

Time-Based Analysis of Haptic Feedback and Collaboration in Human Dyads Using the KINARM

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INTRODUCTION

- Human cooperation relies on dynamic role-switching and information exchange in dyadic interactions
- Previous research shows that haptic interaction in motor tasks enhances learning and performance.
- Shorter time windows rely more on anticipatory (feedforward) control while longer time windows engage both anticipatory (feedforward) and reactive (feedback) mechanisms.
- This study examines how interaction timing (0–400 ms vs. 400–800 ms) influences cooperation dynamics.*
- Provides insight into the role of haptic feedback in improving coordination and performance.

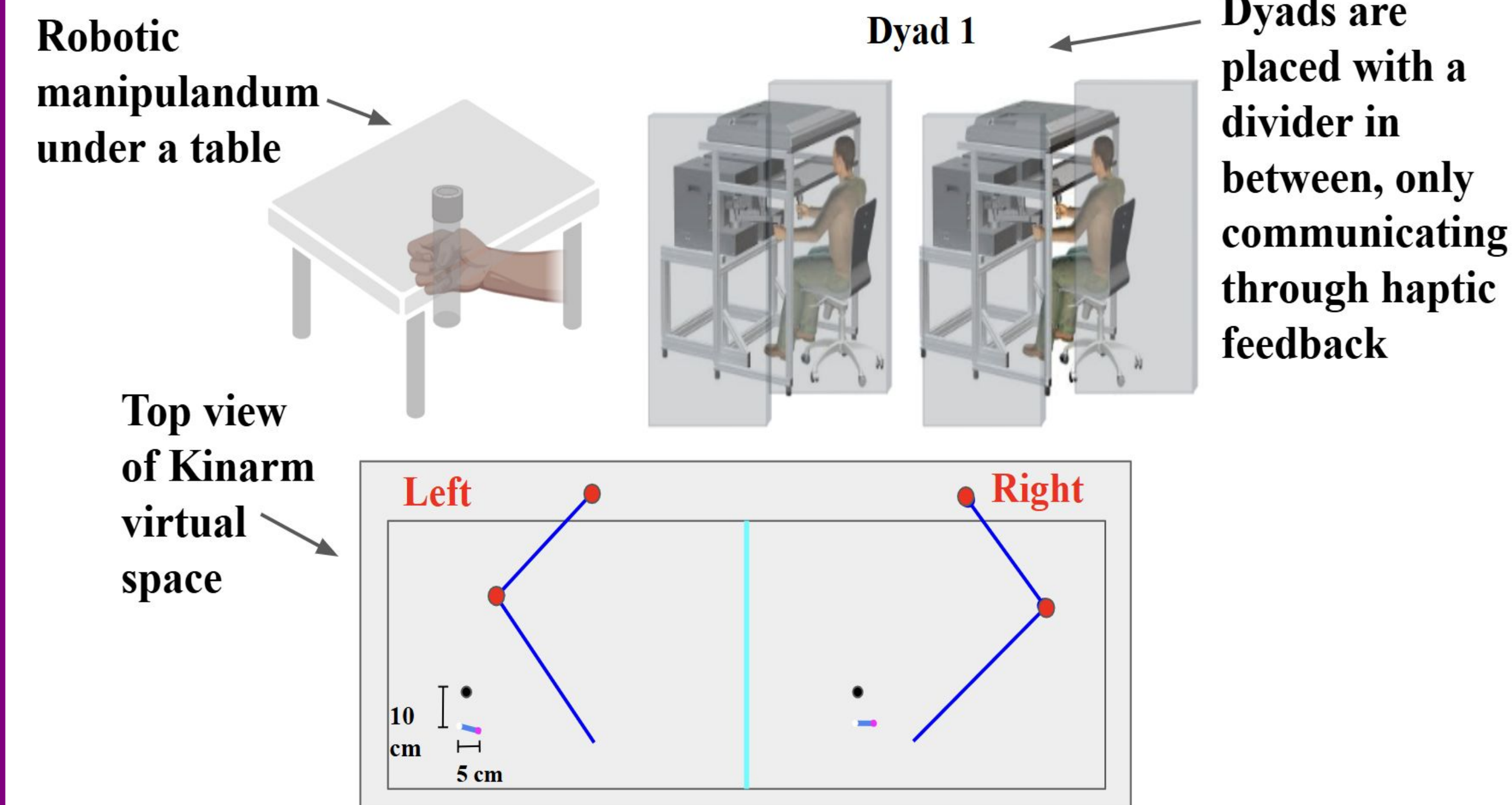
METHODS

There are 5 experimental blocks and associated conditions in task performance study.

Block	Condition	Description
1	Effect of Task Error	Manipulation of target size
2	Effect of Task Effort	Excess force on participant handle
3	Effect of Target Uncertainty	Target disappears after 100 ms
4	Effect of Information Transformation	Absence of collaborative frequencies
5	Effect of Partner Predictability	Visual delay (last 15 beam positions are shown)

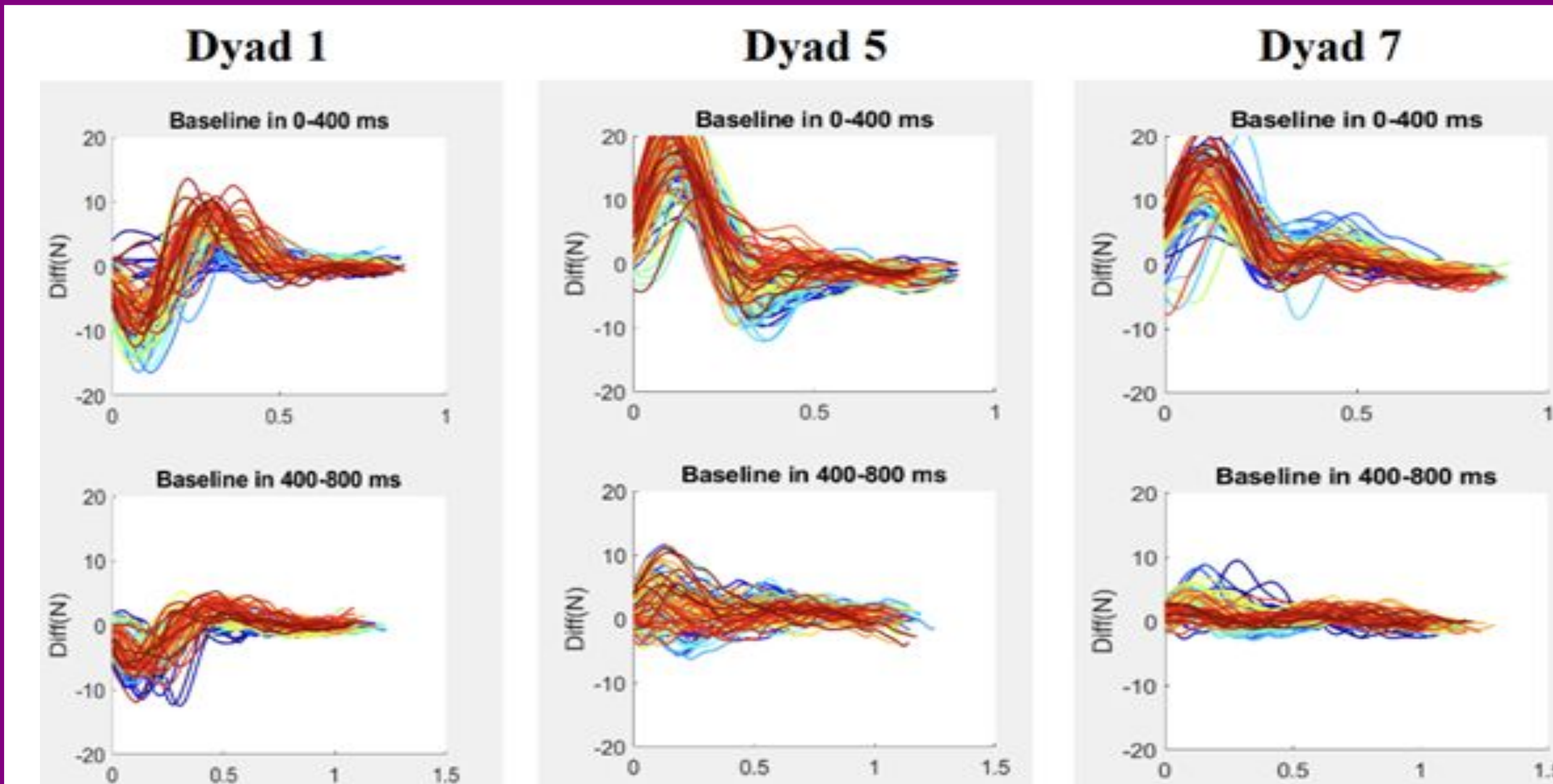
METHODS

Various motor tasks were performed using the KINARM interactive environment.



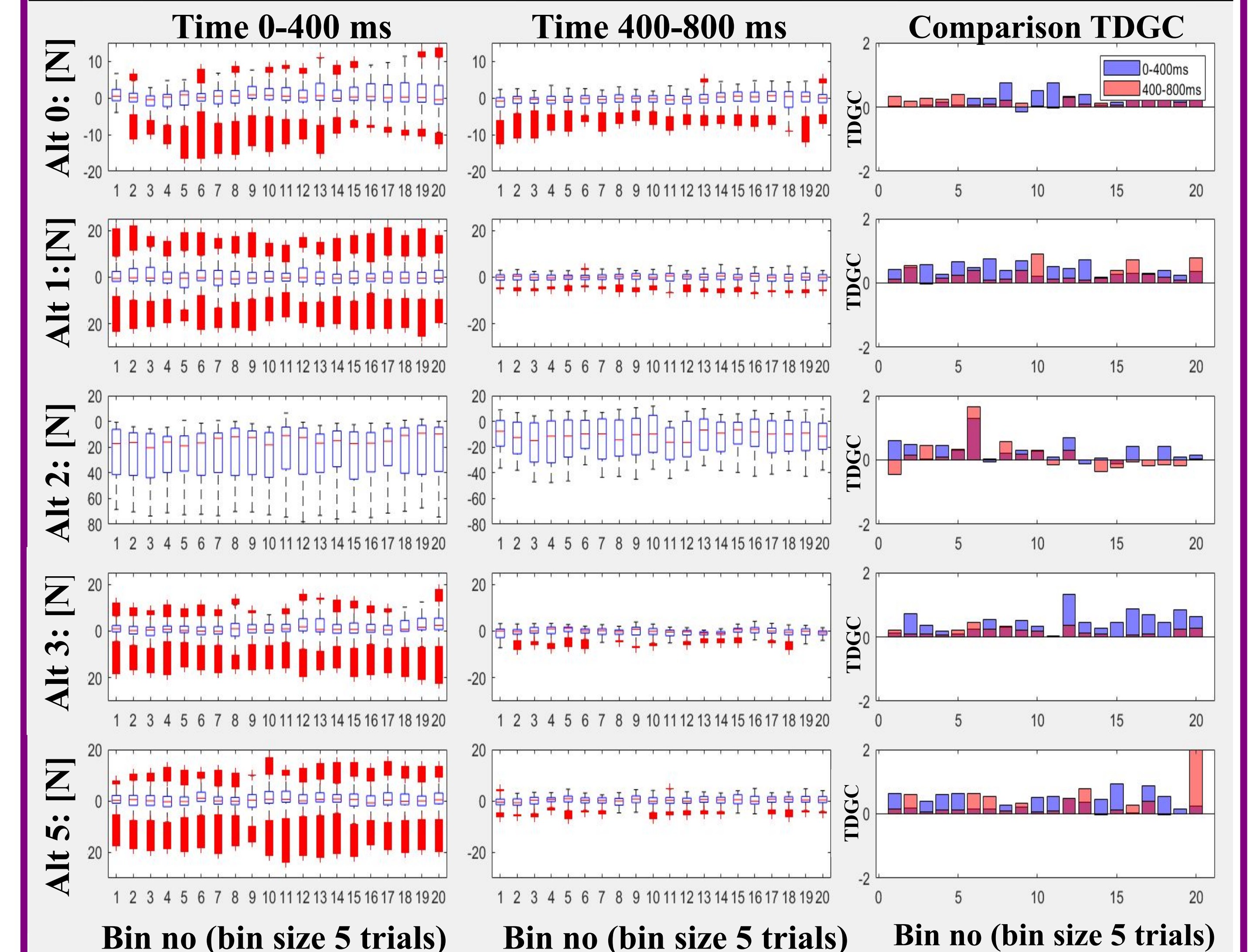
- Each dyad completes **14 blocks** with **100 successful trials** per block.
- Trials are classified as successful if both participants meet the time and performance requirements.
- Feedback is provided for unsuccessful trials: “too slow,” “too fast,” or “did not remain in target.”

RESULTS



This is the force difference (L-R) comparison. Beginning trials (blue) ending trials (red). There seems to be less of a force difference with the 400-800ms time frame.

RESULTS



Alt 0- Baseline, Alt 1- Change in Target Size, Alt 2- Excess Force, Alt 3- Disappearing Target, Alt 5- Visual Delay -Force [N]

SUMMARY, CONCLUSIONS AND FUTURE DIRECTIONS

- Preliminary results suggest the 400–800 ms window represents a more stable phase of interaction, with reduced force differences and fewer outliers.
- The initial 0–400 ms period likely reflects reactive, uncoordinated responses before partners adapt to each other’s movements.
- Findings suggest coordination improves after an initial adjustment period, possibly requiring >400 ms for effective motor synchronization.

REFERENCES/APPROVAL

Work has been approved by ASU IRB (#STUDY00017679)

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