

Action-Based Communication in High Speed Games

ABSTRACT

Multiplayer games provide a setting for social interaction and demand a high level of coordination, both cooperative and competitive. Yet there is often very little verbal interaction. The necessary communication is through nonverbal actions. The problem is how to study action-based communication. We report on an initial study into action-based communication in online board games, including analysis using Layers of Interaction from Clark's [2] model of language. The study provided a great deal of insight into the types and structure of information communicated. We describe how the methods can be applied to understanding coordination in high speed games.

Categories and Subject Descriptors

K.4.3 [Computers and Society]: Organisational Impacts – *computer supported cooperative work*.

General Terms

Experimentation, Human Factors.

Keywords

Cooperation, competition, action-based communication, games.

1. INTRODUCTION

Internet-based multi-player games are extremely popular and successful. In terms of coordination, these games range from turn-based games such as Chess and Backgammon, to high-speed real-time games such as Street Fighter and Quake. There are many types of group activity as people coordinate and compete.

However, previous research, e.g. [7], has found that in board games, despite the social setting, there is little verbal communication. This same research has suggested that the game moves are the mechanism for social interaction, and are a substitute for conversation in this setting.

But how do we study these action-based interactions? Our solution is to analyse the actions as conversations.

We have performed an exploratory study analysing game moves according to Clark's [2] theories of language. We had participants play a board game online and then interviewed them separately to discuss their interpretations of each move. We compared responses from both opponents to gain insight into the information flow and shared understanding between opponents.

We found that there is a cooperative, with players worked together towards the shared goal of successfully finishing the game. Built on top of the cooperative layer is a competitive strategic layer. There are more divergences in shared

understanding at the strategic layer than in a cooperative verbal conversation as players do not wish to correct their opponent's misunderstandings

The insight that we gained into information transmission and shared understanding in action-based communication through this study is encouraging. In this paper we suggest adapting the method to studying high speed games.

Action-based social mechanisms for high speed coordination in real-time games are understudied. Existing research (e.g. [10]) focuses on the verbal while showing that the verbal is very minimal and highly dependent on action-based interaction. Often in this type of games, the action is simply too fast for verbal coordination.

In competitive situations, players do not want their opponents to know their strategy and so do not engage in any verbal coordination. However, players still know what the opponent is doing and respond to it.

In this paper we propose extending the methodology used to explore turn-based games, to investigating action-based communication in high speed real-time games.

2. RELATED WORK

Non-verbal coordination is not a new concept. Game research has found many examples, and CSCW research has repeatedly emphasised the importance of artefacts and actions. We also give a quick summary of the work of Herbert Clark's [2] theories of language, which we use to structure our analysis.

2.1 Game Communication

Various studies of online games have noted that social interaction happens without explicit verbal utterances. For example, studies of Massively Multiplayer Online Games [4,8] and a board game site [7] have observed complex interaction between players with little verbal interaction. McEwan et al. [7] suggest that the moves within the game can be considered as communicative acts and are a replacement social interaction for the missing verbal exchanges.

In their study of the virtual environment *There*, Brown and Bell [1] emphasise the importance of being able to "*do things with others*" or "perform" friendships. In *There*, a core component of performing friendships was interacting around and referring to objects. In this work, we focus on communication through objects.

This work is a result of these ideas – actions replacing the verbal and building relationships through action.

2.2 Coordination Through Artefacts

Much CSCW research has emphasised the importance of communication through artefacts. For example, workplace studies such as Heath and Luff's [5] study of a London Underground control room demonstrated the importance of individuals making their actions publically visible to colleagues. Public visibility resulted in mutual awareness of actions enabling tightly interwoven actions. Their work describes how individuals make visible actions on their own artefacts. In contrast, board games have everyone focused on a shared artefact.

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Conference '10, Month 1–2, 2010, City, State, Country.

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Perhaps closer is Dix's [3] concept of *feedthrough*, which describes how artefacts can be a channel for communication as or more important than verbal communication in a task.

In the online games, feedthrough is necessary to coordinate actions. However, feedthrough implies a level of disconnect between the people involved. Rather than the participants acting around an artefact, they use it as a medium for communication.

2.3 Language and Joint Action

We use the theoretical framework of communication proposed by Clark [2], in which actions and artefact manipulations can be seen in strongly communicative terms, such that they can take the role of utterances in a conversation. The main elements of Clark's theory are:

1. Actions in the world can be explicit communicative acts (he calls these *manifesting actions*) – for example moving a chess piece “says” something explicit and concrete to another person (e.g. “it’s your move”);
2. The idea of *joint actions*, in which the communicative acts consist of sending meaning through signals to an audience that is monitored for understanding, with the goal of jointly achieving *shared understanding*;
3. The idea of *layers of communication*, suggesting that a single utterance or action can have different meanings at different contexts; this is similar to Robinson's [9] idea of ‘double level language’ in CSCW;
4. The idea of *common ground*, shared knowledge that allows people to interpret each others’ communicative acts, and to simplify their communication because they know how the other person is likely to interpret their contribution.

We choose to employ Clark's framework because it seems to best encompass the characteristics of the game-based interactions that we have observed, and because the temporal, turn-based, and back-and-forth nature of board games does seem to suggest the idea of a conversation of actions.

3. EXAMPLE STUDY OF BOARD GAMES

The goal of our study was to gain insight into shared understanding developed through the game moves. To achieve this we had people play a game online and participate in a solo interview where they discussed the meanings of each move.

3.1 Participants

Participants responded to recruitment emails asking for expert players of Chess, Backgammon, or Checkers. We asked for expert players so that there would be interesting strategic play, and to produce insightful commentary on their opponent's strategy. Despite our request for experts, we had a range of experience, though all participants had at least a basic ability with the games.

3.2 Procedure

Participants first filled out a short questionnaire about their experience, relationship to their opponent, and how often they had played against them. They then played a game against each other online. They were physically separated so that they could not converse verbally. The game did provide a text chat, but nobody chose to use it. The games were ten minute timed games, so games lasted a maximum of 20 minutes.

After the game, each participant was interviewed separately for 30 minutes about the game. The investigator set up a real world board and replayed each move. After each move the investigator

asked either “Why did you make this move?” or, “Why did your opponent make this move?” The interviewer often asked follow-up questions.

3.3 Analysis of Four Layers of Interaction

One investigator watched videos of the interviews and summarised people's comments. We used Clark's concept of interaction layers to arrive at four layers for analysis:

1. Physical: the board and pieces used for the game
2. Syntactic: the basic rules of the game
3. Strategic: using the syntactic to compete
4. Personality: conclusions about the opponent

3.3.1 Communication at the Physical Layer

The physical layer consists of the board and pieces (although it does not have to be physical – for example, it could be displayed on a screen, or on a real world board). Players in general did not comment on the physical layer in the interviews – the only comment we received about this layer was from one player who expressed how different the real board looked and felt compared to the online game interface. In general, there was such a strong shared understanding at this layer that the players did not even think about it. This is perhaps similar to verbal conversations where two people speak the same language; they do not notice the actual speaking level. Even though players do not often consciously think about this layer, information can ‘bubble up’ to be used to make inferences at higher layers.

3.3.2 Communication at the Syntactic Layer

This layer specifies the basic rules of the game and is built on the the physical layer. The rules specify the starting state, how players take turns, how pieces can be moved, and the termination condition, e.g. in checkers, a piece can only move diagonally into an empty square. This level of interaction is highly mechanical and so responses are well known. An example from everyday life is passing conversation: “hi”, “how are you?”, “fine”.

This layer was almost never mentioned during our interviews. While we have no confirmation, we can infer three probable reasons for this. First, the game was played through an online system that enforced the rules. Second, this is assumed common ground. Our recruitment process asked for people who could play the games and so, while players may have had assumptions about how well their opponents played, they did not question whether they could play. Third, people did not mention the basic rules as they assumed the rules were not interesting to the interviewer. For example, they assumed we knew a knight could move to that place and that we were more interested in why they moved it there. The few comments that we heard during interviews were dismissive; for example, when an interviewer asked about a chess move that was forced, the only reply was “*That was the only move he had an option to do, so [player trails off]*”

One of our participants mentioned an obscure chess rule (En passant), knowledge of which often indicated experienced players. This is similar to spoken conversation where we make assumptions about a person's sophistication based on their verbal behaviour. There is a wider range of expression in spoken language than in a board game, so there is likely to be a “ceiling effect”, i.e. a lot of people perform perfectly at the game rules.

3.3.3 Communication at the Strategic Layer

The Strategic Layer is the competitive layer where the players strive to gain advantage over their opponent and eventually win

the game. Movements take on strategic and tactical meanings. For example, moving in chess may have several meanings, e.g. placing pressure on a piece, or gaining position. Strategy makes use of the rules of the game, but is more than just the rules.

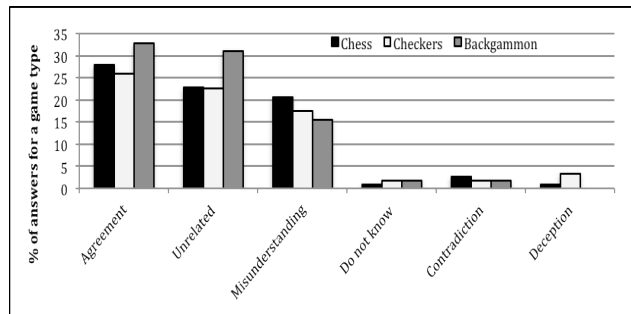


Figure 1: Relative occurrences of Strategic Layer codes.

We compared both players' summaries and coded each move. Initially, we were only interested in whether they agreed. However, we quickly found moves where the players neither agreed nor disagreed, but discussed different topics. We also found different reasons for disagreement – contradictions and misunderstandings. There were also times when a player admitted they did not know why a move was made. Finally, we discovered a few cases of deliberate deception. Our final coding categories were:

1. Agreement: the players agreed on the meaning of the move (though not necessarily whether it was a good move);
2. Unrelated: the players commented on different topics;
3. Misunderstanding: misunderstood strategy of the opponent;
4. Do not know: did not know why a move was made;
5. Contradiction: players directly contradicted each other;
6. Deception: a player explicitly tried to deceive their opponent.

Figure 1 shows relative amounts of each code. We gain several insights into the strategic communication from this simple chart. First, all of the games are very similar (for our very exploratory study), suggesting that the genre of games can be treated similarly.

Second, agreement is quite high and contradiction is extremely low, indicating that players had a good understanding of what was happening most of the time.

Second, misunderstanding is much higher than in a verbal conversation (even arguments [6]). This reflects the competitive nature of the game; players are happy when their opponent does not understand their strategy. Consequently there are no repairs.

Third, unrelated comments are high. Players had a lot of possible topics to talk about and so they frequently talked about different things. We observed that unrelated comments increased with the expertise of the players; experts saw so many more options.

Fourth, we were surprised at how few instances of deception there were given the competitive setting. Players mostly assumed that their opponent knew their strategy and simply sought to play it out in an unassailable manner, taking advantage of small weaknesses as they occurred.

3.3.4 Communication at the Personality Layer

At this layer, players make use of information from all the other layers to form impressions of opponents. This is analogous to drawing conclusions about someone during verbal conversation

based on language and accent (physical layer), dialect and word choice (syntactic layer), and topics of conversation and kinds of rhetorical structures (strategy layer).

Strangers were interesting for how they formed opinions during the game. Unsurprisingly, they started with very general assumptions about other players. For example, one player said, "People are usually a bit more reluctant to take first blood I find" when explaining why he thought his opponent would not swap pieces. They refined opinions based on various strategies, e.g.:

"I start to gauge people when they capture pieces [and] based on which pieces they're willing to sacrifice. So I look at what they're willing to risk rather than position."

And formed many impressions about their opponents, e.g.:

"So he likes to attack, he doesn't want to defend."

From friends that had not played before, we also saw some evidence that knowledge of personality could be used to interpret game moves. For example, one player explained an opponent's move by saying "because she's a very tentative person".

There was a particular congruity between expert chess players who had played each other a lot, especially at the start of games as they played set sequences based on established theory ("from book"). They recognised the sequences and knew the favourite sequences, commenting "this is our usual opening" or "we always play this opening".

In general, however, as in other contexts, people will use whatever information is available to them to draw conclusions. It is likely that those conclusions will be wrong – people are quick to form judgements but the information at this level is highly underspecified.

4. ADAPTING TO HIGH-SPEED GAMES

There is a lot of communication between people in multiplayer high speed games, such as Street Fighter, Quake, and Starcraft. This can be cooperative or competitive.

While there is some verbal communication in cooperative situations, this is minimal and heavily based on the context of actions and artefacts [10]. In competitive environments, there is no verbal communication (at least for coordination).

This section outlines our thoughts on how to adapt the methodology in our board game experiment to study action-based communication in high speed games.

4.1 Participants

It is critical for participants to be experts when studying high speed games. In board games, even relative beginners have some strategy when they play and still gave interesting comments. However, novices often play high speed games without much strategy and could even just be "button-mashers". High proficiency experts can give insight into coordination at the reflex level. We also learnt they are usually better at self-reflection.

4.2 Procedure

The basic steps should remain the same. Participants play a game. Investigators then interview them individually, replaying each move and recording comments. The purpose of the interviews is to understand the players' shared understanding. Questions to the player performing an action should elicit the meaning of actions, and their beliefs about the opponent's understanding. Questions to

the viewer of an action should focus on their understanding, and what they believe their opponent wanted them to understand.

The main challenge of adapting the study methodology will be breaking the game into action ‘events’. In turn based games this step was straightforward as each turn was an action event. In high speed games, the action events are not so clearly defined.

During the interview, the game needs to be replayed move by move. A game expert is needed to identify moves and prepare a video for the interview.

We found during the board game study that non-experts are less likely to make assumptions and are better at playing the role of interested novices to draw out comments from the players. We recommend that the interviewers are not experts.

4.3 Four Layer Analysis

Comments can be analysed using the same four Layers of Interaction from the turn-based game study.

4.4 Physical Layer Communication

This layer contains the hardware and representation of the game. Game representations, i.e. what you see on the screen, are constant. However, hardware can differ greatly as these games are often available on multiple platforms and each platform offers controller and display options.

The influence of this layer is evident in higher layers. For example, the paucity of information in an online chess game is evident when compared to a real-life board, where a player can see hesitations, facial expressions, and postures. The influence of the physical layer is an interesting avenue for research that should be followed up in future studies.

4.4.1 Syntactic Layer Communication

This layer is the rules that constrain the physical. These include basic rules such as “If a character’s health is zero, they are dead”, but also more subtle “rules” such as how a character’s hurt box – the area on the screen where they take damage – changes according to their movements. This layer is still cooperative, as players operate within the game structure to complete the game.

In the board game situations, with a few exceptions, all players understood of the majority of the rules. In the more freeform high speed games, we anticipate more variation in knowledge of rules.

4.4.2 Strategic Layer Communication

As with the board game study, we would expect the majority of comments to be concerning strategy. The comments can be analysed in the same way as those from the board game study – coding and then comparison for shared understanding.

Informal conversations with expert players suggest that they make use of extremely sophisticated strategies. We get the impression that deception is a much larger factor in these strategies than we found in the board game study.

4.4.3 Personality Layer Communication

As with any situation, people make use of any information they can to draw conclusions about others. At the physical layer, if

they are co-located, then they will make note facial expressions, posture, and movement, but if distributed then they will be limited to character movements on the screen.

At the syntactic layer they see which rules their opponent knows, and at the strategic layer they see how their opponent makes use of the rules. For example, does the opponent run away and occasionally strike, or do they try to get close and engage?

5. LIMITATIONS

Two of the primary limitations of the methodology are:

1. Interviews are after the games so players are able to talk about moves with the benefit of hindsight. This is a trade-off as the alternative is to stop them after each move, which, in the case of board games, would reduce the natural context of play, and in the case of high speed games destroy it completely.
2. There is a separation in time between making a move and being asked about it. This could mean that players are giving answers based on a fresh interpretation of the game state rather than their thoughts at the time.

The board game study shows much insight can be gained through this method. It is important to remain aware of the limitations.

6. CONCLUSION

Games feature a lot of cooperative and competitive communication. However, much of the communication is not verbal but action-based – a topic with little previous research. We report on an initial study into action-based communication in online board games, including analysis using Layers of Interaction from Clark’s [2] model of language. We describe how to apply methods to understanding coordination in high speed games.

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