

THE INFLUENCE OF INTERDEPENDENCE RELATIONSHIPS ON TRUST REPAIR STRATEGIES AND COLLABORATION FLUENCY

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Introduction

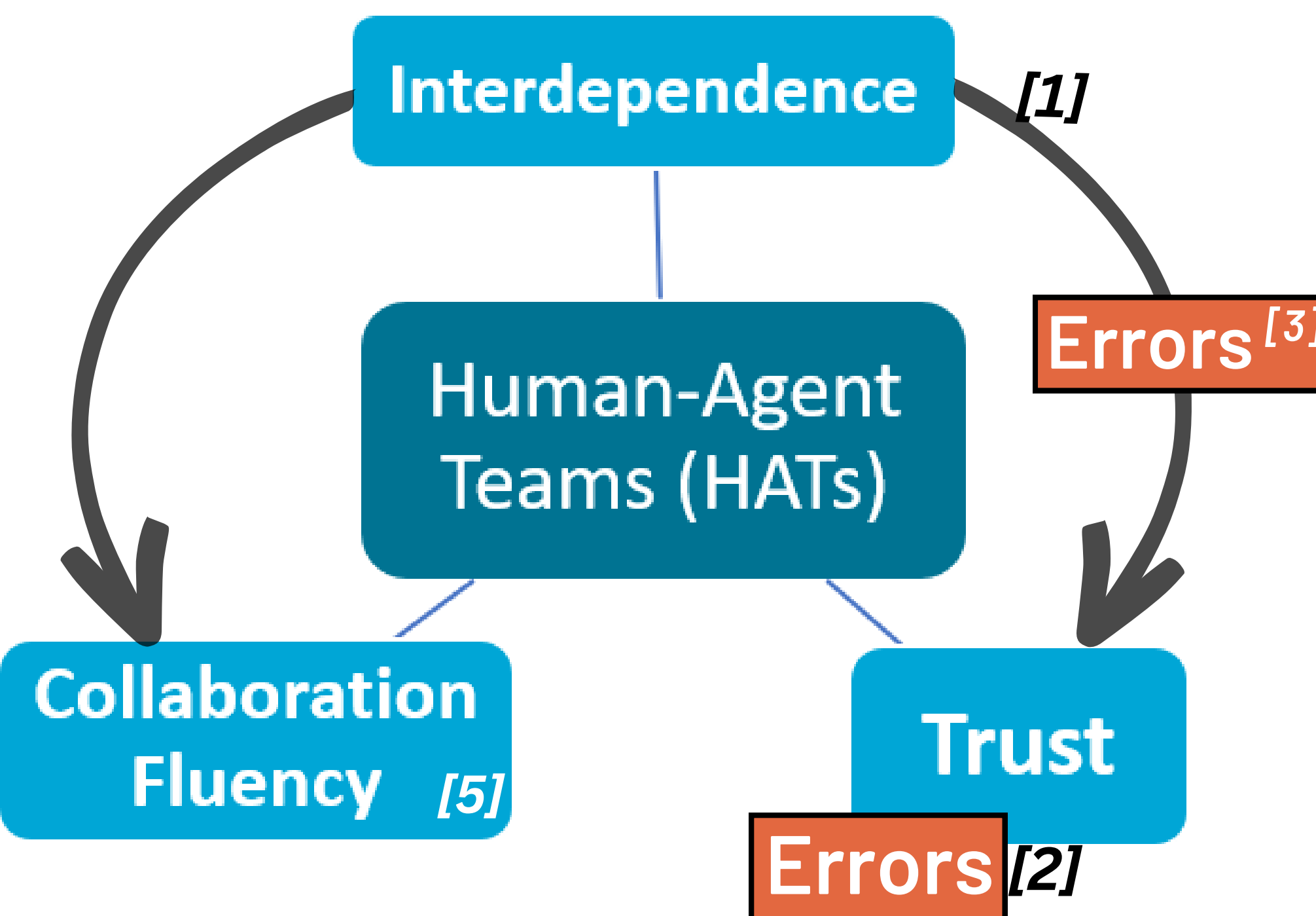


Figure 1: Factors that influence HATs and how they interact with each other

Interdependence ~ Trust [1]

- Opportunities to develop and maintain trust

Errors ~ Trust [2]

- Negative impact on trust and collaboration.
- **Trust repair strategies** mitigate these negative outcomes

Interdependence ~ Trust repair strategy ~ Trust

- No prior research for HATs
- Insights from human teams [1]

Interdependence ~ Collaboration Fluency

- No prior research

Research Questions

How does a mix of interdependence and independence relationships influence:
RQ1) trust violation and trust repair
RQ2) collaboration fluency

Why mix of relationships?

- reflects a realistic HATs setting
- captures complexities of HATs
- consists of a mix of opportunistic and required dependencies, complementary interdependence and independence

Methodology

- User experiment 3 x 2 mixed design:
 - Time: before violation (T1), after violation (T2), after trust repair strategy (T3)
 - Experiment groups: Baseline (n = 15), Interdependence (n = 15)
- Task: Urban Search and Rescue mission (Figure 1)
- Errors: weather predictions (Figure 2)
- Trust repair strategy: regret + explanation
- Measurements TRUST: questionnaire [4], % joint activities
- Measurements FLUENCY: questionnaire [5], robot idle time, performance metrics



Figure 1: MATRX Urban Search and Rescue Environment

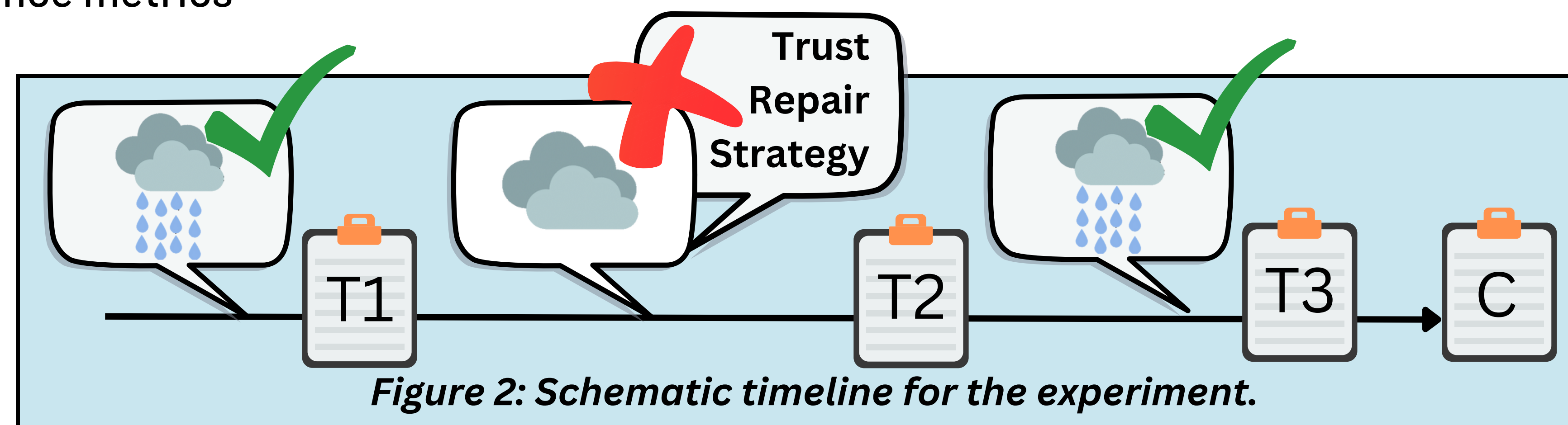


Figure 2: Schematic timeline for the experiment.

Conclusion & Discussion

- Results do not align with prior work interdependence ~ trust [1].

RQ1. Trust Violation

- Errors significantly affect trust development.
- Interdependence affected the perception of trust violation.

RQ1. Trust Repair

- Slow increase in trust after violation.
- Interdependence did not affect how trust is repaired.

RQ2. Collaboration Fluency

- Interdependence did not affect fluency.

Future Work

- 1) Conduct more experiments.
- 2) Compare current results with other interdependence levels.
- 3) Find better ways to ensure the visibility of the messages.
- 4) Conduct this analysis but only for the participants that got penalized at T2.
- 5) Add another trust repair strategy.

Results

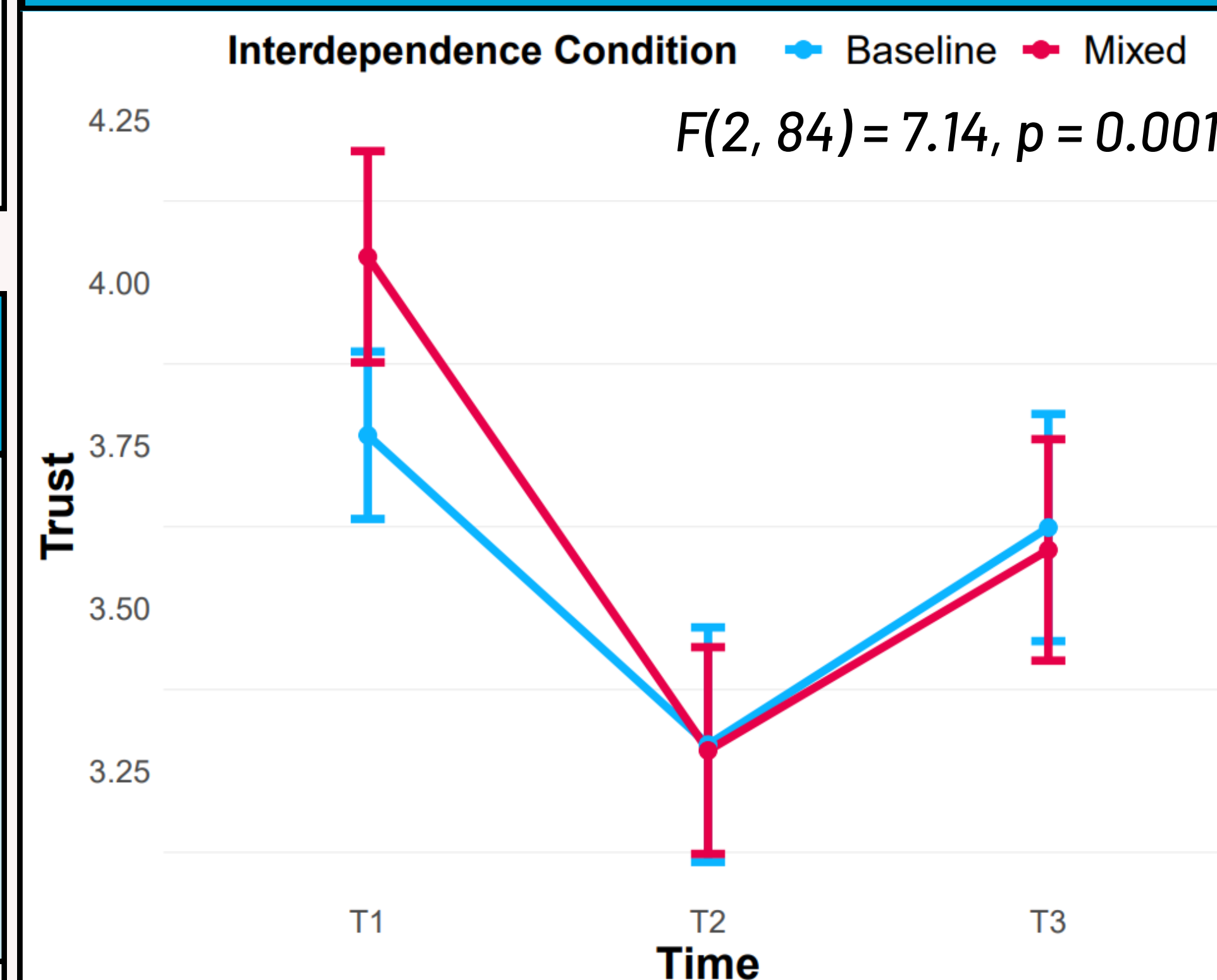


Figure 3: Trust values over time. Mixed ANOVA test shows significant main effect on time.

Time	p_{adj}
T1 - T2	0.119
T2 - T3	0.076
T1 - T3	1

Table 1: Pairwise comparisons for trust values: Baseline (top) and Mixed Interdependence (bottom)



Figure 4: Collaboration fluency between conditions. Mann-Whitney test shows no significant differences.

Limitations

- homogeneity of the participants
- robot's messages visibility
- participants not seeing to the trust repair message
- trust at T2 was recorded after trust repair message was sent

References

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[2] Esterwood, C., & Robert, L. P. (2022). A Literature Review of Trust Repair in HRI. In 2022 31st IEEE International Conference on Robot and Human Interactive Communication (RO-MAN). <https://doi.org/10.1109/ro-man53752.2022.9900667>

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[5] Hoffman, G. (2019). Evaluating Fluency in Human-Robot Collaboration. *IEEE Transactions on Human-Machine Systems*, 49(3), 209-218. <https://doi.org/10.1109/thms.2019.2904558>