ABSTRACT

This chapter discusses the problem of agent aiding of ad-hoc, decentralized human teams so as to improve team performance on time-stressed group tasks. To see how human teams rise to the challenge, we analyze the communication patterns of teams performing a collaborative search task that recreates some of the cognitive difficulties faced by teams during search and rescue operations. Our experiments show that the communication patterns of successful decentralized ad-hoc teams performing a version of the task that requires tight coordination differ both from the teams that are less successful at task completion and from teams performing a loosely coupled version of the same task. We conclude by discussing: (1) what lessons can be derived, from observing humans, to facilitate the development of agents to support ad-hoc, decentralized teams, and (2) where can intelligent agents be inserted into human teams to improve the humans’ performance.
INTRODUCTION

Teams are a form of organizational structure where the decision-making is a bundle of interdependent activities that involve gathering, interpreting and exchanging information; creating and identifying alternative courses of action; choosing among alternatives by integrating the often different perspectives of team members; implementing a choice and monitoring its consequences. It is well recognized that proficient teams achieve goals and accomplish tasks that otherwise would not be achievable by groups of uncoordinated individuals. While previous work in teamwork theory (Salas and Fiore, 2004) has focused on describing ways in which humans coordinate their activities, there has been little previous work on which of those specific activities, information flows and team performance can be enhanced by being aided by software agents. This chapter reports work on, (a) characteristics and challenges of human teamwork, related to decentralization and self-organization in time-stressed situations, (b) study of human teamwork performance that incorporate these challenges in order to establish a baseline, and (c) identification of fruitful ways for agents to aid human teams with these characteristics.

In this chapter, we focus on examining the coordination and self-organization problems faced by decentralized ad hoc human teams. Ad hoc teams are groups that are brought together for the duration of a task and who lack prior experience training together as a team. An ad hoc team can be as simple as a group playing a pick-up soccer game in the park or as complicated as a multinational peacekeeping forces working alongside personnel that lack previous operational experience working together. Much of the previous work on human teamwork for time-stressed situations, most of it in commercial aviation and the military, has focused on (a) teams where the team members already have an assigned role (e.g. a pilot, co-pilot and navigator in cockpit teams), (b) where the team already has a given authority structure, and (c) where the team members were collocated. Recent interest in supporting emergency response teams, military interest in operations other than war, and coalition operations, motivates the need for teams that engage in time-stressed tasks, are distributed in space and time, and are ad hoc in their organization.

Some important issues arise in ad hoc teams: when faced with a new task, how do team members that come together as a team for the first time create roles and allocate them to team members, when no organizational structure is exogenously provided? To design and build software agents that can assist ad hoc and self-organizing human teams tackling unfamiliar tasks, we need to address this question. If the supporting agents are insensitive to shifts in the team’s organization, they cannot effectively monitor the team’s activities. (Please see Chapter XIX, “Dynamic Specifications for Norm Governed System” by Artikis et al., for more discussion on the problem of run-time organizational shifts).

Although our research is focused towards the ultimate goal of developing agent assistants for human teams, we believe that this work is also relevant to researchers studying purely agent-based teamwork, especially as agents become increasingly sophisticated and capable of human-like teamwork.

Work in the team literature (Fiore et al. 2003) has found that establishing effective communication patterns are the key to creating effective ad hoc agent systems and human teams; this is especially true for distributed ad hoc teams in which communication is cited as a key problem area (Pascual et al., 1999). Our research is an initial step towards the problem of identifying communication patterns of teamwork of ad hoc and distributed teams in time-critical situations so that suitable agent aiding strategies could be developed. The identification of the patterns is through communication logs collected from human teams. The results of prior research on team communication have typically been used for developing guidelines for team training. In contrast, we are interested in using team communication results for