

# Privacy and Awareness in Multiplayer Electronic Games

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## ABSTRACT

Multi-user electronic entertainment products have a unique set of requirements for the support of user awareness and information privacy. The level of support has a profound effect on the gaming experience, and can result in the same game providing a very different experience on two different systems. The available support for these requirements depends largely on the structure of the gaming system, be it a distributed groupware system such as networked PCs, or a Single Display Groupware system such as a PlayStation console. This paper analyzes the support for awareness and information privacy of several games from both of these broad categories. A new category of systems is also discussed, dubbed Single Display Privacyware, that takes advantage of the strengths of both distributed groupware systems and Single Display Groupware systems.

## Keywords

electronic games, video games, multi-player games, privacy, awareness, Single Display Groupware (SDG), distributed groupware, Single Display Privacyware (SDP)

## 1. INTRODUCTION

The electronic gaming industry has provided a wide variety of mechanisms for supporting privacy of information and user awareness in its products. This is largely due to the diversity of collaborative and combative interactive relationships that can be found in a gaming environment. Different relationships between the players of a game require different levels and types of awareness, and hence different levels and types of privacy.

Awareness and information privacy in multiplayer games depend on many factors, perhaps the largest being the physical proximity of the players and the relationship between what the different players are looking at. These factors can be analyzed by separating gaming systems into two categories,

distributed groupware systems and Single Display Groupware systems.

Distributed groupware systems are common in both gaming and more general purpose multi-user computer environments. Each user uses a separate computer attached to a separate monitor and is physically “distributed” from other users. The only medium for communication between users is through the computer system itself.

Single Display Groupware systems are less pervasive in general multi-user computer environments, but are quite common as gaming systems. Console gaming systems, where users gather around a shared display and interact simultaneously with the game, are examples of Single Display Groupware systems. The research area of Single Display Groupware, as outlined by Stewart et al. [6], deals with the study of how users benefit when they interact with a shared display. These benefits can include social benefits, through enriched inter-user interaction, and performance benefits, through improved inter-user coordination.

This paper examines the different types of support for privacy in a variety of different games for both Single Display Groupware systems and distributed groupware systems. An alternative to these two viewing techniques, dubbed Single Display Privacyware, is proposed. This viewing technique is designed to take advantage of the strengths of both Single Display Groupware and distributed groupware, while eliminating their weaknesses.

## 2. AWARENESS

In groupware systems, the question of awareness deals with the knowledge by users of other users’ state and intentions. State information that may be relevant to all users includes who is in the workspace, where in the workspace the different users are working, and what tools the users are using. Intent information, which can often be implied by state information, is often necessary so that users can coordinate future actions. Coordination makes it possible to minimize interference between users.

Examples highlighting the importance of awareness can be given within the framework of a collaborative text editor. In this scenario it is important to know what portion of the document each user is viewing. Otherwise, it will be difficult for one user to communicate information specific to a particular portion of text. Awareness of what other users are looking at is necessary. To highlight its importance, consider the example of knowing user editing positions. If a user’s cursor is at a certain position, it can be assumed that

the user wishes to edit that section. In this case, another user deleting that section would qualify as interference. In this example the line between state and user intention is vague. Indeed, intent is fairly abstract and is often implied through awareness of user state.

## 2.1 Awareness in Distributed Groupware

Awareness has been a topic of much study in the research area of distributed groupware. In distributed groupware systems there is inherently very little awareness information available. Since users have no direct contact with each other, state and intent information must be explicitly communicated by the system, usually through the use of awareness widgets. These widgets communicate information such as cursor position and viewing position to remote users. The use of awareness widgets has been extensively studied by Gutwin et al. [2; 3; 4]. A discussion on the design of awareness widgets has also been undertaken by Dourish and Belotti [1], with a focus on user effort and involvement.

## 2.2 Awareness in Single Display Groupware

Unlike distributed groupware systems, where awareness information must be explicitly communicated and displayed, Single Display Groupware systems automatically have a large amount of awareness information available. Since all users are looking at the same screen, all information is available to all users. Any state information that must be communicated to a user, for example through the shading of a selected tool on a toolbar, is also communicated to all other users of the system. This is a benefit in that it makes it unnecessary to explicitly provide awareness support. This can be unfortunate, however, for scenarios in which it is desirable to have private information. It is very difficult to display private information to a subset of users, because all users are looking at the same screen.

## 2.3 Awareness in Electronic Gaming Systems

Most multiplayer electronic gaming systems can be categorized as either distributed groupware or Single Display Groupware. It is important to understand the differences in support for awareness and privacy that these systems offer, because awareness is often a critical element of a multiplayer gaming experience.

It can be assumed that added awareness for a player increases that player's ability to achieve the desired goal. Increased knowledge implies an increased ability to make correct decisions. However, since player goals in gaming systems are often mutually exclusive, the design of awareness mechanisms is often quite different than in other groupware systems. Widgets providing critical awareness information may be purposefully left out, may only provide limited information, or may even provide misleading information. In gaming systems awareness knowledge is often a commodity that is gathered by players, and guarded from opponents. Whereas in other systems the goal is to provide awareness information as easily as possible, without disturbing the user, in gaming systems the gathering of awareness information is often a key part of the task.

Many collaborative electronic games, especially PC based games, fall under the category of distributed groupware. Most of these games include mechanisms for the broadcast of awareness information over a network. These mechanisms have developed over many years and have been proven to be

commercially successful. The examination of these mechanisms is relevant not only to the design of future electronic gaming systems, but to all distributed groupware systems. Most home console game hardware and much of the related software is designed to support Single Display Groupware interactions. The gaming industry is perhaps the only industry that has spent a large amount of money and effort developing solutions for SDG environments. It is therefore very valuable to examine the solutions that the gaming industry has developed, in the hope that these solutions can be generalized and adapted to influence the development of Single Display Groupware systems in general.

## 3. PRIVACY

The issue of privacy arises out of the issue of awareness. If there is information that is meant to be private, it is desirable for it to be only visible to a limited subset of all users. The act of making information private is essentially the act of limiting user awareness.

Maintaining information privacy can serve different purposes. Firstly, it can serve to limit the flow of information. This is useful as users can only process limited amounts of information. Secondly, it can serve to keep private information that holds no relevance to other users. This could be considered to be a special case of the first purpose, but is deserving of special mention. Thirdly, in a competitive environment, maintaining information privacy can serve to limit dissemination of information that would have a negative impact on a certain user. This third condition occurs almost exclusively in gaming environments, as most non-gaming environments involve cooperative projects, where the goals of different users are compatible.

## 4. PRIVACY AND AWARENESS IN MODERN GAMING SYSTEMS

Modern electronic games support privacy and awareness in a wide variety of ways. These methods involve both the use of special hardware and software. Different hardware configurations allow for the dissemination and holding of private information in different ways. Different software widgets also allow for control over private information in distributed and co-located environments.

### 4.1 Single Display Groupware Games

The support for private information in existing Single Display Groupware systems is very poor. Most games are either designed so that state and intent information is meant to be public, or in a manner where the issue of privacy is simply ignored. In situations where the requirement for privacy is ignored, the game has very different interaction dynamics than are intended. This is often a detriment to the gaming experience. Table 1 shows a comparison of three popular software titles for SDG gaming systems. Each of these titles requires a different level of privacy support for either user state or intent. The actual support in the titles ranges from none to limited.

#### 4.1.1 *GoldenEye*

*GoldenEye* is a very popular game for the Nintendo 64. The game is often categorized as a "First-Person Shooter," or FPS. Games in this category usually involve players exploring a virtual world by viewing it from a first person perspective. FPS games were originally developed for personal

Table 1: SDG Games Privacy Support

Game Name	Platform	Privacy Required		Privacy Supported	
		State	Intent	State	Intent
GoldenEye	N64	Yes	Yes	No	No
Madden NFL 2000	N64/PlayStation	No	Yes	No	Limited
WWF: War	N64	No	No	No	No

computer systems, and in terms of multiplayer play they are well suited to these systems. The distributed groupware nature of multiplayer PC gaming makes the display of private information easy. On console systems FPS games have not been as successful. The SDG nature of console systems significantly changes the player interactions in the game, relative to that found in PC playing environments. Figure 1 is a screenshot of GoldenEye being played in multiplayer mode on a Nintendo 64 console system. It shows that multiple players are supported by subdividing the screen, with each subdivision providing the first-person view for one player. The information in a subdivision, if known to other players, provides valuable state information such as player location, player health, and weapon selection. In a distributed environment, each of these views would only be visible to its respective player. In an SDG environment, all information is available to all players, at any time.

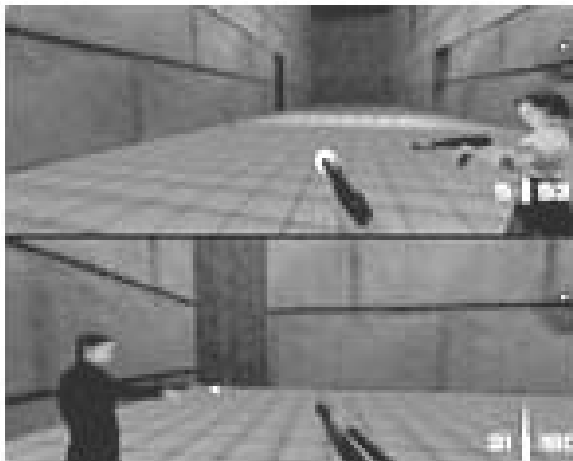


Figure 1: Gameplay Screenshot of GoldenEye

As indicated by Table 1, GoldenEye requires support for privacy of both state and intent. Neither is properly supported on console systems. All state information for every player is visible on-screen at all times. Intent information is not displayed but can be deduced from the state information. The result is that the game playing experience is very different from that of the same game when played in a distributed scenario. Players are omniscient of opponent state, and can easily adjust their strategy to accommodate. The entire gaming aspect of searching out awareness information is removed.

#### 4.1.2 Madden NFL 2000

Madden NFL 2000 is the latest in a series of North American football simulation games produced by Electronic Arts. The

game is popular as a multiplayer game on console systems such as the Nintendo 64 and Sony PlayStation. It is unusual among most electronic games in that player state information is meant to be public, but player intent information is meant to be private.

Intent information in all football games, both electronic and real, is explicitly formed ahead of time. The sequence of events to be performed by players on the field are planned out ahead of each play. Players then improvise within the framework of the play chosen. In Madden Football, statements of intent are made in a planning stage, as shown in Figure 2, where players choose how their computer controlled players will behave during the next play. In real football games this is done secretly, as knowledge of an opponent's intent would give a great advantage. In order for an electronic game to mimic a real game as much as possible, it should be possible for players to choose plays secretly.

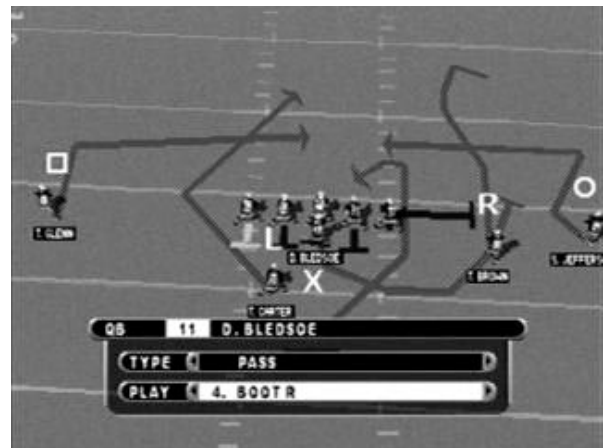


Figure 2: Gameplay Screenshot of Madden Football

In most electronic football games, the mechanisms for keeping intent information private involve information obfuscation. A common technique is to show three possible plays on the screen at a time for a player to choose from. The player chooses one of the three plays by pressing one of three buttons, one button corresponding to each play. When a button is pressed, no feedback from the screen indicates which of the three plays was chosen. An opponent can be sure that the play chosen was one of the three shown, but cannot be sure which one it is. This technique takes advantage of the fact that a user's controller is a relatively private device.

Electronic football games are more suited to SDG environments than FPS games because there is no need to keep state information private. The need to have certain intent information kept private is helped by techniques that confuse opposing players when intentions are explicitly formed.

### 4.1.3 WWF: War

WWF: War, as shown in Figure 3, is one title of many in recent years that deals with professional wrestling. The title is very popular as a multiplayer game, players enjoy taking on the role of their favourite wrestlers and battling with their friends.



Figure 3: Gameplay Screenshot of WWF: War

Games such as WWF: War are particularly suited to SDG systems such as gaming consoles because neither state nor intent need to be private. Unlike GoldenEye, both users always look at the same portion of the virtual world. Also unlike GoldenEye, there is no necessity to keep player health or weapons status private. The game is a reflection of the television viewing experience for an average fan, where all information is known at all times. Knowledge of player state is part of the entertainment aspect of the sport.

In WWF: War, unlike Madden football games, there is no need to explicitly state intent at any stage of the game. Players can freely adapt their strategies at any time in order to take advantage of a situation. This makes it unnecessary to support privacy for intent information.

## 4.2 Distributed Groupware Games

Distributed Groupware gaming systems offer a level of support for privacy that Single Display Groupware systems cannot. As discussed in Section 2.1, distributed systems make all information private by default. Explicit steps must be taken by the software to make information public. As a result, as indicated by Table 2, there is very little problem in maintaining privacy in distributed games.

### 4.2.1 StarCraft

Support for privacy in multiplayer games of StarCraft is crucial for a good gaming experience. This is perhaps one reason why StarCraft has only been developed as distributed groupware, not as Single Display Groupware. The game is a good example of a distributed groupware game that makes use of awareness widgets. In the bottom left corner of Figure 4, is a map widget showing what sections of the workspace are occupied by allied players. Non-occupied sections of the workspace are black on the map, and example of limiting awareness information with the goal of improving

the gaming experience. Sound cues are also used to inform a player about events that are occurring outside of their current workspace.



Figure 4: Gameplay Screenshot of StarCraft

### 4.2.2 Quake III: Arena

Quake III: Arena, shown in Figure 5, is similar to GoldenEye in that it is a First-Person-Shooter. The fact that it is played in a distributed PC environment means that added support for privacy is available. Not only is it unnecessary to split the screen for multiplayer support, as with GoldenEye (Figure 1), but players are no longer able to “spy” on the actions of other players. This provides a more traditional, and most would say more satisfying, FPS gaming experience.



Figure 5: Gameplay Screenshot of Quake III: Arena

### 4.2.3 Madden NFL 2000

Madden NFL 2000, which was discussed in Section 4.1.2 in a Single Display Groupware context, is also available for PCs for play in a distributed groupware environment. Contrasting the same game in two environments gives some indication as to why Single Display Groupware is desirable in

Table 2: Distributed Games Privacy Support

Game Name	Platform	Privacy Required		Privacy Supported	
		State	Intent	State	Intent
StarCraft	PC	Yes	Yes	Yes	Yes
Quake III: Arena	PC	Yes	Yes	Yes	Yes
Madden NFL 2000	PC	No	Yes	Yes	Yes

gaming situations, even though it provides such poor support for privacy. As indicated in Table 2, Madden NFL 2000 does not require state information to be private, yet the distributed scenario still forces users to be in physically disjoint spaces. Separating users makes impossible the rich inter-user communication that occurs in any interactive activity. Co-located users can freely discuss and gesture, all the while maintaining natural eye contact or physical contact. Anyone who has observed a pair of teenagers beat another pair at Nintendo will confirm that the ability to discuss and gesture is freely employed and greatly appreciated.

## 5. SINGLE DISPLAY PRIVACYWARE

There are different aspects to distributed groupware and Single Display Groupware systems that lend them strength as interaction environments. Distributed groupware systems easily support the display of private information. This is important for multiplayer games where opponents wish to keep information from other players. Single Display Groupware systems, on the other hand, allow for natural interaction between multiple players. Most electronic game players will confirm that playing a game, such as WWF: War, with friends in a co-located environment is more enjoyable than playing the same game in a distributed environment.

It is desirable to develop a system that takes advantage of the strengths of both distributed groupware and Single Display Groupware. A prototype system is being developed that allows for information to be kept private, while being displayed on a public display [5]. The current prototype uses CrystalEyes shutter glasses to provide a private view of a public display for two users at a time. The glasses work so that information drawn on both even and odd screen refresh frames is public, whereas information drawn on only even or odd frames is visible to only one user. It is hoped that this display technique, which has been dubbed Single Display Privacyware, will make it possible to support both the natural inter-user interactions inherent in Single Display Groupware systems, and the privacy of information inherent in distributed groupware systems.

## 6. CONCLUSIONS

Different multi-player gaming environments provide different levels of support for awareness and privacy. Distributed gaming environments, such as remotely networked PCs, provide a high level of privacy, while making it difficult to provide user awareness. Single Display Groupware environments, on the other hand, automatically provide a high level of awareness, but information privacy is difficult to achieve. Neither of these conditions is inherently more desirable than the other. Each condition is suitable for certain games, and unsuitable for other games. A problem arises if a game requires both a high level of inter-user interaction and a high level of information privacy. A possible solution to this dilemma is to introduce a new environment, known as Single

Display Privacyware, that provides support for both natural inter-user interactions, and a high level of information privacy.

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