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Introduction

- Trust in automation (TiA) is a crucial factor in the widespread adoption and successful integration of automation systems.
- Although trust is often treated as a static measurement, it is a construct that evolves over time due to changing conditions [1].
- Literature suggests that performance, workload, and risk influence intentions, and subsequently behavior [1,2].
- Research Questions**
 - Does a linear combination of performance, risk and reliance provide a robust TiA estimation?
 - Are different timescale measures of trust good predictors of decision-making?
 - What are the trust dynamics across different automation conditions? Of operators with different performance levels?

Components of Trust and Data-Set

- Automation usage (decision-making) is an observable indicator of trust [3].
- Trust components can encompass short and medium timescales [3].
- Performance, Relative Risk, and Reliance are measurable trust components [3].

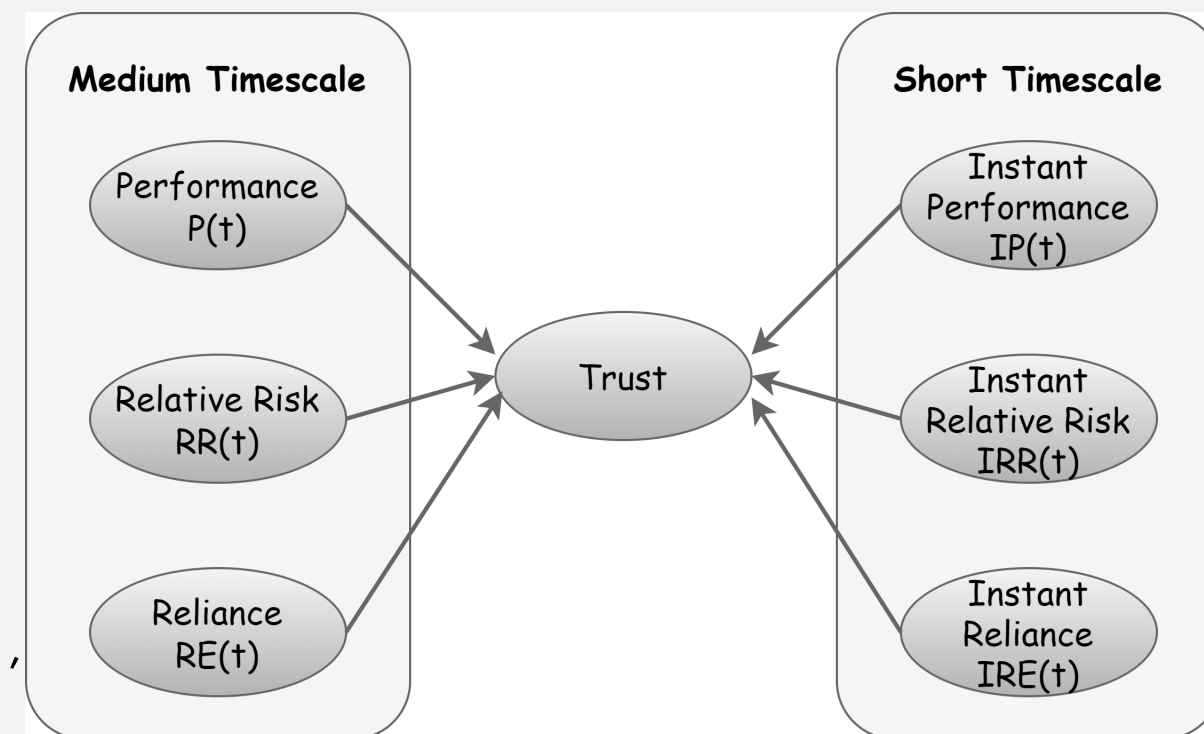


Figure 2. Measurable components of trust and their timescales.

Data-set

- Sixteen participants performed a driving task where they could use an automation [4].
- They performed five trials: Manual (M), Speed Low (SL), Speed High (SH), Full Low (FL), and Full High (FH).
- Trust estimation was one of the main objectives of the experiment.

Methods

- Components of trust were measured at short and medium timescales.
- Linear combinations of performance, risk, and reliance were assumed to estimate trust in automation.

Short Timescale Trust: $Tr_S(t)$

Medium Timescale Trust: $Tr_M(t)$

$$Tr_S(t) = \alpha_S \cdot IP(t) + \beta_S \cdot IRR(t) + \gamma_S \cdot IRE(t)$$

$$Tr_M(t) = \alpha_M \cdot P(t) + \beta_M \cdot RR(t) + \gamma_M \cdot RE(t)$$

- Random Forest models were trained with short and medium timescale trust measures to predict automation usage.
- Prediction accuracy guided the optimization of the weight assigned to each component influencing trust.
- The estimated weights were used to study the dynamics of trust under different automation conditions.

Impact of Trust Measures on Decision-Making Prediction

- Prediction accuracy increased significantly when trust measures were used.
- Short timescale trust became the most important factor for the model's prediction.

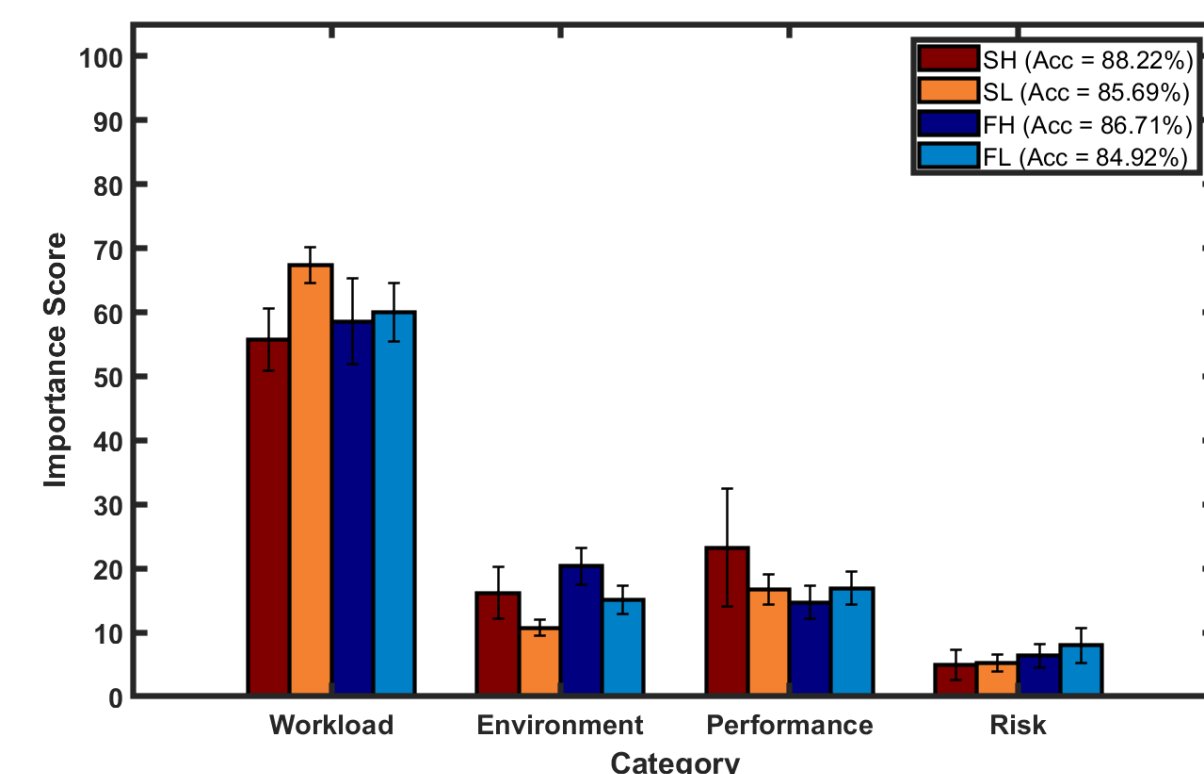


Figure 3. Baseline model's performance (Not including trust).

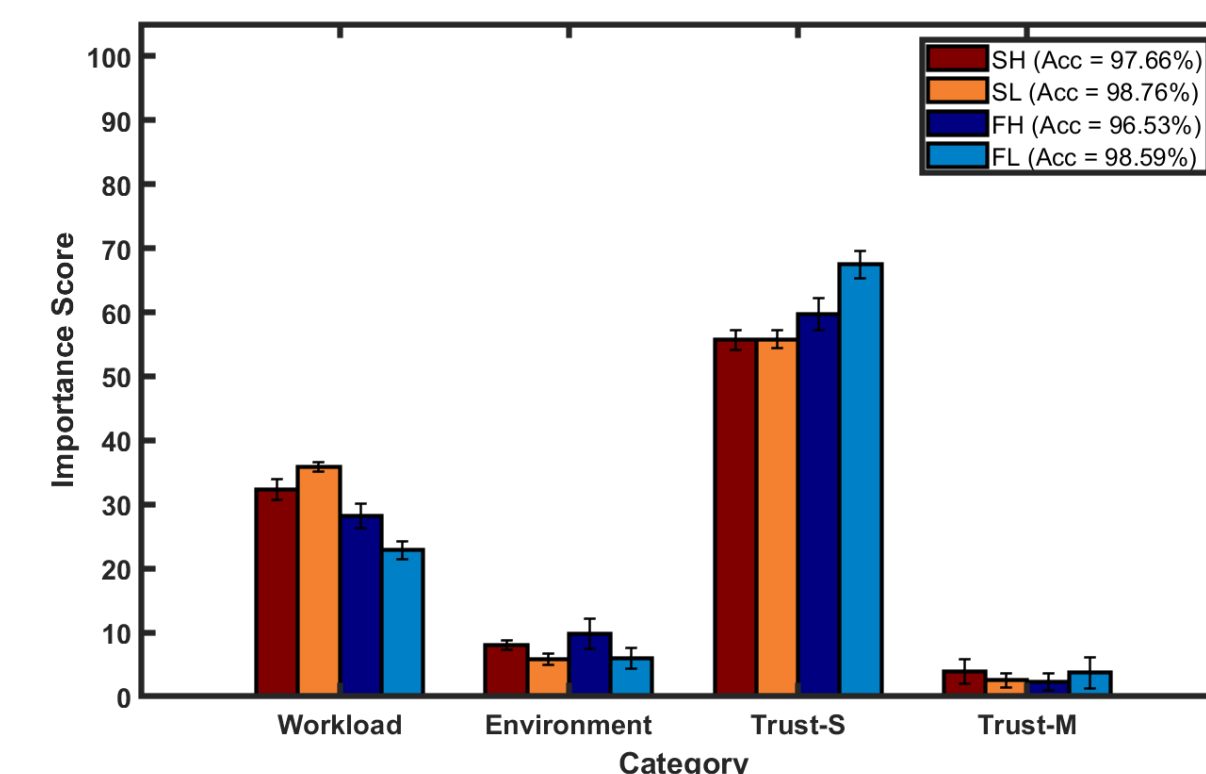


Figure 4. Model's performance with short and medium timescale trust components.

Trust Dynamics of Different Performance Groups

- SH Trust: Med-Performing > High-Performing > Low-Performing
- SL Trust: Low-Performing > Med-Performing > High-Performing
- FH Trust: Med-Performing > Low-Performing > High-Performing
- FL Trust: Low-Performing > Med-Performing > High-Performing

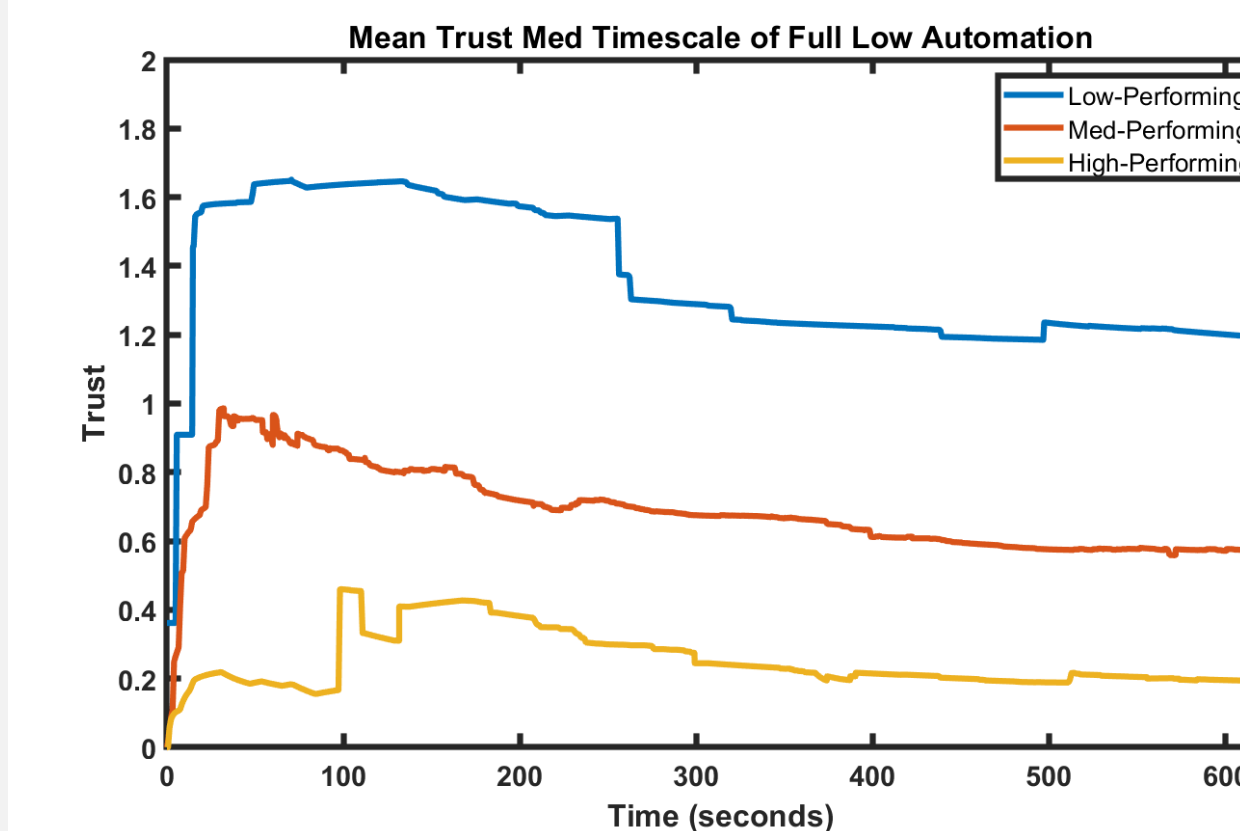
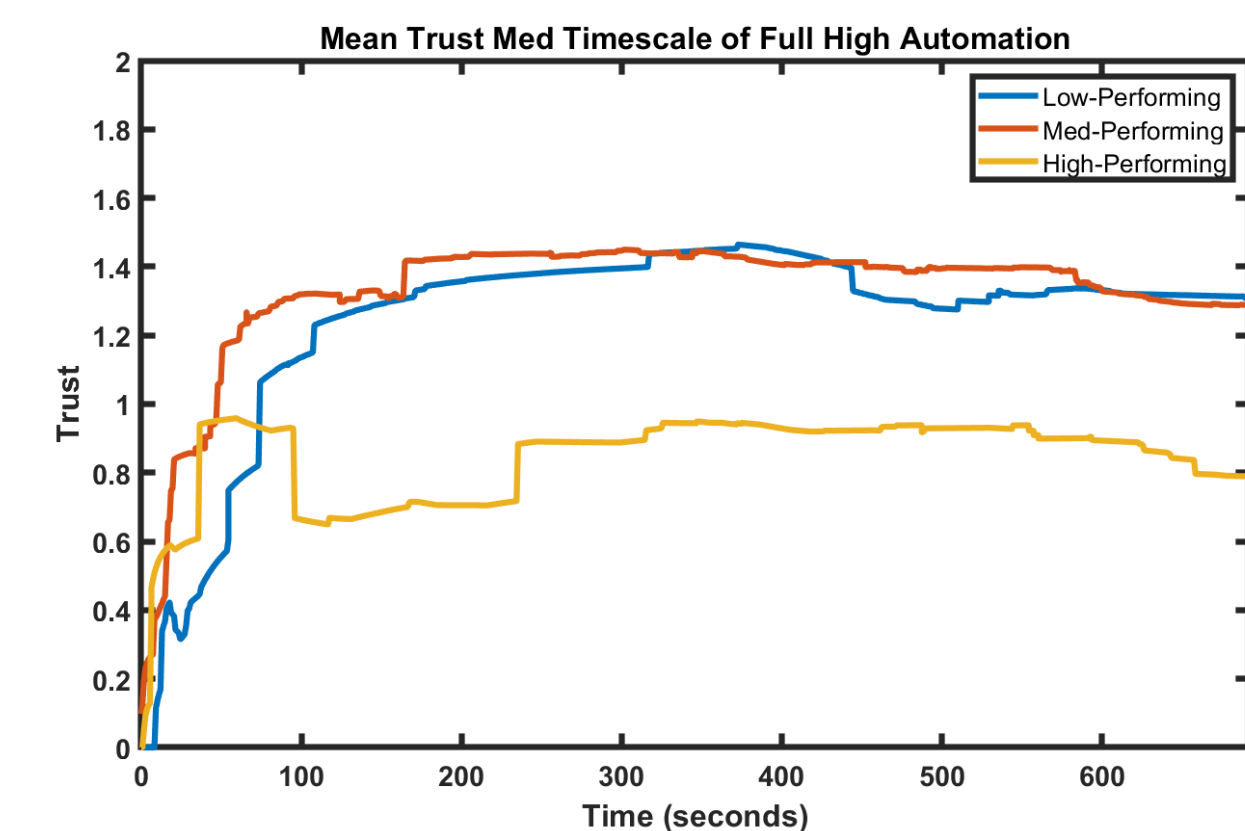
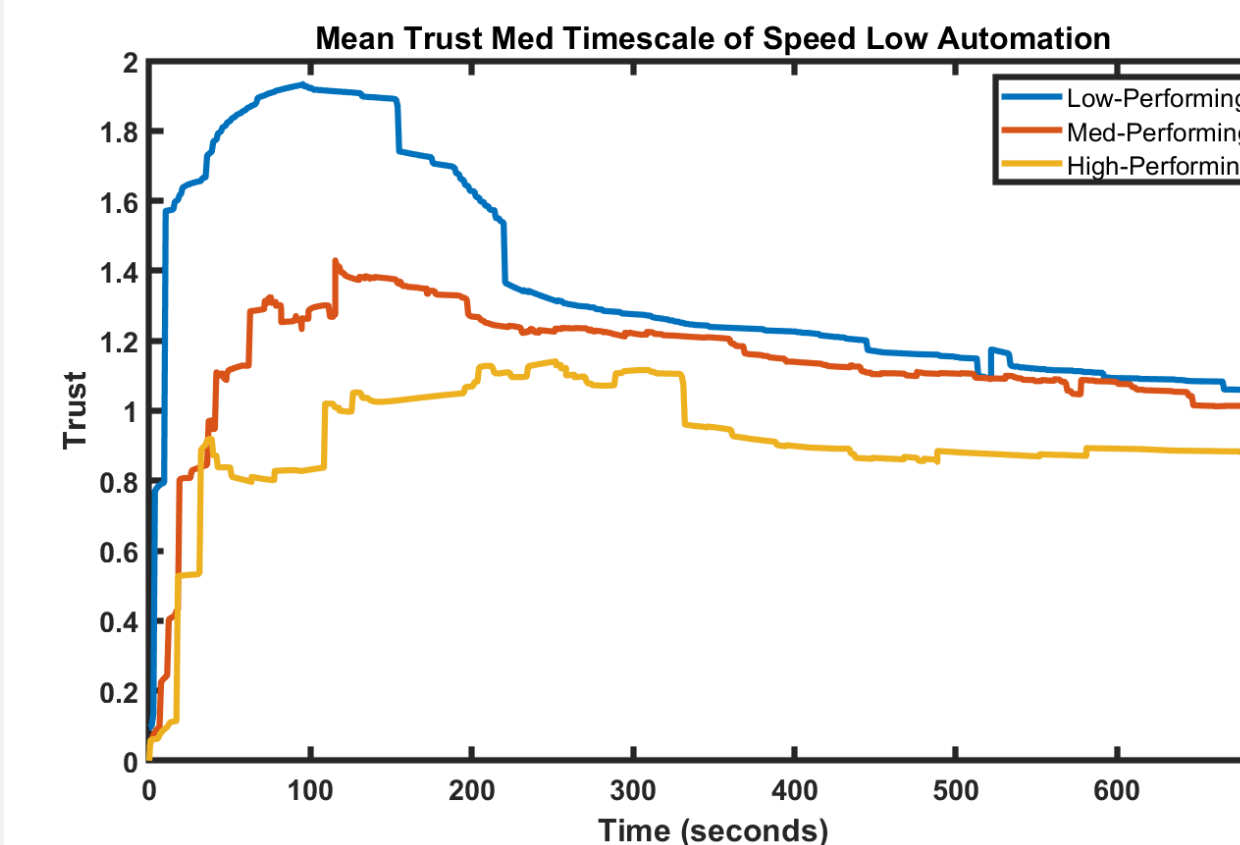
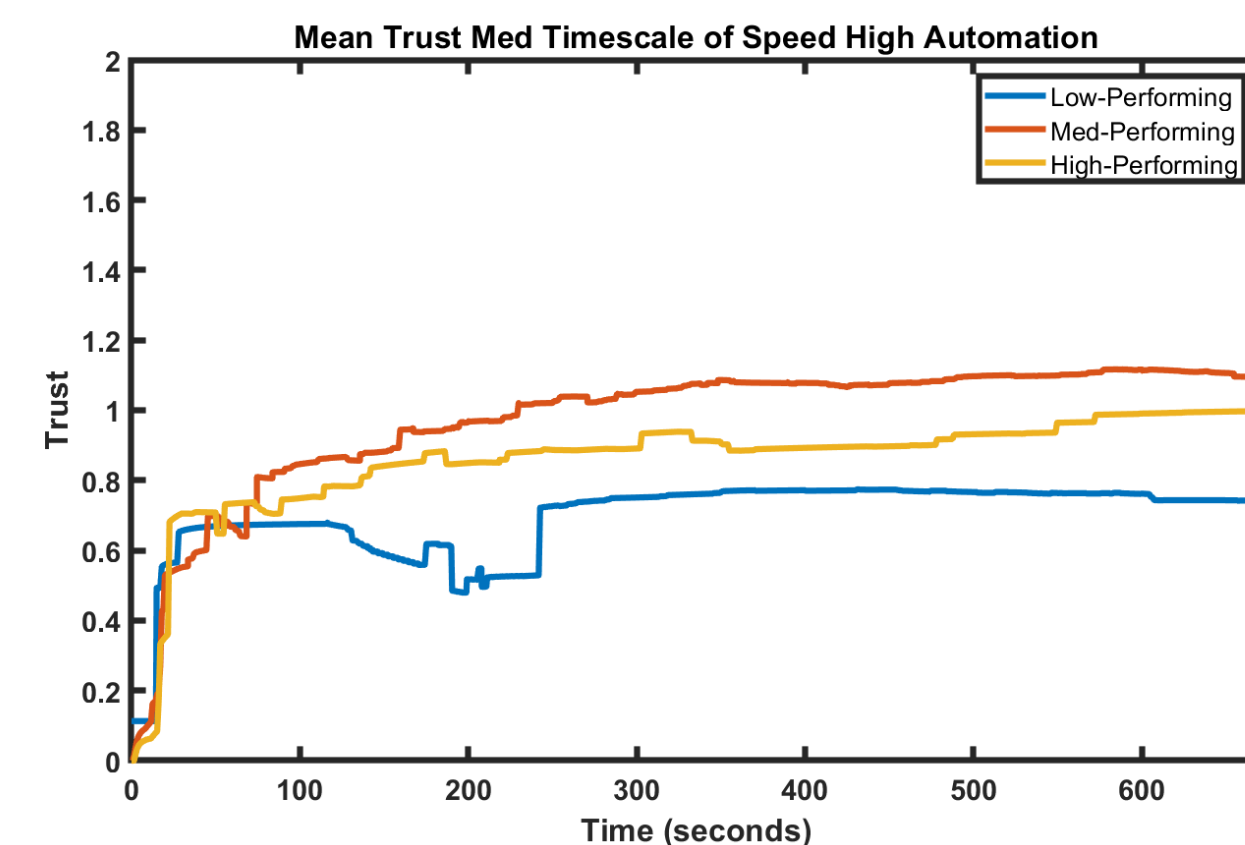


Figure 5. Impact of varied automation conditions on the mean trust dynamics of different performance groups.

Conclusions

Impact of Trust Measures on Decision-Making Prediction

- Short timescale trust was found to have a greater impact on decision-making than medium timescale.
- A linear combination of performance, risk, and reliance provides a robust estimation of trust, leading to highly accurate predictions of decision-making.

Trust Dynamics Analysis

- Operators need ~50 secs to assess the capabilities of the automation and calibrate their trust.
- High-Performing Operators tend to trust more on automated systems that have fewer degrees of freedom (Speed type).
- Incorrect trust calibration of the low-performing operators heavily affected their performance.

Future Research

- Perform more experiments to improve accuracy and study the dynamics of trust more in depth.
- Development of models for trust and reliance on automation.

Acknowledgements

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