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# Combiform: Beyond Co-attentive Play, a Combinable Social Gaming Platform

**Edmond C. Yee**

Interactive Media Division  
School of Cinematic Arts  
University of Southern California  
900 West 34<sup>th</sup> Street,  
Los Angeles, CA 90089-2211, USA  
[eyee@usc.edu](mailto:eyee@usc.edu)

**Josh C. Joiner**

Interactive Media Division  
School of Cinematic Arts  
University of Southern California  
900 West 34<sup>th</sup> Street, Los Angeles, CA  
90089-2211, USA  
[jjoiner@usc.edu](mailto:jjoiner@usc.edu)

**Tai An**

Computer Science Department  
Viterbi School of Engineering  
University of Southern California  
3650 McClintock Ave, Los Angeles, CA  
90089, USA  
[taian@usc.edu](mailto:taian@usc.edu)

**Andrew S. Dang**

Interactive Media Division  
School of Cinematic Arts  
University of Southern California  
900 West 34<sup>th</sup> Street, Los Angeles,  
CA 90089-2211, USA  
[adang@usc.edu](mailto:adang@usc.edu)

**Abstract**

Combiform is a novel digital gaming console featuring four combinable handheld controllers. It is a new and unique tangible gaming interface that stresses the importance of co-located, co-attentive social interactions among players. In particular, multiple players may freely combine and lock together their handheld game controllers, thereby creating a very flexible collective and transformable tangible interface. Combiform emphasizes social interaction through controller-to-controller contact. The platform and its 10 games introduce novel, tangible and physical co-attentive experiences that are not found in traditional co-located gaming platforms using 'embodied' controllers (e.g. Nintendo Wii and Microsoft Kinect). Based on observations, this new interactive technique has successfully transformed typical co-located social play experiences into a multisensory physical activity.

**Keywords**

Game controller, co-attentive, co-located, social gaming, social presence, tangible user interface, joint gesture

**ACM Classification Keywords**

H5.2 Information interfaces and presentation: User Interfaces – *Input devices and strategies*. General Terms: Experimentation.

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**figure 1.** Combiform with one controller detached

## Introduction

Combiform [see Figure 1] [video: 14-14] can be understood as an emerging gaming system attempting to expand the co-located social play experiences introduced by platforms such as Nintendo Wii, Microsoft Kinect, Hasbro Bop-it, and Twister [10]. Rather than playing games against predictable non-player characters (NPCs), people often prefer to play with other human players. In fact, gamers reported that socializing is the most important goal of playing games [9].

While mediated setting is commonly acknowledged as a more popular model used for social play, studies have found that co-located play evoke stronger social engagement and higher overall level of fun [4, 5]. Co-located play is more engaging to most players because it is a complete multi-sensory social experience (e.g. visual, tactile, auditory, etc.). However, the causation is not simply between physical proximity and overall enjoyment. It is the enhancement of shared attention that increases the level of social presence but not merely co-existing in the same space [1]. Therefore, although most co-located gaming allows richer social interactions, being in the same space (co-located) does not by itself guarantee high social engagement and excitement in gaming [1].

Most co-located video games direct players' attention to face the screen but not to other players. This arrangement counter-acts the natural affordances required for social interaction. It takes away many opportunities for complex interpersonal communication [1]. This stereotypical arrangement could be significantly improved through careful game and interface design. De Kort. et. al. [1] suggested that "[Game interface characteristics] influence how close others can get, and whether they can look at each other while playing." Combiform is especially designed to drastically improve *co-attentiveness* during co-located play.

These handheld controllers are designed to emphasize tangible body-to-body interaction via flexible combining and decombining mechanism. Based on observations [video: 14-2], this new interactive technique affords an exceptionally strong re-enforcement for player to pay close attention to other players. In some games, participant needs to actively choose who to combine with; thereby, transferring majority of attention to other players and not just to the screen [video: 14-7]. While in other games, players need to work together through a tangible, strong-enough magnetic connection [video: 14-2]. In addition to significantly improving focus attention, players could now feel and direct each other's movements and gestures via these tangible links between controllers [video: 14-1, 14-11].

## Co-located, Meditated, and Virtual co-play

Social presence is defined as "the subjective counterpart of objective closeness in communication: 'the sense of being with another'" [5]. There are three common configurations for digital games to achieve this sensation for players: 1) co-located co-play (playing in the same physical location), 2) meditated co-play (online play), and 3) virtual players co-play (playing against virtual opponents). [3, 5]

## Highest Social Richness: Co-located co-play

Gajadhar. et. al. [5] completed a comprehensive experiment to test player enjoyment in the three different settings: Co-located, virtual, and meditated. His group found that "co-located co-player settings significantly add to the fun, challenge, and perceived competence" in gaming compares to both meditated and virtual co-play [5]. While a co-located setting induces more positive play experiences, it does not add to the overall players' frustration or aggression. His group suggested that these results are closely related to the opportunity for richer social interactions during co-located play. In particular, increasing affordances for communication



**figure 2.** Tangible Co-attentive play  $\subseteq$  Co-attentive play  $\subseteq$  Co-located play

through multi-modal social cues (e.g. facial expressions, body gestures, etc.) is the key for players to report higher levels of enjoyments while playing in a co-located space [5].

Other experiments yield similar results in both competitive and collaborative gaming through physiological arousal and subjective reporting in enjoyment levels. [7, 8, 11]

### From Co-located to *Tangible Co-attentive play*

According to Venkatesh and Mukherjee, “Physical proximity avenues for spontaneously interacting with friends. In contrast, playing online games with the same user group of friends does not offer this rich multi-sensory engagement” [13] De Kort. et. al. added that “... in co-located settings we can also experience varying degrees of awareness, involvement and engagement, i.e., social presence.” [1] There are many factors that could influence players’ excitement level even if playing against human players in the same confined space. Interpersonal distance, body orientation, physical interaction (sense of touch), gesture, verbal communications, facial expression, etc. are all important factors in determining the level of social engagement [1]. These could be summarized as a form of attention between players, which we call “co-attentive” play (see Figure 2). There has been quite a few digital interfaces developed that attempt to achieve co-attentiveness during play. The Hasbro Bop-it [10-3] requires other players to pay close attention to the active player even if they are not currently interacting with the device. A recent study has shown that natural-mapping interfaces used in system such as Nintendo Wii and Microsoft Kinect [10-6, 10-5] improve player co-attentiveness during play [12]. Acceleroto Air Hockey [10-1] is one of the many co-located social games on the Apple iPad/iPhone that encourage players to face each other during play.



**figure 3.** Two players combined, achieving joint movement and gesture (Game: 1. Blow-it up)

Most of these designs have effectively improved co-attention among players either through changing players’ body orientation and interpersonal distance [1] or exaggerating gestures and body movements using natural-mapping interfaces [2]. Combiform attempts to improve co-attentiveness via both means from an entirely new perspective. Players are required to actively choose to attach and detach their interfaces in some games; thus, they must pay close attention to others while playing. Since players have to move closer and away from each other for combining, interpersonal distances are dynamically and drastically changed during play, as illustrated in [video: 14-5]. They are completely eliminated in combined mode, merging engaged players’ attentions together. Players are required to move their arm (or even jump) together after they have combined, achieving a natural-mapping *synchronized* interface that draws face-to-face and body-to-body attentions among players (see Figure 3 & 4). It also amplifies players’ gestures which enhance social presence in gaming [12, video: 14-2].

### Tangible Co-attentive play

One very unique aspect of Combiform not found in any other previous work is the *‘tangibility’* it possesses. Instead of funneling people’s attentions to the virtual world like most gaming interfaces, Combiform creates a physical link among players to directly feel each others’ gestures and movements. This opens up possibilities for directing other players’ movements during play. Communication during play can even be done via this tangible link in non-verbal form. For instance, a player could feel when the other player(s) is not doing quite well and subtly direct his/her movements with the established magnetic connection [video: 14-1, 14-7]. The combining mechanic also affords players to tap into other people’s play space in competitive games. Attaching and detaching the controllers is a highly visible action for all



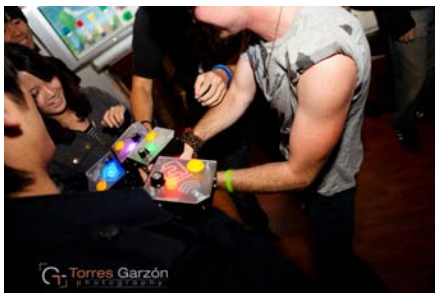
**figure 4.** Two players combined, achieving joint movement and gesture (Game: 1. Blow-it up)

players. This visibility of movements increases possibilities for immediate physical response from other players as seen in [video: 14-5]. These emerging actions can be interpreted as tangible means of augmenting digital gaming through the introduction of flexible attaching and detaching interface. This full-range of tangibility (particularly the joint gesture feedbacks) is not seen in recent experimental effort, Copenhagen Game Collective Joust! [10-2].

### Hardware Design and the Affordances

Combiform resembles the shape of a squared pie cut in four quarters (see Figure 1). This configuration is especially designed to encourage players to pay close attentions to others rather than to the screen. When all four controllers are combined, the players' bodies face each other (see Figure 5). Each controller is equipped with a motion sensor, one big button, one big knob, a multi-color light emitting diode (LED), and four pieces of magnets. The shells are constructed with break-resistant high quality ABS plastic. All controllers are communicating through Digi XBee® Wireless RF modules. The transformation can be summarized into five modes: 1) all separated, 2) all combined, 3) three combined, one separated, 4) two combined, two separated and 5) two separate pairs combined.

The two sides of the controllers are equipped with two sets of neodymium magnets. They provide about 10lb of perpendicular pull force. As discussed in the previous section, this magnetic combining system encourages unique full body social interactions in digital play. In addition to the attaching mechanism, all assets of the controller are chosen to maximize direct visibility and transparency of in-game actions. Each Combiform controller has a LED that is capable of emitting any color in the visible spectrum. The LEDs are often used as important visual communication tools that are easily perceived in a co-located space. Hence,



**figure 5.** Players' bodies are facing each other when all controllers combine (Game: 6. Agent Purple)

information communicated between players and the game becomes completely transparent to the public. This is demonstrated in one of our games called T.A.I. [video: 14-5, 14-6]. The motion sensor (3 axial accelerometer), the big button and the big knob simplify play experiences and make it easy for other players to see and interrupt peers' actions. It would be very difficult for players to see what button someone pressed in a traditional controller, but it would be obvious in a Combiform controller. It seems logical to hypothesize that enlarging tangible inputs (e.g. big buttons) has similar effect compared to naturally-mapped motion controls. Both of these designs enhance social presences through simplified, clearly visible actions.

### Game Design: Enriching Co-attentive Play

We are presenting 10 different game experiences using the Combiform [14]. Games that are in the 'Competitive' category result in only one player winning; all players are competing against each other. In 'Cooperative' games, all players must work together against the game. 'Team Competitive' games require players to pair up in teams and compete against each other. We are demonstrating a wide range of versatility in the Combiform platform. These games range from purely active social-fun (e.g. Blow-It Up), to board-game-like social experiences (e.g. Match!), to serious games for improving Mathematics skills (e.g. Pop Quiz), to beautifully rendered media art/musical hybrid piece (e.g. Unison). It is worthwhile to note that all of these games can be mapped in a continuum of social presence that could lay a foundation for later studies. Self reports on the Game Experience Questionnaire (GEQ) and Social Presence Questionnaire (SPGQ) can be used as subjective measure of effectiveness for all games [6]. Players' physiological data can be captured via galvanic skin response (GSR) and electrocardiography (EKG) [8] for future data analysis and evaluations. We will selectively describe 5 of our 10 games

in this paper. The rest of the game descriptions could be found under the actual viewing area of the videos [14].

#### 1. *Blow-It Up (Team Competitive)*

Timing and cooperation are the staples of Blow It Up. The game will ask players to form teams of 2, and then combine with their partner's controllers. They will then have to move their controllers up and down at the same rate to inflate their color coordinated balloons. The team blows up the balloon first wins. [video: 14-1, 14-2]

#### 2. *Pop-Quiz (Serious Game) (Cooperative)*

Pop-quiz is a math-based game. Each player has an avatar color coded to their controllers on screen. The teacher on screen will put a random number on the chalkboard, and players will each have a number in their avatars answer box. They will then have to find the proper combination of their numbers to equal the number on screen, and then press the button to submit their answer. Addition or multiplication modes are both available. [video: 14-8]

#### 3. *Switch (Cooperative)*

Switch is a rendition on the classic Twister. Played with 2 to 4 players, it doesn't require the screen at all. The beginning of the game starts with all 4 controllers connected in the middle, 2 are lit blue and the other 2 are lit purple. Players must switch the position of the 2 purple controllers without separating the blue ones. It may seem easy at first, but soon you won't be able to tell where your body stops, and your partners begin! (2-Players [14-13], 4-Players [14-14])

#### 4. *For Here, To Go (Cooperative)*

One to four players test their service industry tray balancing skills in For Here, To Go. All Combiform controllers are combined and held at shoulder length to symbolize a waiter's tray. As players walk to serve tables, their drinks will

randomly slide around the tray. By counterbalancing the controllers, they can prevent the drinks from crashing to the floor. [video: 14-11]

#### 5. *Tournament of Artificial Intelligence, T.A.I. (Competitive)*

T.A.I. is Combiform's rendition of Simon Says [10-7]. During the round, the computer will shout out commands such as "combine" or "press button". If the players' controller is blinking, they must complete the command. However, if their controller is not blinking, they must not do the action. Players can force an action onto another players' controller when they aren't paying attention as an offensive maneuver. [video: 14-5, 14-6]

#### 6. *My Light, My Game* [video: 14-3, 14-4]

#### 7. *Match!* [video: 14-10]

#### 8. *Agent Purple* [video: 14-7]

#### 9. *Firewall* [video: 14-9]

#### 10. *Unison (Media Art Piece)* [video: 14-12]

### Conclusion

Studies have shown that co-located gaming is more fun and engaging than playing online or with virtual players. Nevertheless, simply having players in the same space will not guarantee involvement and social engagement. Combiform's attaching and detaching mechanism is specifically designed to enhance co-located co-play experiences. The interface and the 10 games are designed to require players to not only be co-located in the same space, but more importantly, co-attentive to one another via physical and tangible means. It attempts to open up an entirely new level of collaborative and competitive play experiences where both body-to-body and body-to-screen interactions happen in parallel.

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- [14-7] Agent Purple <http://youtu.be/a7nXlFVrgLM>
- [14-8] Pop Quiz <http://youtu.be/7kpB32bsosc?hd=1>
- [14-9] Firewall <http://youtu.be/7a8BfBYBNWU?hd=1>
- [14-10] Match! <http://youtu.be/Gen72As4rqI>
- [14-11] For Here, To Go <http://youtu.be/ej7ZZ0rmWC0?hd=1>
- [14-12] Unison <http://youtu.be/eCjvmu6xw1o>
- [14-13] Switch <http://youtu.be/1MmbDTRiCo> (2 Players version)
- [14-14] Switch <http://youtu.be/ytZ5ttFE7xw> (4 Players version)
- [14-15] Promotional Video <http://youtu.be/r92cDygrDiM?hd=1>