

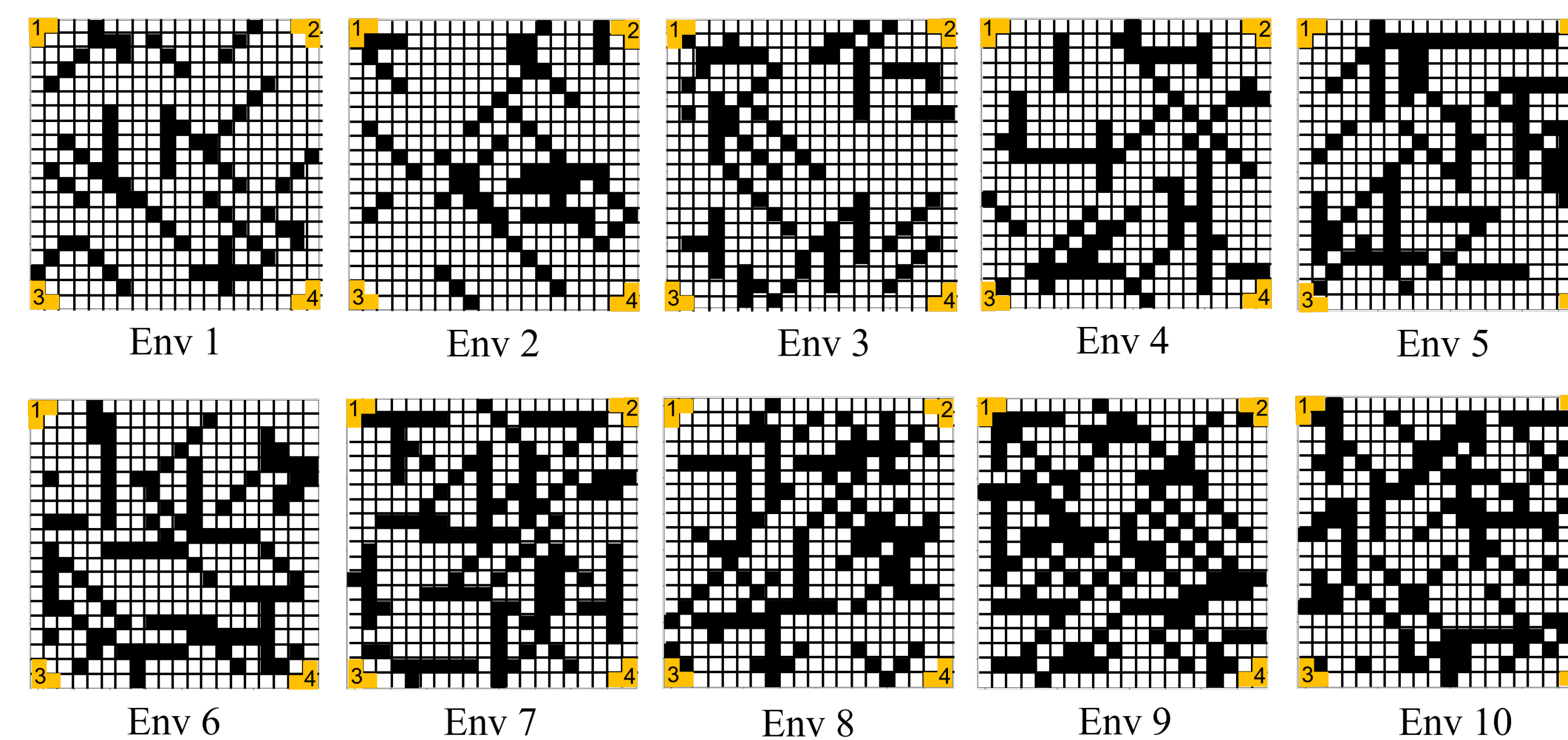
Background

Cooperative multi-robot teams need to be able to explore cluttered and unstructured environments together while dealing with communication challenges. Specifically, during communication dropout, local information about robots can no longer be exchanged to maintain robot team coordination. Therefore, robots need to consider high-level teammate intentions during action selection.

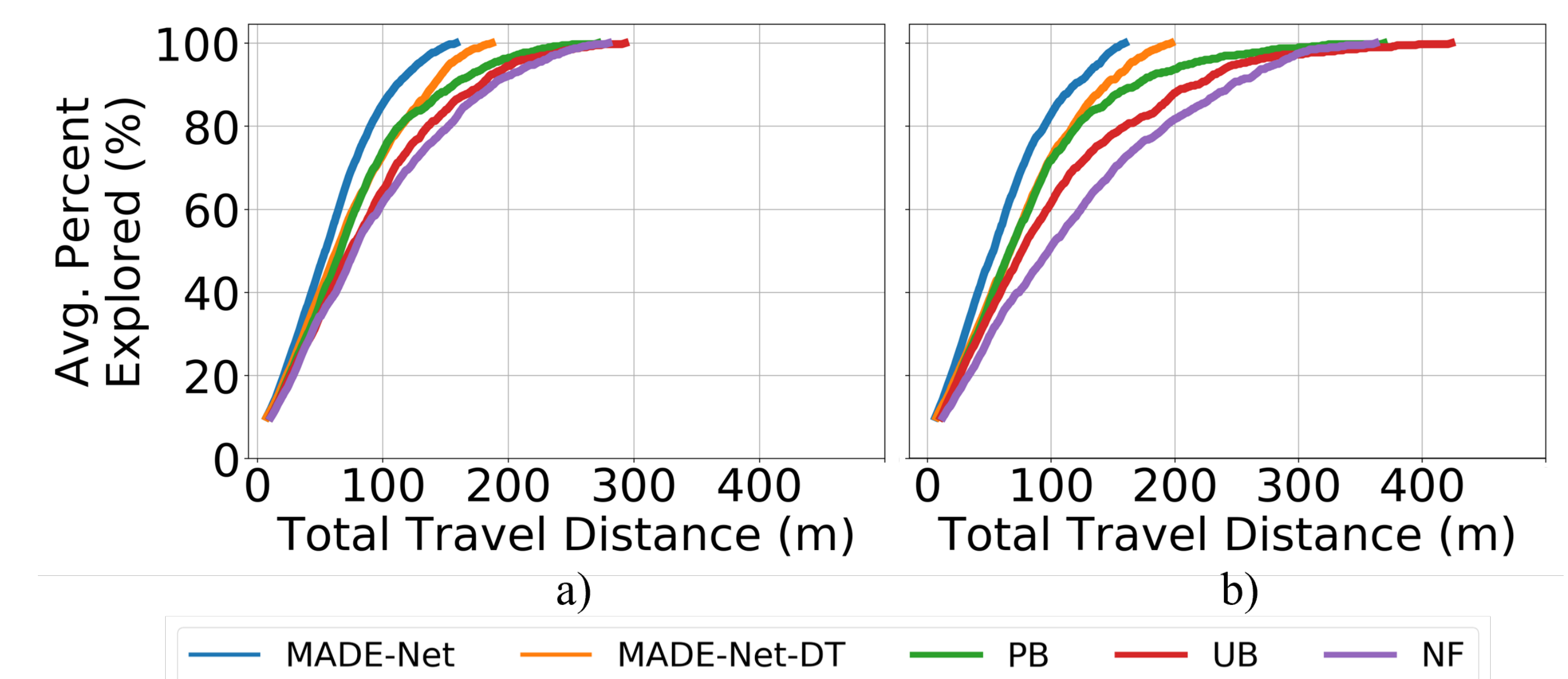
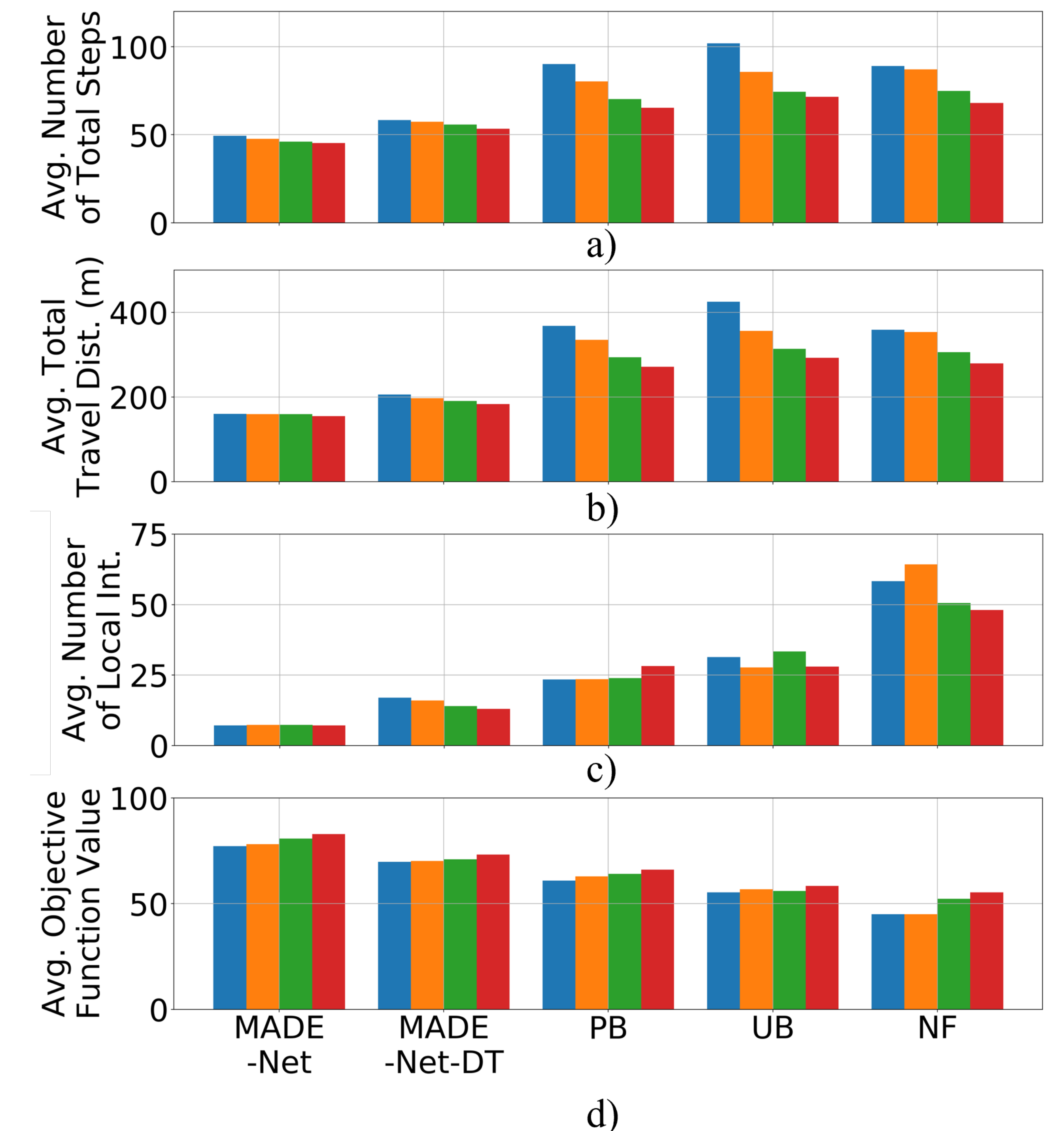
We present a novel multi-agent DRL method, known as MADE-Net (Macro Action Decentralized Exploration Network) to address the challenges of communication dropout during multi-robot exploration in unseen, unstructured, and cluttered environments. We utilize Centralized Training for Decentralized Execution (CTDE) [20] to learn robot coordination and teammate intentions with centralized information (system states, observations, and actions) while only using local perception during decentralized exploration execution.

Experiments

Ten **20 x 20 grid environments** were randomly generated with increasing degrees of clutter to investigate spatial distribution within robot coordination. Robots had a **10% sensor dropout** and **90% movement success probability**. **Communication dropouts** are represented by the failure of robots to exchange information with each other within sensing range. **Benchmarked** against three classical decentralized exploration methods and one DRL method that utilized macro-observations/actions.



Exploration Results



Macro Action Decentralized Exploration Network (MADE-Net)

