Sarah Mathew
CUNY Hunter College
ArticuLab, Carnegie Mellon University
sarah.mathew@macaulay.cuny.edu

Social Game Representation

I. Introduction

While students are increasingly taught under the teach to the test paradigm, general problem solving and collaborating are becoming highly sought-after skills in today's economy. Students should be learning these skills so they can successfully navigate whatever problems they are faced with.

The Sensing Curiosity in Play and Responding (SCIPR) project will scaffold curiosity through multi-party collaborative game play [10]. It will have a model of curiosity and track the behavior of people who are playing the Outbreak game. By leveraging this information, the agent will behave in a way (e.g. asking more questions) that may evoke curiosity from the players. This project also explores how small-group setting and technological interfaces can be useful. This is especially relevant since classes are oversized and schools are incorporating more devices into education.

In order to allow an agent to do this, it must be able to understand and play a game. What separates this representation from others such as chess is that there is communication and shared knowledge. The agent must take advantage of what other players say during the game. Representing a cooperative game has not been done before.

II. Background

Embodied Conversational Agents

Embodied conversational agents (ECAs) are a technology that can interact with humans using social and verbal behaviors. They have been used as tutors, conversation facilitators, and guides [6,8]. Gamble is an ECA that plays a game with two people [9]. It is built with emotional and personality models, nonverbal behaviors, and verbal behaviors learned from others who have played the game. In this study, users found the ECA to be a competent player and partner.

General Game Playing

A general game playing system can accept a definition of a game and then play it autonomously [2]. What separates this system from those such as Watson and AlphaGo is that a general game player is able to play any arbitrary game, while the others are highly specialized for one game. Traditionally, the games used for the system are two-player deterministic board games.
There have been extensions to the GGP system to incorporate stochastic changes and incomplete knowledge into the game representation. GDL-II is a version that uses a random player to allow unpredictable state changes (die roll outcome), and a tag for incomplete information (e.g. not

knowing your opponent's cards) [13]. GDL-III has been the latest suggestion that allows introspection, or shared information between players [14].

Recently, an ECA has been developed that can use the GGP system to play games with others [5]. The primary goal in this setting, however, is to be entertaining to the other players, rather than to compete.

Curiosity

Research shows that curiosity can contribute to problem-solving by asking questions and seeking information. Recently, a computational model of curiosity has been defined that is based on sequential behaviors [12]. There is also research suggesting that an autonomous robotic peer can influence a child's curiosity level simply by acting curious [4]. For our research, we are focused on affecting curiosity in a purposeful way.

Outbreak

Outbreak is a cooperative table-top game with physical pieces [15]. Three to four players must work together to escape the board with enough antidotes. They are given gear cards that each have specific skills. They also share a robot piece that moves across the board once a die is rolled. If they stop on a room, they are given question templates, and must ask questions according to the structure within an allotted time. They must figure out what possible threat is in the room, and what skills they may need. After this period, they discuss what gear cards to send in and the current player makes the final decision. There is data for several games played by children. Some were annotated for verbal behaviors and/or nonverbal behaviors. This was done so the behaviors can be incorporated into the agent so it can play like humans and also affect curiosity using natural behaviors.

Decision making

STRIPS is a planner that uses tree-search algorithms that apply an action to some state [1]. A Hierarchical Task-Network Planner works by choosing complex actions, which decompose into atomic actions, to reach some goal [3]. Maes's planning architecture is flexible and works in a dynamic environment; it tunes the importance of various actions depending on time, current state information, and state updates [7].

III. Method

I first approached this by separating the Outbreak game into various central phases. They are the initialization, board, question asking, discussion, and results phases. These are separated by actions that transition to difference behaviors. For example, once players land on a room and choose a threat level, they can start asking questions about the room. I used Stanford's ggp-base validator software to check my game description. I separated the description for each phase, and iteratively tested it.

I also worked on developing a logic for the player to use to figure out what actions (verbal behaviors) it can take during the game. This was designed to suggest actions if there was incoming information that changes a state.

IV. Experiment

Each week the SCIPR team tested the game with one member behaving as the virtual player and receiving suggestions for verbal behaviors from me. This information was recorded through a WoZ system. Afterwards, we would analyze what the virtual player did well, and what it lacked.

IV. Results

Using GDL does not work well for Outbreak since the agent has specific actions that it must know (like suggesting to use a card). GDL are for general game playing systems, and during the course of this research, the verbal behaviors were defined as actions that the agent would need to refer to if it was chosen in the description.

For the game testing, we found that people expect agreement from the agent, and it must be quick, otherwise the other players move on. Also, players expect the agent to respond to suggestions and tell them if its cards can be used. Even with defined verbal behaviors, players expected more from the agent.

V. Conclusion

The results from this work are two-fold. Firstly, there should be a dialogue management system that tags verbal behaviors exhibited by other players. Next, in the long run, there should be a game playing system that integrates social behaviors. More and more games require interacting with other people, and these systems should allow for actions such as negotiation or building rapport.

VI. Future Work

The next step is to work on a dialogue management system that can label and track behaviors.

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