# Towards Communicative, Collaborative and Constructive Multi-Player Games

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## Abstract

*This paper provides a description and applicable models of the concept of interaction in the context of multi-player games. The description is not restricted to the level of current implementations. More concrete takeaway consists of the conceptual interaction model and the hierarchical interaction model, which can be used as basic guidelines for richer interaction design. Furthermore, the empirical part describes several cases providing deeper insight into the area of combining games and academic research.*

## Keywords

*Interaction, virtual environment, communication, behaviour*

## INTRODUCTION

The ambiguous, subjective and often very narrow definitions associated with the concept of *interaction* makes it difficult for researchers and game designers to communicate and combine their efforts in a way that would lead to more supportive and appealing multi-player games. The worlds of practice (the entertainment industry) and theory (academic research) are, often, totally ignorant of each other. In order to bridge the gap between theory and practice, this paper aims to provide more understanding into the concept of interaction in the context of multi-player games and game design. The paper illustrates the aspects of computer-mediated interaction by drawing from

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the theories of interaction and communication. The practical point of view is conveyed by presenting four empirical design cases.

Massively multi-player on-line games are gaining increasing popularity among the gaming community. Are the social and communicative aspects of game play the major driving forces behind this, or are the games just played for fulfilling players' materialistic and entertainment needs? There are plenty of games promoting inter-personal communication and interaction – either forcefully, or with a more subtle approach. What is the level of actual inter-personal interaction in these games? Are the players merely a bunch of mechanically performing solo artists, or, is there enough freedom and possibility to communicate, collaborate and co-ordinate with other participants?



Current multi-player games tend to follow the path of more or less straightforward action without any deeper creative sides. The constructive game-play often equals building up ones personal statistics in a relatively materialistic and non-creative way. However, the related research conducted within the context of Multi-user Dungeons (MUDs) clearly demonstrates the potential for creative and communicative togetherness [8, 4, 18]. Multi-player games offer enormous potential for collaborative activities and shared experiences. With the enhanced communicative features, the players would be able to express themselves and share their thoughts more naturally. Furthermore, the rich interaction support would offer players a more flexible and creative set of actions.

The attempt to overcome the communication limitations of networked applications has led many game designers to approach the problems of interaction in a top-down manner. However, it would seem that higher-level interaction (e.g., group dynamics, cognitive processes, motivational issues and tacit communication) is difficult to model and pre-program due to the complexity and scale of the matter [19, 23]. Partially because of this, the natural ways of interacting are still missing in many networked games. This has lead to highly limited game systems which lack the support for rich interaction.

The focus of this research is on those interaction forms which can be found within, and applied to, multi-player games. Interaction forms are descriptions, illustrations, representations or manifestations of actions targeted either at other players, or at the game environment. The work does not address interaction techniques or user interface issues, since the scope is 'inside' the virtual environments created by the game engines. In the search to find new and more innovative approaches to rich interaction design, this work concentrates on two research questions:

- What does the concept of interaction consist of in the context of multi-player games, and what forms of interaction can be explicitly classified?
- How would the understanding of interaction forms help the design of multi-player games?

The paper aims at providing both research and practitioner communities a new approach for designing multi-player games. A general understanding of interaction will enable game designers to develop more usable and, perhaps, even more engaging games. If designers know what type of interactions promote certain activities in the game, they can provide a setting that best suits their vision and focus.



## GAME DESIGN AS RESEARCH FOCUS

Game related phenomena have been studied from the psychological, sociological and cultural points-of-view. However, the anatomy and design of games have mainly been left to the practitioners of the application domain. Clanton [5] has claimed that the design communities of collaborative virtual environments (i.e., consisting mainly of researchers) and game developers (i.e., the industry) have complementary skills but rarely mingle and have little awareness of one another. Few software application designers attend game design conferences and, consequently, few software applications show any awareness of techniques of game design that could make them easier and more fun to learn and use. One of the few exceptions of applying game design to non-game virtual environments is provided by Clarke-Willson [6].

There exists an increasing body of literature describing and analysing games from the design perspective [7, 21, 2, 20]. However, the approach in these is mainly practitioner oriented, and, thus, does not necessarily tackle the research issues. Still, numerous publications discuss game design as an internal part of research experiments. Irrespective of whether these are text-based MUDs [22], 3D game platforms [13, 3, 11] or game-like testing environments [9], they all apply game design to solve their research problems.

The importance of a holistic game research, that would also entail design aspects alongside sociological, cultural, and aesthetic issues, has been raised by Aarseth [1]. Although his main focus is not on design issues, he clearly emphasises its value for the academic community. In view of this light, the scope of this paper covers the domain of multi-player games. The focus is on design issues, such as, supporting interpersonal interaction and enabling flexible and intuitive communication and collaboration in a constructive manner.

## RICH INTERACTION

In the context of this work, the term rich interaction follows the definition provided by Manninen:

> interaction set consisting of a large number of individual action and interaction types and possibilities that allows more complex interaction sequences. The complexity refers to the more natural forms of interacting, but due to the limitations in simulations, the virtual counterpart tends to stay far behind from the real-world one. [15].

Laurel [12] has provided one definition for the level of interactivity. In her definition, at least part of the interactivity could be characterised by three variables: frequency (how often you could interact), range (how many choices were available), and significance (how much the choices really affected matters). However, rich interaction is not just a quantitative measure; there is an as important qualitative aspect as well. The attempt to replicate every detail of real world interaction is similar to the attempts to increase the graphics resolution, or the data transfer bandwidth. Although there are several application domains requiring a high degree of realism, there is usually a need to maintain a certain amount of selectivity in the process of replication. The issue has been described by terms such as *selective fidelity* [10] and *artistic selectivity* [12]. Rich interaction is, thus, not merely related to the speed and the frequency of interaction. Aspects of qualitatively rich interaction also require full attention.

There are several possibilities to model interaction. This paper proposes two models that can be used to illustrate the horizontal and vertical dimensions of interaction forms. The horizontal dimension illustrates the range, or possible forms, of interaction. Figure 1 represents the model depicting the first layers of the applicable interaction forms. The model illustrates the main interaction forms that can be found, partially in the physical world, and partially in current multi-player games. The conceptual understanding of the interaction forms was used in the experiments as the guiding philosophy to define the mapping of the feature set. The aim was not to follow the model in every detail, but instead, it was used as background material from where the corresponding set of interaction forms was selected.

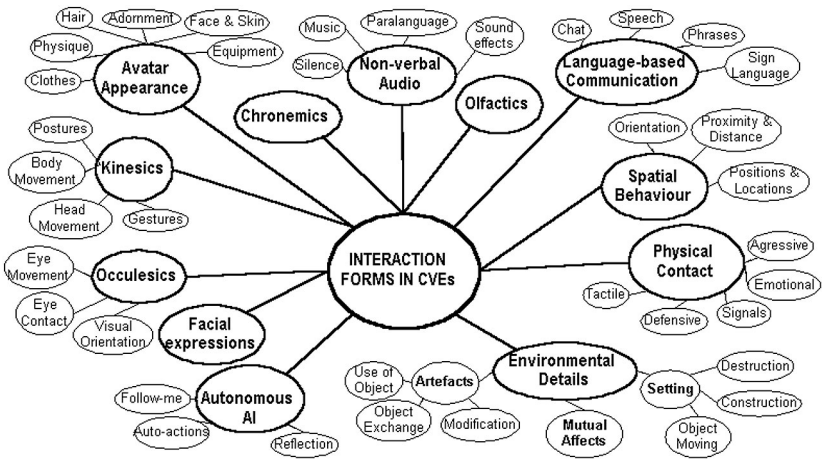



*Figure 1. Top-level categories of the rich interaction concept model.*

The vertical dimension of rich interaction is the hierarchical interaction model which defines the layers of interaction.

Figure 2 illustrates the model and corresponding application examples as inverted pyramid structures. The inverted pyramid is used in order to

emphasise the number of possible acts, variables, or degrees of freedom in each level. The main idea of this structure is to divide and classify the actions included in interaction, in order to create a hierarchical structure starting from low-level signal-type actions and ascending to the level in which the cognitively generated goals and objectives define the purpose of the interaction itself. The fields of robotics and artificial intelligence, as well as the game industry have used similar hierarchical structures.

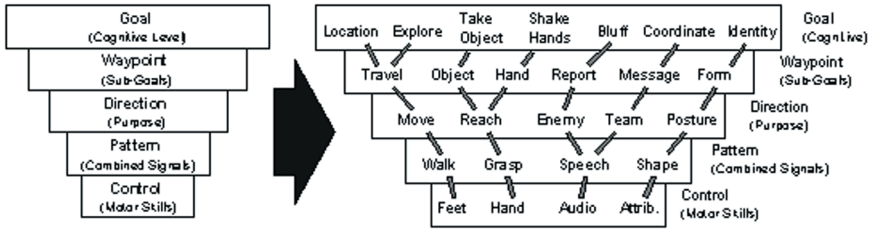



*Figure 2. Hierarchical interaction model and application examples.*

## EMPIRICAL CASES

The practical examples of applying the rich interaction concept models are demonstrated with four case implementations. The cases illustrate how theory and practice can be combined by introducing multi-player games and game ideology to the research domain. The case projects presented include:

1. *"Mobile Console Demo"* – Contextual Virtual Reality Prototype of a mobile multi-player multimedia game
2. *"Tuppi3D"* – Networked 3D playing card simulator with enriched interaction through non-verbal communication support, hierarchical interaction models and environmental aspects
3. *"Team Game"* – Collaborative aspects of interaction (communication, co-ordination, co-operation and construction)
4. *"Virtual LARP"* – Communication and enactment aspects of interaction and rich experience through group play combined with artistic approach

### Mobile Console Demo – Simulated Playing Context

The first empirical experiment – ConsoleDEMO – was used to demonstrate the utilisation of Contextual Virtual Reality Prototyping (Contextual VRP) in mobile application development. The main emphasis in this approach was the enlarging of the virtual prototype to cover also the environment, use case, and other contextual issues of the product under development [14].

In order to simulate the contextual aspects of the future ubiquitous game concept, a suitable virtual environment platform needed to be constructed. The purpose of the platform was to provide a level of immersion, enable contextual interactions, and control autonomous actors, as well as allow access for multiple simultaneous users via the network. In this sense, the virtual environment acts as a virtual laboratory, which can be used to design, develop, evaluate, and market games and game products with the aid of Contextual VRP.



The main idea of the ConsoleDEMO experiment was to create a demonstration of a hand-held mobile game console by using the Contextual VRP approach. The demonstration simulates a small city environment which users can explore by walking around. The product prototype (i.e., the game console) can be used to access information and services located in the 'city'. For example, allowing the user to view the world through a semi-transparent screen of the mobile console, and to see any virtual objects located there, the demonstration shows the possible functions and activities the user can do. Figure 3 illustrates the same location of the world viewed with and without the mobile console. The penguin (the right hand side picture) is a virtual object and, thus, is visible only through the screen of the console. This feature of the prototype illustrates one possible location-dependent, augmented reality type of interaction where the user can use the console as a looking glass to access the virtual aspects of the particular real world environment.

The experimental game concepts include augmented reality and location dependent *'Catch the Penguin'* and the pseudo-physical version of *Pacman*. Both game concepts were meant to be played out in the open, i.e., in the park and on the streets of the city. The console enabled the players to see the virtual objects, provided the networking support, and handled all the game-related controls and statistics.

The demonstration did not utilise highly realistic interaction techniques between the user and the prototype. The main input devices were the keyboard and the mouse. However, the mouse interactions were replicated as realistically as possible in trying to estimate and imitate the real-world case. This meant that it was possible to 'press' the buttons of the console by pointing at and clicking on them with the mouse.


*Figure 3. Same location of the world viewed with and without the console.*

The *Unreal Tournament* game engine from *Epic* was selected as the technical base for the demonstration as, at the time, it was the most suitable game engine for applications such as this. Firstly, the engine has stood the tough test of real world 3D game development. Secondly, the previous experience of working with the engine reduced the effort to get started. The first playable, although relatively restricted, version of the demonstration was created in one week. The overall development time for the complete interactive demonstration was less than 100 working hours.

The main contribution of this case was the successful utilisation of a game platform for prototyping purposes. The selected approach enabled the designers to focus their effort on contextual interaction support, which in turn, offered added value for the concept evaluation. Although game platforms have been used as tools for academic research for a long time, it is only recently that they have been acknowledged as potential platforms for research in product and service design [13]. It could be said that the research and development of games have been able to harness games as essential tools for constructing different gaming concepts.

The significance of this work, in terms of developing games towards the communicative, constructive and collaborative direction, is the enlarged scope for virtual prototyping. When developers have the possibility and necessary conceptual knowledge to simulate various game concepts in a more holistic way, there is a strong likelihood of achieving fruitful results.

### Tuppi3D – Rich Interaction through Non-verbal Communication

The second empirical experiment, Tuppi3D, was designed and developed in order to test and demonstrate the rich interaction design approach in a more holistic manner. The experiment was developed on top of the existing 3D game engine by designing and constructing all the necessary rich interaction features of the game and the game world. The task concentrated on research issues, such as analysing the needs and possibilities for rich interaction, demonstrating the relevant concepts and providing creative support for the mobile game design and development. The focus was on rich interaction (freedom of choice, activities, gestures, expressions, environment, audio, illusion, experiences, etc.) and team play (social setting, community, communication, etc.). The experiment was used to simulate the game concepts, the gaming environment, and the potential rich interaction features to be included in the mobile version of the game.

The *key issues* in designing and developing the prototype were as follows:

- Understanding the design and development process of interactively rich multi-user applications
- Using the interaction concept model and hierarchical interaction model in the design and development of the application
- Simulating and modelling of the look and feel of the familiar concept and community (i.e., the *Tuppi* card game) in a computerised environment

The described case is part of a research project involving the production of a computerised version of *Arctic Bridge* (or *Tuppi* in Finnish), a traditional team-based card game which has its origins in northern Finland. The game shares many similarities with *Bridge* – its more widely known counterpart. The aim of this case was to construct a team game that would follow the idea of the original real world version. The rich interaction experiment was constructed in the form of 3D representation of the game, its players and the corresponding thematic environment.

The experiment design follows the traditional lumberjack theme with various environment and atmosphere effects that support and enrich the interaction and intensity of the experience. Artefacts within the environment are not only used to provide the context, but also to present 'side stories' for the users (e.g., fishing, tree climbing, etc.). The main features of the experiment include various card manipulation possibilities and several forms of interpersonal interactions (e.g., non-verbal communication). The system is designed to provide a flexible and rich set of interactions, which can be freely combined by the players.



The main playing scene consists of a log cabin with a central table for card hitting. The interior of the cabin is spacious enough to allow up to 16 people to be accommodated for an exciting card game. Usually four people take part in the actual game play, while the others act as observers. Figure 4 illustrates the interior of the log cabin with one player in action (left) and a first-person view of the card table (right). Players 'act' their roles according to their personal interests. The enactment and embodiment requires a large set of atomic actions that can be combined on-the-fly by the players. The purpose of these actions is to allow the players to express themselves beyond the pre-designed interactions (i.e., supporting flexibility and freedom of choice).

One of the ideas behind the playing card simulator is to enable human-directed card play in situations where there are no traditional cards available. This means that the players can define and decide on the rules, the number of players, and the corresponding parameters, without application-related restrictions. The simulator can, thus, be used as a general card game core with the possible add-on rule sets and other game dependent features. Rich interaction possibilities are, in this manner, increased by allowing users to select the actions and activities they would like to perform. The experiment is not a game in the sense that there are no predetermined challenges or goals. It merely acts as a virtual 'sandbox', in which users can freely play and fulfil their imagination.

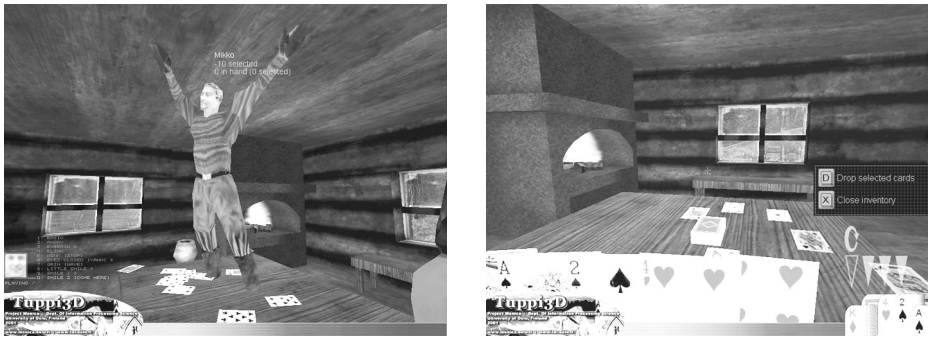



*Figure 4. Log cabin with one player avatar performing a winning act and the view through the players 'eyes'.*

The analysis of non-verbal communication in the gaming sessions within the Tuppi3D platform shows that the support for rich interaction can have a immense positive effect on the communication and collaboration within the virtual environment. In addition to this, the minimum amount of pre-programmed rules allowed the participants to construct their own style of playing and socialising [17].

## Team Game – Constructive Collaboration

The team game experiment – a continuation of Tuppi3D – emphasises the collaborative and constructive approaches to problem solving and team experiences. The experiment consists of various action areas that can be explored by group of players. Figure 5 illustrates a group of players who collaboratively try to construct a tower consisting of both player avatars and virtual objects. One of the players stays away from the main scene and co-ordinates the actions of the others. The seesaw, in this example, is used to throw players and objects into the air.


*Figure 5. Group of players trying to solve a problem by constructing a tower.*

The design philosophy behind the team game experiment was to utilise rich interaction design and to introduce some amount of thematic challenges and activities for the players. However, the game world was not build as a consistent path that would encompass the players in a strictly linear sequence of actions. The prototypical nature of the implementation meant that there were a number of tools, objects, obstacles and areas for the participants to explore. This, as noted when experimenting with the system, led to interesting phenomena as players mixed the tools and used the areas in contradicting ways. The designers, in this case, were not strict implementers of the game. They just provided a basic set of scenes and objects for the players to experience.



The data gathered from the experimental sessions with the Team Game indicates that adequate support for communication is critical for co-ordinating the actions of a team. Although there was a certain tendency towards chaotic behaviour, as in many multi-player action games, the significant obstacles and problems to be solved bound the members together.

The constructive aspect of gaming was seen as a potential area for further development, while the current implementation offered some destructive possibilities, such as, breaking the objects. The most significant finding of this case is the overall design implication: it is much more difficult to design constructive multi-player games than the traditional destructive ones. However, when successful, constructive gaming would seem to be more engaging from the players' point of view.

Games and game-like activities offer enormous potential for practitioners and researchers. While the game setting itself can be of great value, there is also the additional benefit of acquiring research material from these playing sessions. Because the game system has been designed with the research task in mind, it adequately supports various forms of data collecting (e.g., video capture, observer views, control mechanisms and log files).

## Virtual LARP – Future Directions through Enactment and Role-play

The final case presented in this paper is more a glance into the future than a past experiment. The aforementioned cases have made way for future designs by providing a clearer understanding of the interaction forms that enhance communication and collaboration in multi-player games. However, the previous research indicates that current multi-player games do not support these aspects in an adequate manner [16]. Although there are some exceptions, the implementations seem to support interaction forms only in a very limited manner.

Contemporary on-line role playing games (RPG) do not offer enough communication and action possibilities for adequate collaboration. Instead, they usually drive the players towards the straightforward hack 'n' slash style of gaming – either as solo players or as a group. Live role playing, on the other hand, limits the playing with the existing real world spaces and places. This places too much emphasis on the imagination and physical acting skills

of the players in order to achieve engaging experiences. Many of the potential role players do not have adequate skills and the appearance to enact the roles they would like to.

The Virtual Live Action Role-Play (V-LARP) experiment is a multi-player 3D virtual environment that uses rich interaction to enhance the collaborative role-playing games created and experienced by the players and the environment. V-LARP offers players, game masters and the supporting crew with the possibility to engage in audio-visual and interactive experiences that are not restricted by real world limitations.

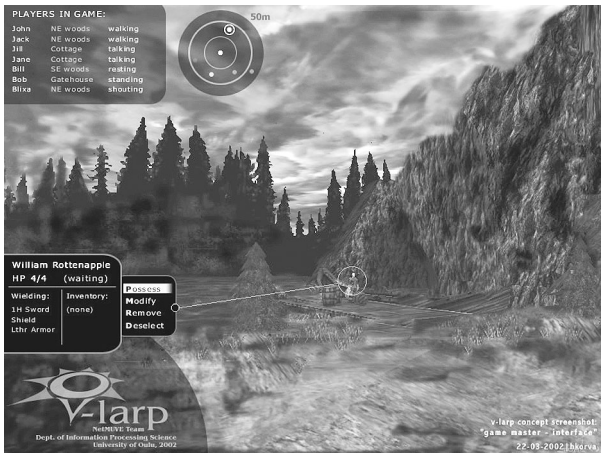
The players live and experience their roles by using their modifiable avatars in the atmospherically engaging virtual world. Role enactment and player-to-player communication is supported by versatile non-verbal communication (expressions, gestures, clothing, appearance, *kinesics*, *vocalics*, etc.).

V-LARP enables a flexible and rich action set which can be combined and used according to the desires of the players. The mysterious smile of the wanderer, or the sad ballad played by the bard in tears tell their own non-verbal stories. The speeding fireballs of the chanting wizard, cloud-scraping flying carpets, or the dextrously built sturdy bridge across the river are but a few examples of the possibilities provided by the virtual environment. The dynamics of the world, combined with the non-determinism of the human players, create the starting point for the unique and creative playing sessions.

V-LARP offers a virtual stage that can be used by the players to get inside the world they are playing. The player controlled avatars support and enhance the enactment and representation of the character roles. This makes it possible to break the experiential barriers and to partially live the mediated scenarios. Figure 6 illustrates the concept art of V-LARP experiment.

*Figure 6.*

*Game master's interface of V-LARP concept.*



The rich interaction design for V-LARP utilises all the aforementioned models and theories of interaction. However, the difficulty of designing multi-player experiences still exists. This problem has been solved by "prototyping" the role-playing session with the standard MUD system. The textual environment offers unbeatable freedom of action due to the fact that all shortcomings of the system can be overcome by imitating and imagining them verbally (e.g., using emotes). In other words, the MUD session was a non-graphical version of the computer-mediated collaborative play in which the textual interaction was supported by speech audio.

The main challenge for the V-LARP experiment is to allow enough possibilities for the participants to express themselves non-verbally and to pursue their desired activities. The balance between numerous degrees of freedom and an intuitive enough user interface may prove to be difficult to achieve. The evaluation of the system will be conducted through test games that follow the manuscript of an existing LARP scenario. This approach makes it possible to compare the virtual role playing with the real world counterpart.



## DISCUSSION

The major problem in game design, from the researcher's point of view, is the secrecy. It is difficult, almost impossible, to gather concrete material from the entertainment industry. The trade secrets of individual game houses are not usually openly disseminated. In relation to this, the scientific community can contribute to the existing body of knowledge by applying action research and experimental approaches. The problems and solutions can be openly discussed if the purpose of the work is mainly academic. The open source development, which is also widely applied in game design, is one practical implication of the possibilities and benefits.

The aforementioned experiments describe some possibilities of utilising games domain not only as a target for the research, but as the tools of the research as well. The issue of game research is twofold: First, games are an extremely interesting area of research and they provide abundant research questions to be considered. Second, the anatomy and soul of games can only be fully understood by playing and designing them. The empirical experience from the domain can greatly enhance the understanding and analyses of game researchers.

The benefits of applying game design in academic research are relatively clear. However, the game designers may find it difficult to apply the results of the researchers, although there are numerous examples of successful knowledge sharing, for example, in the areas of artificial intelligence, graphics rendering and simulation. This paper proposes a conceptual approach to interaction analysis and design, which could be applied by game developers as well. The theoretical discussion in the fields of communication, human-computer interaction and computer supported co-operative work can all provide useful concepts and tools for the practitioners.

The holistic concept of interaction forms, and the corresponding rich interaction design approach, is a synthesis between theoretical background and empirical findings. Although the models presented in this paper are mere abstractions of the phenomenon, they do provide a concrete set of issues to be considered in practical design work. The foundation of communication and collaboration stays the same even if the medium is somewhat different. The computer mediation may limit some of the interaction, but at the same time the virtuality offers novel ways of interacting not possible in the physical world.



The concept of interaction is by far too broad subject to be tackled within the confined space of one paper. The research of rich interaction in this context is still in its infancy and, thus, there are major problems to be solved and questions to be answered. For example, the problem of replicating real world activities includes both philosophical and implementation issues. Furthermore, the possibilities of successful artistic and aesthetic perspectives to rich interaction design are yet to be analysed.

## CONCLUSIONS

The significance of this paper relates to the increasingly important role of multi-player games in the entertainment sector. The main objective is to bridge the gap between the world of games and the world of academic research, as multi-player games can provide an abundance of good examples and lessons learnt for fields outside the entertainment industry as well. In addition, the theoretical research can prevent the continuous re-inventing of the wheel in the industry settings. The benefits of the paper can be listed as follows:

- A deeper and more holistic understanding of the concept of interaction in the context of multi-player games
- Concrete proposals about how to join the fields of practice and research in games design
- More supportive and communicative game applications by applying the interaction models and theories

The analysis of the rich interaction forms in multi-player game sessions indicates that the participants can effectively use various forms of communication, if the system is designed to support them in a memorable, yet invisible, way. A creative combination of various communication channels makes it possible to enhance the overall interaction and further increases the communicative, collaborative and constructive uses of the virtual environments.

The results are significant for multi-player game designers, as they illustrate the importance and possibilities of, for example, non-verbal communication in networked settings. Thus, it is possible to reduce the limitations and restrictions of computer mediation by enabling more flexible

and natural interaction. Although the naturalness and intuitiveness of face-to-face communication is hard to achieve, the virtual environments provide additional and novel ways to enhance the weak areas of interaction.

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