Ability Requirements for Next Generation Aviation Professionals

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Aviation and Space Psychology

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Overview

- Background DLR
- Single European Sky
- Research on ability requirements
- SJU project overview
- Proactive tools in WP 16.04.03
- Results & Conclusions

DLR German Aerospace Center

DLR Site Hamburg
Gross Borstel

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Institute of Aerospace Medicine, Department of Aviation and Space Psychology

Employees: 70
Building area: 3500 m²

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DLR selection process for DFS ATCOs

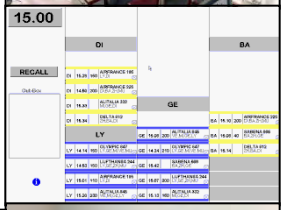
-Phase I

-Formal Application Requirements

-Basic Ability Testing

-English - Memory - Attention - Processing Speed
Personality Questionnaire

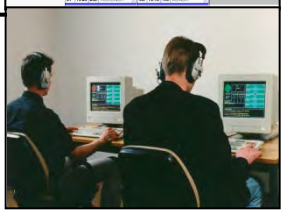
-Work-Sample Tests



-Phase II

-AC: Team Exercises

-Partner and Group Exercise



-Oral English Examination

-Semi-Structured Interview

-Medical Examination (Eurocontrol Class 3)

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HOT by DLR
HOSTED TESTING

Application Area | DLR

HOT: The Test for Fliers und High-Fliers

In aviation, selecting suitable candidates is an important measure for guaranteeing quality. The world wide increasing air traffic, as well as automation of regulatory and monitoring systems and changing forms of information transfer are inevitably leading to fundamental changes in what is required of pilots and air traffic controllers.

HOT sets standards worldwide

The DLR Department for Aviation and Space Psychology has set itself the target of contributing directly to the safety, efficiency and cost-effectiveness of man-machine systems in aviation through the selection and training of operational personnel. Through its decades of scientifically based development work in the psychological aptitude selection of operational professions, it currently occupies a top national and international position. Airlines all over the world thus have an effective and unique instrument in their search for suitable applicants: HOT!

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Testcenter Istanbul THY

Cooperation since 2009

Installation in 2011

2012: > 600 pilot applicants

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European Aeronautics: A Vision for 2020

Challenges *and associated goals*

- **Quality and Affordability**
  - *Reduced passenger charges*
  - *Increased passenger choice*
  - *Transformed freight operations*
  - *Reduced time to market by 50%*
- **The environment**
  - *Reduction of CO2 by 50%*
  - *Reduction of NOx by 80%*
  - *Reduce perceived external noise by 50%*
  - *Substantial progress towards 'Green MMD'*
- **Safety**
  - *Reduction of accidents rate by 80%*
  - *Drastic reduction in human error and its consequences*
- **The Efficiency of the Air Transport System**
  - *3X capacity increase*
  - *99% of flights within 15' of schedule*
  - *Less than 15' in airport before short flights*
- **Security**
  - *Airborne - zero hazard from hostile action*
  - *Airport - zero access by unauthorised persons or products*
  - *Air navigation - No misuse. Safe control of hijacked aircraft*

(January 2001)

SESAR Definition Phase - The Market Deliverable 1 at a glance

What is SESAR?

The SESAR programme is the European Air Traffic Management (ATM) modernisation programme. It will combine technological, economic and regulatory aspects and will use the Single European Sky (SES) legislation to synchronise the plans and actions of the different stakeholders and federate resources for the development and implementation of the required improvements throughout Europe, in both airborne and ground systems.

The products of the SESAR Definition Phase will be the result of a 2 year study awarded to an industry wide consortium supplemented by EUROCONTROL's expertise. It will ultimately deliver a European ATM Master Plan covering the period up to 2020 and the accompanying Programme of Work for the first 6 years of the subsequent Development Phase.

The SESAR Definition Phase will produce 6 main Deliverables over the 2 years covering all aspects of the future European ATM System, including its supporting institutional framework.

The SESAR Consortium has been selected to carry out the Definition Phase study which, for the first time in European ATM history, has brought together the major stakeholders in European aviation to build the Master Plan; this is considered to be a major achievement.

Who is the SESAR Consortium?

AEA (Association of European Airlines), Aéroports de Paris (ADP), AENA (Aeropuertos Espanoles y Navegacion Aérea), AIRBUS, Air France, Air Traffic Alliance E.I.G / G.I.E, Amsterdam Airport SCHIPHOL, Austro Control GmbH, BAA (UK airport group), BAE Systems, Deutsche Flugsicherung GmbH (DFS), Deutsche Lufthansa AG, DSNA (Direction des Services de Navigation Aérienne), EADS, ENAV, ERA (European Regions Airline Association), FRAPORT, IAOPA (International Council of Aircraft Owner and Pilot Associations), IATA (International Air Transport Association), Iberia, INDRA, KLM, LFV (Luftfartsverket), LVNL (Air Traffic Control The Netherlands), Munich International Airport, NATS (National Air Traffic Services), NAV Portugal, SELEX Sistemi Integrati, THALES ATM, THALES AVIONICS.

The SESAR Associated Partners are:

ATC EUC, Boeing, CAA UK, ECA, ETF, EURAMID, IFATCA, IFATSEA, Honeywell, Rockwell-Collins, Dassault (representing EBAA).

Research Centres: AENA, DFS, DLR, DSNA, INECO, ISDEFE, NLR, SICTA, SOFREAVIA.

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Context and objective

The SESAR Concept Of Operations (CONOPS) Step 1 document provides the top level guidance and serves as the main common reference for all operationally related SESAR tasks.

The objective is to describe the ATM operation envisaged so that civil and military Airspace Users, Service Providers, Airports, Aviation and ATM industries and SESAR Programme tasks gain common understanding of the operational characteristics of ATM in the first step of SESAR development and the main changes they imply in operating practices along with the support they require.

At the same time, the Concept recognizes the continued important role of humans in the future system. Procedures will change significantly and future situational awareness needs will differ from today.

- When controllers and pilots' tasks will change significantly, what about the ability requirements in selection?

DLR projects Aviator 2030, Aviator II

1 Future ATM Concept
2 Development of Simulation
3 Study and Experiments

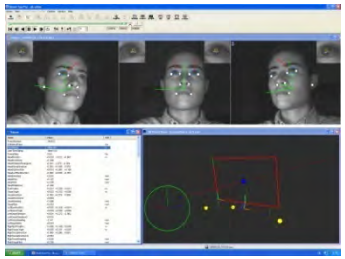
Period: 2007 - 2013
Volume (full cost): 3.5 Mio €
Industrial partners: DFS, DLH

Objectives DLR project Aviator

workshops with domain experts'

future concept of ATM

simulation and experiments



future ability requirements

deriving criteria of requirements

future ability tests

Aviator 2030

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Fleishman Job Analysis Survey (F-JAS)

Experienced job holders are requested:

„to rate the task on the level of the ability required“
(Fleishman 1992)

Using a set of about 70 well developed and clearly defined scales, each scale providing anchors for different scale values

Covering different ability domains:
cognitive abilities, psychomotor abilities, physical abilities, sensory abilities, interactive/social scales

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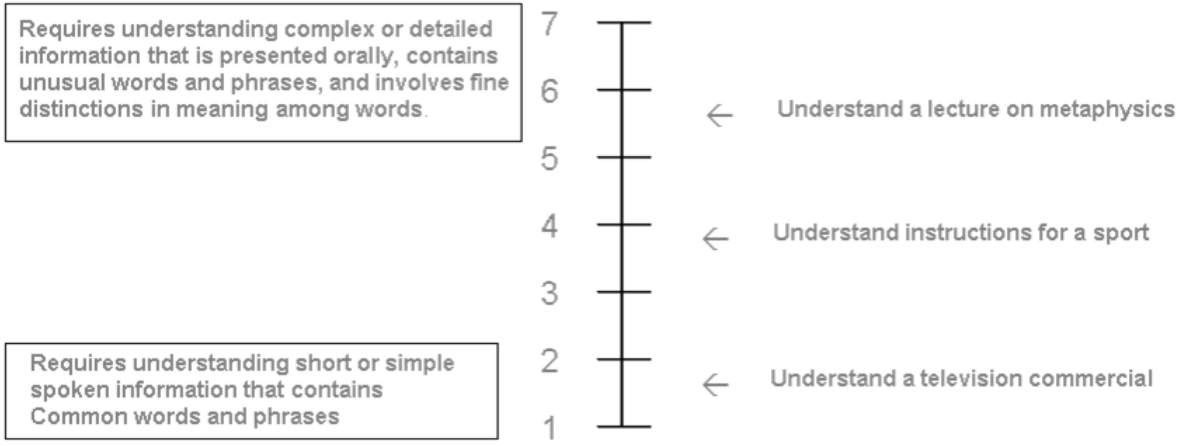
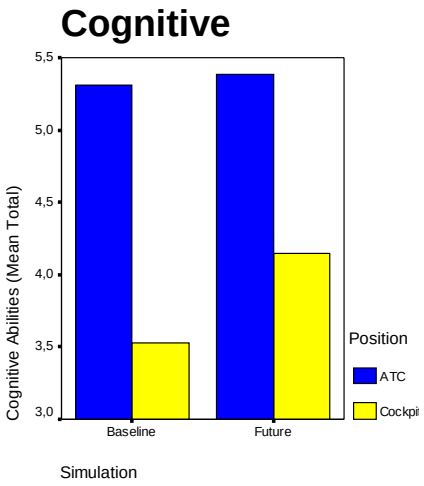
F-JAS: Scale (example)

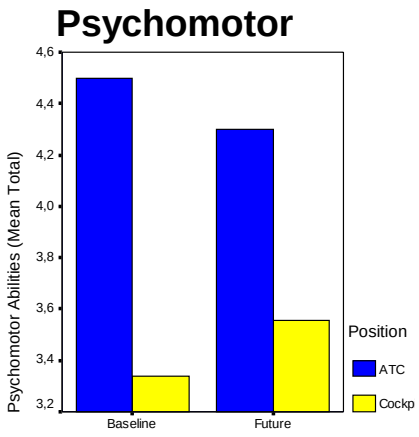
Oral Comprehension This is the ability to listen and understand spoken words and sentences

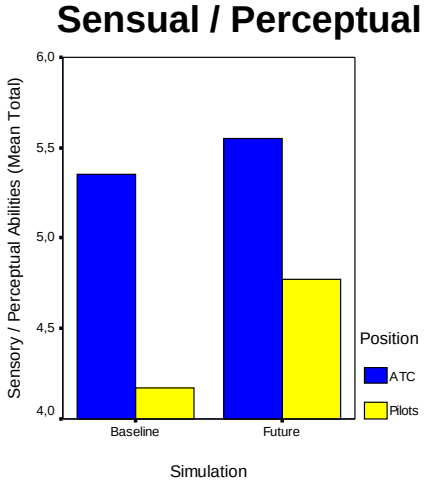
How Oral Comprehension is Different from Other Abilities		
Oral Comprehension: Involves **listening** to and **understanding** words and sentences spoken by others	vs.	***Written Comprehension:*** Involves **reading** and **understanding written** words and sentences.
		Oral Expression and Written Expression: Involves **speaking** or **writing** words and sentences so others will understand.

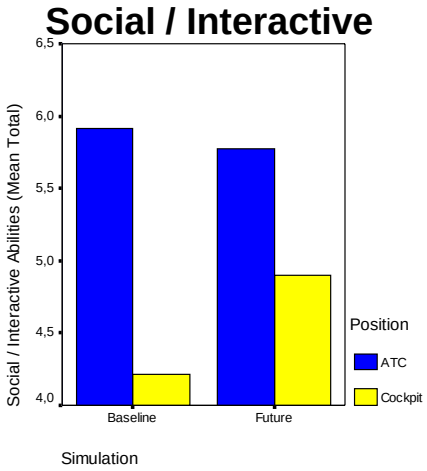


F-JAS AviaSim:
Mean scores by ability domains









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Aviator summary I - AviaSim

AviaSim participants on the pilot side indicated significant increase in some cognitive abilities with free flight future scenarios. This can be explained by the new task of airborne separation. However according to our results controllers did not profit from this transfer of tasks.

The trend of pilot and air traffic controller ability requirement profiles assimilating in future ATM conditions is supported by simulation data (r_b .65, r_f .72).

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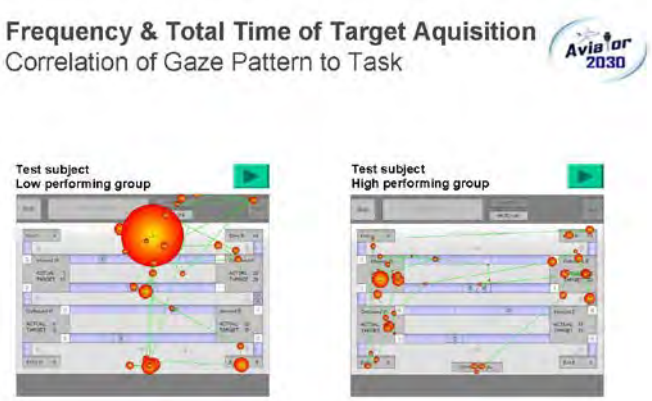
Aviator summary II - Ability requirements

The most important change in ability requirements for pilots is seen to be visualization, as in the future, the task of conducting airborne separation in free flight airspace requires ‘having a picture’ of relevant elements of air traffic similar to that of air traffic controllers. This new requirement is not reflected in today’s selection profiles of pilots.

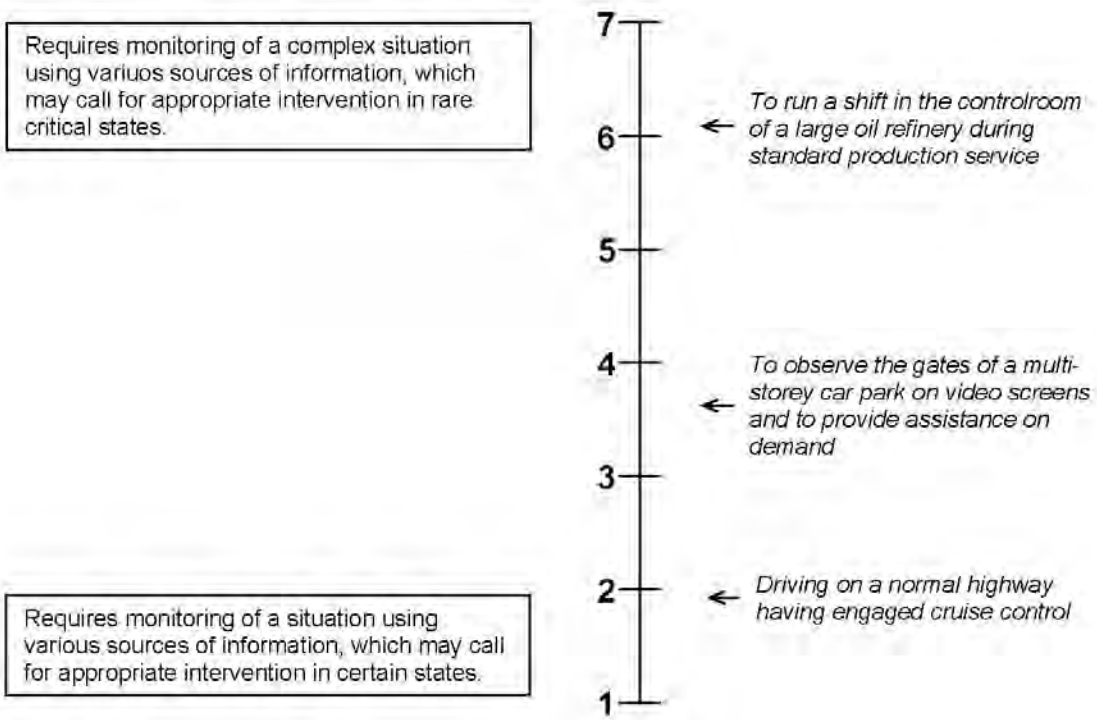
Findings from the workshop debriefings as well as from other research within Aviator 2030 suggest a new requirement to be crucial for humans operating in man-machine settings: ‘operational monitoring’.



Operational Monitoring

This is the ability to follow up meaningful information from various sources (e.g. an automated system) responsibly without direct need for action. It involves being prepared to fully take over the handling of a system at any time, for example in the case of malfunction.

How Operational Monitoring Is Different From Other Abilities		
Operational Monitoring: Refers to continously paying attention to discover a critical state as early as possible.	vs.	*Resistance to Premature Judgment*: Is to withhold judgment until facts have been gathered and evaluated.
Operational Monitoring: Involves paying attention to various sources of information in systems of some complexity.	vs.	*Vigilance*: Involves continuous monitoring and a sustained state of alertness while observing a monotone situation.



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Proactive Analysis Tools for Selection, Training, Competence and Staffing – Specification

Document information	
Project Title	Impact of Future Systems and Procedures on Selection, Training, Competence and Staffing (including Advanced Automation)
Project Number	16.04.03+
Project Manager	DFS
Deliverable Name	Proactive Analysis Tools for STCS – Specification
Deliverable ID	M011
Edition	00.00.05
Template Version	03.00.00
Task contributors	
Airbus, DFS, EUROCONTROL,Thales	

- SELAT

- TACAT

- STAFFAT

1 What the Proactive Analysis Tools will do

This section will describe the output for each of the tools and relates it to the requirements of the HP Assessment V3.

1.1 SELAT

SELAT is the Selection requirements – Proactive Analysis Tool.

During the human performance assessment, a primary project has the task to consider its impact on recruitment and selection. Argument 4.3 in the WP16.04.01 document on **HP Assessment process for projects in V3** describes the following activities:

> *Analyse whether the changes in competence and ability requirements require modified operator's profiles used in recruitment & selection or modified selection criteria.*

With the SELAT this argument can be served for all groups of operators. Most likely these will be air traffic controllers and pilots, as other affected groups (e.g. ATSEPs) rarely undergo a specific selection system. However if the degree of standardisation and professionalisation continues to develop, selection might become an issue here as well and may be supported by the SELAT.

When applying the SELAT, a measurement will be provided concerning the ability requirements before and after the exposition to future procedures or tools. This is done either in a pre/post design requiring repeated measurement (preferred) or in an evaluation against given anchors of the job under scrutiny. The comparison of results will build a base to describe relevant changes in job profiles or selection requirements. Methodological advice will avoid over-interpreting differences but concentrate on requirements being significantly different.

1.2 TACAT

The TACAT is the Training and Competence – Proactive Analysis Tool and is divided into three separate sub-tools catering for three actor groups, namely; ATCs, pilots and ATSEPs.

Argument 4.2.1 of the WP16.04.01 document on **HP Assessment process for projects in V3** describes the following activities:

- *Determine knowledge, skill and experience requirements, and*
- *Compare updated knowledge, skill and experience requirements with existing requirements and identify differences and gaps.*

Furthermore, Argument 4.4, concerning the training needs of the affected human actors, describes the following activities:

- *Determine training content for each actor group, and*
- *Determine the duration of training for each actor group, and*
- *Determine the methods and modes for each actor group*

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SELAT checklist

SJU Project N°16.04.03

Thank you for taking part in the SELAT baseline study. This checklist will guide you through this process and assure your data can be integrated to the European sample.

1. Pick up the study material from your focal point: The questionnaire booklet with some 30 pages, the answer sheet (4 pages) and this checklist.

2. Look for a room where you can work through the material without disturbances for about 60 to 90 minutes and start reading the instruction in the booklet carefully.

3. After having finished the instruction please start with the **first** sequence, where you rate **your actual job experience**. Please only mark whole numbers on the answer sheet as in the example shown below. Do not write anything into the booklet.

   Marking

   ① ② ③ ④ ⑤ ⑥ ⑦

4. From time to time you should check that the scale number you are filling in on the answer sheet still correctly corresponds with the ability scale in the booklet.

5. At the end of the first sequence please check that you did not overlook any scale.

6. Please then start the **second** sequence to indicate for which abilities you consider **changes in ability requirements having occurred**. You will find that this sequence consumes considerably less time as you now already know the scales.

7. If you for any reason have separated the answer sheets, please make sure they are marked with the same individual code (for instance $K&/) to be correctly processed together.

8. Finally please hand back the booklet and the answer sheet to your focal point who will collect all material and send it back for data processing.

☺ Thank you very much for your participation ☺

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SELAT baseline study

Sample characteristics

		Frequency	Percent
	AIR FRANCE	15	4,6
	DFS	23	7,0
	DLH	36	11,0
	EANS	24	7,3
	ENAV	59	18,0
	EUROCONTROL	29	8,9
	LFV	82	25,1
	SAS	13	4,0
	THY	46	14,1
	Total	327	100,0
	(+ ATSEP	28)	
	66% ATC		
	19 % Female		
	Mean age ~ 40		

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1. Step: Actual job experience

Age: _____ Years Gender: _____ Company: _____

First operational licence: _____ Year Current rating / endorsement:_____

Experience with the current a/c type / ATM system: ____ months Unit location: _____

Special job functions: _____

Where on a scale reaching from 'traditional' to 'advanced' would you estimate your current a/c or system to be? (please position your mark accordingly)

traditional _____advanced

In the **first** sequence, please rate your actual job experience with 1 indicating that your job requires that ability only to a very low to minimum level and 7 meaning the highest level that any job could require.

Mark only whole numbers. Do not use fractions.

Cognitive Abilities

1. Oral Comprehension ↓
① ② ③ ④ ⑤ ⑥ ⑦

2. Written Comprehension
① ② ③ ④ ⑤ ⑥ ⑦

13. Information Ordering
① ② ③ ④ ⑤ ⑥ ⑦

14. Category Flexibility
① ② ③ ④ ⑤ ⑥ ⑦

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Actual job experience:

Top 10 SELAT Scales

N = 327 participants

	Mean	Std.Dev.
63. Self Control	6,37	,795
21. Time Sharing	6,24	,872
70. Perseverance	6,03	1,043
56. Dependability	5,95	,959
22. Operational Monitoring	5,91	,999
20. Selective Attention	5,80	,984
51. Speech Recognition	5,69	1,059
23. Vigilance	5,65	1,177
8. Problem Sensivity	5,58	1,073
49. Auditory Attention	5,55	,928

Actual job experience

Self Control	This is the ability to remain calm and levelheaded in difficult or stressful situations. This ability involves maintaining composure by keeping emotions in check in the presence of irritating, unexpected, or stressful stimuli.
Time Sharing	This is the ability to shift back and forth between two or more sources of information. The information can be in the form of speech, signals, sounds, touch, or other sources.
Perseverance	This is the ability to maintain an optimal level of effort until work tasks are successfully completed. This ability involves having the mental energy to persist for a long period of time despite obstacles such as fatigue, boredom, or distractions.

	Mean
Perseverance	6,03
Dependability	5,95
Operational Monitoring	5,91
Selective Attention	5,80
Speech Recognition	5,69
Vigilance	5,65
Problem Sensivity	5,58
Auditory Attention	5,55

Top 10 SELAT Scales
N= 217 ATC

	Mean
1. Time Sharing	6,37
2. Self Control	6,34
3. Perseverance	6,13
4. Dependability	5,94
5. Operational Monitoring	5,88
6. Selective Attention	5,88
7. Speech Recognition	5,80
8. Vigilance	5,65
9. Visualization	5,64
10. Speed of Closure	5,58

Top 10 SELAT Scales
N= 110 Pilots

	Mean
1. Self Control	6,43
2. Time Sharing	5,99
3. Rate Control	5,97
4. Dependability	5,95
5. Operational Monitoring	5,95
6. Resistance to Premature Judgement	5,86
7. Perseverance	5,85
8. Spatial Orientation	5,82
9. Response Orientation	5,82
10. Vigilance	5,67

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2. Step: Changes since initial training

In the **second** sequence, please indicate for which abilities you consider changes in ability requirements when comparing todays a/c or system with the one you have been trained for initially. This will help us understanding past changes in ability requirements.

Marking '++' indicates that to your impression this ability has become significantly more required with the actual a/c or system compared to the former one. If you consider an ability requirement equal for actual and former a/c or system, please mark 'o'. If you do not mark an ability, this will also be treated as 'o' or equal for actual and former condition.

Cognitive Abilities

1. **Oral Comprehension** ↓
   -- - o + ++
2. **Written Comprehension**
   -- - o + ++
3. **Oral Expression**
   -- - o + ++
4. **Written Expression**
   -- - o + ++
5. **Fluency of Ideas**
   -- - o + ++
6. **Originality**
   -- - o + ++
13. **Information Ordering**
    -- - o + ++
14. **Category Flexibility**
    -- - o + ++
15. **Speed of Closure**
    -- - o + ++
16. **Flexibility of Closure**
    -- - o + ++
17. **Spatial Orientation**
    -- - o + ++
18. **Visualisation**
    -- - o + ++

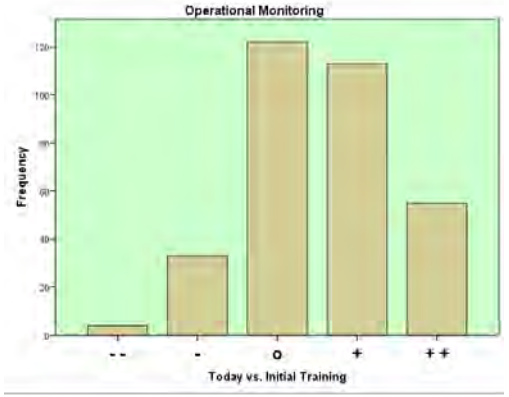
Changes since initial training

N = 327 participants

Operational	Monitoring	This is the ability to follow up meaningful information from various sources (e.g. an automated system) responsibly without direct need for action. It involves being prepared to fully take over the handling of a system at any time, for example in the case of malfunction.

1. Operational Monitoring	3,56
2. Openness to Experience	3,50
3. Time Sharing	3,45
4. Visual Color Discrimination	3,43
5. Information Ordering	3,43
6. Behavior Flexibility	3,43
7. Coordination	3,42
8. Selective Attention	3,40
9. Self Control	3,40
10. Coaching	3,40

Operational Monitoring		Frequency	Percent
	- -	4	1,2
	-	33	10,1
	o	122	37,3
	+	113	34,6
	+ +	55	16,8
	Total	327	100,0



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Operational Monitoring	This is the ability to follow up meaningful information from various sources (e.g. an automated system) responsibly without direct need for action. It involves being prepared to fully take over the handling of a system at any time, for example in the case of malfunction.
Openness to Experience	This is the ability to be open-minded and curious about new ideas and environments. This ability involves being tolerant of diversity and the beliefs of others.
Time Sharing	This is the ability to shift back and forth between two or more sources of information. The information can be in the form of speech, signals, sounds, touch, or other sources.

	Mean
3. Time Sharing	3,45
4. Visual Color Discrimination	3,43
5. Information Ordering	3,43
6. Behavior Flexibility	3,43
7. Coordination	3,42
8. Selective Attention	3,40
9. Self Control	3,40
10. Coaching	3,40

N = 217 ATC

1. Operational Monitoring
2. Openness to Experience
3. Visual Color Discrimination
4. Behavior Flexibility
5. Time Sharing
6. Coaching
7. Selective Attention
8. Coordination
9. Vigilance
10. Information Ordering

N = 110 Pilots

1. Information Ordering
2. Operational Monitoring
3. Time Sharing
4. Resistance to Premature Judgement
5. Self Control
6. Coordination
7. Perseverance
8. Problem Sensivity
9. Selective Attention
10.Vigilance

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DLR-PROFA-Symposium

Psychological requirements of future aviators

12.-13. November 2013

Hamburg, Radisson BLU Airport

Aviator II

HYBRID

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