KNOWLEDGE CONVERSION IN MASSIVE PEERS: A PRELIMINARY STUDY ON MUTUALISTIC CO-PRESENCE

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Abstracts

This study aims to investigate massive peers, which is an unique characteristics of Massively Multiplayer Online Game (MMOG), and to empirically explore its role on knowledge conversion driven by different types of motivations from an ecological perspective. A number of researchers had investigated learning behaviors in the MMOG virtual environment, however, theoretical justifications of collaborative learning and helping behaviors among massive peers is still under-researched. To bridge this gap, this study proposes two new constructs of mutualistic co-presence based on the theory of symbiosis in the field of ecology, and integrates with technology-based collaborative learning streams of research to theoretically explore the patterns of knowledge conversion in MMOG. PLS analyses on a preliminary data of 87 MMOG participants show that there are strong correlations between different motivation profiles and knowledge conversions.

Keywords: MMOG, Mutualism, Co-presence, Collaborative Learning Behavior, Knowledge Conversion, Motivation Profile
1 INTRODUCTION

The concept of Massive Peers is unique to Massively Multiplayer Online Game (MMOG). In contrast to traditional computer games which are limited to a few numbers of participants and limited by physical spaces, the virtual environment of MMOG allows massive amount of players to interact with each other and also replicated complex social structures (Pena and Hancock 2006).

From the gaming perspective, MMOGs are defined as games which “… are highly graphical 2- or 3-D videogames played online, allowing individuals, through their self-created digital characters or ‘avatars,’ to interact not only with the gaming software (the designed environment of the game and the computer-controlled characters within it) but with other players’ avatars as well. These virtual worlds are persistent social and material worlds, loosely structured by open-ended (fantasy) narratives, where players are largely free to do as they please – slay ogres, siege castles, barter goods in town, or shake the fruit out of trees” (Steinkuehler 2004).

An increasing number of educational researchers have started to adopt online game as an educational platform and suggest that MMOG has numerous exclusive features that may motivate gamers to acquire, share, integrate and create knowledge together through collaborative learning behavior in the MMOG game-play (e.g. Gee 2004, Childress and Braswell 2006, Kong and Kwok 2011). This track of research follows the school of social constructivism based on Vygotsky’s Theory of Psychological Development, which emphasizes that knowledge is being developed through social interactions (Park et al. 2011). It is also believed that the unique characteristics of MMOG as an IT artifact play a role to facilitate collaborative learning in the virtual environment (Kong et al. 2012). However, the commonly agreed justifications for the occurrence of collaborative learning behavior in MMOG and the motivation drivers for learning to occur in a massive environment are still unknown.

To explore this under-researched area, this study intends to extend our understanding of learning in MMOG game-play by looking at how the dynamics on collaborative knowledge conversion modes are related to the continuum of level motivational profile and gamers’ perception of co-presence in the typical massively collaborative online game-play environment.

In the next section, we will present our literature review on MMOG game-based learning, co-presence and motivational profile. Then we will discuss our research model and hypotheses. Afterward, we will describe our research methodology and data analyses results. Lastly, we will present the implications and conclusion in the final section.

2 LITERATURE REVIEW

From the game-based learning prospective, MMOG has numerous exclusive features (e.g. avatar/virtual identity, co-presence, group identity and transparency) that can motivate gamers to participate in collaborative learning behavior in the gaming context (Kong et al. 2012). This track of research follows the school of social constructivism based on Vygotsky’s Theory of Psychological Development, which emphasizes that knowledge is being developed through social interactions (Park et al. 2011). For example, the use of avatar of MMOG aligns with Gee’s (2004) example of virtual identity in gaming environment that the self-created avatar is necessary for players to commit and take on a new identity they value and in which they become heavily invested in deep learning; Transparency in MMOG is to allow players to retrieve statistical performance figures of other players in the environment. Such characteristic allows informational influence to happen between players’ actions in the virtual environment, which in return generate an internalization process when a player perceives information as a means to enhance his/her knowledge above that of reference groups (Kelman 1961). Players can also join named groups (e.g., guilds in World of Warcraft) in order to socialize and play together. Previous research also shows that learning intentions in MMOG can be driven by peer-motivations (Kong et al. 2012), and different modes of collaborative knowledge conversion processes do occur at different stages of engagement level throughout the MMOG game-play (Kong and Kwok 2011).
2.1 Co-Presence in MMOG

In sociology, co-presence is a traditional concept that describes human individuals interact with one another face to face from body to body (Cooley 1956, Goffman 1963). The term co-presence is primarily used in literatures as the sense of being together with other people in a remote physical environment (Mühlbach and Prussog 1995, Slater et al. 2000), or the sense of being together with other people in a technology-generated environment (Durlach and Slater 2000, Slater et al. 2000). Together the rise of technology, the number of literature related to the concept of co-presence is increasing, and there are more researchers extending research on presence to the technology-facilitated environment (Zhao 2003). The concept of co-presence is also an important characteristic of MMOG, as the design of MMOG is a type of computer-mediated communication with recreational and playful context that designed to support dynamic social structures, which players engages in the same virtual environment and interacts with each other during the game-play process (Vogiazou and Eisenstadt 2005, Pena and Hancock 2006). Co-presence is also being called social presence (Rice 1992, Short et al. 1976), which refers to the sense of being together with others in a mediated—either remote or virtual—environment. Co-presence is the fundamental prerequisite of collaboration between MMOG gamers and is claimed to be one of the most crucial social components of computer-mediated communication (Spears and Lea 1992).

The typology of co-presence by Zhao (2003) classifies different forms of co-presence based on two major characteristics of colocation: distance between the interacting individuals (i.e. physical proximity and electronic proximity) and whether the individuals are bodily present at the site of colocation (i.e. corporeal presence on both sides, on one side, and one neither side). Table 1 summarizes Zhao’s typology of co-presence.

<table>
<thead>
<tr>
<th>Corporeal Presence on</th>
<th>Distance Between Two Sides</th>
<th>Physical Proximity</th>
<th>Electronic Proximity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Sides</td>
<td>Corporeal Co-presence</td>
<td>Corporeal Tele-co-presence</td>
<td></td>
</tr>
<tr>
<td>One Side</td>
<td>Virtual Co-presence</td>
<td>Virtual Tele-co-presence</td>
<td></td>
</tr>
<tr>
<td>Neither Sides</td>
<td>Hyper-virtual Co-presence</td>
<td>Hyper-virtual Tele-co-presence</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Taxonomy of Co-presence (Zhao 2003)

In the MMOG’s virtual environment, players select and control their own avatar as a representation of themselves in the MMOG virtual environment. Also, in a one-to-one interaction in the MMOG environment, both sides of players perceive each other’s avatar as a representation of other player in their own electronic proximity. Therefore, using the typology of Zhao (2003), we classify the co-presence of players in the MMOG environment as a type of hyper-virtual tele-co-presence, which individuals’ senses of being together with other players in the MMOG are virtually present through digital representations that are located in each other’s electronic proximity.

In addition, co-presence facilitates the emergence of group identity in the virtual environment, with which players can join together and perform in-game tasks in groups (Kong et al. 2012). Collaborative-victory is introduced in MMOG game-play and encourages collaboration among in-group players to compete with the out-group players (Williams et al. 2006). However, the mechanism of such complex inter-personal relationship related to co-presence feature of the MMOG is not well understood, especially in the MMOG game-based learning context with massive peers.

2.2 Mutualistic Co-Presence with Massive Peers

In this research, we propose two constructs of co-presence based on the theory of symbiosis in the field of ecology on biological interaction to explain and predict gamers’ motivational profile and participation in knowledge conversion mode in the MMOG game-based learning. With reference to studies of ecology in biological interactions, co-presence of players in the MMOG environment is similar to the mechanism of symbiosis that is related to “the living together of unlike organisms” (Wilkinson 2001). There are a number of symbiotic relationships in biological interactions that can be used to interpret player-to-player survivability in the MMOG environment: (1) Competition –
players (as competitors) decrease survivability, (2) Predation – the player (as predator) increases survivability while the player (as prey) decreases survivability, (3) Parasitism – the player (as host) decreases survivability while the player (as parasite) increases survivability, and (4) Mutualism – both players (as win-win partners) increase survivability.

Given that the MMOG game-based learning and its relationship with gamers’ perception of co-presence with massive peers (i.e. sense of “being in the MMOG game-play and being together with other players”) is rarely researched, this study aims to examine a specific symbiotic relationship, i.e. mutualism, which is highly relevant to the MMOG game-play ecological environment where the incentive of collaborative victory (win-win relationship) is in place.

The concept of mutualism is originated from ecology to describe the biological interactions between two organisms of different species, and both organisms will benefit from the interaction in terms of fitness to the environment. Boucher et al. (1982) defines mutualism as “an interaction between species that is beneficial to both”, and defines benefits in terms of individual level and group level. Benefit on the individual level is conceptualized by the relative fitness within a species of individuals participating to various degrees in the mutualistic interaction. Benefit on the group level is conceptualized by considering the whole population of a species engaged in the mutualistic interaction. Charles Darwin in his famous work The Origin of Species, discussed mutualistic interactions will emerge through selfish actions in nature, limited by costs and driven by conflicts of interest between interacting parties.

Prior research on visibility, relationship and co-presence in the online environment (e.g. Bregman and Haythornthwaite 2003) suggests that the perception of co-presence (especially with “win-win partners”) enhances an individual’s feeling of perceived warmth and intimacy in a closely bonded community. Also, in contrast to animal behaviors, the cognitive abilities of human being allow players to alter their level of interactions in response to whether punishment exist (Fehr and Fischbacher 2004), and whether the interacting players are competing locally or globally for benefits (West et al. 2006). Players of MMOG may also fine-tune their interactions that alter the direct benefit of cooperation (Fehr and Fischbacher 2004, Henrich et al. 2005). This sense of co-presence can also motivate individuals to act for the benefit of “win-win partners” (with the same social identity and common goals) since they usually enjoy helping others (Wasko and Faraj 2005). This contradicting view of mutualism in terms of human behavior, especially in the context of MMOG with massive peers, is rarely discussed. Therefore, to bridge this gap, this research will investigate the underlying motivational forces of helping behaviors among massive peers in the context of MMOG, and look into the purposes of collaboration based on the needs of MMOG players.

2.3 Motivational Profile

Motivation has long been used to explain various human behaviors related to goal pursuits. Classical motivational theories basically classify motivation into intrinsic and extrinsic, in which Self-determination Theory (Deci and Ryan 1985; Ryan and Deci 2000) intends to explain both the “what” and “why” of goal pursuits. A fundamental hypothesis of Self-determination Theory is that people are more probable to participate in behavior when they are self-determined or acting out of their own volition. When people want to do something rather than feeling as though they have to do it, they are more likely to participate in it and will move to higher level of self-determination.

Within Self-determination Theory, there is a continuum of level of motivation (we call it motivational profile in this paper), in which the lowest level is amotivation, the middle level is extrinsic motivation, and the highest level is intrinsic motivation. Amotivation is a state in which a person is not stimulated to engage in an activity or behavior. Extrinsic motivation is often activated by regulations that may be external, introjected, identified, or integrated (e.g. gaming attitudes or beliefs relating to the benefits and barriers of gaming behaviors). Intrinsic motivation is usually guided by self-regulation that draws upon one’s competence and satisfaction in relation to experiences (e.g., the self-efficacy of performing gaming behaviors).

In this paper, based on prior related research on co-presence, mutualistic interactions and MMOG gamers’ motivational profiles, we propose to extend the traditional continuum of level of motivation
by including the “peer” level motivations (Kong et al. 2012) (including peer-intrinsic motivation and peer-extrinsic motivation) into the existing motivational profile, which may accurately and significantly predicts gamers’ participation in knowledge conversion process and their perception of co-presence in the MMOG game-play.

3 RESEARCH MODEL

To extend the concept of co-presence in MMOG game-play according to the theory of symbiosis in the field of ecology on biological interaction (Trivers 1971, Clutton-Brock 2009), the study aims to propose two new constructs of co-presence based on mutualistic relationships, namely pseudo-mutualistic co-presence and true-mutualistic co-presence, and examines their moderating effects on the relationship between the motivational profile and collaborative knowledge conversion. The concepts of pseudo-mutualistic co-presence and true-mutualistic co-presence are new and form the core of this project.

![Research Model](image)

**Figure 1.** Research Model

<table>
<thead>
<tr>
<th>Motivational Profile</th>
<th>Collaborative Knowledge Conversion Process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internalization</td>
</tr>
<tr>
<td>Self-extrinsic</td>
<td>H1: Acquire other’s knowledge</td>
</tr>
<tr>
<td>Self-intrinsic</td>
<td>H2: Share their own knowledge</td>
</tr>
<tr>
<td>Peer-extrinsic</td>
<td>H3: Integrate group knowledge</td>
</tr>
<tr>
<td>Peer-intrinsic</td>
<td>H4: Create group knowledge</td>
</tr>
</tbody>
</table>

**Table 2. Summary of Hypotheses**

More specifically, the concept of mutualism (collaborative relationship between win-win partners) in the sense of co-presence in MMOG game-play can be further defined according to the underlying purpose of massive peer collaborations with the incentive of collaborative victory in the MMOG environment. Prior experimental work also show that given sophisticated punishment and reward systems, individual human beings possess the cognitive abilities to fine-tune their behaviors in order to alter the direct benefit of cooperation (Fehr and Fischbacher 2004, Henrich et al. 2005). True-mutualistic co-presence can be defined as an individual player’s perception of collaborating with other players in the MMOG game-play with the mutually beneficial relationship, without considering any individual benefit out of the collaboration. It is a higher degree of mutualism in which win-win collaboration is driven by considering others with uncalculated helping behavior in the virtual
environment. On the other hand, *pseudo-mutualistic co-presence* can be defined as an individual player’s perception of collaborating with other players in the MMOG game-play with the mutually beneficial relationship, but considering the social comparison of his/her performance with that of other players. It is a lower degree of mutualism in which win-win collaboration is driven by considering the comparative individual benefit out of the collaboration.

In the following hypotheses (see Figure 1 for the research model; and Table 2 for the summary of the hypotheses), we will associate different modes of knowledge conversion processes with the six cognitive domain of Bloom’s Taxonomy (Anderson and Krathwohl 2001), involving knowledge and development of intellectual skills moving from the lowest level of learning to the highest: (1) knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis, and (6) evaluation.

3.1 **Hypothesis 1: Acquiring knowledge from others via internalization**

Nonaka (1994) defines internalization as a knowledge creation process by converting explicit knowledge to tacit knowledge. In the MMOG context, the internalization process emphasizes that a player can learn through reading explicit knowledge (e.g. written walkthroughs and guides in blogs and forums, listening to advices and suggestions in in-game chats, etc.) written using game specific languages (Kong and Kwok 2011). Through internalization, players acquire other players’ knowledge to formulate their own game specific skills, action strategies and experiences. This mode of knowledge conversion exhibits memory of previously learned materials to associate internalized facts, terms and basic concepts answers, which is associated with the lower levels of Bloom’s Taxonomy (e.g. knowledge and comprehension levels).

As elaborated earlier, there is a continuum of level of motivation in the motivational profile, from amotivation to extrinsic motivation and finally intrinsic motivation. In the starting point of motivated game-play, the MMOG player will extrinsically focus on the advancement of avatar through accumulation of experience point (a.k.a. *grinding*) and in-game equipment (a.k.a. *farming*). Consequently, such self-extrinsic motivational drive may trigger the feeling of envy and social comparison (Kong et al. 2012) even among other team players (win-win partners) of the same guild. In this project, we define this specific perception of co-presence with others MMOG players as *pseudo-mutualistic co-presence*.

Based on these arguments, we hypothesize that a player with a motivational profile of higher self-extrinsic motivation will result in higher level of internalization in collaborative knowledge conversion. Also, the relationship between self-extrinsic motivation and internalization is stronger for players with higher level of perception of *pseudo-mutualistic co-presence*.

3.2 **Hypothesis 2: Sharing knowledge to others via externalization**

Nonaka (1994) defined externalization as a knowledge creation process by converting tacit knowledge to explicit knowledge. In the MMOG context, the externalization process emphasizes that a player can learn through sharing his/her experience and skill of playing the game in community forums, and share the knowledge to other players in the MMOG (Kong and Kwok 2011). The sharing of the explicit knowledge can be occurred through verbal conversation or in-game chat, and written experience in blogs, which are accessible and communicable to other players. Different from internalization, this mode of knowledge conversion exhibits MMOG players’ application of previously internalized materials in the MMOG game-play and sharing of their experiences to other players, which is associated with a higher level of Bloom’s Taxonomy (e.g. application level).

According to Self-determination Theory (Ryan and Deci 2000), a sufficient level of self-efficacy is an important factor to initiate and sustain behavioral change. Self-efficacy is an individual’s belief in their ability to accomplish a specific goal (Bandura 1986). In the MMOG context, a player will gain sufficient self-efficacy when his/her game specific knowledge is accumulated to a certain point, and as a result, the player will enjoy the participation with fun in the MMOG game-play based on self-intrinsic motivation. Also the player doesn’t mind to share or externalize his/her knowledge to others as he/she has accumulated a satisfactory level of experience point that he/she is happy with it. In this
project, we define this specific perception of co-presence with others MMOG players as *true-mutualistic co-presence*.

Based on these arguments, we hypothesize that a player with a motivational profile of higher self-intrinsic motivation will result in higher externalization in collaborative knowledge conversion. Also, the relationship between self-intrinsic motivation and externalization is stronger for players with higher level of perception of *true-mutualistic co-presence*.

### 3.3 Hypothesis 3: Integrating group knowledge via combination

Nonaka (1994) defined combination as a knowledge creation process by converting explicit knowledge to explicit knowledge. In the MMOG context, the combination process emphasizes that a player can learn through integrating individuals’ knowledge of a group (Kong and Kwok 2011). This mode of knowledge conversion requires the demonstration of breaking down facts and ideas into elements and parts, and then combining the breaking elements and parts to form a new whole, which is associated with the higher levels of Bloom’s Taxonomy (e.g. analysis and synthesis levels).

According to the Social Categorization Theory (Turner et al. 1987; Turner 1985), the identity of self may become less salient, or even anonymous within a group. Depersonalization may then occur when individuals directly base their behavior on the goals and needs of a salient group (Brown and Turner 1981); and subsequently hyper-personalization may happen when individuals offer their friendship help and support to others of a group without questioning their individual identities (Walther 1996). In the context of MMOG, tasks are assigned to groups while rewards will be given to every player of the group after successful completion of tasks through collaboration among players (win-win partners). This reflects the concept of collaborative victory. Similar to hypothesis 2, when players have accumulated a satisfactory level of experience point, they are motivated to help others to achieve game rewards based on their peer-extrinsic motivation. They don’t mind combining relevant externalized individuals’ knowledge to form a consolidated knowledge of a group in the form of blogs and forums for the benefit of all players of the group.

Based on these arguments, we hypothesize a player with a motivational profile of higher peer-extrinsic motivation will result in higher combination in collaborative knowledge conversion. Also, the relationship between peer-extrinsic motivation and combination is stronger for players with higher level of perception of *true-mutualistic co-presence*.

### 3.4 Hypothesis 4: Creating group knowledge via socialization

Nonaka (1994) defined socialization as a knowledge creation process by converting tacit knowledge to tacit knowledge. In the MMOG context, the socialization process emphasizes that a player can create group knowledge through observation and imitation of other game players (Kong and Kwok 2011). This mode of knowledge conversion exhibits demonstration, evaluation, design and creation of game specific skills and action strategies among MMOG players, which is associated with the higher levels of Bloom’s Taxonomy (e.g. synthesis and evaluation levels).

In the context of MMOG, in order to create higher levels of game skills and action strategies (like Chinese *Kung Fu* practice) when verbal and textual description can no longer define, learning through observation and imitation will take place. Similar to hypotheses 2 and 3, when most players of a group have achieved a high level of experience point, they are motivated to help others to achieve collective enjoyment based on their peer-intrinsic motivation. They are happy to demonstrate their game skills and peer-evaluate each other with the purpose to design and create new set of game skills with fun as they start to enjoy playing and practice together without considering the personal and collective extrinsic rewards out of the collaboration.

Based on these arguments, we hypothesize a player with a motivational profile of higher peer-intrinsic motivation will result in higher socialization in collaborative knowledge conversion. Also, the relationship between peer-intrinsic motivation and socialization is stronger for players with higher level of perception of *true-mutualistic co-presence*.
4 METHOD

A survey design was used to investigate the aforementioned postulations. Survey questions were constructed with reference to prior empirical work and modified to fit the context of MMOG gameplay activities. All questions were phrased from the perspective of current World of Warcraft and Diablo players. In particular, the measurement of collaborative knowledge conversion will be adapted from Kong and Kwok (2011); the measurement of co-presence will be adapted from Wilkinson (2001) and Wasko and Faraj (2005); the measurement of motivational profile will be adapted from Kong et al. (2012). All questions were anchored on 7-point Likert scale from Strongly Disagree (1) to Strongly Agree (7).

A total number of 40 questions were modified from the perspective of players based on Kong and Kwok (2009). Conceptual construct validation of these 40 items was carried out following Moore and Benbasat’s (1991) card sorting procedure. Table 3 summarizes descriptive statistics of these items and their corresponding Cronbach’s Alpha.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Intrinsic Motivation (SIM)</td>
<td>... I was motivated by finding the game enjoyable</td>
<td>5.14</td>
<td>1.53</td>
<td>0.945</td>
</tr>
<tr>
<td></td>
<td>... I was motivated by finding the game exciting</td>
<td>5.16</td>
<td>1.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by finding the game pleasant</td>
<td>5.10</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by finding the game interesting</td>
<td>5.20</td>
<td>1.61</td>
<td></td>
</tr>
<tr>
<td>Self-Extrinsic Motivation (SEM)</td>
<td>... I was motivated by the experience points I can get</td>
<td>4.70</td>
<td>1.84</td>
<td>0.898</td>
</tr>
<tr>
<td></td>
<td>... I was motivated by the recognitions I can earn from my peer players</td>
<td>4.76</td>
<td>1.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by in-game rare items I can pick up</td>
<td>5.10</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was strongly motivated by the gold coins I can earn</td>
<td>4.72</td>
<td>1.84</td>
<td></td>
</tr>
<tr>
<td>Peer-Intrinsic Motivation (PIM)</td>
<td>... I was motivated by knowing my peer players find the game enjoyable</td>
<td>4.41</td>
<td>1.60</td>
<td>0.962</td>
</tr>
<tr>
<td></td>
<td>... I was motivated by knowing my peer players find the game exciting</td>
<td>4.47</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by knowing my peer players find the game full of fun</td>
<td>4.62</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by knowing my peer players find the game interesting</td>
<td>4.56</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>Peer-Extrinsic Motivation (PEM)</td>
<td>... I was motivated by knowing my peer players get experience points</td>
<td>4.52</td>
<td>1.72</td>
<td>0.954</td>
</tr>
<tr>
<td></td>
<td>... I was motivated by knowing my peer players earn reputation points</td>
<td>4.47</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I was motivated by knowing my peer players get in-game rare weapons</td>
<td>4.75</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td>Socialization (SOC)</td>
<td>... I imitated game skills (e.g. fighting a boss) of other players without talking to my peer players</td>
<td>4.00</td>
<td>1.77</td>
<td>0.937</td>
</tr>
<tr>
<td></td>
<td>... I observed game fighting techniques (e.g. pulling a monster) of my peer players without chatting with him/her in words</td>
<td>4.15</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I followed game movement (e.g. solving a quest) of other players without communicating with my peer players in text</td>
<td>4.17</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I replicated game actions (e.g. collecting quest items) of my peer players without speaking to him/her using language</td>
<td>4.00</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>Externalization (EXT)</td>
<td>... I talked to my peer players about my knowledge of playing the game</td>
<td>5.07</td>
<td>1.54</td>
<td>0.897</td>
</tr>
<tr>
<td></td>
<td>... I contributed my gameplay knowledge in the game channel with my peer players</td>
<td>4.79</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I described my gameplay experiences with my peer players in our guild forum</td>
<td>4.49</td>
<td>1.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I illustrated my gameplay experiences with my peer players through personal communication/instant messaging</td>
<td>4.49</td>
<td>1.87</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I explained my gameplay experiences with my peer players on game wiki</td>
<td>3.85</td>
<td>1.91</td>
<td></td>
</tr>
<tr>
<td>Combination (COM)</td>
<td>... I merged several blog entries of other players’ gameplay experiences, to share them with my peer players in our guild/public forum</td>
<td>4.05</td>
<td>1.85</td>
<td>0.972</td>
</tr>
<tr>
<td></td>
<td>... I combined several forum discussion threads of other players’ gameplay knowledge, to share them with my peer players in our guild/public forum</td>
<td>4.08</td>
<td>1.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I integrated several in-game discussions of other players’ gameplay knowledge, to share them with my peer players in our guild/public forum</td>
<td>4.01</td>
<td>1.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I put together several other players’ gameplay experiences that I came across, to share them with my peer players in our guild/public forum</td>
<td>4.01</td>
<td>1.85</td>
<td></td>
</tr>
</tbody>
</table>
I captured several parts of the user game manual, to share them with my peer players in our guild/public forum

... I studied the gameplay knowledge of my peer players in the game channel
... I read the gameplay experiences of my peer players written in our guild forum
... I learnt the gameplay experiences of my peer players from personal communication/instant messaging (e.g. Windows Live Messenger)
... I examined the gameplay experiences of my peer players documented on game wiki

Table 3. Measurement of Items in the Self-Reported Survey

The variable of mutualistic co-presence is calculated by comparing the items of mutualistic peer-benefit with those of mutualistic self-benefit. For instance, an item of mutualistic peer-benefit minus a corresponding item of mutualistic self-benefit, is then divided by six. That is, a negative value of mutualistic co-presence represents a pseudo-mutualistic co-presence, while a positive value represents a true-mutualistic co-presence. This method has been selected so as to standardize the items as the value will provide a meaningful zero, and at the same time the value will be linear between -1 and 1.

4.1 Data Collection

This study utilized an online survey website to collect data from current players of World of Warcraft and Diablo. Players were invited to fill in the survey through online gaming communities, like game forums and corresponding network on Facebook. To guarantee the quality of respondents, raw data were filtered based on the method used by Kong et al. (2012). Table 4 summarizes the demographic information of respondents.

Table 4. Demographic Information of Respondents
4.2 Data Analysis

The descriptive statistics and Cronbach’s Alpha were calculated in SPSS 17. SmartPLS 2.0 (Ringle et al. 2005) with 200 iterations of bootstrapping technique was used to estimate reliability and validity of items, as well as Partial Least Square (PLS) path analyses.

4.2.1 Reliability and Validity

In PLS analysis, the Internal Composite Reliability (ICR) attempts to assess inter-item reliability, so as to ensure internal consistency of indicators. Average Variance Extracted (AVE) attempts to measure the amount of variance that a latent variable component captures from its indicators relative to the amount due to measurement error, so as to assess the convergent validity of the constructs. The acceptable value of ICR for perceptual measure is above 0.70, where the AVE should be higher than 0.50. (Chin 1998) Table 5 summarizes the measurement model results with all ICR and AVE values satisfied the acceptable value:

<table>
<thead>
<tr>
<th>Construct</th>
<th>No. of Item</th>
<th>ICR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM</td>
<td>4</td>
<td>0.961</td>
<td>0.862</td>
</tr>
<tr>
<td>SEM</td>
<td>4</td>
<td>0.928</td>
<td>0.765</td>
</tr>
<tr>
<td>PIM</td>
<td>4</td>
<td>0.972</td>
<td>0.897</td>
</tr>
<tr>
<td>PEM</td>
<td>4</td>
<td>0.966</td>
<td>0.879</td>
</tr>
<tr>
<td>SOC</td>
<td>4</td>
<td>0.955</td>
<td>0.841</td>
</tr>
<tr>
<td>EXT</td>
<td>5</td>
<td>0.925</td>
<td>0.714</td>
</tr>
<tr>
<td>COM</td>
<td>5</td>
<td>0.978</td>
<td>0.899</td>
</tr>
<tr>
<td>INT</td>
<td>4</td>
<td>0.944</td>
<td>0.810</td>
</tr>
<tr>
<td>MC</td>
<td>3</td>
<td>0.865</td>
<td>0.689</td>
</tr>
</tbody>
</table>

| Satisfied criterion | > 0.7 | > 0.5 |

Table 5. Result of Confirmatory Factor Analysis

4.2.2 Hypothesis 1: Acquiring knowledge from others via internalization

H1 hypothesized that a player with a motivational profile of higher self-extrinsic motivation will result in higher level of internalization in collaborative knowledge conversion. Also, the relationship between self-extrinsic motivation and internalization is stronger for players with higher level of perception of pseudo-mutualistic co-presence.

![Figure 2. PLS Analysis for Hypothesis 1](image)

The $R^2$ value for internalization (INT) was 37.6%. As shown in the figure, for the path between self-extrinsic motivation (SEM) and internalization was significant ($\beta = 0.605$ and $p < 0.01$). The path between mutualistic co-presence (MC) and internalization was not significant. The interaction between self-extrinsic motivation and mutualistic co-presence (i.e. SEM x MC) was not significant.
4.2.3 Hypothesis 2: Sharing knowledge to others via externalization

H2 hypothesized that a player with a motivational profile of higher self-intrinsic motivation will result
in higher externalization in collaborative knowledge conversion. Also, the relationship between self-
intrinsic motivation and externalization is stronger for players with higher level of perception of true-
mutualistic co-presence.

![Figure 3. PLS Analysis for Hypothesis 2](image)

The $R^2$ value for externalization (EXT) was 29.4%. As shown in the figure, for the path between self-
intrinsic motivation (SIM) and externalization was significant ($\beta = 0.537$ and $p < 0.01$). The path
between mutualistic co-presence (MC) and extrinsic was not significant. The interaction between self-
intrinsic motivation and mutualistic co-presence (i.e. SIM x MC) was not significant.

4.2.4 Hypothesis 3: Integrating group knowledge via combination

H3 hypothesized a player with a motivational profile of higher peer-extrinsic motivation will result in
higher combination in collaborative knowledge conversion. Also, the relationship between peer-
extrinsic motivation and combination is stronger for players with higher level of perception of true-
mutualistic co-presence.

![Figure 4. PLS Analysis for Hypothesis 3](image)

The $R^2$ value for combination (COM) was 22.9%. As shown in the figure, for the path between peer-
extrinsic motivation (PEM) and combination was significant ($\beta = 0.395$ and $p < 0.01$). The path
between mutualistic co-presence (MC) and combination was marginally significant ($\beta = -0.854$ and $p
< 0.1$). The interaction between peer-extrinsic motivation and mutualistic co-presence (i.e. PEM x MC)
was significant ($\beta = 1.066$ and $p < 0.05$).

4.2.5 Hypothesis 4: Creating group knowledge via socialization

H4 hypothesized a player with a motivational profile of higher peer-intrinsic motivation will result in
higher socialization in collaborative knowledge conversion. Also, the relationship between peer-
intrinsic motivation and socialization is stronger for players with higher level of perception of true-
mutualistic co-presence.
The $R^2$ value for socialization (SOC) was 29.4%. As shown in the figure, for the path between peer-intrinsic motivation (PIM) and externalization was significant ($\beta = 0.537$ and $p < 0.01$). The path between mutualistic co-presence (MC) and extrinsic was not significant. The interaction between self-intrinsic motivation and mutualistic co-presence (i.e. PIM x MC) was not significant.

To summarize, this study intends to extend our understanding of learning in MMOG game-play by looking at how the dynamics on collaborative knowledge conversion modes are related to the continuum of level motivational profile and gamers’ perception of co-presence in the typical massively collaborative online game-play environment. Our findings showed that all our hypothesized direct effects between player’s motivation profile and knowledge conversion behavior were significant. However, for the interaction effect between mutualistic co-presence and motivational profile, our data analyses show that only hypothesis 3, which is the interaction between peer-extrinsic motivation, mutualistic co-presence and combination, was significant. The following table summarizes our analyses results.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Direct Effect</th>
<th>Interaction Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: SEM $\rightarrow$ INT</td>
<td>$0.605$</td>
<td>$0.340$</td>
</tr>
<tr>
<td>(37.6%)</td>
<td>($p &lt; 0.01$)</td>
<td>(not sig.)</td>
</tr>
<tr>
<td>H2: SIM $\rightarrow$ EXT</td>
<td>$0.537$</td>
<td>$0.057$</td>
</tr>
<tr>
<td>(29.4%)</td>
<td>($p &lt; 0.01$)</td>
<td>(not sig.)</td>
</tr>
<tr>
<td>H3: PEM $\rightarrow$ COM</td>
<td>$0.395$</td>
<td>$1.066$</td>
</tr>
<tr>
<td>(22.9%)</td>
<td>($p &lt; 0.01$)</td>
<td>($p &lt; 0.05$)</td>
</tr>
<tr>
<td>H4: PIM $\rightarrow$ SOC</td>
<td>$0.526$</td>
<td>$-0.287$</td>
</tr>
<tr>
<td>(29.2%)</td>
<td>($p &lt; 0.01$)</td>
<td>(not sig.)</td>
</tr>
</tbody>
</table>

Table 6. Summary of Analyses Results

5 LIMITATION AND PROPOSED FUTURE RESEARCH OF MMOG GAME-BASED COLLABORATIVE KNOWLEDGE CREATION

There are two major limitations of our study. The first concern is related to the sample of the study. Our preliminary data was collected from a number of MMOG players of World of Warcraft and Diablo only. We suggest further research may conduct a boarder data collection and compare players of different MMOGs for a more generalizable conclusion. The second concern arises from the data collection method. Our data were collected from MMOG players using an online survey method only. The small sample size and survey method may lead to sample bias. For future research, we suggest using a longitudinal multi-method approach, including interviews and focus group discussion, to collect qualitative and quantitative data at different time schedule of data collection to further explain the change of knowledge creation modes during the MMOG game-play.
6 IMPLICATION AND CONCLUSION

This is one of the very first studies to explore the effect of massive peers on the collaborative knowledge conversion process and helping behaviors in the MMOG online gaming environment. More specifically, this study tried to bridge the research gap of understanding the underlying purpose of collaboration, by using mutualism (a concept from ecology) as the explanation which facilitate knowledge conversion in the virtual environment. This study proposed two new constructs of co-presence, namely pseudo-mutualistic co-presence and true-mutualistic co-presence, and examines their moderating effects on the relationship between the motivational profile and collaborative knowledge conversion. Analyses on preliminary data show that there is a direct effect between our hypothesized relationships between various motivational profiles and modes of collaborative knowledge conversion. Also, our analyses show that mutualistic co-presence is a significant moderator on the relationship between peer-extrinsic motivation and combination.

To conclude, the findings presented in this paper provide theoretical contributions to the research of learning in MMOG, by exploring the relationships between player’s motivational profile and modes of collaborative knowledge conversion, using concepts of mutualism from the field of ecology. We wish our findings will provide directions for educators, researchers and game developers who seriously explore using MMOG as a new generation of educational platform.

References

Childress, M.D. and Braswell, R. (2006) Using massively multiplayer online role-playing games for online learning, Distance Education, 27:2, 187 – 196


