification of Core Nontechnical Skills and Implications for Training Systems Design

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In normal flight operations, crews are faced with a variety of external threats and commit a range of errors that have the potential to impact negatively on the safety of airline operations. The effective management of these threats and errors therefore forms an essential element of enhancing performance and minimizing risk. Recent research has reinforced the need to examine a range of nontechnical or crew resource management skills that form threat and error countermeasures. This article provides an analysis of the predictors of threat and error management in normal flight operations within the context of a Southeast Asian airline. Through the structured observation of crews' performance during normal flight operations, data were collected in relation to a set of contextual factors and nontechnical skills. Crews' threat and error management actions were then analyzed in relation to these factors, and predictive models of threat and error management at various phases of flight were developed. The results of this study demonstrate the ways in which this type of data analysis can highlight the strengths and weaknesses of operational performance and suggest that this type of performance evaluation can offer individual organizations invaluable information for enhanced training system design through the further development of scenario-based training.

For any organization involved in high-risk operations, the adequate performance of personnel is a crucial aspect of maintaining safety. It is now clearly understood that any failures of safety stem not simply from isolated incidences of human error

TABLE TWELVE

Logistic Regression Analysis - Contributions of contextual factors and non-technical skills to crew's failure to respond to an error during the descent-approach-landing phase.

Predictor	β	S.E. β	Wald's χ^2	*df*	*p*	e^{β}
Captain as Error Origin	1.555	.608	6.531	1	.011	4.735
Assertiveness	-.849	.339	6.253	1	.012	.428
Constant	.856	.979	.764	1	.382	2.354

Model $\chi^2 = 21.994$, $df = 2$, $p < .001$, Nagelkerke $R^2 = .293$, 70.8% correct classification.

Culture, NTS, and Error Management

If captain made the error, crew ***4.7 times less likely*** to manage error

If crew scored high on assertiveness, ***2.3 times more likely*** manage error

Crew Familiarity: Operational Experience, Non-Technical Performance, and Error Management

MATTHEW J. W. THOMAS AND RENÉE M. PETRILLI

THOMAS MJW, PETRILLI RM. *Crew familiarity: operational experience, non-technical performance, and error management.* Aviat Space Environ Med 2006; 77:41–5.

Introduction: Crew familiarity, in terms of having recent operational experience together as a crew, is seen as an important safety-related variable. However, little evidence exists to unpack the underlying processes with respect to familiarity. This study investigated the relationships between crew familiarity, non-technical performance, and error management. ***Method:*** Data were collected during normal line operations at a commercial airline by observers using a methodology based on the Line Operations Safety Audit (LOSA). A total of 154 flights were analyzed, 31% of which were operated by an unfamiliar crew, with 69% operated by a familiar crew. ***Results:*** The rate of error occurrence was found to be higher for unfamiliar crews, and these crews were found to make different types of errors when compared with familiar crews. However, with respect to the management of error events, no significant difference was found between unfamiliar and familiar crews. No significant effect of crew familiarity was found with respect to crews' non-technical performance. However, strong correlations were found between crews' non-technical performance and the management of errors. ***Discussion:*** The findings indicate that crew familiarity, in terms of whether a crew has flown together recently or not, has little operational significance with respect to the management of error events during normal line operations. Accordingly, the suggestion that unfamiliar crews operate at a higher level of safety-related risk was not supported. Non-technical performance appears to be a stronger driver of effective error management than crew familiarity, and is highlighted as a focus for further investigation and intervention.

Keywords: crew resource management, human error, rostering.

THE FAMILIARITY of flight crew, in terms of having recent operational experience together as a crew, has been the focus of speculation with respect to either enhancing or impairing operational performance and safety. Limited empirical investigation of crew familiarity has taken place, and significant conflicting evidence exists with respect to the relationship between crew familiarity and safety. In a major simulator-based study of commercial airline short-haul crew, it was found that flight crew with recent operating experience together performed better on a number of dimensions relevant to flight safety than crews who had not flown together recently. In this study, crew familiarity was seen to improve crew communication, and specifically the willingness of crewmembers to exchange information. Similarly, crews with recent operating experience together made less operationally significant errors than crews who had not (3).

Typically, the beneficial elements of crew familiarity have been explained in terms of crewmembers developing an appreciation of each other's operating style. After operating several flights together, crewmembers increase their knowledge and awareness of individual preferences for interaction, and are able to tailor their own style to suit the needs of other crewmembers. Accordingly, "familiar" crews maximize the opportunity to convey operationally significant information through this process of tailoring communication to match the preferences of other crew. Analyses of accident data in commercial aviation have reinforced these research findings, with a recent controlled flight into terrain accident report highlighting that a lack of crew familiarity can contribute to crew failing to adequately monitor and communicate exceedences from critical flight parameters (11). Similarly, a meta-analysis of U.S. commercial aviation accidents between 1978 and 1990 in which crew actions were involved as a contributory factor found that in 73% of the 15 accidents for which data was available, the crew had not flown together before the day of the accident (10).

However, crew familiarity has also been implicated in the degradation of crew performance. For instance, even the two-person crew of the modern flight deck can be seen as susceptible to "groupthink," a term coined to describe the negative effects of team cohesion on effective decision making (7). According to the theory of groupthink, one of the implications of over-familiarity is the reduction in monitoring and criticism of others' actions. A number of recent commercial aviation accident and incident investigations have highlighted such negative processes in crews who had flown together frequently in a period leading up to an accident or incident. In one example, crew familiarity was determined to be a likely cause for an inadequate approach briefing, which then led to an attempted visual approach in poor weather and near controlled flight into terrain (1). Similarly, empirical research has found a lower error rate in unfamiliar military crews when com-

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TABLE II. RELATIONSHIP BETWEEN PROPORTION OF EFFECTIVELY MANAGED ERRORS AND NON-TECHNICAL MARKERS

Non-Technical Marker	Correlation Coefficient
Communication Environment	.278**
Leadership / Followership	.356**
Inquiry	.285**
Assertiveness	.293**
Cooperation	.145
Statement of Plans and Changes	.247**
Vigilance	.299**
Monitoring and Cross-Check	.243**
Briefing and Planning	.243**
Workload Management	.077
Workload Assignment	.276**
Automation Management	.045
Fatigue and Stress Management	.161
Contingency Planning	.180*
Problem Identification	.213*
Evaluation of Plans	.183

* = $p < 0.05$ ** = $p < 0.01$

Culture, NTS, and Error Management

Strong correlations between NTS markers and Error Management

Top five markers:

Leadership / Followership

Vigilance

Assertiveness

Inquiry

Communication Environment


Instructional Use of Error and NTS...

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Safety Research Grant – B2005/0121

ERROR MANAGEMENT TRAINING

Defining Best Practice

ATSB Aviation Safety Research Grant Scheme Project 2004/0050

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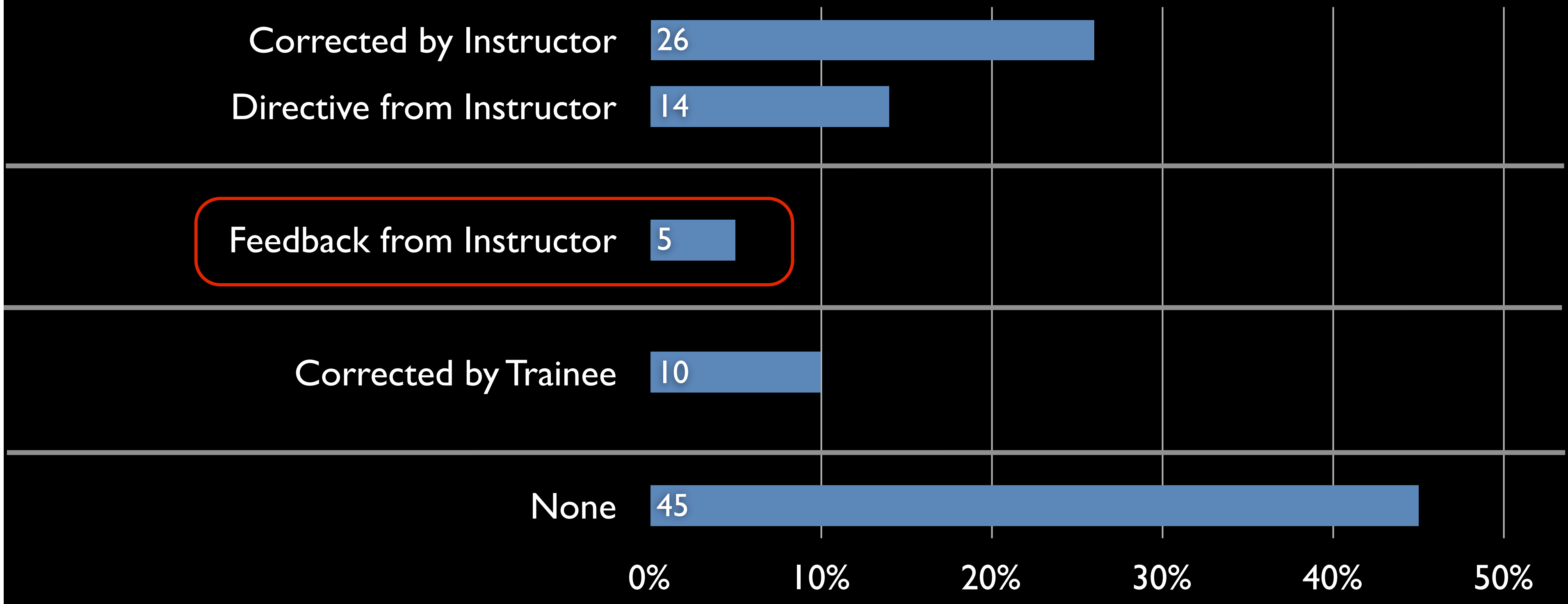
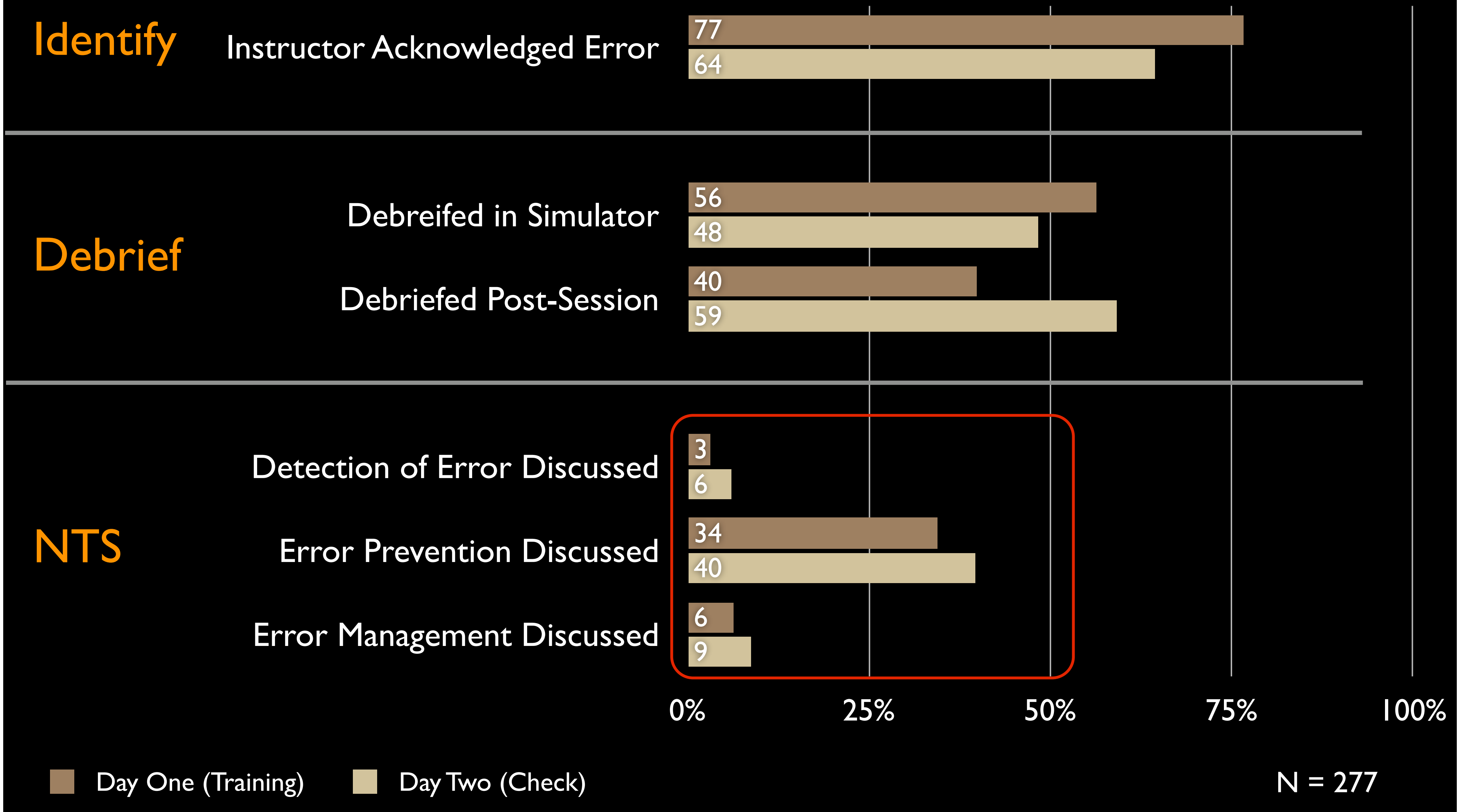
Use of Error in Line Training



TEM in the Simulator



Error Type	Training Focus
“Gotcha” - error due to situational demands	Early recognition and management strategies.
“Random” - slip or lapse due being human	Detection and response strategies.
“Deficit” - lack of knowledge or skill	More practice!
“Mistake” - decision-making or judgement	Dig deeper and understand why. Need to identify where decision process went wrong.

Summary

Some good data on the role of NTS in crew performance during normal operations

NTS are still not a real focus in recurrent training / checking programs

CRM in the classroom and NTS in the simulator / on the line are not yet aligned

TEM can be used as a focus for NTS in training

Regulatory Context

CASA - Civil Aviation Safety Authority (AUSTRALIA)

13 Jan 2009

NOTICE OF FINAL RULE MAKING

Implementation of Safety Management Systems (SMS) and introduction of Human Factors (HF) Training and Non-Technical Skills (NTS) Assessment

Amendments to Civil Aviation Orders (CAOs) 82.3 and 82.5 (Air Operators Certificates - RPT

CASA - Civil Aviation Safety Authority (AUSTRALIA)

RPT AOC holders must "have a program, approved by CASA, to train and assess personnel in human factors and non-technical skills with the aim of minimising human error."

Human Factors (HF) means the minimisation of human error and its consequences by optimising the relationships within systems between people, activities and equipment.

Non-Technical Skills (NTS) means specific human competencies, including critical decision making, team communication, situational awareness and workload management, which may minimise human error in aviation.

CASA - Civil Aviation Safety Authority (AUSTRALIA)

17 Sep 2009

Project OS 09/15 - Minor Amendment of CAO 82.3 & 82.5 to remove the legislative requirement for assessment and to provide more time for Industry to conduct Human Factors Training

Project approved.

FAA - Federal Aviation Administration (USA)

Federal Aviation Administration

Funded some great research.

Got burnt by AQP?

Has produced some good Advisory Circulars (AC120-51E CRM).

EASA - European Aviation Safety Agency (EUROPE)

EUROPEAN AVIATION SAFETY AGENCY
AGENCE EUROPÉENNE DE LA SÉCURITÉ AÉRIENNE
EUROPÄISCHE AGENTUR FÜR FLUGSICHERHEIT

EU-OPS and EU-FCL

Requirement for assessment of CRM performance

EU-OPS 1.965 Recurrent Training and Checking — Pilots

Line checks

(i) Line checks must establish the ability to perform satisfactorily a complete line operation including pre-flight and post-flight procedures and use of the equipment provided, as specified in the Operations Manual.
(ii) The flight crew must be assessed on their Crew Resource Management CRM skills in accordance with a methodology acceptable to the Authority and published in the Operations Manual. The purpose of such assessment is to:
(A) Provide feedback to the crew collectively and individually and serve to identify retraining; and
(B) Be used to improve the CRM training system.
(iii) CRM assessment alone shall not be used as a reason for a failure of the line check.
(iv) When pilots are assigned duties as pilot flying and pilot non-flying they must be checked in both functions.

Safety Regulation Group

Civil Aviation Authority

CAP 737

Crew Resource Management (CRM) Training

Guidance For Flight Crew, CRM Instructors (CRMIS) and CRM Instructor-Examiners (CRMIES)

www.caa.co.uk

NOTECHS

Categories	Elements	Example Behaviours
CO-OPERATION	Team building and maintaining	Establishes atmosphere for open communication and participation
	Considering others	Takes condition of other crew members into account
	Supporting others	Helps other crew members in demanding situation
	Conflict solving	Concentrates on what is right rather than who is right
LEADERSHIP AND MANAGERIAL SKILLS	Use of authority and assertiveness	Takes initiative to ensure involvement and task completion
	Maintaining standards	Intervenes if task completion deviates from standards
	Planning and co-ordinating	Clearly states intentions and goals
	Workload management	Allocates enough time to complete tasks
SITUATION AWARENESS	System awareness	Monitors and reports changes in system's states
	Environmental awareness	Collects information about the environment
	Anticipation	Identifies possible future problems
DECISION MAKING	Problem definition/ diagnosis	Reviews causal factors with other crew members
	Option generation	States alternative courses of action Asks other crew member for options
	Risk assessment/ Option choice	Considers and shares risks of alternative courses of action
	Outcome review	Checks outcome against plan

Summary

NTS Assessment is coming... (albeit very very slowly).

Australia is going backwards as quickly as it is going forwards.

European regulations are the most advanced, but what about implementation?

We should be setting the standards by worlds best practice rather than awaiting regulatory requirements.

Getting the most out of NTS
Assessment / Evaluation

The core requirements...

Supported by *standardized and customized* tools.

BEHAVIOURAL MARKERS

Supported by *good resources* for instructors and crew.

TRAINING &
INTER-RATER RELIABILITY

Starts with *good syllabus & scenario design* for the simulator.

INTEGRATION OF TRAINING

Provides focus for *brief and debrief* during training.

FOCUSSING ON SKILL DEVELOPMENT

Behavioural Markers and NTS Assessment

During the late 1990s the “Holy Grail” was a universal standardised set of Behavioural Markers for NTS.

NOTECHS

Behavioural Markers for NTS

Categories
CO-OPERATION
LEADERSHIP AND MANAGERIAL SKILLS
SITUATION AWARENESS
DECISION MAKING

NOTECHS

Rating Scale

Very Poor	Poor	Acceptable	Good	Very Good
Observed behaviour directly endangers flight safety	Observed behaviour in other conditions could endanger flight safety	Observed behaviour does not endanger flight safety but needs improvement	Observed behaviour enhances flight safety	Observed behaviour optimally enhances flight safety and could serve as an example for other pilots

		Very Poor	Poor	Acceptable	Good	Very Good	Comments
1	Co-operation						
2	Leadership and/or managerial skills						
3	Situation awareness						
4	Decision making						

Element Checklist

1. Co-operation
- Team-building and maintaining
- Consideration of others
- Support of others
- Conflict solving

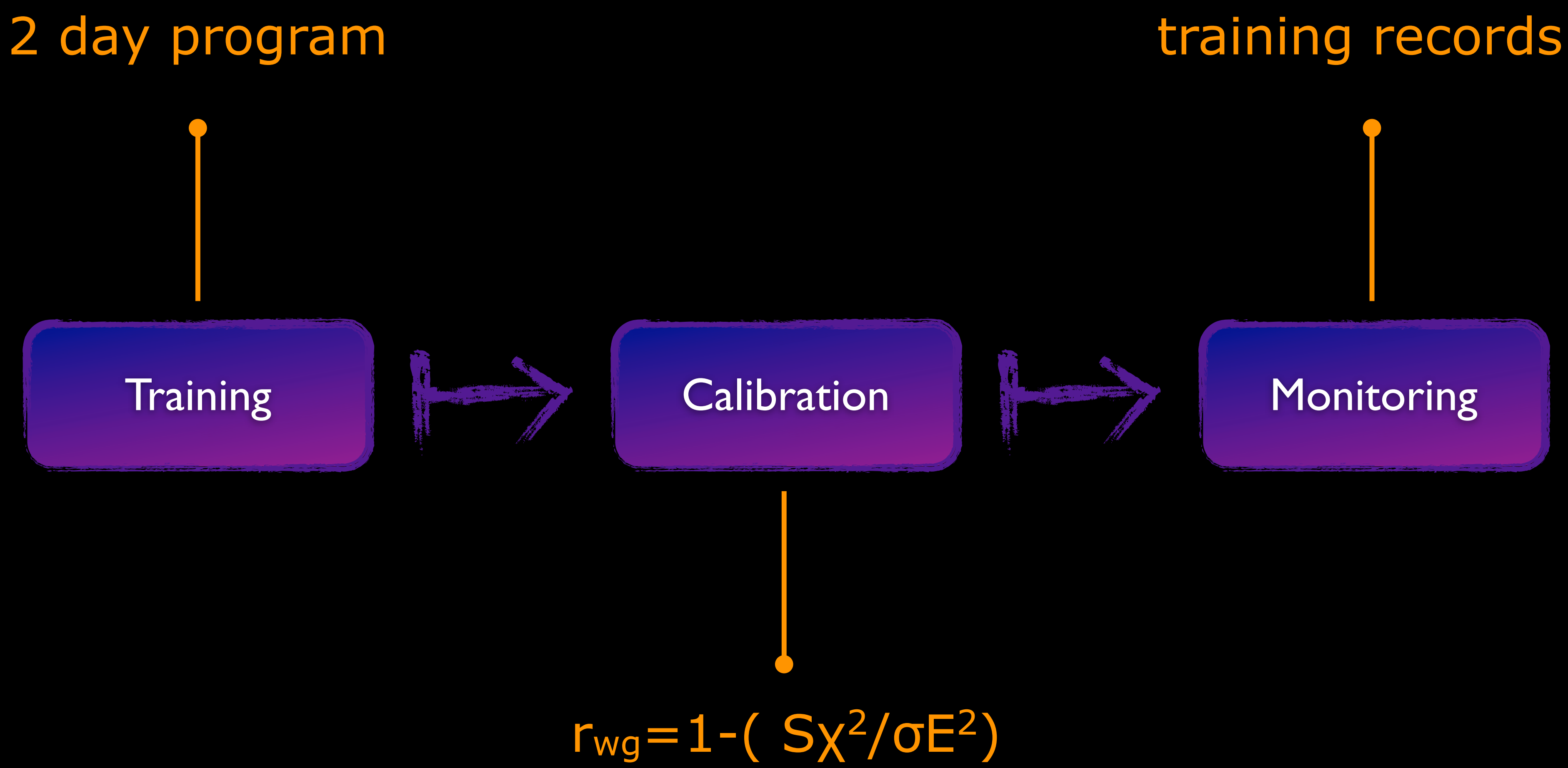
2. Leadership and managerial skills
- Use of authority and assertiveness
- Providing and maintaining standards
- Planning and co-ordination
- Workload management

3. Situation awareness
- Awareness of aircraft systems
- Awareness of external environment
- Awareness of time

4. Decision making
- Problem definition and diagnosis
- Option generation
- Risk assessment and option selection
- Outcome review

FAIL	PASS

Training and Inter-Rater Reliability


2 day program
training records
Training
Calibration
Monitoring
$r_{wg}=1-(S\chi^2/\sigma E^2)$


MASTER AND COMMANDER
THE FAR SIDE OF THE WORLD

Integration


335
140
300
8000
335

Crosswind Takeoff

The crosswind guidelines shown below were derived through flight test data, engineering analysis, and flight simulator evaluations.

Note: Engine surge can occur with a strong crosswind or tailwind component if takeoff thrust is set before brake release. Therefore, the rolling takeoff procedure is strongly advised when crosswinds exceed 20 knots or tailwinds exceed 10 knots.

Takeoff Crosswind Guidelines

Crosswind guidelines are not considered limitations. Crosswind guidelines are provided to assist operators in establishing their own crosswind policies.

Takeoff crosswind guidelines are based on the most adverse airplane loading (light weight and aft center of gravity) and assume an engine out RTO and proper pilot technique. On slippery runways, crosswind guidelines are a function of runway surface condition.

Runway Condition	Crosswind Component (knots) *
	without / with winglets
Dry	36 / 34
Wet	25
Standing Water/Slush	15
Snow - No Melting **	25
Ice - No Melting **	15

*Winds measured at 33 feet (10 m) tower height and apply for runways 148 feet (45m) or greater in width.

** Takeoff on untreated ice or snow should only be attempted when no melting is present.

Directional Control

Initial runway alignment and smooth symmetrical thrust application result in good crosswind control capability during takeoff. Light forward pressure on the control column during the initial phase of takeoff roll (below approximately 80 knots) increases nose wheel steering effectiveness. Any deviation from the centerline during thrust application should be countered with immediate smooth and positive control inputs. Smooth rudder control inputs combined with small control wheel inputs result in a normal takeoff with no overcontrolling. Large control wheel inputs can have an adverse effect on directional control near V1(MCG) due to the additional drag of the extended spoilers.

Note: With wet or slippery runway conditions, the PM should give special attention to ensuring the engines have symmetrically balanced thrust indications.

Rotation and Takeoff

Maintain wings level during the takeoff roll by applying control wheel displacement into the wind. During rotation continue to apply control wheel in the displaced position to keep the wings level during liftoff. The airplane is in a sideslip with crossed controls at this point. A slow, smooth recovery from this sideslip is accomplished after liftoff by slowly neutralizing the control wheel and rudder pedals.

Gusty Wind and Strong Crosswind Conditions

For takeoff in gusty or strong crosswind conditions, use of a higher thrust setting than the minimum required is recommended. When the prevailing wind is at or near 90° to the runway, the possibility of wind shifts resulting in gusty tailwind components during rotation or liftoff increases. During this condition, consider the use of thrust settings close to or at maximum takeoff thrust. The use of a higher takeoff thrust setting reduces the required runway length and minimizes the airplane exposure to gusty conditions during rotation, liftoff, and initial climb.

CROSSWIND TAKEOFF - PROFICIENCY CHECK (FIRST OFFICER)

SCENARIO DETAILS

Crew are re-positioned to holding point of RWY 30 in Hobart and cleared LT ALPHA THREE departure for YMML, instructed to remain on tower frequency and provided with updated weather. Simulator setup as per below. Crew requested to call when ready (given opportunity to set up and re-brief).

Scenario involves identification of threat (crosswind near company limitations) and focuses on crosswind handling technique.

Airport	Hobart (YMHB)	**WND**	260/30
RWY	30	**OPR INFO**	WET
Time	DAY	**WX**	BKN 2000
TWR	118.1	**TMP**	15
		QNH	1001

"GOTCHA" - COMMON ERRORS

Failure to identify threat (significant x-wind)
Failure to re-brief
Failure to calculate x-wind component & check limitations
Failure to ascertain F/O recency and competence with x-wind

Incorrect application of thrust
Incorrect x-wind technique – under-controlling
Incorrect x-wind technique – over-controlling
Poor monitoring and support from Captain

TECHNICAL PROFICIENCY ASSESSMENT

Pilot Flying (First Officer)		Pilot Monitoring (Captain)	
Appropriate thrust setting & rolling takeoff procedure		Symmetrical thrust maintained throughout roll	
Appropriate control wheel displacement into wind and forward pressure		Standard support calls made	
Appropriate directional control during takeoff roll – smooth ruder inputs			
Wings maintained level through rotation and liftoff			
Smooth slow recovery from slideslip once airborne			
Maintains centre-line tracking			

NON-TECHNICAL SKILLS ASSESSMENT

Pilot Flying (First Officer)		Pilot Monitoring (Captain)	
SA (External Environment) Identifies threat of x-wind		**SA (External Environment)** Identifies threat of x-wind	
D-M (Risk Assessment): Assesses risk of x-wind near WET RWY limits		**LEAD (Planning and Coordination)** Establishes F/O proficiency as PF	
SA (Aircraft Systems) Monitors aircraft during take-off roll and rotation		**SA (Aircraft Systems)** Monitors aircraft during take-off roll and rotation	
D-M (Problem Identification): Identifies and rectifies any problems		**CO (Support)** Provides support to First Officer	

Predictions for the Future

Changes in Structure

- Targeted → CFIT / ALARP
- Integrated → Skills. Full stop.
- Aligned → CRM = NTS = TEM
- Beyond Classroom → Still important
- More Simulator and Line → Skill Development

Changes in Content

Fitness for Duty	→	Fatigue / Health /...
Emotions "HEA"	→	Frustration / Stress Confusion
Performance Protection	→	Adapting to Situations
Systems Thinking	→	Safety Emerges from System

Some Good Resources

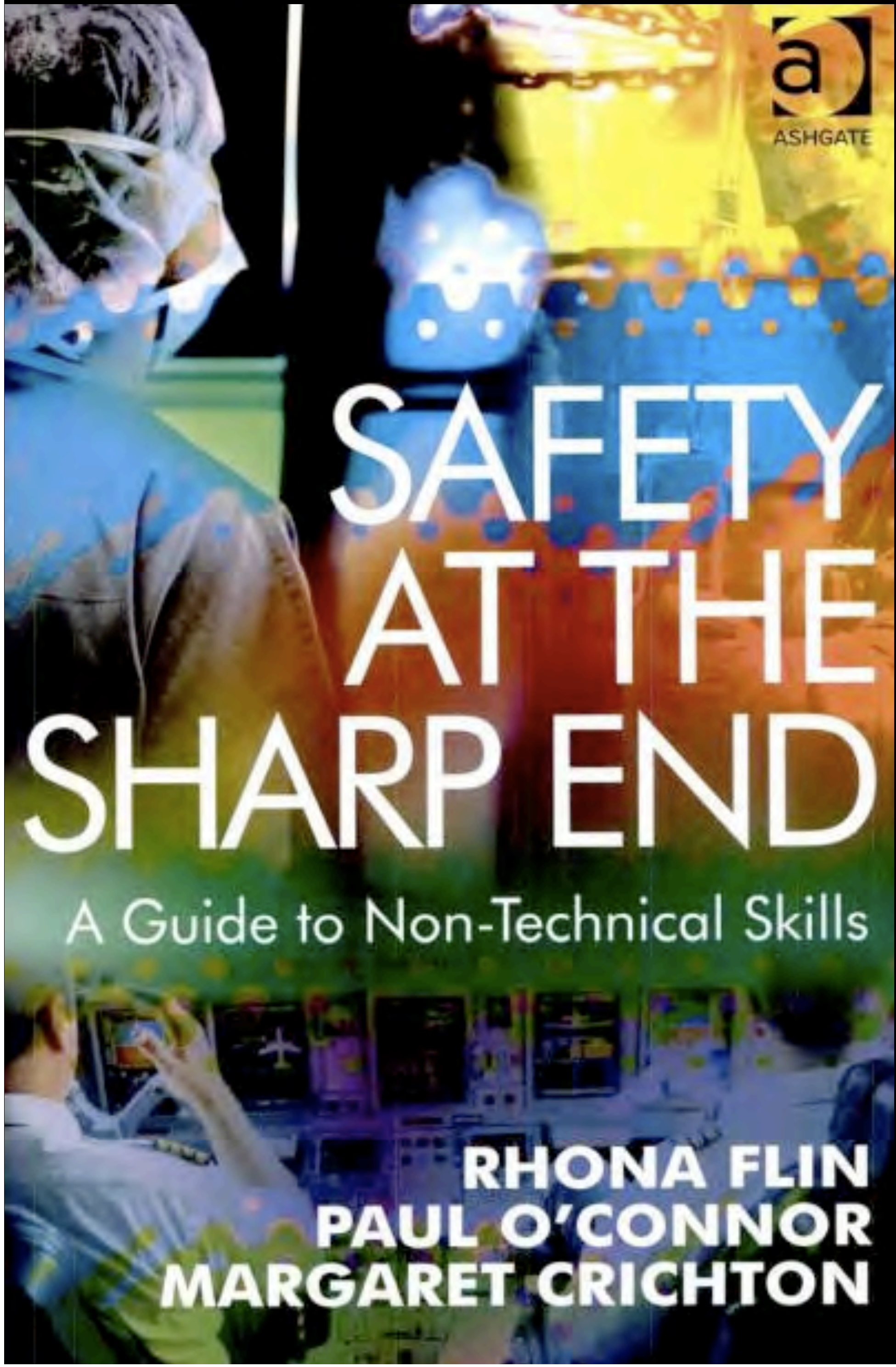
GOTTLIEB DAIMLER-
UND
KARL BENZ-STIFTUNG

GIHRE

Group Interaction in High Risk Environments

Enhancing Performance in High Risk Environments

Recommendations for the use of Behavioural Markers


ASHGATE
SAFETY AT THE SHARP END
A Guide to Non-Technical Skills
RHONA FLIN
PAUL O'CONNOR
MARGARET CRICHTON

http://www.aavpasymposium.org

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