

Construal Level Theory (CLT) for designing operational explainability for Human-AI Teaming interfaces in aviation contexts

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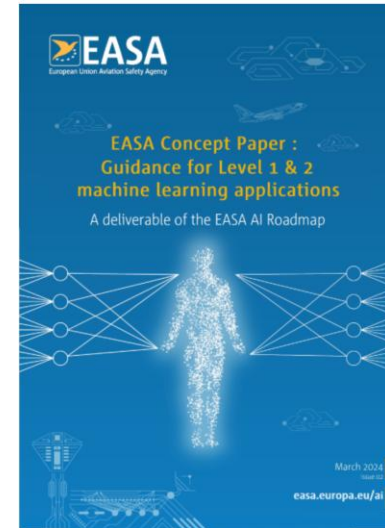
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Introduction: what is Operational Explainability?

OpXAI: *"capability to provide the human with understandable, reliable and relevant information with the **appropriate level of detail and with appropriate timing** of how an AI/ML application produces its results"* [European Union Aviation Safety Agency]

**Crucial element in safety-critical contexts
(i.e.: aviation, defence, healthcare)**



Types of XAI: Technical XAI vs OpXAI

Technical XAI <>

Goal: to make system interpretable from the algorithmic perspective

Model-Centered

Technical & architectural aspects

Enables ->

Operational XAI

Goal: to present explanations to operators (via HMI)

User-Centered

Human Factors & Human-AI Teaming

OpXAI of an ATM Use Case

We present the design of OpXAI applied to an Air Traffic Management application,

ISA (Intelligent Sequence Assistant)



Construal Level Theory (CLT):
borrowed from psychology,
applied in interface design for
OpXAI

Construal Level Theory [Trope and Liberman, 2003]

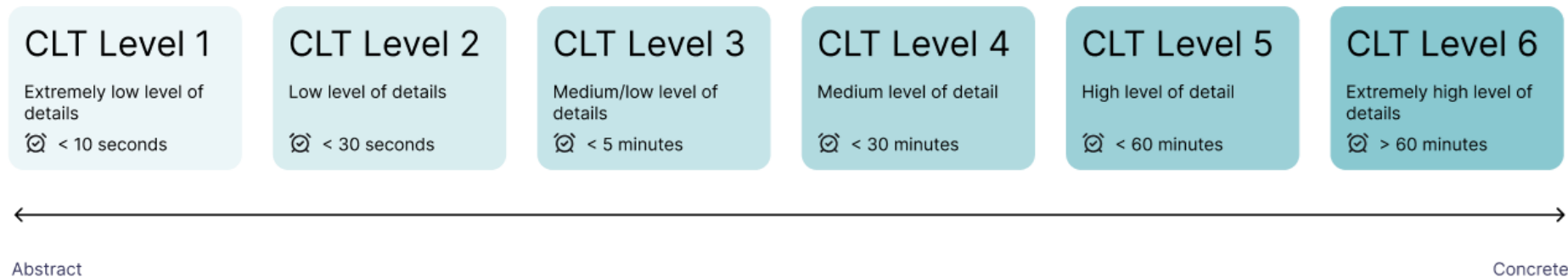
How humans mentally represent objects based on psychological distance (temporal, spatial, social, hypothetical).

If the object is "far", we think of it more abstractly (focus on more high-level features)

If the object is "near", we think of it more concretely (focus on immediate and most important details)

Application to interface Design (McDermott & Folds, 2022)

Based on psychological distance, information in UIs can be organised in abstraction levels accessible through “Progressive Disclosure”



Application on HAIKU Use Case 4: Intelligent Sequence Assistant (ISA)

LEAL

ATIS B

QNH: 1012

TL: 075

28
28

MULTIRAD

WR MULTI

NORMAL-SEG

NORMAL-PV

INT AR

MOD0_CDM

DCL

COLAT

RAD

SECT

Rwy10

Overview

Timeline

Table

F/M

VFVE

☒ Info ☒ HSS ☐ MANUAL

OBS

CCARR

W

☒ ISA is ON

Current sequence calculated <1 min ago

Show ISA Controls

AIRBORNE

-

DEP

EZY789

☒

A320

M

0956

10

45

MITOS3A

I

2

↑

BAW412

☒

A320

M

0952

10

45

I

RWY 10

1

LDG

RYR457

☒

A320

M

0951

10

45

I

3

↓

L/U

KLM321

☒

A320

M

0945

10

45

MITOS3A

I

TWY 10

-

TAX

ITY311

☒

A320

M

1000

10

45

MITOS3A

I

09:50:18

△ BENICOLET

△ MITOS

△ BESOR

△ MUCHAMIEL

△ SUMMO

△ OSVAN

△ UESADA

BAW412 MITOS63A ---
A320M 10 C A5
18 030 GIR

KLM321 MITOS63A TAX
A320M 10 C A5
18 000 GIR

RYR457 MITOS63A LDG
A320M 10 C A5
18 000 GIR

EZY789 MITOS63A DEP
A320M 10 C A5
18 000f180 GIR

Interaction Scenario

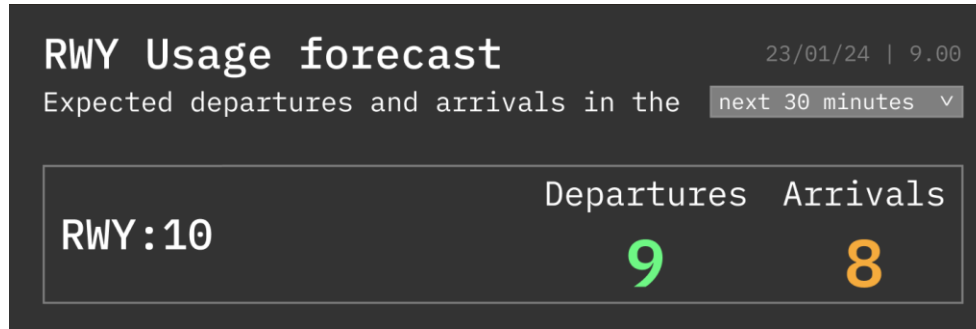
An Air Traffic Controller sits down for the shift. The task is to sequence incoming/outgoing aircraft (= decide the order of arrival and departure).

The following slides show the interaction with the HMI of ISA and the CLT levels during (and after) operations

CLT Level 1 for ISA

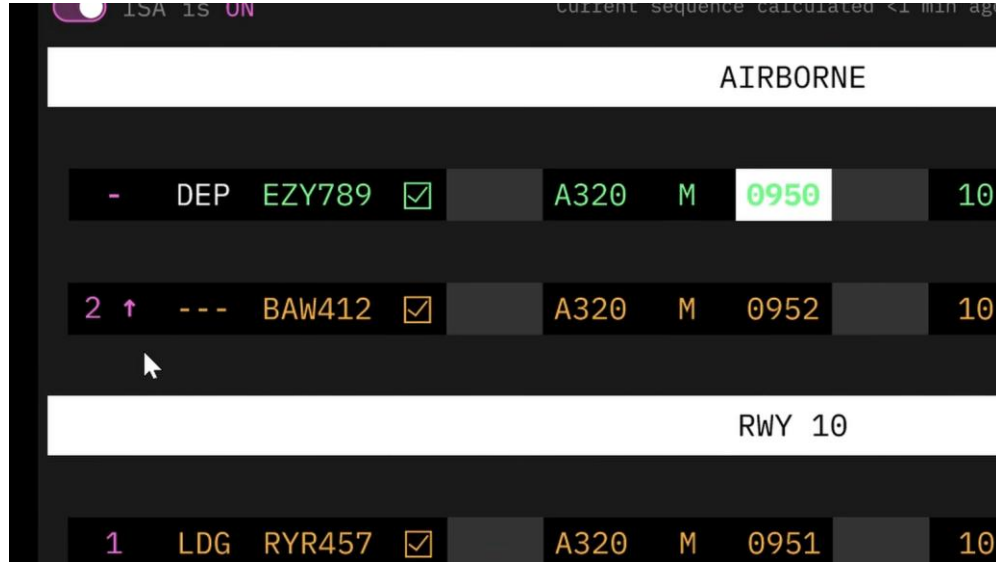
ATCO wants an overview of the expected traffic to build a mental picture of the ongoing situation

Level of detail: low, Assimilation time: less than 5 seconds



CLT Level 2 for ISA

The AI suggests a solution for a sequence, and a concise explanation is provided when hovering the electronic strip
Level of detail: low, Assimilation time: less than 10 seconds



The screenshot shows a user interface for aircraft sequencing. At the top, it says 'ISA IS ON' and 'Current sequence calculated <1 min ago'. The interface is divided into two main sections: 'AIRBORNE' and 'RWY 10'. Each section contains a list of aircraft with various status indicators and a '10' in a box at the end of each row. A mouse cursor is hovering over the second row in the 'RWY 10' section.

AIRBORNE									
-	DEP	EZY789	<input checked="" type="checkbox"/>		A320	M	0950		10
2	↑	---	BAW412	<input checked="" type="checkbox"/>		A320	M	0952	10
RWY 10									
1	LDG	RYP457	<input checked="" type="checkbox"/>		A320	M	0951		10

CLT Level 3 for ISA

The ATCO has time to look at the reasons for the sequence change

Level of detail: Medium/low, Assimilation time: less than 1 minute

Sequence Change details

ISA triggered a sequence change involving BAW412 and KLM321

BEFORE		AFTER	
2	KLM321	2 ↑	BAW412
3	BAW412	3 ↓	KLM321

Data involved in the sequence change

Speed of BAW412

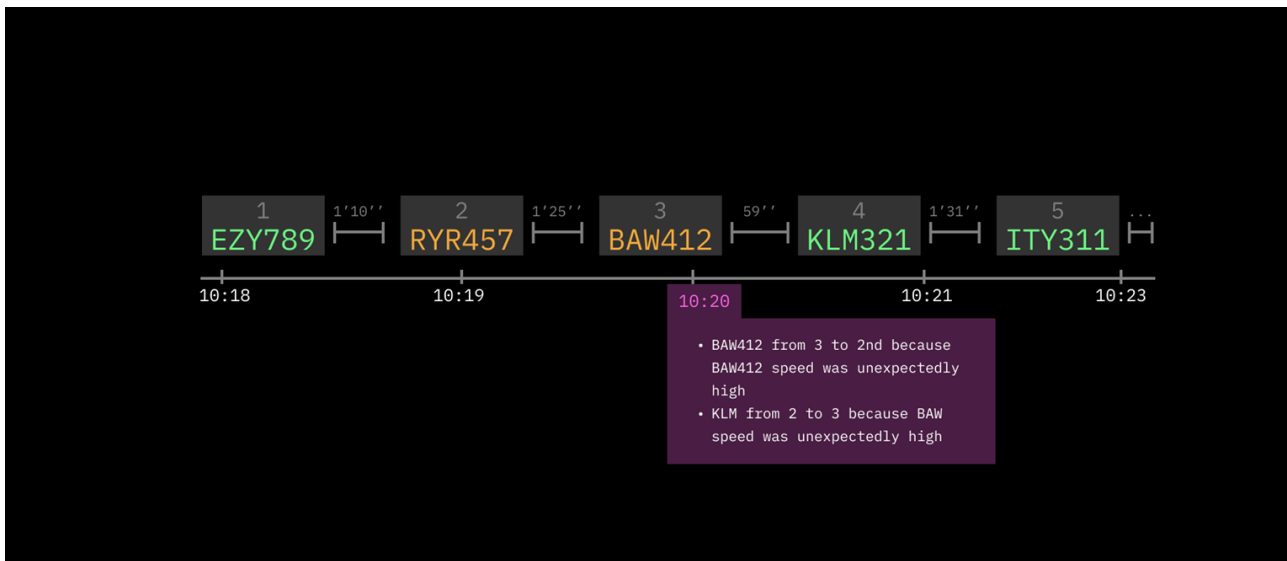
This aircraft speed in Final Approach changed from 150 to 250 knots, which made it arrive 1 minute earlier than expected.

Phase	Timestamp	Speed (knots)
Final Approach	09:50	250

CLT Level 4 for ISA

After the operations, the ATCO has time to review all sequences, and the detailed reason behind each change

Level of detail: Medium Assimilation time: Between 1 and 5 minutes



Conclusions

CLT can be used to answer questions related to OpXAI such as

What information to show?

When to show?

For how long?

At what level of detail?

To what user?

HAIKU Project: Human AI teaming Knowledge and Understanding for aviation safety

OpXAI is a topic we researched in HAIKU. HAIKU is a 3-year (2022-2025) project financed by EU that aims at developing 6 aviation AI-powered prototypes.

Key challenge: **human-centric Intelligent Assistants**,
integrating **human values, needs, abilities** and **limitations**.

HAIKU Website (come have a look!) ->

