Coordination in Homogeneous and Heterogeneous Teams

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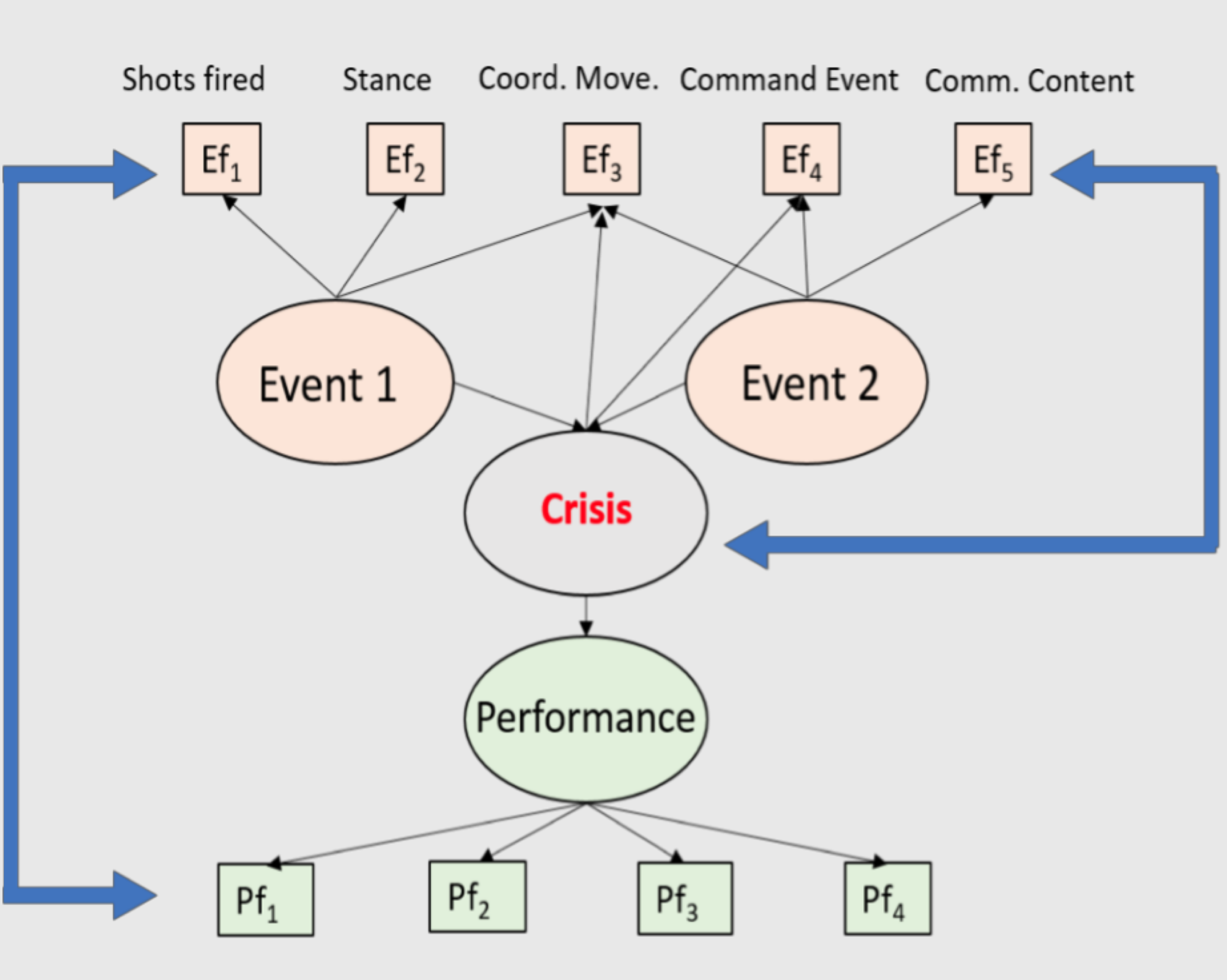
Abstract

Cross-domain indicators of coordination connect to performance. In a design task, teams coordinate behavior through **similarity** in solution space exploration and reduction. In highly dynamic military planning task, teams coordinate movement in **complementarity**.

Design and Planning Tasks

Solutions for <u>design problems</u> consist of component configurations that achieve functional goals and constraints; whereas, solutions for <u>planning problems</u> consist of sequences of actions (i.e., plans) and their executions that achieve environmental goal states. Although seemingly different, they have parallels. Bridge design requires coordination between team members on an optimization problem and a hostage rescue planning requires coordination on the best set of values, one for each team member.
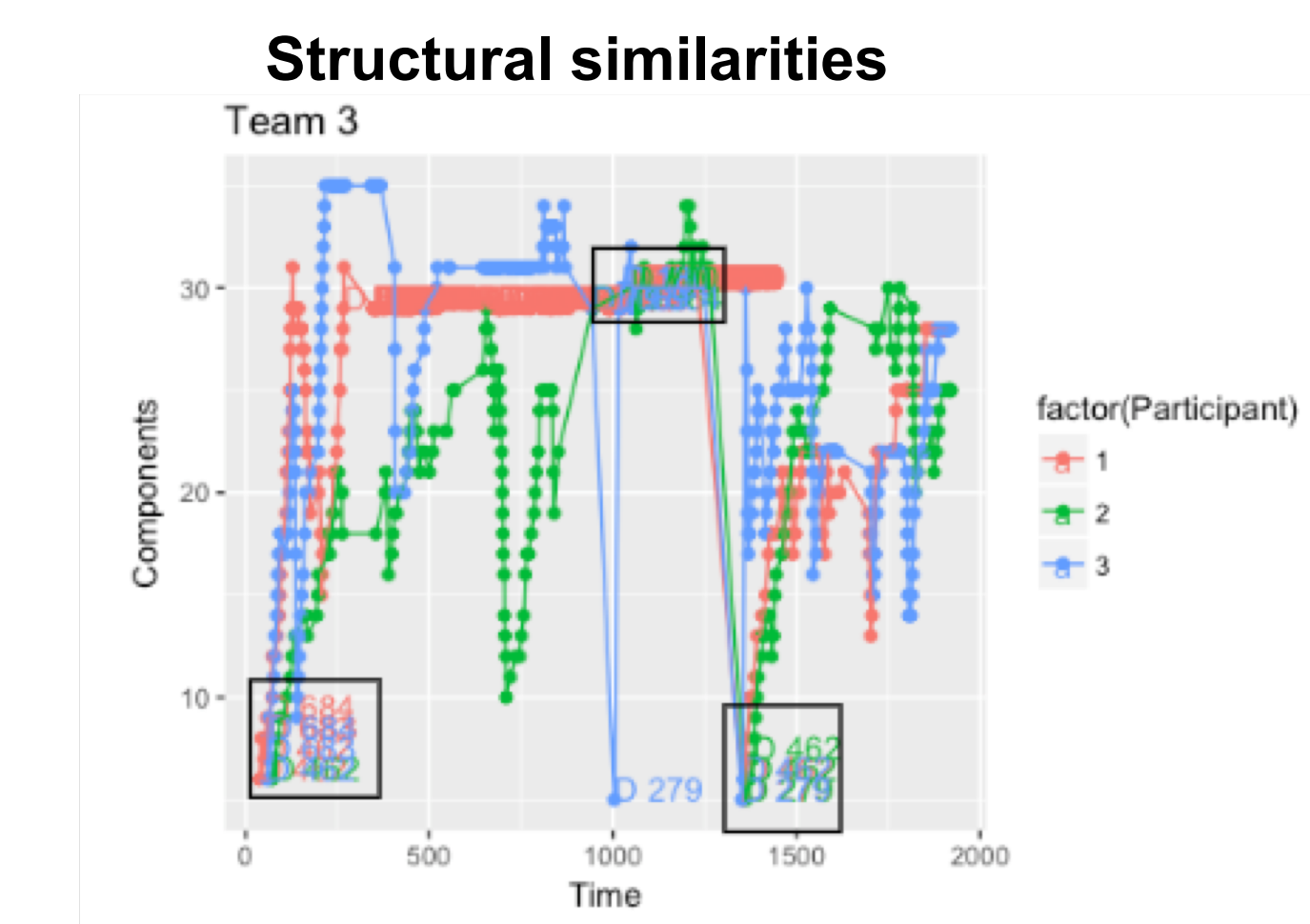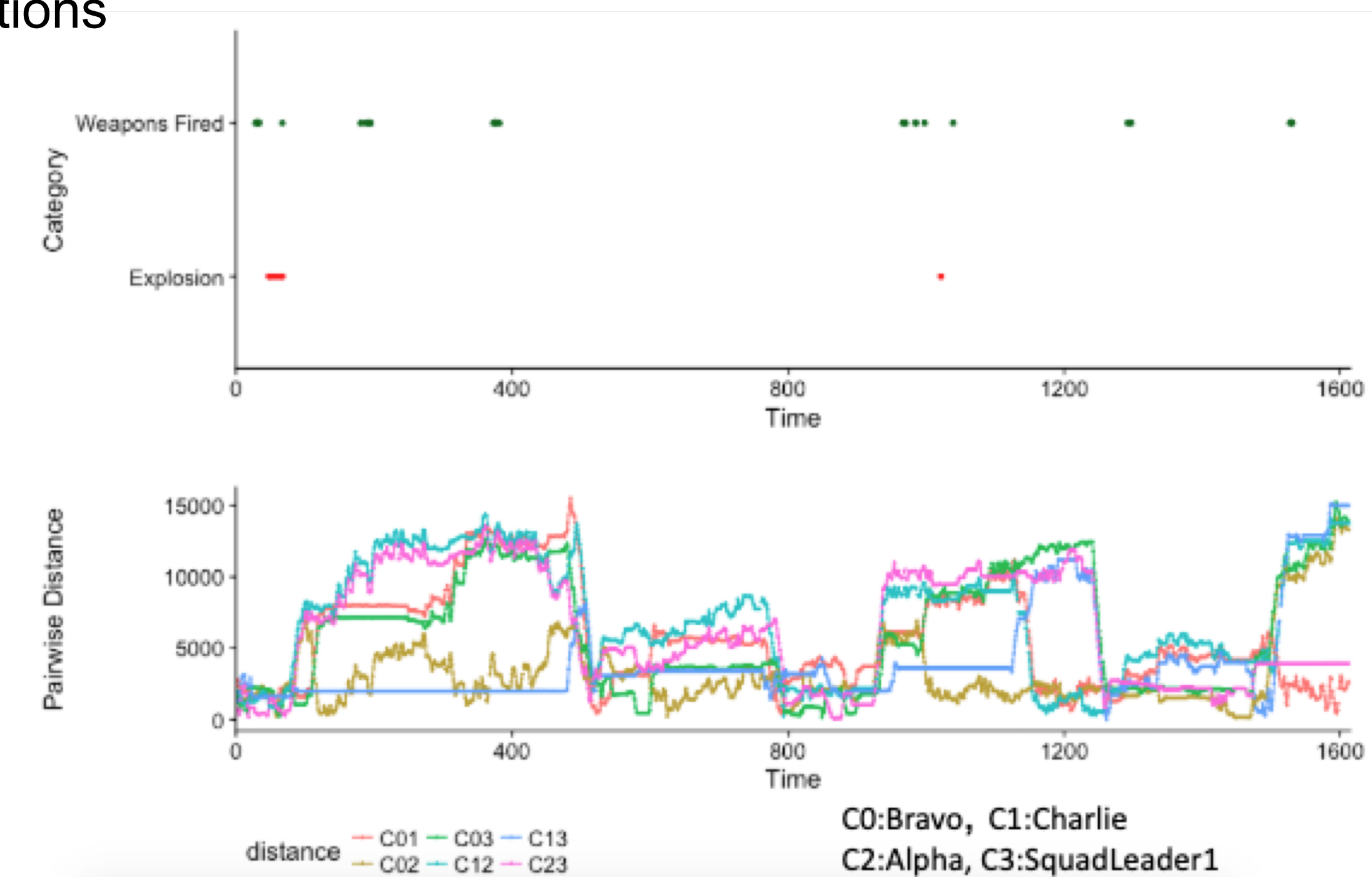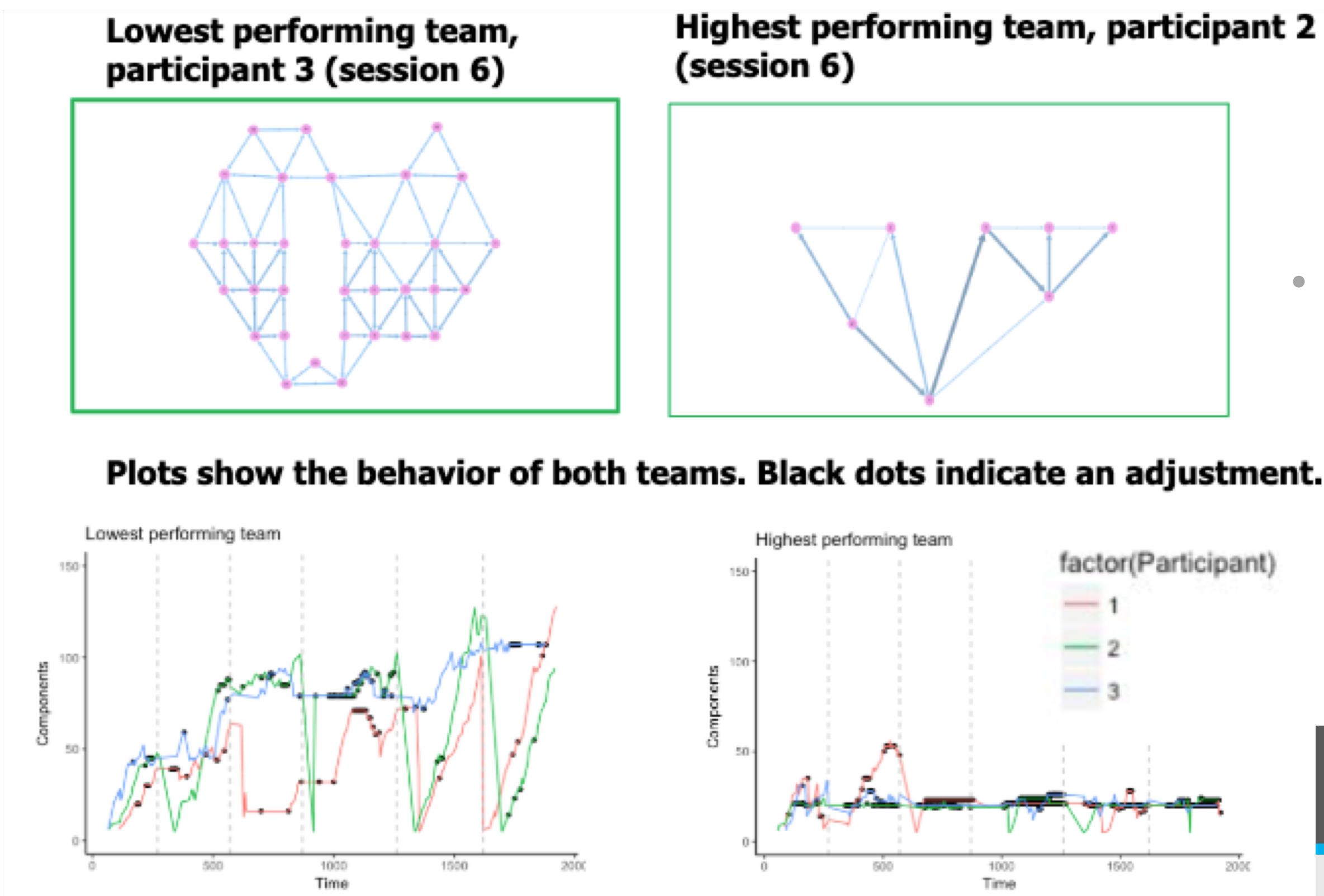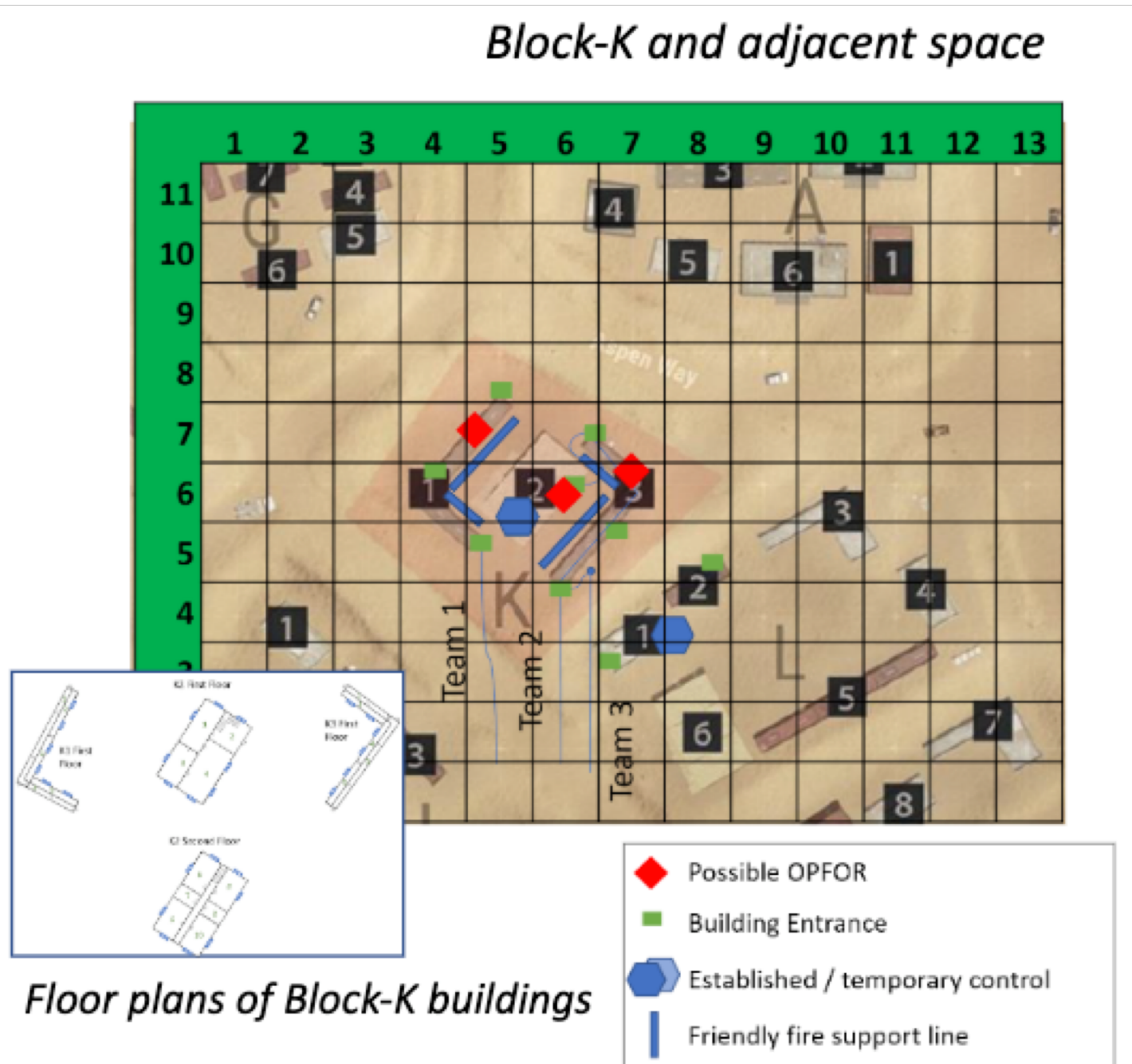
Objective

Method

Metric	Hostage rescue mission	Bridge design task
Solution properties (individual) at time t	Angle Speed Stance	Design: Number of edges Weight
Distance to teammates (Pairwise distances)	Between pawns positions: Angle team (direction) Dispersion	Between teammate designs: number of edges separating two graphs
Distance to self in time (differences at t-1, t+1)	Acceleration Stance change Angle self (direction)	Design evolution Rate of design changes
Sudden disruptions (in problem representation)	Distance between pawns	In design sizes In number of edges between designs
Problem change	Death in the team	Problem statement change

- **Bridge design task:**
  - 16 teams of 3
  - Unexpected problem statement change at 2 points

Structural similarities
Team 3

Lowest performing team, participant 3 (session 6)

Highest performing team, participant 2 (session 6)

Plots show the behavior of both teams. Black dots indicate an adjustment.

Lowest performing team

Highest performing team

- **Hostage rescue planning:**
  - 4 cohorts (4 participants) – 4 simulations

Block-K and adjacent space

Floor plans of Block-K buildings

- Possible OPFOR
- Building Entrance
- Established / temporary control
- Friendly fire support line

C0:Bravo, C1:Charlie C2:Alpha, C3:SquadLeader1

Results

Feature	Result
Global	
Adjustment	r(14)=-0.53, p=.04*
Structure	r(14)=-0.08, p=.8
Momentary	
Adjustment	r(14)=-0.67, p < .001**
Structure	r(14)=0.64, p < .001**
Graph similarity	r(14)=-0.54, p=.03*

Feature	Result
Global	
Speed	r(14) = -0.26, p=.3
Dispersion	r(14) = 0.42, p=.1
Angle variation	r(14) = 0.09, p=.7
Stances variation	r(14) = -0.20, p=.4
Momentary	
Speed	r(14) = -0.94, p< .001***
Dispersion	r(14)=0.57, p=.02*
Angle variation	r(14)=-0.93, p< .001***
Stances variation	r(14)=-0.91, p< .001***

- **Bridge design task:**
  - Average coordination in high performing teams was also higher than in low performing teams (t(5.04)=-2.87, p=.03).
  - Graph similarity predicted 32% of the between-team variance in performance.
  - Performance_rank=5.96*similarity-0.73; F(1, 14)=7.912, Adj. R sq.=0.32, p=.01.
- **Hostage rescue planning:**
  - Dispersion, speed, stance variation and angle predict 93% of the between-team variance in performance
  - Deaths= -3.445e-01 speed+1.060e+00 angle-7.289e-01 stancesd+1.238e-04 speed*Dispersion-2.995e04 Dispersion*angle+1.713e-04 Dispersion*stancesd + 2.768e+01; F(4,11)=50.97, Adj. R.sq.=0.93, p< .001).

Conclusions

Coordination before critical changes (problem statement in the bridge design task and deaths in the rescue domain)

Explore what observables indicate team coordination and the different types of coordination

Coordination in design domain = design similarities

Coordination in the hostage rescue domain = cooperation towards the same goal (proximity, speed, directions, etc.)