

Designing for Social Play in Co-located Mobile Games

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ABSTRACT

In this paper we explore how mobile devices and co-location in mobile contexts contribute social play in game design, addressing the limited understanding of social interactivity in mobile games. Using the Mechanics-Dynamics-Aesthetics (MDA) framework, we code four games illustrating effective use of mobile, social, and co-located elements. Subsequently, we analyse and discuss this data to identify generalisability in these games. In our discussion we identify how these findings address game design problems of designing collaborative games. Furthermore, we contribute to theory of designing for social play from the perspectives of co-located mobile contexts in game design by identifying how mobility: (1) affords co-locating with other players in public spaces, (2) supports physical interactions using spatial context and players bodies, extending games beyond their formal system, (3) supports asymmetric design with information and interaction. Finally we contribute the concept of a pocket magic circle, a particular magic circle, to support a focus on game design leveraging these intersecting properties.

Keywords

Game design; mobile games; social play; embodied interaction; co-located play; asymmetric play; magic circle

Categories and Subject Descriptors

H.5.m. [Information Interfaces and Presentation (e.g. HCI)]: Miscellaneous

1. INTRODUCTION

Mobile devices are increasingly popular and can support ubiquitous social experiences. These experiences can be supported by social networking apps, games, and other forms of software designed with social interaction in mind. For example, a quick look at the top games available on app stores reveals the increasingly popular social games on mobile platforms. However, these social networking service (SNS) mobile games support social interaction through the Internet and do not design around a co-located context of play. Despite the popularity of mobile games, the knowledge of

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how their design can support social play in co-located and mobile contexts is limited. The discussion about the intersection between mobile and social has been largely focused on SNS games and pervasive games. This begs the question, how can games be designed to support meaningful social play in a co-located context using mobile devices? In this paper, we focus on informing the design and research of social play in co-located mobile games.

Previous research has called for a better understanding of how game and interaction design supports social interactions [33], as seen in collaborative and tangible user interfaces, co-located play [21, 8, 13], as well as LAN parties [32, 1, 20] and pervasive and online multiplayer games [7]. These types of social games and interfaces have unique potential to support collaboration, but are also difficult to design [34], although progress in understanding collaborative game design is an ongoing topic (e.g. [22]), but the topic of designing social mobile games for co-located play remains relatively unexplored.

To support our focus of contributing to game design theory we selected four games evidencing social play with the criteria of being: co-located, mobile, and social. The games selected are: Bounden [15], Spaceteam [29], i-identity [16], and Fingle [14]. We believe these games contributed some form of innovation to mobile games and provide exemplary artifacts for analysis. Three of the games have won numerous awards and accolades and another has already been subject to scholarly discussion (see [17]). To work toward a generalised understanding of these games, we have coded the design elements of these games using the Mechanics-Dynamics-Aesthetics Framework (MDA) [19]. Taking this as input for analysis and discussion, we have highlighted the recurring themes of embodied interaction with social meaning, their themes of cooperation and competition, and how they make distinct use of co-located space. We finally discuss the contribution of mobile technology to games and their distinction from pervasive games by drawing on theory of the magic circle. By analyzing the design of co-located social games from collaborative, mobile and embodied perspectives, we to contribute to the broader topic of designing meaningful social play [28] for mobile platforms.

1.1 Qualitative Coding with MDA

Games are irreducible and complex systems. As part of a process of play, they support emergent experiences. As artifacts, they contain knowledge embedded within them as a 'concrete embodiment' of theory [35] that can elude the written language focus of academic discourse. In game design, understanding a relationship between a game's constituent elements and with play is critical. In this paper, two authors have coded four games using the

Mechanics-Dynamics-Aesthetics (MDA) game design framework [19]. MDA has previously been used in the investigation of social game design [5] and provides a useful tool allowing us to explicate a game for analysis and discussion.

Through the MDA framework, a game can be understood within the language of three elements: mechanics, dynamics, aesthetics. Mechanics represent apparent action oriented elements of the game, interactions as they create meaning from the game's perspective. Mechanics might be as simple as "jumping" in a game, but the emphasis is not on the pressing of a button, but of its meaning in the game. Secondly, dynamics are useful for understanding the emergent properties of the game; what happens when these mechanics interact? How does time sensitivity create conflict? This provides a way to investigate complexity, specifically perceived complexity, in the games. Lastly aesthetics explore the abstract cohesive interaction between the underlying design elements. Aesthetics can describe a top-level designerly intent; what should the player feel? What does this game mean? In MDA, these elements bidirectionally interact, each influencing how the game comes together. Coding can be imprecise, as the authors acknowledge that an element might be perceived as a mechanic to one person, and a dynamic to another, for example. Even a dynamic can fit into a second-order dynamic in more complex system. However, this framework provides a useful game design means to code and understand the game's elements.

The MDA coding generates interesting details about the ultimate particular. As such, this might provide a perspective useful to other game designers. Though more importantly, we are using the MDA coding as the basis for our analysis and discussion. In the discussion we can evaluate the four games in the context of each other as well as current theoretical understanding, in order to work toward generalized claims for game design theory.

2. SPACETEAM

Spaceteam [29] is a social game available on mobile devices. This co-located multiplayer game supports 2 to 4 players, each operating as part of a fictional space ship. Each player connects their mobile device to an ad hoc wireless network. Each player is provided with a control panel on the touch screen with instruments for the user to manipulate, such as buttons, toggles, dials, and knobs. The controls are labeled with text such as "Ferrous HoloSpectrum" or "Astral Synth". Along with the control panel, each player is provided a visual representation of the ship's imminent threat, such as fire chasing them. Additionally, each player has a text box showing a command to be actioned on any one of the player's control panels.

During each wave, which represent progress in the game, players must communicate their instructions provided in the text box with the 'space team' so that the appropriate actions may be taken. For example player 1 might require player 2 to "Soak Ferrous HoloSpectrum". Failure to execute required instructions within the time limit puts the players at risk. Consecutive successful completions advance the players to the next wave, increasing difficulty. Accordingly, new elements are added to the game to increase difficulty. Quick time events such as asteroids or worm holes require all of the players to listen to a player's instruction and action them by this time manipulating the device physically.

2.1 Mechanics

2.1.1 Networking

While typically a technology consideration, networking, specifically synchronous local networking, becomes an important mechanic in Spaceteam, affording more complex dynamics such as asymmetry. Uncommon to mobile games, which often rely on turn-based, networking actively involves every player concurrently and presents them with a different helm of command as part of the team in a space ship.

2.1.2 Aural and Cognitive Bandwidth

With an abundance stimuli - activity in the game and the orders shouted by your team - there's a lot to mentally absorb and verbally communicate. The difficult part of this mechanic is that every player is pressed to vocalize their action, but every action shared at once simply becomes noise - the cognitive bandwidth of processing all of these actions becomes saturated.

2.1.3 Time Limit

Every action to be taken on the ship has a time limit, a bar that decreases until the time has run out on this action. This timer does not wait for players and competes with every other mechanic in the game. This mechanic contributes to the dynamics including time sensitivity and the aesthetic of intensity in the game.

2.1.4 Visual & Interactive Noise

As the waves progress and the space ship falls apart, effects are introduced into the game to add an additional layer of difficulty. Visual noise such as smoke, lights and distortion effects interfere with the players visibility of their digital interface. Furthermore, reoccurring touch based actions require the player to repair the ship. For example, the panel or interface of the ship may fall apart requiring the player to rotate the piece into place. Other effects such as oil that must be wiped off.

2.2 Dynamics

2.2.1 Unstructured Communication

Players are required to communicate with each other events and the state of the 'space ship', but there are no prescribed means to do this. The game provides no rules for communicating with others, nor does its technology afford any means of communication. Players find their own means of communicating with each other, inventing short hands, using proximity, and possibly body language too. The unstructured nature also supports unstructured play by giving opportunity to the players to engage with the game their own ways.

2.2.2 Information Overload

There's a lot of activity in Spaceteam, visual and aural noise, and things getting in the middle of your operating the spaceship. Memory comes into play in Spaceteam where you have to balance remembering various vocalized orders from the team until you can action them and there are plenty of obstacles delaying you from actioning, requiring an active management of information.

2.2.3 Balancing Time and Information

As each player concurrently has a time sensitive action, the urgency of players to communicate their required state-changing action and the overloading effect of every player communicating at once must be balanced. Players therefore need to gauge the urgency of their teammate's command and find means of communicating this concern effectively. The communication mechanic is augmented by this dynamic, as volume becomes part of communication (shouting) and additional information must be conveyed, e.g. "I'm almost out of time. Quickly everyone!"

2.2.4 *Uncertainty and Ambiguity*

It is not always clear what type of action you require your team to perform, but even more importantly it is unclear who needs to respond to the action. Who to address the game issued state change required to? Who has what control panels? Each wave the controls change, but for mindful players that manage to communicate or infer it, the ambiguity is resolved progressively through play as players may identify which controls belong to which player. This dynamic is important in contributing to information overload - at least initially in a wave, each player must consider every command at their inconvenience.

2.3 **Aesthetics**

2.3.1 *Unnatural and Unintelligible Concepts*

Adding challenge to a game that is fundamentally about communication, unusual symbols, unintuitive switches, and unlikely phrases are used. This adds challenge to communicating with other players: how do you understand what they are saying? Is there a shorthand for this? How can I verbalize this strange icon? This added layer of difficulty contributes both to a comedic aesthetic in the game (players shouting nonsense aloud), but also enables a new form of mastery in the game as players become experienced with the unfamiliar.

2.3.2 *Teamwork*

The game quickly establishes cooperation as a core aesthetic in the game - all players must jointly press a button to begin the game. While the unenforced nature of the cooperation does allow for deviation, fundamentally players must work together persevere in the game. Everyone is co-dependent for success. Players must work together to balance the dynamics of limited communication bandwidth, spontaneous events, and joint actions such as when the game presents obstacles required shared action (e.g. everyone shakes their device to avoid asteroids).

2.3.3 *Comedic Social Play*

The designed combination of mechanics and dynamics lead to the comedic play in Spaceteam. By nature of playing the game, players can be said to be in the lusus attitude [31], enabling a comedic tone which is in turn supported by the co-location and cooperative attitudes of players. These elements set the stage of comedic play, but do not create it. The nonsensical elements and intensity of play, in this designed magic circle, allow players to make mistakes, act out physical humour such as representing an action, and engage in absurdity and nonsense.

3. **BOUNDEN**

Bounden [15] is a mobile dancing game supporting two players. This local multiplayer game is supported by physically sharing one device between two players. Designed by Game Oven in association with the Dutch National Ballet, this game brings players to dance with their bodies in physical space. Players become dancers, levels become choreographies, and gameplay becomes dance as they manipulate the device to achieve the open-ended dance of Bounden.

To start a game, players both hold and balance the mobile device to start. They both have to keep touching the device after the level begins. Following this, the mobile device becomes the physical space reference for a virtual sphere displayed on its screen with a guiding disc. Level design consists of virtual targets placed on the sphere in a way to choreograph movement, and a level is

progressed by players manipulating the device, thereby rotating the virtual sphere, and approaching the targets with the disc. Advanced levels introduce music and a corresponding pace that players must reach the targets at.

3.1 **Mechanics**

3.1.1 *Single Device*

Bounden is played on a single shared mobile device. Input data, such as from gyroscopes and accelerometers, does not distinguish between players. From a conventional games perspective, the controller and the display are shared. Thus players are physically joined, or bound, through the sharing. Each player still moves independently at the mechanic level. This shared body introduces an element of physicality, but bodily contact is prescribed in the game.

3.1.2 *Uninterrupted Hold*

Players start the game by jointly holding their corresponding thumbs on their respective side of the device as registered by the touchscreen. A circle signifies where to hold your thumb and the edge of the phone affords a closed grip similar to regularly holding a mobile phone. Players' hands are locked for the duration of a level.

3.1.3 *Device Rotation*

The game provides axially constrained, spherical levels. Players are required to rotate the device, directed toward targets placed along the sphere, visible on the screen. Some targets require the device being rotated into place, while others also require the device to be oriented at a certain angle.

3.1.4 *Music Synchronization*

Levels with music require players to keep up with the tempo for successful completion. This introduces an element of time into the play.

3.2 **Dynamics**

3.2.1 *Interpretation*

How do players map the level, as seen as a sphere on the device for rotation, into choreographed movement, or dance? Without a prescriptive way to play, players can play 'out of order' or try to find the shortest linear path. Players (dancers) find their own way to dance while meeting the constraints of the level.

3.2.2 *Cooperation through Nonverbal Communication*

As the saying goes, "it takes two to tango." Players work together, sharing visibility of the one screen and negotiating movement in space. As in dance, players may find leading roles, cooperating to overcome their physical constraints of their 'shared body' to meet the needs of the level, following the choreography through dance. Nonverbal communication works naturally and also contributes to the aestheticism of the game.

3.2.3 *Constrained Movement*

The shared body and constrained handed orientation of holding the device limit the freedom of movement of the players. They are dancing with a tether. Combining the constrained movement with the level design (or choreography), certain movements are afforded. Navigating the complexity of the level design, players find ways to express or play the level and these designed patterns afford dance. For players unfamiliar with the choreography, attentive sharing of

the display further constrains movement to maintain shared visibility.

3.2.4 *Symmetry*

Bounded finds a balance between both strong symmetry and asymmetry. Typically players start opposite, with matching handedness, as if to mirror each other. Through play, this may change as one player takes lead. To achieve necessary rotation, both players can contribute movement, or one player can, with cooperation, move around the other. Through playful juxtaposition, both symmetrical and asymmetrical elements are found.

3.3 **Aesthetics**

3.3.1 *Aesthetic Pursuit*

Not to be confused ‘aesthetic’ from our MDA analysis, this aesthetic is indeed aestheticism, the pursuit and emphasis of aesthetic. Bounden is largely about form over function. While the game quantifies a technical score for the game, it is technique the players find value in. Where other games might boil down to a leader board, players find value in the performance whether it is private, recorded in video, or shared with an audience.

3.3.2 *Performativity*

The players create their own meaning in the performance of Bounden, and they may pursue their own aesthetic identity. However, the level design affords a certain elegance and fluidity somewhat reinforced or framed by the visual and aural experience only natural to a game designed in collaboration with Dutch National Ballet. Mastery of the game becomes more than simply learning the level design, and how that choreographs a dance, but about forming a means of expression as the level is transformed into a unique performance.

4. **FINGLE**

Fingle [14] is an iPad game where two players play together on the same device to manipulate virtual objects using multi-touch interactions. Play involves each player using their fingers to drag up to five buttons of one color at once onto their matching targets. The targets can be static as well as moving. All of the colored buttons must simultaneously collide with their corresponding targets for a period of time to progress, otherwise the timer will reset.

4.1 **Mechanics**

4.1.1 *Holding Touch*

The fundamental touch-based interactions incorporated is dragging and maintaining touch to physically manipulate a virtual object to different positions on the screen. To increase the complexity of the interaction, the game facilitates multi-touch gameplay by requiring a unique touch point to be made with each virtual object.

4.1.2 *Moving Targets*

Complexity arises when on-screen targets are moving around the screen rather than remaining in fixed positions, requiring players to move their fingers with the targets while also coordinating each other’s movements to avoid getting their body and fingers in the way of the other player.

4.2 **Dynamics**

4.2.1 *Body Contact*

The touch-based interactions facilitate a kinesthetic form of play occurring within the shared space that is situated above the screen. The physical constraint of this spatial configuration of bodies and device often mediates indirect body contact between players. The level design invites rather than enforces bodily contact by positioning a target close to or behind another player’s target, which can result in players’ hands accidentally bumping into each other. The close physical proximity of kinesthetic and touch-based interactions means players’ hands gradually become intertwined in physical space, often making it challenging for players to avoid making bodily contact during the course of the game. This potential for indirect bodily contact contributes to an intimate aesthetic in the game as players attempt to negotiate the closely shared physical and virtual spaces.

4.2.2 *Coordination*

The level design engages with interpersonal physical interactions by establishing bodily coordination of movements as a core dynamic in the game as each player must coordinate their movements with the other player to play the game, as players simultaneously share the same physical space around the device screen. While players manipulate different buttons onto different targets on the screen, fundamentally they are co-dependent on each other for success. Early levels only has one button for each player to drag to a fixed target, with advanced levels challenging the players to drag multiple buttons at once onto targets that move back and forth at a certain speed to different positions around the screen. At this stage, the increased complexity of the levels means targets will move in patterns and cross paths in ways which requires the players work together to figure out the best way of coordinating their movements so as to drag the buttons with the targets without getting in each other’s way.

4.3 **Aesthetics**

4.3.1 *Intimacy*

Intimacy is a core aesthetic as the game brings the players into close range to each other to physically share the limited space that surrounds a single device that often brings them to touch. Not only does the level design encourage players to move in a rhythm with the targets that move in patterns around the space, the physicality of this interaction with the device demands the joint coordination of another’s body in space towards a shared goal. The intimacy afforded by shared space in co-located play leads to a sense of togetherness and kinaesthetic awareness of another’s movements as key parts of the overall social experience.

5. **I-DENTITY**

i-identity [17, 16] is a collaborative movement-based game played with a set of PlayStation Move controllers or mobile phones. Players assume the role of an interrogator or as one of the three or more spies. The three spies each hold a mobile device, with one of the phones randomly assigned by the game to represent the spies’ leader. The leader’s movements illuminate all three of the spies’ screens, while the other spies’ movements are ignored. Vibration feedback is discretely sent to the leader’s device to let them know their role in the game. A leader’s role is only known amongst the spies.

The interrogator, whose goal is to identify the spies’ leader asks the spies to perform movements. For example, the group may be asked to jump up and down, to ‘pretend they had just been shot’, or play air guitar. However, the interrogator can only address the spies together, as a group (so the interrogator cannot say ‘only the

person in the middle should jump'). While the leader moves his/her controller in response to acting out a command, all the spies' lights turn on. When the leader is stationary the lights go out. The spies copy the leader's movements in an attempt to innominate the representation so the interrogator cannot work out whose movement controls the light. The game continues until the interrogator believes she/he knows the identity of the spies' leader. At this stage, the interrogator points towards the leader. This player then waves their mobile device; if all spies' screens illuminate, the interrogator wins and he/she switches roles with the leader, otherwise the leader and the spies win.

5.1 Mechanics

5.1.1 *Physically Stabilizing the Game Controller*

As the devices are situated with movements in a co-located context, this means the focus of the interaction is with the body. This small disparity between movement and representation allows focusing on the gameplay challenge of coordinated movements. The focus on the body rather than the screen designs an intended experience. Firstly, it contributes to awareness for non-verbal and non-screen based communication. Secondly, it contributes to the spectacle created by placing an emphasis on the players' physical performances.

5.1.2 *Asymmetric Mapping*

The input mapping is not one-to-one, as one player's movement representation is duplicated multiple times across to the others' devices. This input mapping of a player's movement to control of the lights is clear and obvious if only one of the spies moves. However, when spies move together at once as a group, this makes the input mappings of their movements unclear to those outside of the group. This ambiguity in mappings leaves room for alternative (and incorrect) interpretations, often resulting in verbal discussions due to speculation over who is thought to be the spies' leader.

5.1.3 *Movement Synchronisation*

The digital interaction facilitates interpersonal synchrony, requiring the group of spies to maintain a rhythm in their body movements to make it difficult for other players to figure out which of them controls all of the lights. To succeed, the group must have awareness for each other's bodies such that they can effectively coordinate their movements at once.

5.1.4 *Conducting*

Whenever the interrogator or a spectator holding a mobile device connected to the Bluetooth network is touching his/her mobile phone screen, he/she becomes the conductor, with his/her movements sensed. At this stage, the group is required to coordinate their movements in sync with the interrogator or spectator's performance, otherwise the game will reveal who the leader is.

5.1.5 *Ad hoc Spectator Joining*

Any spectators who have a mobile device can quickly and easily join in by connecting to the local Bluetooth network. Upon doing so, they can conduct the group by touching the screen on their device at any time during gameplay.

5.2 Dynamics

5.2.1 *Experimentation*

Gameplay is open-ended as opposed to being predetermined by the game itself. This freedom of interaction affords an emergent

and spontaneous type of physical play, as players experimenting with a range of strategies to succeed by surprising and challenging players, such as getting the group of spies to raise one leg while performing movements to challenge balance, face the group in different directions so it is difficult for them to see each other, or provoke laughter. The spies can also experiment with the use of non-verbal communication as a play strategy, such as body language to deceive other players.

5.2.2 *Cooperation*

With the asymmetric mapping and requirement for movement synchronisation, this encourages cooperation to successfully coordinate movements. Without a prescriptive way to play, players could perform movements differently in response to a command. In particular, commands that are more open-ended, such as "spin your arms around in a circle", raise questions regarding the speed and direction of the movement. To overcome this ambiguity, players must cooperate by following the choreography.

5.3 Aesthetics

5.3.1 *Ambiguity*

With its combination of mechanics and dynamics, it is clear that ambiguity is a core aesthetic. Firstly, the game builds social drama from the ambiguity around the unknown player associations to specific roles, encouraging communication and spectator involvement with gameplay due to the ongoing speculation. Secondly, this ambiguity is heightened by the use of bluffing, with players working together to deceive or misdirect other players and spectators through their body language and facial expressions. The ambiguity that emerges through play creates an intense and involving co-located social experience.

6. DISCUSSION

As we selected the games based on the criteria of being mobile, social, and co-located, our MDA analysis of these games progresses us toward a better understanding of how these characteristics intersect to create novel experiences. From a game design lens the mechanics, dynamics, and aesthetics, and their respective interactions with one another highlight some of the common strengths in these games, each with their own nuances. As we identified through the analysis, these games all make use of collaborative and cooperative elements to facilitate their social play toward shared goals. We start our discussion by exploring collaboration from the perspective of game design theory, illustrating how their designs address identified problems facing collaborative game design through the use of asymmetry requiring multi-modal communication. Secondly, we investigate how these co-located games leverage physicality from the perspective of embodiment. We finish our discussion from the perspective of how mobile devices and contexts contributed the design of these games. We consolidate the contribution of mobile in game design by introducing the notion of pockets, magic circles differentiated from those in network multiplayer games. As we break down these intersecting characteristics of social, mobile, and co-location in game design, from these three perspectives we offer insights into their affordances and potential to contribute to the study of games and theory of game design.

6.1 *Designing Collaboration & Cooperation*

The games we analysed, all rely on a coordination of play and movements, drawing on communicative and collaborative elements [22]. From Spaceteam, needing communication of assignments and actions, and coordinating a ballet dance in Bounden, to combining

your fingers movement to succeed in Fingle, and completely synchronise the bodily movements of a entire team of spies in i-dentity. All these co-located mobile games are highly driven by this cooperative element of coordination. Investigation into camaraderie in games illustrate design patterns for facilitating social elements at an aesthetic level [5]. Furthermore, Zagal et al. identify three pitfalls facing collaborative games: (1) games have to provide rationale for collaboration, (2) players need to care about the shared outcome, (3) re-playability requires nuanced experiences [34]. In this section, we address how the mechanics and dynamics used in game design can address these pitfalls by saliently taking advantage of co-location.

6.1.1 *Social Play Gives Rationale to Collaborate*

Multiplayer games often take advantage of forms of teamwork. However, online games can motivate players by selfish or instrumental goals. For example online multiplayer games such as MMORPGs are often without motivation to converse with other players, but may have short interactions for instrumental purposes such as healing [10]. Other online games support stronger forms of collaboration, but often rely on meta-game elements such as online forums to support community [7]. In social media games, players are drawn by increasing their levels or progress in the game [33] and drawing social elements to support this. Such games fall into the first pitfall of collaborative games [34] by placing only small economic incentive to collaborate, but not designing collaboration into meaningful play through social elements.

Conversely, the games in our study all have shared goals fundamental to the game - goals that are ephemeral and without persistent gameful or instrumental gain, such as in MMORPGs or on leaderboards. Furthermore each of these goals is achieved through social elements, especially communication. With communication, the games designed distinct dynamics to emerge offering unique experiences of social play. In Spaceteam, players needed to balance communication bandwidth to avoid overload and mix modality of communication. Bounden had forms of cooperation through coupled embodiment and in Fingle, players coordinated their hands, constrained by physical space. In i-dentity, spies synchronize their movements cooperatively. Each of these dynamics show how social elements were at the core of these designs, creating social play as a motivation, and even requirement, in the game. Rationale to collaborate is designed into the fundamental goals of the games where the game is about collaboration.

6.1.2 *Co-location Brings Meaning to Outcomes*

The power of communication and coordination can be seen in online games [7], supported through meta-game activity in online forums and community supporting game systems such as guilds. This supported processes such as reflection and helped reaffirm group identity, strengthening the group. Co-location provides a parallel to these digital constructs. By requiring co-location, its natural affordances are exposed to support the group and socialization, both inside and outside of the game.

Inside the magic circle during the play of the game, requiring the players to co-locate and communicate helps create group identity. Players aim toward shared goals, while sharing feedback with each other as affirmation or disapproval, bringing social meaning to actions within the game. Feelings of success are infectious and failure leads to out of game reflection. For example, the laughter brought through unstructured communication and unintelligibility in Spaceteam creates playful intrinsic value in the comedic

aesthetic in gameplay. The aesthetic of intimacy in Fingle leverage the closeness to find social value of play. Additionally, social drama is created through resolving ambiguity and heightened by the inclusion of spectators to support the interrogators in i-dentity. Similarly the performativity and the spectacle it creates also brings social meaning to play.

Other multiplayer games might disconnect players after a game, limiting their meta-game interaction. The meta-game, as seen through pre and post game interaction, supports further social interaction and group identity. The incorporation of co-location means the game as a system is only part of the experience it creates. Co-location supports social interaction providing additional feedback into the meaning of game and its outcomes. In addressing the topic of mastery in games, players have the opportunity to reflect on their performance, such as how they might have miscommunicated an action in Spaceteam. Excellent performances in Bounden may warrant social acts of sharing, such as by video recording. Engaging with the audiences these games also allow for elements of spontaneity, such as spectators rotating with players and temporary groups forming around located play. The social context supports imparted social meaning onto the play and outcomes of gameplay. Players care about the shared outcome to the group and audience.

6.1.3 *Mixing Physical with Digital for Complexity*

Re-playability is an issue facing the games, where the value of returning to play the game can diminish without new challenge in the game. This has specifically been identified as a pitfall in collaborative games [34]. The games we investigated overcome this by mixing physical elements of their design with digital. One way this is achieved is through the use of multi-modal interaction, which may contribute to their experience such as through increased sense of immersion [3]. Using game design, this is also accomplished through asymmetric mechanics creating ambiguity and uncertainty through the integration of digital elements in physical space which is resolved through communication during play. With asymmetry, each player can have a different perspective into the game's world. For example, in Spaceteam each player is provided with different instructions and control panel for interaction. This asymmetry obliges players to engage in a lusus attitude [31] to support the unnecessary challenge of operating a ship through communication instead of screen sharing. If this game had alternatively been designed for a split screen, the asymmetry would be lost and the challenge consequently reduced. i-dentity uses the goal of symmetry between the spies, requiring the spy players to collaborate to avoid asymmetry. Elements only afforded by blending digital and physical, such as moving perspective, fatiguing players, and requiring physical coordination are dynamics that bring complexity to i-dentity. Fingle and Bounden design for physical asymmetry, allowing for emergent lead roles and physical interactions that can create experiences such as intimacy or awkwardness not possible without digital-physical mix. These dynamics highlight how digital game design can use physical elements to provide complexity and challenge, and supporting re-playability in collaborative games.

6.2 **Design Play with Shared Physical Elements**

In this section, we integrate relevant recurrent themes and concepts emerging from our design analysis related to the embodied perspective on social and tangible interfaces [9] for supporting the co-located context of social play in mobile games.

6.2.1 *Use Co-location for Physical Communication*

The intersection between embodied interaction [9] and co-location

supports forms of meaningful play [28] not as accessible in other game design contexts. Modes of communication are supported in the shared space not present in remote-located games. For example, in Spaceteam this includes both verbal, but perhaps more importantly non-verbal communication and physical interaction. Simple verbal communication, for example, is fundamental in its dynamics. However, unlike online games, technology does not play a part of this communication. Something as simple as volume becomes an element affecting the overall communicative experience, and it is further augmented by proximity of players, non-verbal communication, ultimately incorporating proxemics of co-located play [27, 23] into the game design. Bounden, Fingle and i-dentity each rely more heavily on the non-verbal communication. In particular, the ambiguity aesthetic of i-dentity places an emphasis of play on how body language is used and interpreted by players. While physical sensing games certainly support a degree of this, such as with the Kinect, their experiences are still mediated through technology [26]. All of these rely on communication only currently possible for games designed for physical co-location, where players can use their bodies to interact.

6.2.2 Support Interpersonal Physical Interactions

Each of the games use an embodied approach in different ways to support a shared experience. While social mobile games typically prioritize visual content over other forms of sensory communication, each of these designs make use of embodied approaches to extend the interaction into physical world. In Spaceteam, the mobile devices are networked, however the players do not have the ability to interact with each other digitally. This makes designed use of the co-located context to create a shared space of social communication occurring through verbal and non-verbal interactions between players. In Fingle, the screen is necessary, but the visual focus is shared with following the players' hands as they interact with and above the screen. This interpersonal physical interaction facilitated by the game's spatial configuration is further encouraged through collaborative game elements designed to facilitate a type of kinesthetic play that demands coordinated movements. As the game progresses, players develop an awareness of each other's physical interactions and adapt accordingly, thereby building a sense of kinesthetic empathy [12].

In Bounden, the screen is only necessary to 'learn' the choreography, otherwise the players focus is on one another's bodies and their interrelationship in shared physical space. As the game also requires the physical sharing of the device through uninterrupted touch, the design leads to three aesthetics supporting interpersonal physical interactions: choreographies that embody a metaphor for partnered physical movement as dance, sharing of body movements contributing to an aestheticism of form in the players' coordinated physical performance, and mobile devices affording physical performativity to support the creation of meaning in interaction, placing an emphasis on form over function. In i-dentity, visual information conveyed by the device is exclusively limited to a light indicating activity. The players only find meaning in this by considering the movement of the device holders, who through their shared physical movements also appear to share the same digital representation. The mobile context is ideal for supporting these games, as a shared common screen is not the anchor connecting players.

All together, each of these games supports shared interactions between people and devices in physical space. The digital interaction between the players and the systems include elements of co-located context to support the players' experience of interacting

together in the real-world through shared embodied experience. In particular, the embodiment of play involving player-player kinesthetic interactions and communication means the interpersonal physical interactions is easily observable, drawing attention to shared body movements, devices, and space. This interplay between physical and digital elements in co-located play lends themselves to the support of interpersonal physical interaction supporting social play.

6.2.3 Mediate Intimacy with Shared Embodiment

The designed intention of shared embodied play reinforces the theme of intimacy as a social experience in co-located contexts that emerges in distinct ways in all four games. This creates a sense of closeness or fellowship among players. Spaceteam fosters a sense of togetherness through co-operation, where the players' shared goals require co-located communication. The potential of information overload makes players work as a team in order to balance each other's physical communication, through verbal and non-verbal means. Bounden and Fingle achieve a degree of this through the physicality of their designs. In Fingle, the shared display enables players to remain in the intimate proxemics zone [18], as they are required to come into close range of each other and at times the level design even brings them to touch. This intimacy of close spatial proximity between people and their kinesthetic and touch-based interactions, as potential causes of tension and awkwardness [24], serves to challenge social norms and contribute to Fingle's core aesthetic. Bounden and i-dentity achieve this through binding the players together as one body - the two (or more) become one. Bounden achieves this through tethering players to a shared device, where players submit their localised autonomy into one body to achieve the choreography in the game. Conversely, i-dentity provides players each with their own device, however the goal of the game requires the spies to act in parallel, as one entity. These designs, through their use of physical co-location to support the social and physical contexts of embodied play, creates an intimately shared experience. The players work together, as a team, a dance pair, a group of spies, to work towards the goal of the game. When co-location is combined with elements of communication towards a shared goal, cooperation emerges and embodied play expands this experience, both emotionally, but also tangibly such as in supporting high fives and verbal gratitude. This all lead to a sense of togetherness and intimacy in play, creating a richer social experience.

6.3 Design Mobile Games

In this section we consolidate our analysis into game design theory. Mobile games are made mobile by the context in which they are played and the hardware that supports these contexts. To investigate the context of play, we draw on the magic circle and its extending boundaries in mobile contexts. As these boundaries extend, the discussion intersects with pervasive games. Next we move on to discussing how mobile makes co-located play accessible. Afterwards we discuss what's inside the magic circle; the play and interaction within a co-located space with mobile devices to highlight what interactivity mobile devices afford and what this means to game design. Finally we conclude by highlighting how pervasive and mobile games differ, introducing a concept to frame social mobile game design.

6.3.1 Expanding Magic Circles

The magic circle is a concept in game studies providing language to delineate the context in which playing a game occurs. This circle describes the temporary space we create and in which we play games. This space comes with its own set of rules, values,

and meanings. The concept was first introduced into game design by Salen and Zimmerman [28]. The magic circle has been criticised [30], particularly dichotomised use of it, implying a discrete boundary. However, it is a useful game design aid without such dichotomy.

The mobile games in this paper extend the magic circle. Their design intentionally includes context not captured by the formal system. For example, these games include the audience, spectators, informal players, and action not entirely captured or measured by the game (as software). Pervasive games are said to expand the magic circle beyond the conventional perceptions of its boundaries [25], offering similar spatial, temporal, and social expansion. However, mobile games, and their magic circle, differ from pervasive games.

Pervasive games are described to pervade into the lives of players. The magic circle of a pervasive games have boundaries so expanded they become ambiguous [25]. Conversely, in mobile games the contract of the magic circle is clear to players, they know when and where they are playing and the degree to which they are part of the formal system, or not. If pervasive games exploit the ambiguity of the boundaries of the magic circle [25], then these mobile games exploit the distinctiveness of these boundaries. You know when you are a formal player, when you are spectating, and when the game is being played. While both pervasive and mobile games share expanded and diffused boundaries of the magic circle, enveloping a larger context of play, these mobile games differ by designing for explicit playful participation or meta-play.

These mobile games further differ from pervasive games by their agnosticism to location and infrastructure. While pervasive mobile games may find utility in mobile devices to support location-based pervasive games [6, 11] mobile entitles games to be unconstrained by location, to be mobile. Other pervasive games build around fixed infrastructure such as Treasure [2]. Such games highlight the potential to design with seams, holes in the networking infrastructure. Mobile games share a physical location as a context, indeed we are looking at physically co-located games, but location is irrelevant to the formal system. The games do not need know of the existence of our non-game world nor are they dependent on infrastructure outside of the magic circle. With these mobile games, players can create a magic circle wherever they can take their mobile devices. Pervasive games make the world their arena. Mobile games find a small space within the world.

6.3.2 *Mobiles Make Co-location Accessible*

In the case of these games, mobility during play does not importantly contribute to the experiences of the players. When players set up these games, they anchor their magic circle. In other words, these games are not played in mobility. However, each of the games analysed take advantage of co-location in meaningful ways and would not be readily accessible without mobile devices.

At the mechanics level, Fingle and Bounden both require co-location for coupled interaction with a single device. Alternatively, Spaceteam and i-identity use ad-hoc networking of multiple devices. These games do more than simply require players to come together however. As we explore the dynamics of these games we see how each requires some form of communication, such as vocalizing to each other in Spaceteam or using body language in Bounden to move in harmony. The subtleties in these dynamics is

what contributes to the aesthetics in these games. The cooperation with spectators in i-identity to resolve ambiguity, the bodily coordination creating intimacy in Bounden, the ability to orient yourself to a teammate and shout at them in Spaceteam, create experiences that are best, if not only possible, by being co-located.

It has been argued that computers offer communication flexibility as players no longer need to be co-located and that computers open the design space for multiplayer games [34]. Considering our analysis, we would say that technology can indeed extend the design space of collaborative games, but when it is used in conjunction with physical modes of communication. Through co-location new dynamics emerge. Mobile devices provide a strong example of how technology can enable ubiquitous communication, providing flexibility of play through availability. However this does not necessarily contribute to the richness of the experiences it can enable in games. In the end we believe the flexibility of mobile devices and how their technology brings accessibility to co-locate players, just as networked computers provide the flexibility to play without co-location. Game designers can look to mobile devices as a means to support co-located play while also taking advantage of the digital elements, particularly those offered most prevalently in mobiles as we will discuss next.

6.3.3 *Mobiles Support Asymmetry and Physicality*

Mobile devices are popular and commonly personal devices. Typical smart phones and tablets have various types of sensors such as accelerometers and gyroscopes as well as screen resolutions now comparable to computer monitors. While these sensors have made their way into the controllers of consoles, they do not provide the screens that mobiles do, with the exception of the Wii U GamePad, a tablet, which only serves to strengthen the argument for mobile devices. Next we identify how mobiles distinctly afford play using physical space and asymmetry.

One way mobiles afford play is through interaction asymmetry. As each mobile device has its own touch screen for input and output, vibration, and additional sensors, each player can independently interact. This allows the use of strong asymmetry while still being co-located. Each player can interact differently, or be provided different information compared to the other players. For example, Spaceteam makes use of both of these asymmetries, by providing different control panels and information to players. i-identity makes use of the spies' desired symmetry, requiring asymmetry avoidance to overcome the interrogator. Contrastingly, co-located console games, with the exception of the Wii U, make use of techniques such as split screens to create asymmetry, but the potential to cheat or overcome this asymmetry makes it more limited to design with. Tabletop or board games make regular use of strong asymmetric elements, but through wilful concealment of cards or other medium in physical space. In the context of games, mobile devices support asymmetry by containing the virtual game in a physical device that can be moved by the player in physical space.

Mobile devices support the concept of blended space, mixing physical and digital [4]. This brings physicality into digital play. Their mobility, making them physically portable and able to be moved around, combined with their physical sensing can bring the body, and not just the fingers, into play. For example, Bounden with the two players oriented around the device dancing, would not be possible without the physical sensing of the device. While at a mechanics levels, it might be possible to play a similar game using game controllers with comparable technology, it would not be

the same experience. The aesthetic of performativity, including elements of the spectacle, would be diminished without the ability to find appropriate spaces, and perhaps audience, afforded by mobile.

6.3.4 Pocket Magic Circle: Mobile Play

Co-location brings a distinct element to mobile games, a pocket magic circle. Although these games are mobile, they are not played in mobility. As players establish the magic circle, they create an anchor for play, fixing the co-located space in which they play. However this anchored space is transient. These games are not attached to infrastructure, nor to specific locations. Players are able to pocket the magic circle, to bring the co-located game with them. This allows players to designate the played space, unlike infrastructure bound co-located games. Furthermore, this means players can choose to find an audience, spectators, privacy, or whatever the context for play. The players control and balance how diffused the boundary of the magic circle is.

Characteristic of these co-located mobile games is a magic circle that is transient, mobile, but anchored during play. The boundary of this magic circle expands to invite spectatorship, and passive play, but participation is transparent and explicit. Conversely, these games also allow privacy by letting them place the magic circle, to designate the place in which they play. These co-located mobile do not integrate with the outside world during play, just as stepping into the magic circle disconnects you from reality, so to these devices exist within the magic circle.

7. CONCLUSION

In this paper, we introduced and analysed four co-located social mobile games: Spaceteam, Fingle, Bounden, i-identity. Using the Mechanics-Dynamics-Aesthetics framework, we coded a game design perspective of these games. We took these codings as qualitative data for discussion and analysis. Through this analysis we identify how emergent social play in these games is possible, or at least made accessible, through game design using mobile devices for three reasons. Firstly, mobility affords co-locating with other players in public spaces, overcoming requirements of infrastructure and installations. Secondly, the devices support physical interactions using context of players bodies and space, extending play beyond the formal system. Thirdly, multiple linked devices support asymmetric design patterns, including asymmetric information and interaction. Furthermore, symmetry and physical play combine with mobile devices to allow players to control symmetry and information by moving the device, controlling the context of play.

We identify how embodied communication is a valuable resource for game design, allowing for emergent complexity. We identify how ambiguity and uncertainty in players dealing with this complexity can be used as a resource in game design incorporating communication into the design. We identify particular ways co-location can support embodied communication and physical interactions in games. Finally we introduce the pocket magic circle, a particular magic circle evidenced in co-located mobile games. This design concept highlights a mobile and transient magic circle, that becomes anchored during play to support social co-location. These contributions support future emphasis in game design and research by explicating some unique strengths in designing games intersecting with the characteristics of co-location, physical and embodied play, and collaboration supporting social play.

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