Dedicated to innovation in aerospace

How much is too much?

Levels of A.I. Explainability in Decision Support Systems' User Interfaces for improved decision-making performance

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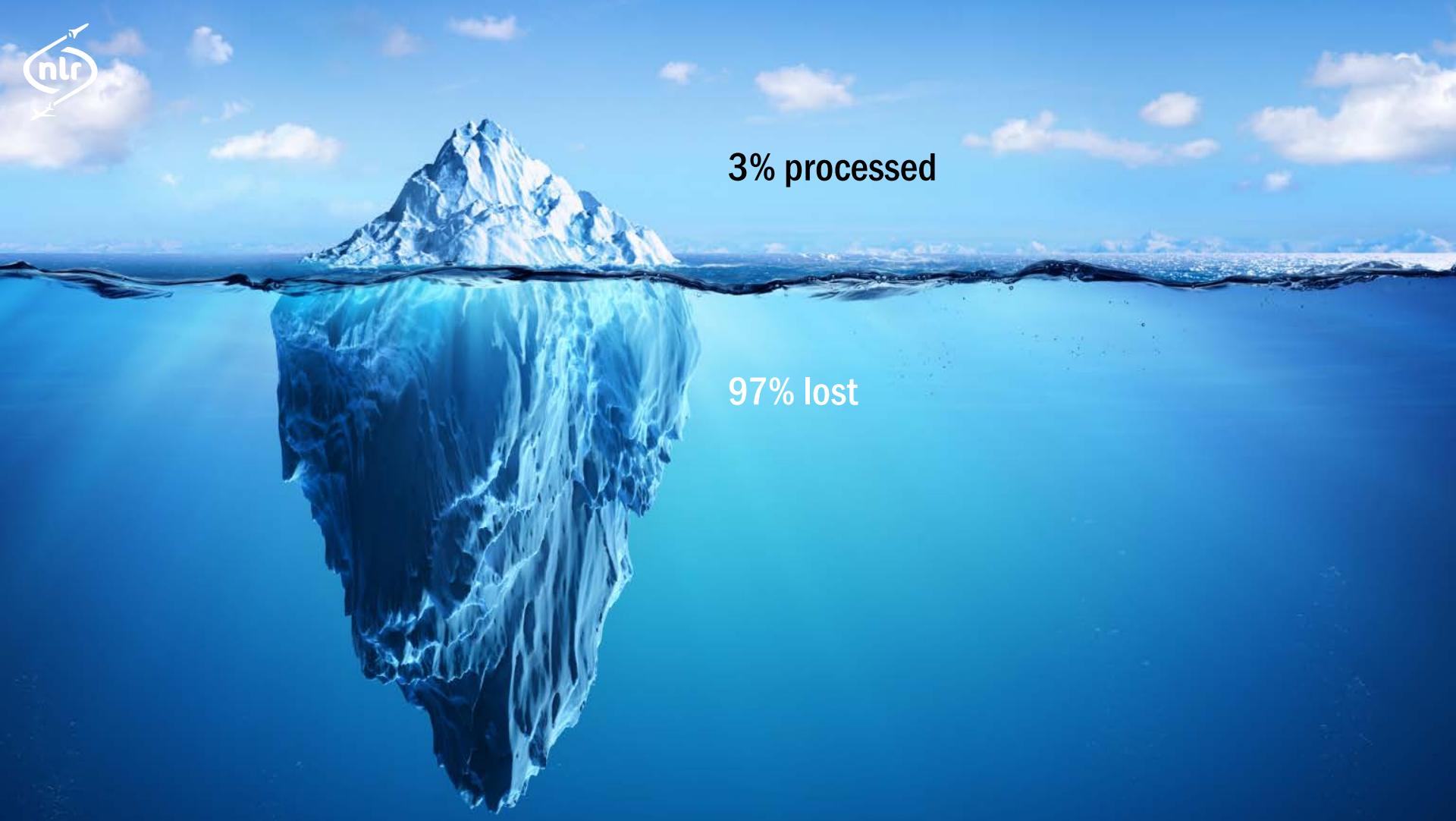

Information overload

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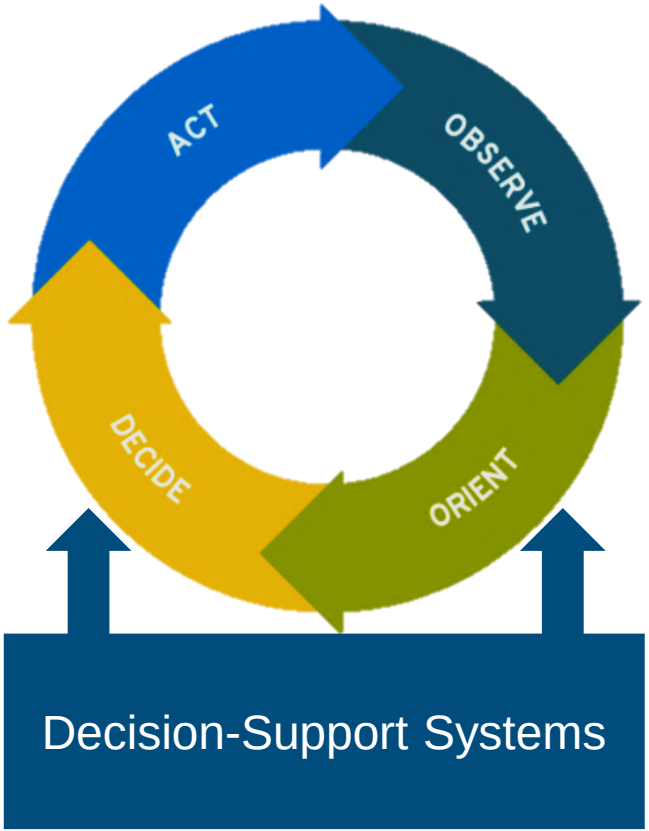
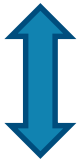
M-001

Background



More information to process



Limited time to process

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Definitions

Decision-Support System: a DSS is an information system that can support (military) decision-making activities. It helps people make decisions about problems that may be rapidly changing and not easily specified in advance. DSS's can be either fully computerized or human-powered, or a combination of both.

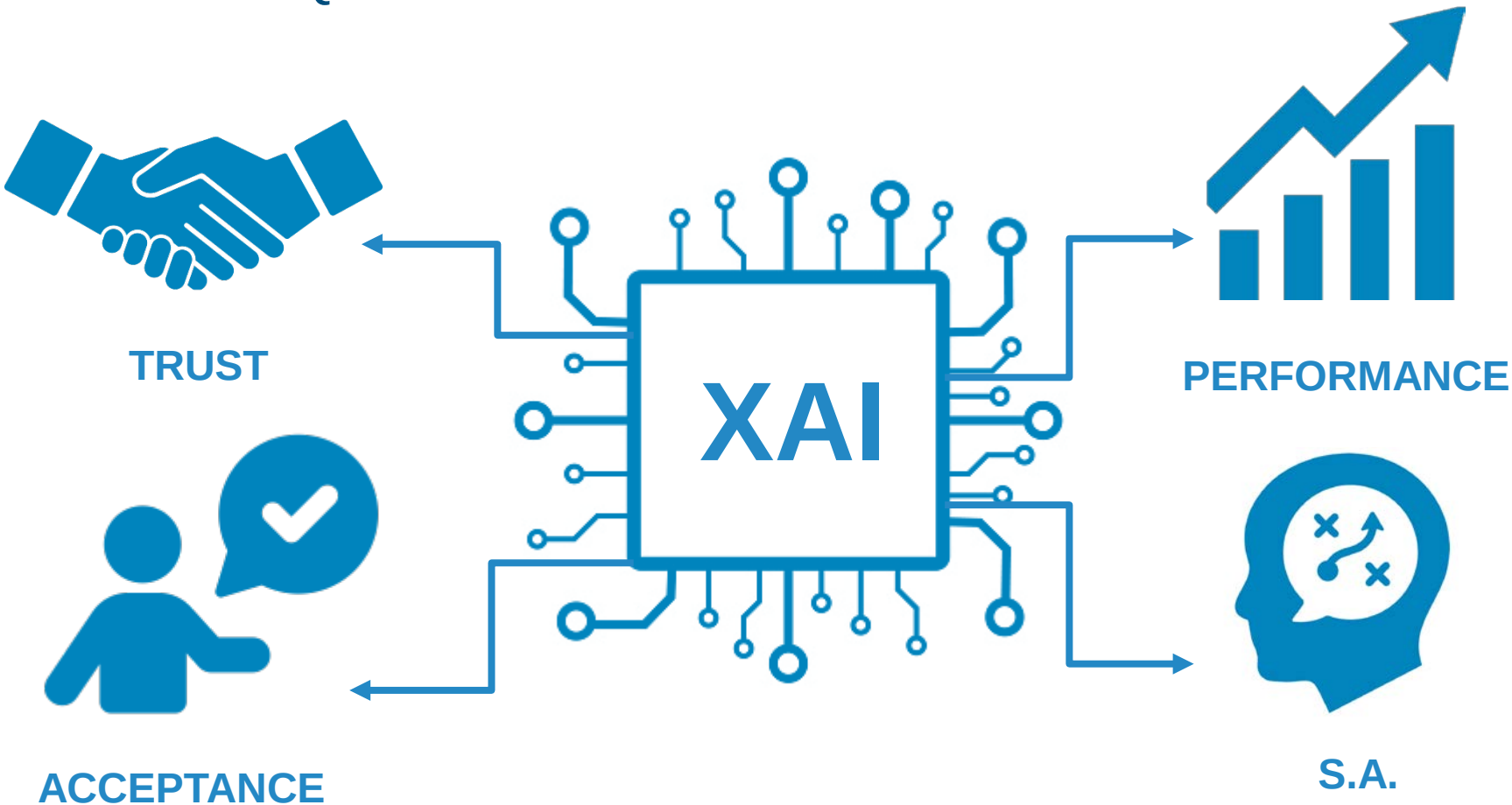
Definitions

Artificial Intelligence: machines (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving". A.I. systems are often better equipped to process large volumes of dynamic data than the human brain, making them a valuable addition to a DSS system.

Definitions

Explainability: refers to methods and techniques in the application of A.I. technology such that the results of the solution can be understood by humans. X.A.I. can improve the operator's experience with a DSS by supporting an operator's trust that the A.I. is making good decisions.

Research Question



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Research Question

How should the UI of a DSS - that includes an explainable A.I. - be designed and developed to achieve the highest levels of operator trust, acceptance, performance and SA?

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Levels of Explainability

- Based on Liao et al.'s Taxonomy of XAI Methods

Category of Methods	*Explanation Method*	*Definition*
Explain the model (Global)	*Global feature importance.*	*Describe the weights of features used by the model (including visualization that shows the weights of features).*
	Decision tree approximation.	*Approximate the model to an interpretable decision-tree.*
	Rule extraction.	*Approximate the model to a set of rules, e.g., if-then rules.*
Explain a prediction (Local)	*Local feature importance and saliency method.*	*Show how features of the instance contribute to the model's prediction (including causes in parts of an image or text).*
	Local rules or trees.	*Describe the rules or a decision-tree path that the instance fits to guarantee the prediction.*
Inspect counterfactual	*Feature influence or relevance method.*	*Show how the prediction changes corresponding to changes of a feature (often in a visualization format).*
	Contrastive or counterfactual features.	*Describe the feature(s) that will change the prediction if perturbed, absent or present.*
Example based	*Prototypical or representative examples.*	*Provide example(s) similar to the instance and with the same record as the prediction.*
	Counterfactual example.	*Provide example(s) with small differences from the instance but with a different record from the prediction.*

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Approach

- Developed DSS application with explainable AI
- 4 scenario’s to select appropriate LZ’s for a helicopter raid operation
- Scenario’s and UI Levels presented in random order
- Input ID of two LZ’s
- Fill in questionnaire
- Objective Metrics (Performance):
  - Time
  - Correct Decisions
  - Score
- Subjective Metrics:
  - Trust
  - Acceptance
  - SA

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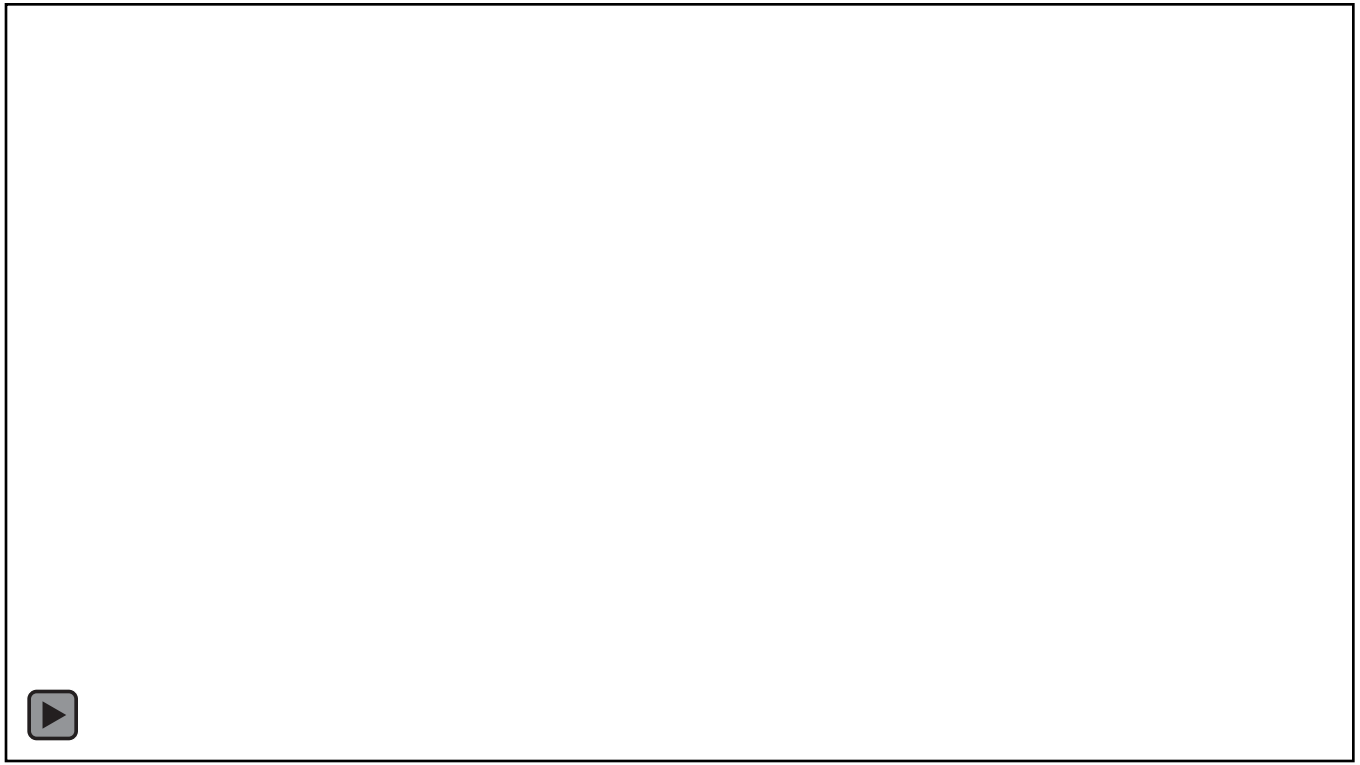
Levels of Explainability: Level 1



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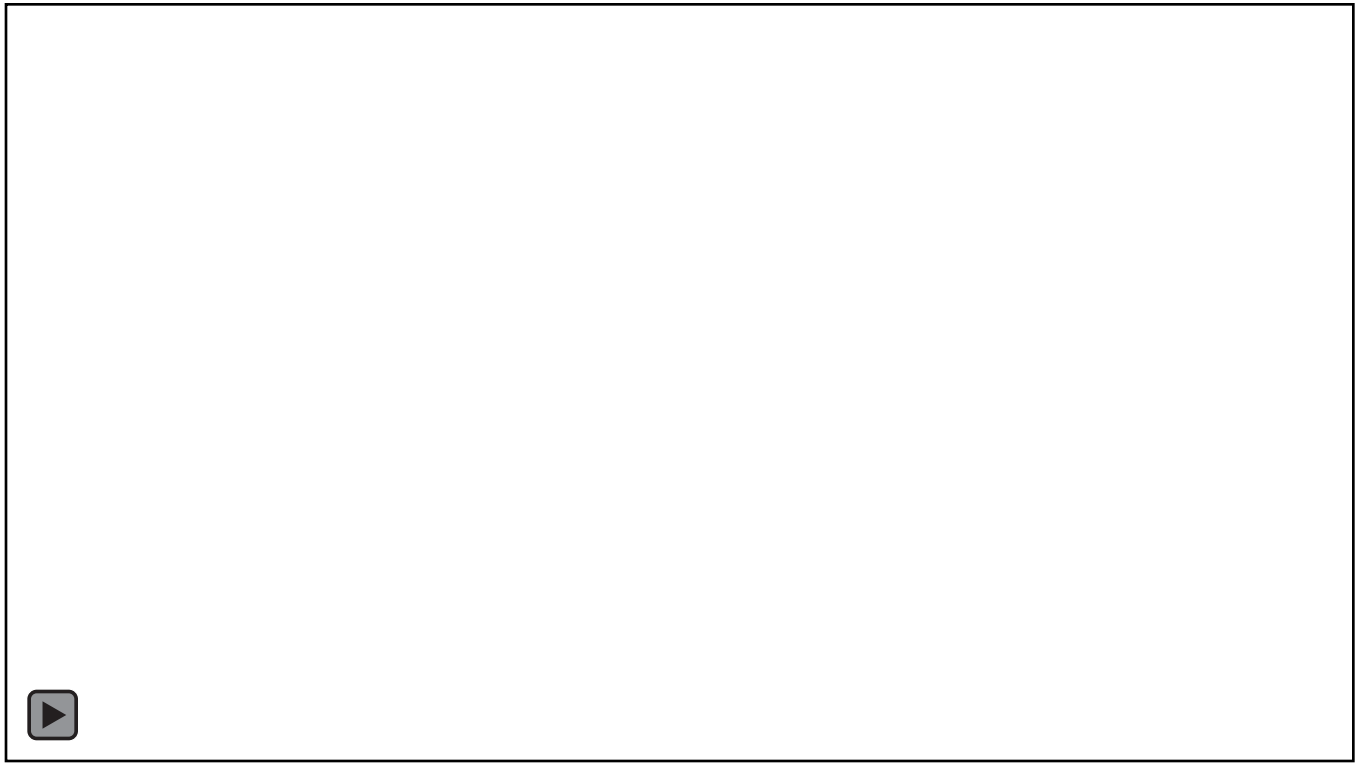
Levels of Explainability: Level 2



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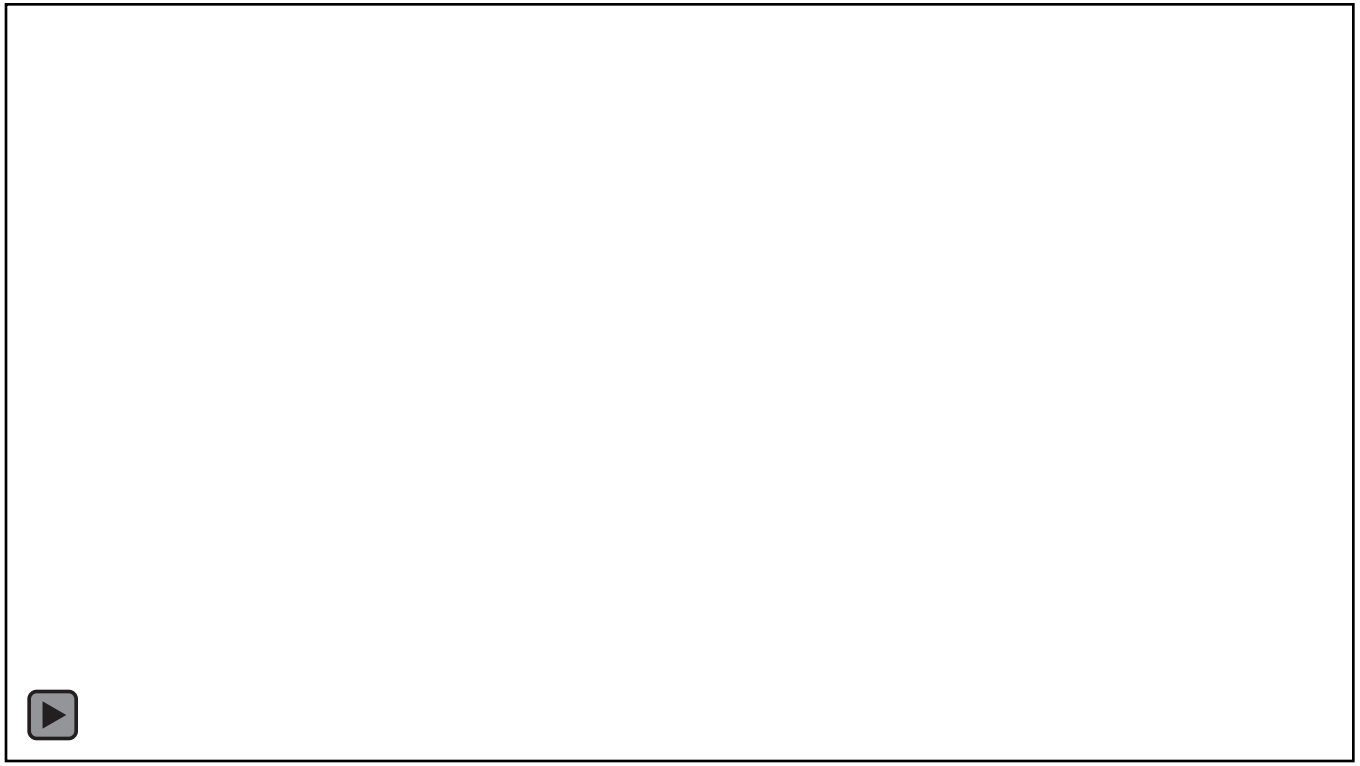
Levels of Explainability: Level 3



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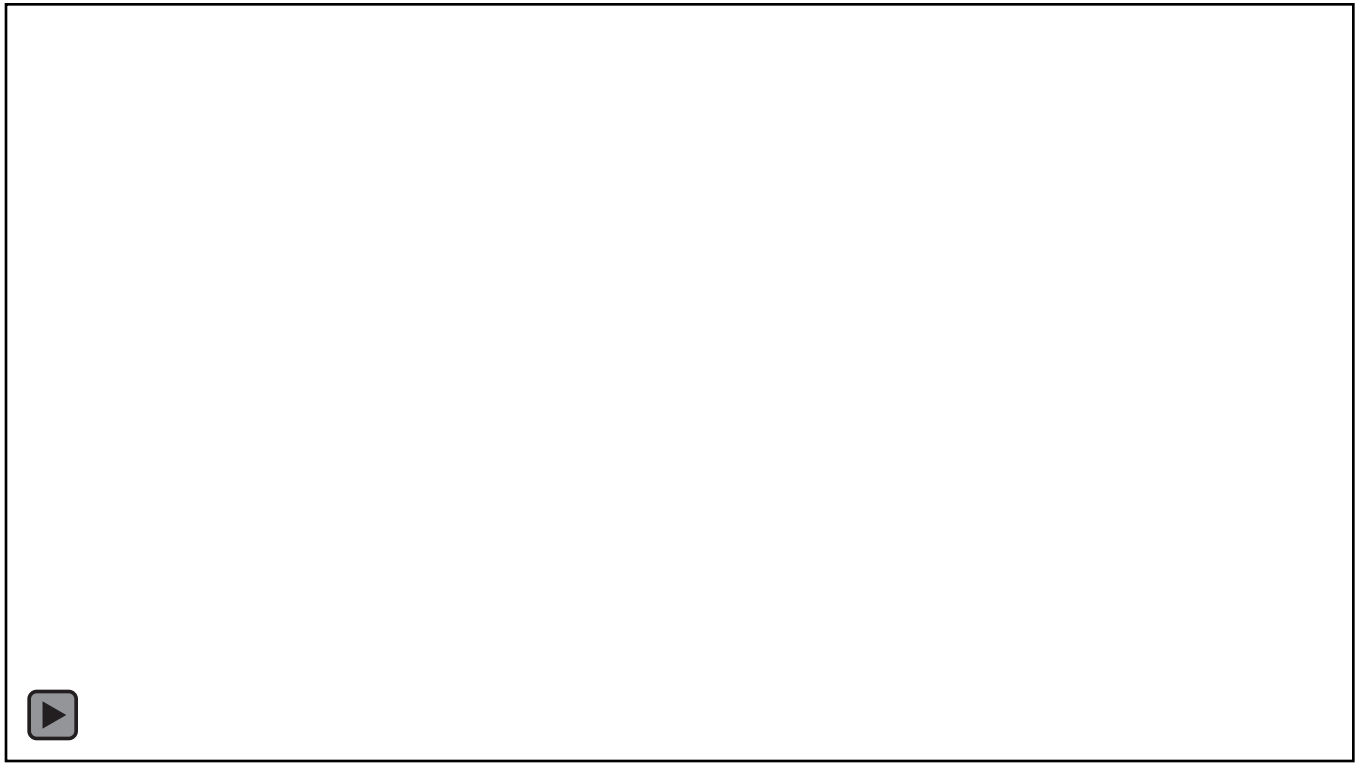
Levels of Explainability: Level 4



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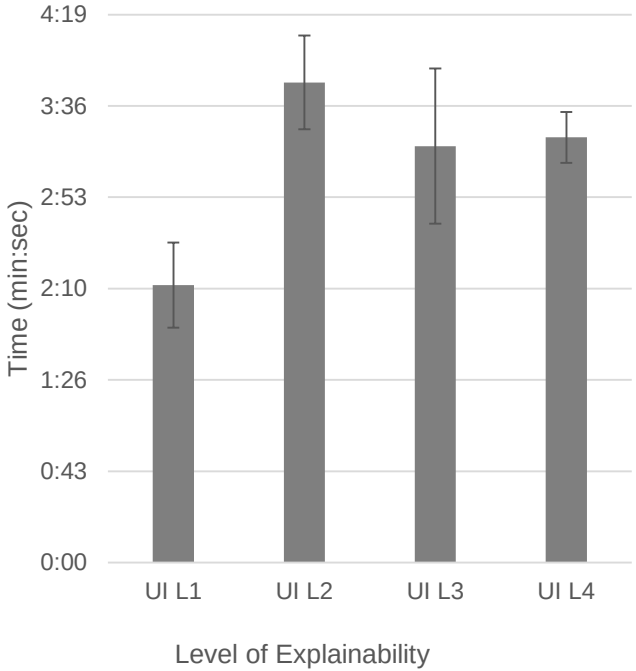
Objective Results: Avg. Time to Decision



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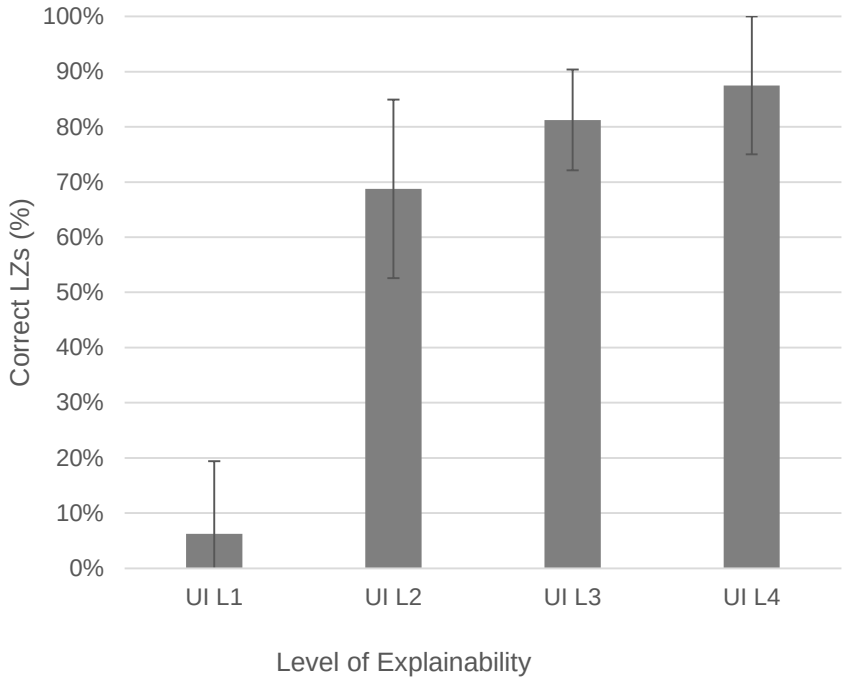
Objective Results: Avg. LZ score



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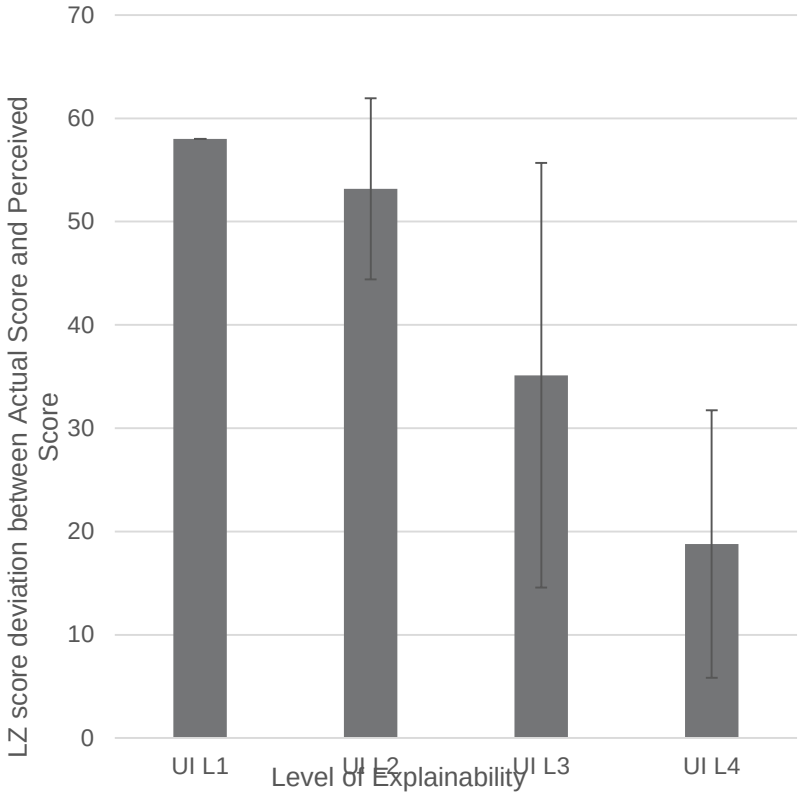
Objective Results: LZ score deviation



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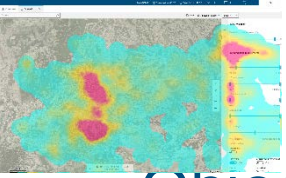
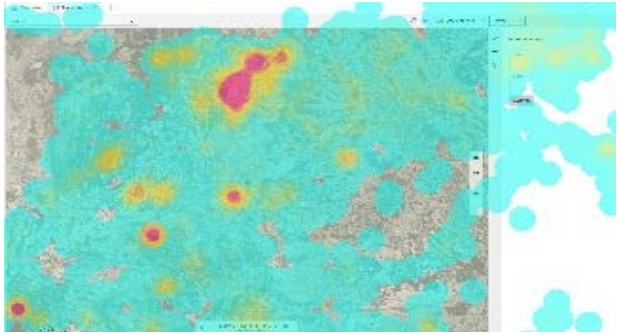
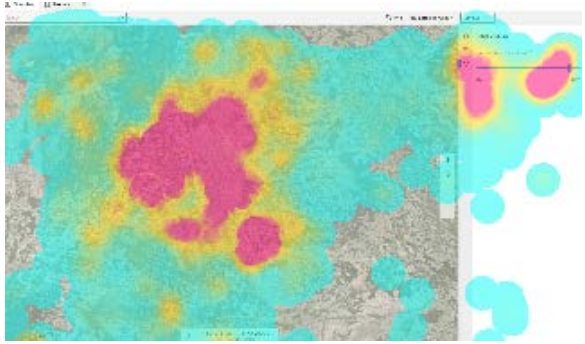


Objective Results: Gaze Behaviour

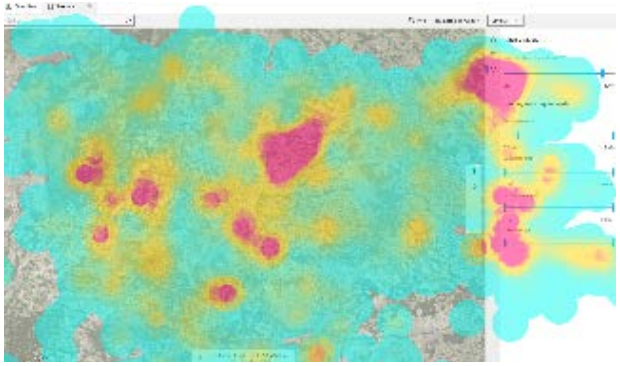
L1



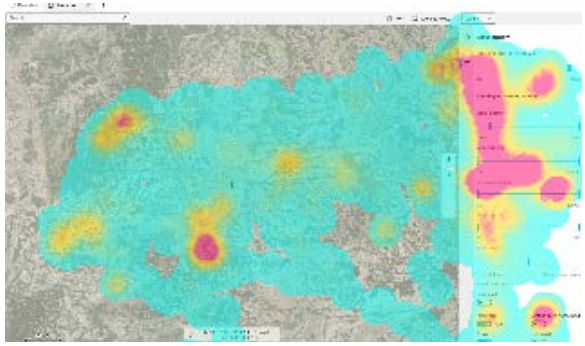
L2



L3



L4



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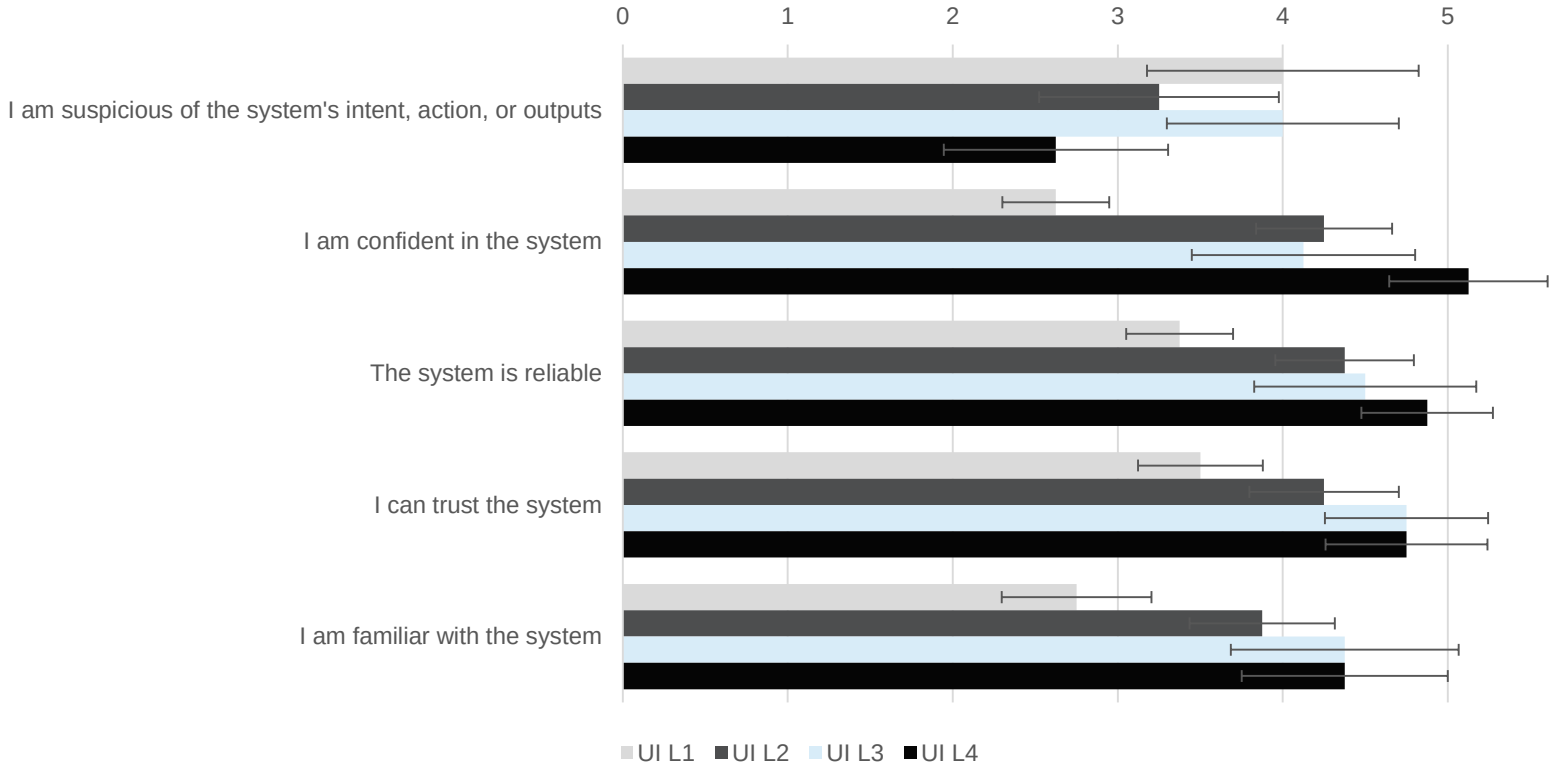
Subjective Results: Trust



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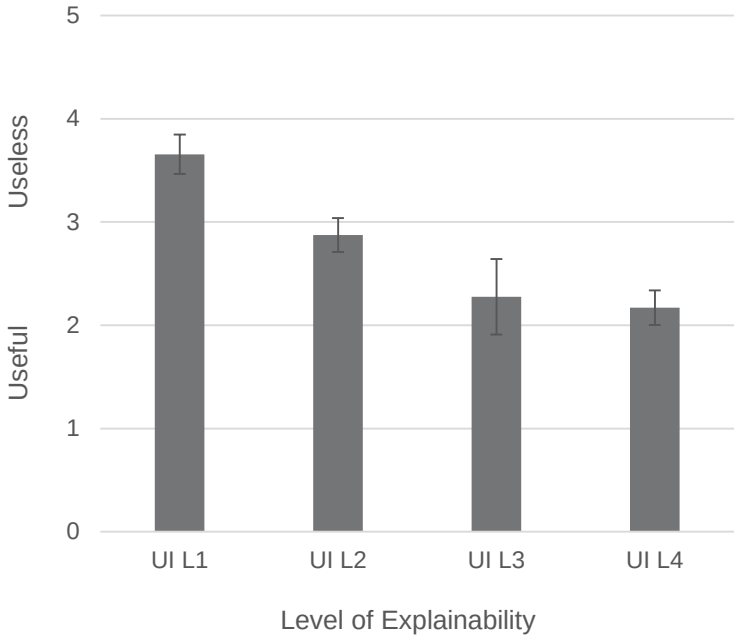
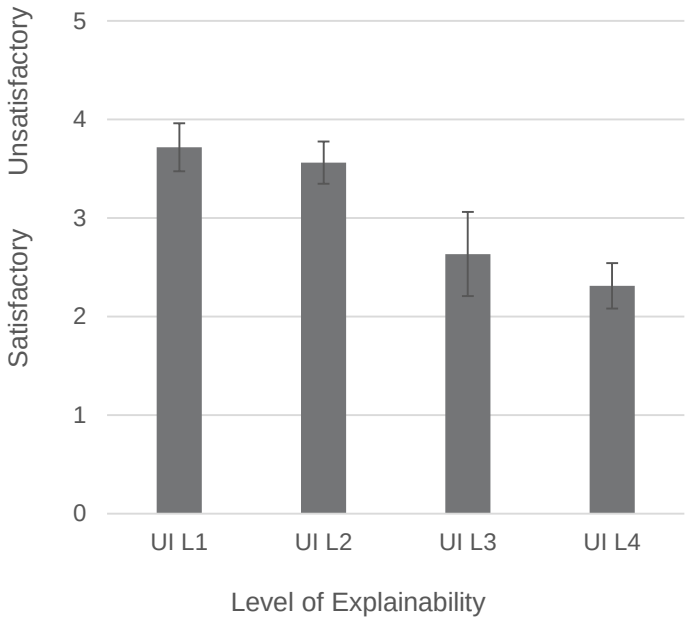
Subjective Results: Acceptance





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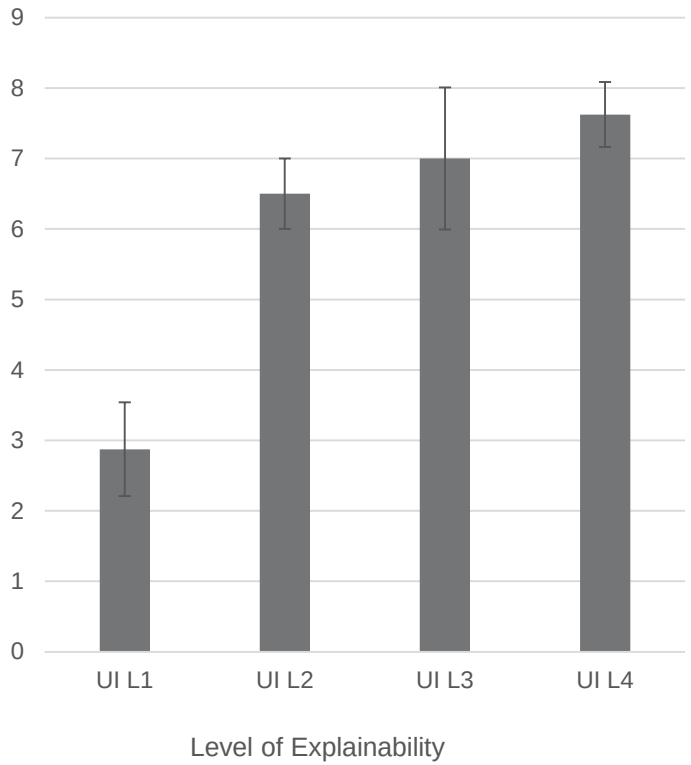
Subjective Results: Situational Awareness



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Conclusion

- L1: (by far) the lowest score for all measurements
- L2: Low interactivity leads to poor UX and performance
- L3: much improved UX and performance, similar to L4
- L4: Overall highest scores, slightly higher than L3.
- L3 and L4 have much higher deviation for subjective measures compared to L1 and L2

Recommendations

- Provide complete information and control, however...
- Showing all options can be overwhelming for some users
- Provide “Advanced” options for users who require more control
- Allow users to customize the UI based on their role, experience level and personal preferences

Thank you for listening!

Q&A

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