

Research Article

A Study of Interaction Patterns and Awareness Design Elements in a Massively Multiplayer Online Game

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Massively multiplayer online games (MMOGs) have been known to create rich and versatile social worlds for thousands of millions of players to participate. As such, various game elements and advance technologies such as artificial intelligence have been applied to encourage and facilitate social interactions in these online communities, the key to the success of MMOGs. However, there is a lack of studies addressing the usability of these elements in games. In this paper, we look into interaction patterns and awareness design elements that support the awareness in *LastWorld* and *FairyLand*. Experimental results obtained through both in-game experiences and player interviews reveal that not all awareness tools (e.g., an in-game map) have been fully exploited by players. In addition, those players who are *aware* of these tools are not satisfied with them. Our findings suggest that awareness-oriented tools/channels should be easy to interpret and rich in conveying “knowledge” so as to reduce players-cognitive overload. These findings of this research recommend considerations of early stage MMOG design.

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1. INTRODUCTION

Interacting online with people from throughout the world is a daily occurrence for millions of Internet players, yet most do it with little perspective on the virtual identity they are projecting. It is generally accepted now that the Internet and online games provide a tremendous opportunity for new forms of entertainment. It is especially true for MMOG characterized by its ability to enable thousands of players to play in an evolving virtual world at the same time over the Internet. Once a player enters the game world, he can engage in a variety of activities with other players who might be sitting at the other part of the globe. Hence, one of the most foremost goals of these MMOGs is to offer a rich social platform for players to interact and socialize as Will Wright, creator of the block-buster game “The Sims,” put it: “*In some sense, what we are really building with these games are communities. That is our primary thing*” [1]. In this regard, awareness is known as one of the most discriminating factors contributing to the success of the social environments. It is defined as “*the knowledge of the presence of other people, including their interactions and other*

activities” [2]. Generally, being aware of each other’s presence (including the workspace environment, their actions, and the manipulating artifacts) provides a clue for their own action in the situated environment, and might guide their own actions accordingly [3]. It is especially imperative in densely populated online virtual communities, where people tend to interact with each other to weave a rather complex, yet, fruitful web of relationship [4]. Careful incorporation of awareness tools in these online spaces thus becomes more essential to foster both collaboration and competition. In the human-computer interaction area, a number of works have been devoted to study awareness, including how to make various awareness tools in a wide variety of applications [3, 5–7] and in MMOGs [5, 8–10]. In fact, MMOGs have attracted more attention recently as a test bed to study awareness and social interaction patterns in some high profile CHI conferences [5, 9]. Unfortunately, very few of them probe into this issue from players’ perspective, that is, whether or not, players have made the most out of these tools to facilitate the in-group and interpersonal interactions, which motivates our study here. Particularly, in this paper, we report out findings on one popular MMOG called

TABLE 1: A brief summary of awareness and interaction design elements in *LastWorld*.

		Tools/approaches/tasks	Information elements
Social awareness	People	Player description (Figure 2)	Who is online? What are their statuses? What are they doing?
	Location	Map, radar (Figure 3)	Where am I? Where are others?
Social interaction		Teamworks such as chatting, fighting, trading	How can I team up with other players? How can I boost up my skills and levels in teams?

the *LastWorld* (available at <http://www.lastworld.com/>) and compare our results with that of *Fairyland*, on evaluating the usability of these tools to raise awareness and encourage players to interact.

In the next section, we will discuss previous study on MMOGs, with a particular focus on how MMOGs act as social sphere. We will then give brief overview *LastWorld* including how they have been designed to raise social awareness and encourage group interactions. We then report the experimental results on *LastWorld* in Section 3. A comparison of *LastWorld* and *Fairyland* on the design efforts to support social interactions will be provided in Section 4; the design implication will also be pointed out. We conclude this paper by discussing our next step in augmenting our research following the path.

2. MMOGS AS A “SOCIAL SPHERE”

2.1. Social awareness: some background

In a distributed, socially populated environment, it is imperative for members to be “aware” of each other and the environment, in terms of their many facets, among them, the information about each other’s actions, the individual environment, and the state of the manipulated artifacts. For instance, in distributed document editing environment, this awareness information can range from who are the active editors, on what part of the document each are working, why the document is being edited, and so on. Game designers have implemented a variety of awareness tools to allow players to formulate general as well as specific awareness of their group mates, or even counterparts in an attempt to execute their actions accordingly. For example, a map can show player position, while the name on top of players reveals player identity to others. The work in [10] summarizes the workspace awareness elements and categorizes them into two major types based on their temporal aspect: those related to the *present* and the *past*.

2.2. Motivation of our work

One notable issue related to awareness is that the tools to support awareness should be *readily accessible*, *easy to interpret*, and *rich* in convey “knowledge” in order to reduce players’ cognitive information overload. It is especially true

in real-time multiuser virtual environment like MMOGs, where players rely heavily on the information to explore, when there might be overcrowded information available on the screen. For instance, imagine a group of players collaboratively engage in a fighting mission at a remote island; valuable information related to it includes individual players’ skills, energies left, location, and identifying the approaching enemies and so on, as shown in Table 1. Hence, when the information becomes overloaded, players have to quickly identify those valuable or in some cases, they even need to choose from among the various awareness sources, in order to gather this information and make a quick assessment of the environment and situations. One extreme is that the information might be too coarse, thus, cannot be used instantly to assist players. The other extreme is that there might be too much information which makes players difficult to spot the most relevant to their current task. Either of these two cases can greatly affect players’ perceptions of the environments. To our knowledge, very few studies addressed this issue, which motivates our study here. The findings of our in-game experiences and player interviews agree with our worries in that players, in fact, are not satisfied with the awareness tools, and pointed out that they are sometimes too busy to compile the information and formulate their presence in relation to the environment and other players.

Before we proceed to present our findings, a discussion on related work will appear in the next section.

2.3. MMOGs as a “Social Sphere”

MMOGs are designed to encourage players socialize through a wide variety of channels, from combating, gesturing, chatting, doing business, and so on; a collected place where we call it a social sphere. Although MMOGs have taken the game-playing world by storm, the work in [8] pointed out that there are lacks of sociological study in the research community. One of the most notable studies was conducted by Ducheneaut and Moore [5], where the researches immersed themselves in Star Wars Galaxies (SWGs), one of the most popular MMOGs to investigate the interaction patterns to support CSCW. The work in [8] further investigates the degree of social activities as supported and exhibited in the “third places” of SWGs: the cantinas. In particular, as originally coined by Oldenburg, these “third places” should



FIGURE 1: (a) A “day” in the world, (b) one of the people awareness tools.

provide “a great variety of public places that host the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work” [11, page 16]. The works in [5, 8] reveal that the majority of visitors have clear *purposes* to socialize in the cantinas, which is in contrast to the pure social interactions that go “beyond the contexts of purpose, duty or role” [12] and their encounters are mostly marked by “short and instrumental” [8, page 11]. To summarize, these studies [5, 8–10] generally examine a variety of social activities players carried out during game-playing to, in some degree, look into the design rationale that MMOGs should encourage and support social interactions. The work in [13] reviews a number of awareness tools in a video game, *Quake*, to investigate how these tools can support team play and team collaboration. However, the study did not reveal players’ perceptions on these tools, which is one of the major differences between their study and ours.

Although in these studies, awareness issue has been casually mentioned, it is not thoroughly investigated, which motivates our study here. Specifically, we attempt to study how sufficient existing awareness tools have been designed to foster social interactions among players, and whether or not players tend to make the most out of these tools to engage in social interactions.

Before we proceed to present our findings, we will give a short overview of *LastWorld*.

2.4. Some background on LastWorld

LastWorld was launched in the summer of 2005 and rated as the number online game at the time of this study [14]. As an MMOG, it aims at providing an entertaining and social platform for players. In order to support social interactions, *LastWorld* provides a wide range of tools, tasks to allow players to interact with each other, as well as with non-player characters (NPCs). Figure 1(a) shows one screenshot of the game, where players can control their characters to take actions, such as fighting, sitting, working, trading items, and so on. Players can also communicate with each other, choosing different types of communicational methods through the conversational panels in the lower right corner of the screen, as shown in Figure 1.



FIGURE 2: (a) People awareness: who’s online?; (b) people awareness: where is the player and who is he/she?.

2.4.1. Social awareness in LastWorld

A number of awareness tools exist in the games. In this paper, we will only focus on tools to support *people* and *location* awareness.

Table 1 summarizes the tools/tasks that we will evaluate in *LastWorld* that are designed to support social awareness and interactions.

Regarding people awareness, the game uses a series of tools to indicate the *status* and *identity* each player. The purpose of these tools is to help users to be aware of other players’ position as well as obtain their identities/skills.

For example, above each character, there are names showing in white and the organization name showing in pale purple, as seen in Figure 2(b). And on notice board, once a team member is connected to the game, it will notify other members of the same team that “[who] member is connected.” Players can also check whether or not their friends are online instantly in the conversation box (see Figure 2(a)).

Location awareness deals with the information players can collect related to whereabouts of themselves, other players, monsters, and NPCs. Sufficient and easy-to-obtain location awareness information can give players an orientation as well as the position of others that can help them formulate their activities and achieve their goals. *LastWorld* provides a number of tools, including *map*, *radar*, *coordinates* to indicate location of players, players’ friends, players’ teammates, enemies, and so on. Players can manipulate it by zooming in and out on it, and perform searching (see Figure 3).

2.4.2. Social interactions in LastWorld

Both player-player and player-game interactions are encouraged in *LastWorld*; the former includes a number of communication channels for players to interact with each other; while the latter provides ways for players to interact with NPCs. In this paper, we focus on the former type of the interactions (see Table 1).

The game provides a couple of communication channels for players to interact with each other. For instance, in



FIGURE 3: Normal map versus zoom-in map.

Trading, players can buy/sell goods in fixed price or by bargaining in any city. Both buyers and sellers can negotiate the prices during trading. In general, Trading provides an excellent platform to encourage players with different professions and skills to communicate with each other. *Chatting* offers another type of player-player interaction in the game where players can engage in 4 types of chatting mode: *public*, *private*, *team*, and *organization*.

3. FINDINGS ON LASTWORLD

3.1. Experiment methodology

To have a real experience in the game community, each of us created at least one character in the game. A total of 10 characters were created, which make up most of the professions in the game. In order to become a part of the community, each of the characters logs on to play the game for at least 40 hours. We then collect data through direct observation of the game environment and interacting with different players in the game. These interactions include participating in different teams, trading, and bargaining with other players. In total, we spent 2 months playing the game regularly and after that, we designed a questionnaire for the team members to complete. The questionnaire targets at how each group of players looks at the awareness tools, their interactions, their attitude, and behavior in the game. We then further interviewed 18 players (with their age ranging from 20 to 30) in the game so as to increase the reliability of the collected data. We tried to divide the players according to their playing frequency. The results are sufficient for us to address the issues raised in this paper.

3.2. How players socialize in LastWorld: experiments

As argued in previous sections, the most fundamental goal of MMOGs is to create a social environment for players to interact through all the possible kinds of awareness-oriented design elements and interaction channels. These elements include a variety of designs in the game, including map, radar, chat, and so on (see Table 1 for those studied in our experiment). We are interested in investigating the degree of awareness of players; that is, how efficiently and easily players

can make use of these elements to foster social interaction, and improve their in-game social welfare. In particular, the following questions are addressed.

- (i) do players know and use these carefully designed awareness elements during game playing?
- (ii) how efficiently the awareness tools can foster players' social interaction?

The first goal is to evaluate the usage of these virtual awareness tools, while the 2nd is to assess the usability of these tools in facilitating player interactions. In our experiment, we studied three types of players, that are, core players, spending more than 30 hours per week; moderate players, spending 11 and 20 hours per week, and casual players, spending less than 11 hours per week. In our study, there is 6, 8, and 4 core, moderate, and casual players, respectively. It is crucial to include all types of players in the analysis so as to understand and compare different players' views on awareness and their interaction.

3.2.1. The usefulness and appropriateness of awareness design in LastWorld

We mainly used questionnaire to gather the information about the awareness for our study. We found out that players have similar points of view in some aspects, but have different opinion in others.

(a) People awareness—Are players aware of the social environment around them?

Issue One. How long does it take for players to be aware that their friends are online?

The result of our study reveals that the majority of players are able to know the status of their friends immediately or within 3 minutes. This suggests that the notification of the friends' connection is helpful for the players who are notified whenever their friends are online. However, 5 out of 18 players are unable to determine whether or not their friends are online. There are some possible reasons for it. Since the notice board shows many things concurrently, newer messages will cover the older ones, so players may easily miss some notification in the board. In addition, players may be busy doing something else such as hitting monsters in the game, so they fail to pay attention to the notice board. As such, some sound alert could be used; and it is often referred to as audible awareness indicators [3].

Issue Two. How difficult is it to find friends?

Obviously, the textual descriptions on top of each character are essential for the players (see Figure 2(b)): at least half of them strongly agreed. The results indicate that the character, organization, and other descriptions are critical to identify players. Surprisingly though, roughly half players, 44%, find it difficult or very difficult to identify their friends from among other people, even though the friends are just next to them, because although these elements can help players identify characters, it is so confused and complicated especially when there are too many players showing on the screen at the same time. To find out how difficult to identify



FIGURE 4: (a) The town centre on a particular day, and (b) some players are willing to talk during trading.

friends, we performed an experiment: we open the game together and sit in the crowd. One of us spent almost 3 minutes to locate all of “us.” When asked what helped him to do so, he pointed to the radar and coordinates rather than player description over the head. Therefore, the helpfulness of player description is less useful if there are too many characters in the same place (see Figure 4(a)).

More than half of core players think it is easy or very easy to locate their friends. Most moderate players vote it as normal or difficult; while all casual players rated as easy or very easy. Core players have much experience in playing game, so they are more experienced to find other ways such as using radar and communication to identify the friends. No other tools might help players find other players in the game except for the description of the characters. For instance, if one player wants to find a personal shop to buy a weapon, what he/she can do is just running around the town and finding a player who is a weapon seller. If he/she wants to find a specific character type to form a team, he/she can only send a message to everyone and wait for their reply, which is very time consuming. In other words, the tools in the game are not sufficient to foster awareness among players.

(b) Location awareness—The usefulness of corresponding design elements

Issue One. Are maps, radars, and coordinates easy to use in support of location awareness?

56% of players think the tools are useful to support location awareness. Our study indicates that a large proportion of players think that map, radar, and coordinates are easy or even very easy to use. Also, 22% of them have neither stronger nor weaker views on this issue. Only one player feels negative with the maps and radars. There are no differences between the three types of player regarding it. This result is not surprising since the game provides comprehensive functions to assist players to use such tools.

Issue Two. Is there sufficient information in the map and radar?

Although the map and radar are useful for players, they may not contain enough information to help players: 78% of players pointed out that the information embedded in the map and radar is not clearly enough to facilitate higher degree of location awareness: know where they and their friends are. The results of three types of player are similar. To further our understandings, we interviewed 10 players in the

game on it. 70% of them reported that there are not enough notations in the map and radar. And 20% of them think that it is just ok. Among the 7 players who admitted that notation is not enough, some pointed out that the map is not detailed enough. Some of players indicate that the details in the map cannot be changed when we zoom in the map except for the town of the current game, as shown in Figure 3 that even though the map is zoomed in, the detail of it will not be enhanced. In addition, the rest of players agree that the map's notation is not enough since the map has no coordinates when the cursor points to the map to help players find others. Some especially novice players point out that the coordinates are meaningless.

3.3. Interaction patterns in LastWorld

In another series of experiments, we attempt to study information on how players make use of the interactions provided by the game to enrich their socially virtual “life.” In particular, we will focus on teamwork and trading system, two of the most representative interactions in the game.

3.3.1. TeamWork

Issue One. Have players ever tried to team up with other players? Are they willing to team up with other players, both in team or outside the team?

Generally, our experiment summarizes that players feel satisfied from working and collaborating with others. Among the 18 players we interviewed, about 90% of them have tried to be involved in different teams. Nearly all (except for one moderate player) expressed their willingness to team up with players of other professions. There are no apparent differences between three groups of players. Furthermore, about 90% players have tried to team up with other players, and only 2 of them are active in socializing with players out of their team. That is, most of the players are reluctant to talk actively with other players; they never or seldom talk actively with players outside their team. However, the number jumped to 15 (94%) when they got involved in the teams. The majority of them commented that they tend to talk more with their team members than with people outside the team.

Issue Two. Why and how players interact with each other through teamwork and in what ways?

The above result gives insufficient information on why and how the players interact through teamwork. To further our understandings, we turn to compare the different effects between players that always team up with other player and those that play the game alone. We created 2 similar characters, A and B, of the same profession and at the same time. A tends to team up with other players, while B is not involved in teamwork at all. We let the two characters do the same thing to gain experience within 5 hours. In the end, A achieved 15 levels, while B achieved 12 levels only. A died once only while B died 5 times. In addition, their interactions with other players are also very different. A always exchanges sentences and communicates with team members, while B

TABLE 2: A comparison of two players in a team and playing alone, respectively.

	Character A (Involved in a team)	Character B (play alone)
Game hour	5	5
Level achieved	15	13
Deceased times	2	5
Interaction (sentences exchange)	Around 180	Around 15

exchanged only a few sentences (roughly 15 sentences within 5 hours) with other players, as shown in Table 2.

These observations are aligned with our previous analysis: it explains why players tend to work and collaborate with other players. That is, those involved in the team tend to gain more experience and die less, which provides a strong intrinsic incentive for players to be involved in teamwork. In particular, the system awards 20 percent more experience to each player involved in the team and players can gain experiences much faster. Meanwhile, when there are characters from different professions involved in a team, the overall power of the team also becomes stronger. The more players involved in a team, the stronger the team becomes. It is not difficult to see that the team members have to have good teamwork so as to survive in more dangerous areas. They have to communicate with each other, and also due to the interdependencies of the jobs, they have to communicate in order to get helps from other team members. Another kind of relationship that evolves from the conversation is altruism among team members, through which players with high levels give a helping hand to new players. These various ways provide an ideal platform to encourage players to help and interact with each other. The more the ways in which players can and are encouraged to help each other, the easier it is for players to meet each other, which basically reinforces the relationships among team members and facilitates group interactions.

3.3.2. Trading

Issue One. Have players ever tried to trade?

Out of 18 players, 14 have tried before. All core game players have tried. This number dropped sharply to 2 (out of 4) for casual players. For those who have ever tried to trade, only a small fraction has tried to bargain with the buyers or sellers. The number is surprisingly low. The result shows short and casual interactions exchanged among players. We found out that for those 14 players that have ever tried to trade, 11 usually do not make any utterances during the trade at all. Though some of them exchanged a few sentences, none exchanged more than 5 sentences during the trade. The data shows that most players have tried to trade without many interactions.

Issue Two. How often do players talk during trading?

To answer this question, we set up 3 personal item shops in the town centre selling the same items. In store A, we set the price of all items 20 percent higher than the market price, while in store B, we set the price 20 percent lower; and to have a control experiment, we further set up store C with all items selling at the market price. After that, we let the stores be idle for 3 hours. No items in store A were sold, while in store B, 18 items were sold and in store C, 4 items were sold. However, for all cases, no players attempted to bargain or talk with us. Nearly all go to the personal item shops simply searching for what they need, without greeting or talking with the merchandiser. They buy items at a reasonable price, and leave nearly immediately when it is rather expensive. The town centre looks like very crowded, with high population density. The players sitting on the square with a text box above them are those opening personal item stores. We spent 30 minutes greeting 100 players. However, only a few of them gives us some response. A major cause is that many players are away from the keyboard (AFK), leaving their avatars idle to earn money for them. When this happens continuously, the players visiting the personal item shops and trying to bargain with the merchandisers will get frustrated. They sense that all players trading in the town centre are AFK-ing (or “microing”) and avoid talking or talk very little. This also explains our previous data, most players tend not to bargain with the merchandisers or say very little. This, of course, greatly affects the quality of interaction [5]. While these game features such as microing allow a wider range of activities to be performed automatically, they can compromise the quality of social interactivity. Nevertheless, this does not prevent some players from talking during the trading. We noticed that there are some players who are genuinely interactive and eager to have longer conversations with others (see Figure 4(b)).

4. A COMPARISON BETWEEN LASTWORLD AND FAIRYLAND

So far, we observed that player performance is largely determined by how players can utilize the tools and other game elements such as in-game tasks, and exploit accordingly. Our observations indicate that not every tool has been fully understood or noticed by players, and not every group-oriented task is capable of *forcing* players to execute group activities: some choose to complete the task alone, while some are willing to form a group. A natural question to ask at this point is that what would happen if we conduct the analysis in another type of game? To answer it, we perform a similar usability study in a different type of game, *Fairyland* which is a fantasy MMOG more suitable for girls. It is different from *LastWorld*, a more action and strategy-packed MMOGs preferred more by boys. In *Fairyland*, players enjoy similar experiences like those in *LastWorld*, for instance, chatting with other players, forming teams to perform tasks such as fighting, trading, and so on. The major difference between the two games is that *Fairyland* is targeted at girl players, while *LastWorld* is targeted more at boy players, which leads to some unique design elements to encourage player interactions. For instance, in *Fairyland*,



FIGURE 5: (a) The map, (b) player description.

there is a Family system, where players can join a family to interact, socialize, and participate in all kinds of activities. The core of the Family system is fundamentally different from the Fighting system in *LastWorld* and many other games in that the Family system is inherently more group-oriented, and is a metaphoric design mimicking human family system. Therefore, we expect that the interactivity in this module should be denser than that in other module in the game. To make a comparison, we will briefly report key findings and compare them to those in *LastWorld*.

4.1. Major findings and the comparisons

Besides in-game experiences, we again distributed questionnaires to players, and received 55 responses. 95% agree that map and coordinates are useful to unfold two major kinds of location information (see Figure 5(a)): buildings or paths around the players, and the general information in the location. Player coordinates are also shown on the small map, so most of them feel happy with the design to support location awareness. 84% of players agree that situational icon containing player description similar to those in *LastWorld* on players' head helps them know what others are doing in the game (see Figure 5(b)). In addition, players feel positive toward the audio alert attached to a location; that is, when a player enters different places, the background music will change immediately in order to alert players that they are staying in a different location now.

Among the various types of group-oriented tasks, the Family mode stands out: 91% reported experiences with it at least once, and among them, 80% like it very much. It is also observed that once players join a family, they always interact with their family members. Half of the subjects indicate that by joining a family, they cannot only interact and engage in more group-oriented activities such as fighting enemies, doing business, but also win real friendship outside the game. Players are quite comfortable with the interaction mode reflecting bindings among players both inside and outside the game. The result reveals the success of design element in *Fairyland* to encourage players to interact and socialize. This finding is different from that in *LastWorld* where players tend to talk with others in a team. As for chatting, our finding is similar to that in *LastWorld* that not many players tend to talk unless required; instead, they prefer to just send some emotional icons during communications which are deemed enough in most occasions (96%).

These key findings lead us to strongly believe that even though the genres and target players of the two games

are different, player expectations and perceptions over the usability in awareness and interaction of the two games are similar: the tools should be designed to allow easy and quick access; the information should be easy to interpret and manipulate. As for the task design, the success of the Family mode in *Fairyland* highlights the importance of the task *per se* to encourage players to collaborate, as opposed to the teamwork mode in *LastWorld* where players seldom talk outside a team.

4.2. Discussions and design implications

Although macroing can automate performance actions and offer a more flexible options for players to continuously engaging in games without physically sitting in front of the games, it, somehow, compromises the quality of social interactivity among players [5]. We also suggest that the deployment of audio alert (as in *Fairyland*) which can quickly inform players of some key information such as who is online, or what is the player's newest status, instead of only changing the color of player names which are relatively difficult to notice as in *LastWorld*. One very interesting observation is that some players are reluctant to socialize when they do not need to, as in trading in *LastWorld*. However, the success of the Family mode in *Fairyland* highlights the importance of the task *per se* to encourage players to collaborate. The result indicates the growing trend and *degree of importance* of these "third place" (i.e., the shop in *LastWorld*; the Family in *Fairyland*) to host the "voluntary and informal" gatherings [11, page 16].

Although awareness tools and interaction patterns are quite prevalent in many MMOGs, little is known about how players perceive and utilize these tools, and exploit them. Our study aims at filling this gap. We suggest that it is rather essential for designers to test whether or not players can make the most out of these tools to realize designers' design rationale.

5. CONCLUDING REMARKS

In this paper, we look into the interaction patterns and the awareness design elements in *LastWorld*, and briefly compare the results with a different type of MMOG called *Fairyland*. The results generally reveal that the emphasis on teamwork is one of the most important components to keep players interacting in the game, such as the success of the Family in *Fairyland*. Thus the MMOGs should include a variety of team-oriented activities and offer a wider spectrum of supporting tools to ensure maximum game-playing immersions.

There are several limitations of our study. The game elements studied and reported in this paper are mostly typical ones to support interaction and awareness. There are more elements designed to encourage player interactivity. In addition, our studies reported here only focus on the usability of awareness and interactions at a coarse level. A finer-grained level of usability analysis is desirable to answer questions such as, as a newly joined group member, can

I quickly and easily obtain information on the progress of other players? These are the focus of our future work.

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