Screen Ecologies, Multi-Gaming and Designing for Different Registers of Engagement

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ABSTRACT

In this paper, we propose the notion of screen ecologies and argue for its importance in the study of contemporary digital game play. We draw on findings from a range of studies to highlight the interplay between screen ecologies, game design, and registers of engagement. We discuss how game play is increasingly mediated by multiple screen configurations, and in turn, how the design of different games are suited to or appropriated within these different screen ecologies. From this analysis we propose a number of modalities of game-engagement that we argue will assist further HCI research into game design and player experience research.

Author Keywords
Screen ecology; games; play; engagement; EVE Online; World of Warcraft; Candy Crush; DayZ; multi-gaming

ACM Classification Keywords
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General Terms
Design, Human Factors, Theory.

INTRODUCTION
As computing technologies have grown increasingly ubiquitous, a proliferation of screens has occurred. In addition to the widespread preference amongst gamers (and non-gamers) for multiple monitors; televisions, laptops, tablets and smart phones have all invaded the domestic personal computing space. Rather than a single screen sitting on a table capturing the full attention of the user, the modern computing experience is commonly much more complex and distributed across multiple devices. Users' engagement with any or all of these screens varies depending upon context or activity. This characterizes the contemporary screen ecology.

In 2008 Daniel Pargman and Peter Jakobsson noted that

games increasingly involved the simultaneous consumption of media, such as watching television in the background, while playing [26]. The intensification of domestic screen ecologies has also led to a rise in multi-gaming; the simultaneous play of digital games. In this paper, we discuss the variety of ways in which this practice supplements, supports and augments the player experience of individual games, and in turn the ways that contemporary screen ecologies are influencing how players experience digital gameplay. Based on our findings, we make a number of recommendations for the design of digital games in the context of the contemporary screen ecology, and articulate a taxonomy of engagement modalities for digital games suitable for this purpose.

Studies of domestic technology use have been a core concern in Human Computer Interaction (HCI) for decades, but rarely has the focus of these studies been on their implications for the play and design of digital gaming experiences. Consequently, we contribute to earlier work by acknowledging the interplay between game design and technology. This paper also integrates with recent work in HCI that has begun considering how multiple frames of activity across screens and non-screens are being consumed by users, and the possibility of this as a resource for design [14, 18]. As screens become more and more ubiquitous in the home, and the capacity for these devices to communicate is increased, the domestic screen ecology only looks to become more complex. While some futurist perspectives may emphasize the likelihood of immersionist, virtual reality digital gaming (*á la* the *Occulus Rift* headset, or [13]), the appeal of multi-gaming and simultaneous consumptions of media suggests an alternate, though perhaps only interim, future which aught be considered in studies of domestic gaming and in game design. Such considerations place the experience of digital games within frames of activity that encompass screens and play, as well as their relation to the material and social frames of everyday life [1, 20].

THE DOMESTIC SCREEN ECOLOGY
This study is situated within the broader trend of multiplying screens and multiple screen activities within domestic environments. Australia, like many developed countries around the world, is undergoing a transformation in the number and variety of computing devices and digital screens populating the home, and an associated transformation in the way people use and interact with media technologies. This trend is being driven by the

intersection of a number of factors, including: the penetration of newer and cheaper consumer electronic products such as tablets, smart phones and consoles; the growth in wireless networks and mobile technologies within the home; and the bandwidth to support the simultaneous operation of multiple internet-connected devices enabled through faster broadband, such as the rollout of a National Broadband Network of fibre-optic infrastructure cabling in Australia [2, 3, 22]

Rather than substituting for older media, however, the addition of newer devices are being used to complement traditional activities such as television viewing with other so-called 'second screen' activities such as simultaneous internet browsing and social networking [25]. Whilst multi-tasking may not necessarily be new, certainly the increasing speed of the internet alongside the mobility of devices is contributing to a situation that affords new configurations, patterns and intensities of screen activities, which we address in this paper in relation to the interplay between gaming, screens and registers of engagement.

MULTIPLE SCREENS AND CONTEMPORARY GAMING

The use of multiple screens during computer use has been long-noted in HCI [e.g., 24], both in the contexts of professional work [11] and non-gaming leisure, such as television viewing [4, 12]. However, Brown et al. [4] note that "*there has been very little research systematically investigating how attention is split during dual-screen human-computer interaction*" [p. 666], with studies focusing on task performance in lab settings or on the usability of dual screen systems [19]. Both Brown et al. [4] and Holmes et al. [12] investigate use in the context of companion applications (TV 'apps' that augment viewing).

In the context of gaming, researchers like Kauko & Häkkilä [15] have explored using multiple smartphone devices to create larger shared displays for social gaming experiences. While Tran et al. [28] have studied multiplayer games that have dual-monitor configurations (where a secondary screen can be used to display information like in-game maps or chat, leaving the central screen less cluttered), finding that secondary screens supported communication and coordination. However, we are not aware of any studies that have investigated the use of multiple screens for distinct, simultaneous frames of leisure activities.

RESEARCH DESIGN

Our interest in the impact of multiple screens on the consumption and engagement with contemporary digital games arose out of a number of separate studies into multiple game titles, including *DayZ*, *EVE Online*, *Candy Crush Saga* and *World of Warcraft*, along with a series of ongoing studies exploring the changing domestic technology environment [22, 29], including children's use of touch screen devices [21], and broadband adoption in the context of Australia's National Broadband Network (NBN). These studies involve qualitative methods such as household technology tours and interviews aimed at understanding the adoption and use of media and communications technology in the home. In each of these

studies, the shift to more complex screen ecologies and interactions emerged as a relevant finding. Consequently, we extended our analysis beyond Australia-specific household screen practices by purposefully collecting further online data on gaming screen configurations and uses relevant to this paper. In particular, we archived and analyzed posts on the reddit gaming forums which featured discussions around the use of multiple screens while playing games. These typically took the form of images of people playing multiple games at once (example Figure 5). The majority of comments on these pages self-reported similar multi-gaming experiences, from which we collected 97 game-combinations and further insight into the role that the screen ecology plays in affecting contemporary game play. These combinations formed the theoretical framework for developing the taxonomy presented later in the paper.

RESULTS

As noted in the introduction, the purpose of this paper is to draw attention to how the proliferation of computing technologies has created a screen ecology in domestic environments which is reshaping the way in which contemporary digital games are engaged with and consequently, experienced. By 'screen ecology', we refer to both powerful computers with multiple screens, but also the parallel use of separate computing devices; tablets, smart phones, laptops and televisions.

In this paper we pull together relevant results from our separate studies into domestic computer-gaming in order to consider and discuss the interplay between screen ecologies, game design, game play and registers of engagement. We begin by documenting different configurations of multiple screens in domestic settings, then discuss various 'combinations' of different games and screen-based activities through the practice of 'multi-gaming'; the simultaneous play of multiple digital games. We then shift into detailed analyses of individual case studies for the specific games we have studied, some of which featured prominently in online discussions around multi-gaming. We discuss how the play of these games is affected by the contemporary screen ecology and in turn, how different game designs are suited to different screen configurations and registers of engagement. Following this close analysis, we propose a taxonomy of game-engagement modalities that we argue will assist further HCI research into game design and player experience research in the context of the contemporary domestic screen ecology.

Screen Configurations

In this section we document typical domestic spatial and technical set-ups in which multiple screens are available for appropriation in game play. This includes configurations of multiple screen ecologies for the purpose of simultaneously playing digital games alongside other screen-based media, such as web-browsing and television, but also for simultaneously playing multiple digital games. The images provided are intended as a representative sample of the scope of domestic multiple screen use as an introduction to the contemporary screen ecology.

Figure 1: Parallel screen set up posted to /r/battlestations forum on reddit.com by user Phaym.

Figure 1 represents a typical configuration of multiple screens and monitors. Dual monitors, connected to a single desktop computer, are nearly always placed parallel to one another. This is likely due to how the Windows OS handles multiple screens, allowing the user to have applications, images and cursor movements move between one edge of the screen onto another, as if they were one long rectangular screen. In this set up, we also see how laptop computers are often used to extend the length of these screens, and tablet computers (and often smart phones) are placed in the foreground for easy interaction without obscuring the desktop computer screens. Seen in action in Figure 5, the physical affordances of these objects make them easily maneuverable, augmenting their easy integration with other, more fixed screens and screen-based play.

Figure 2: Multi-user post on /r/battlestations titled, 'Husband-wife minecraft battlestation. The TV screen is displaying a top-down map of their Minecraft world, augmenting their play. By user '2cats1dog'.

Larger screens, such as television screens, were often wall-mounted and placed above desk-based computer screens, as in Figure 2. As well as working to increase the distance from the user to the screen (necessary for viewing comfort), this example shows how this peripheral screen is being appropriated to augment their play experience by displaying a top-down map of a Minecraft server being played on one of the desktop screens.

Of note in Figure 3 and 4 are the affordances of the traditional desk chair. Unlike the majority of other chairs, desk chairs feature a swivel feature allowing the user to easily re-orientate their body towards a different area. This affordance encourages wrap-around screen configurations

as seen in Figure 3. So, in addition to the physical affordances of laptop and tablet computers allowing for easy switches of engagement, the rarely acknowledged but ubiquitous computer chair does have impact on how screen ecologies are set up and consequently, the effect they have on domestic computer use. The affordances and affects of non-digital objects like furniture, and their relationships with the use of digital objects, demand further study in HCI.

Figure 3: 7 screen configuration, involving laptop, PC and console based play. Via reddit.

Similarly depicting the raised, wall-mounted larger television screen, Figure 4 shows the interplay between TV screen based console play, passive television watching (the screen in the lower left), the swivel desk chair, and desktop computer and tablet use. This set up allows for quick reorientation between passive and active games, as well as other broader screen based frames of engagement.

Figure 4: 5 screen perpendicular configuration, including a passive television screen. Via reddit.

Multi-Gaming Combinations

To gain insight into the breadth of multiple-screen use during play we also archived and analyzed posts on the 'Gaming' page on *reddit* which featured discussions around the use of multiple screens while playing games. While this is a practice possible on a single screen (by 'alt tabbing' between active games or having split windows), multiple screens has enhanced ability of players to rapidly and seamlessly switch engagement between simultaneously active games without hiding them or reducing their size. Comments on these posts provided self-reported combinations of simultaneous game-playing, which we drew on to develop our taxonomy of engagement modalities.

Overwhelmingly, comments reflected that the purpose of

multiple screen ecologies was to fill in momentary lapses in activity during gameplay on the primary screen. Figure 5, from a popular reddit post, depicts someone playing *Rome II Total War* (a mostly passive turn based game that can take over 10 hours to play) in between *Battlefield 4* deaths, a first-person shooter game that requires a player's active attention when alive, and no attention when they are deceased or between the 2-5 minute matches. Comments on this post similarly described combining passive games that do not demand the player's attention during the play of first-person shooter games;

I like to do this when playing civilization and halo. Keeps my mind fresh and active.

Used to do this with CS [Counter Strike] and Civ 4 (desktop and laptop), so indulgent.

Other comments and replies suggested similarly browsing sites like reddit (unsurprising, as this was where the data was sourced from) and social networking sites like Facebook.

Figure 5: Photo posted to reddit titled, 'Ladies and Gentlemen. My brother. Playing Rome II total war in between Battlefield 4 deaths' by user 'Coleey'. Image received 680,000+ views.

Recent installments in the *Civilization* series were a prominent game that featured in these discussions. Like in *Total War* games, the player controls a civilization maneuvering whole armies and developing technology and infrastructure within their borders. These 'grand strategy' games are turn based; *Civilization* does not make time-sensitive demands on the player. In addition to this passiveness, the complexity of these games on less powerful machines means they can take over 2 minutes to calculate non-player moves before it is the user's turn. The top voted comment on the Figure 5 post was consequently '*More like playing Battlefield 4 in between Rome 2 load times.*'

In addition to FPS games, 'MOBA' games (Multiplayer Online Battle Arena) such as *League of Legends* (LoL) were frequently mentioned. Like FPS games, MOBA games demand the player's attention but feature regular downtime due to player-death. The player has to wait a set amount of time before they can respawn and re-enter the game.

This makes me incredibly happy. Just that I do LoL and Civ V nowadays.

This is too familiar....in longer LoL games, between deaths I'll play CoD zombies. nice stress reliever after getting fucked by fucking Jinx's ult

This latter comment reveals not just the contribution of secondary-games to sustaining engagement, but as a complementary form of leisure; working to de-stress the user following stressful play of other games.

While not all comments revealed the composition of these multi-playing situations, many reflected on the use of multiple devices (as in Figure 1) or the combination of desktop and console based gaming. For example, one comment stated; "*I play Infamous second son* [a PS4 exclusive] *in between League of legends* [deaths]". Another, replying to the same thread:

I do that all the time, but i'm more of a Civ 5 (PC) / Skyrim (PS3) kinda guy.

This perhaps reflects limitations in computing power (running modern games simultaneously is beyond all but the most powerful machines) but also potential contributions of control-change; switching between a console controller and keyboard/mouse controls works to distinguish play and limit possible interruptions. Reflecting on these combinations in the context of the screen configurations we discussed earlier in this paper, it is evident how configurations like in Figures 3 and 4 afford (or respond to) the appeal of this kind of multi-gaming.

Revealing the imaginative potential for integrating multi-gaming, one commenter revealed how they imagined the two discreet activities were somehow interlinked, playing two fantasy based games simultaneously;

I like to play Pixel Dungeon on my phone and Banished on PC at the same time. I imagine my warrior is fighting for the village.

Similarly, one player reported playing both the PS3 and smart phone versions of *Madden* (an American Football simulator) while watching American Football on TV. So while in the majority of cases the contemporary screen ecology is affording the simultaneous play of discreet games, these two examples highlight a potential rich space for future design where multi-gaming becomes an integrated experience.

Other games that were prominent were games in the RPG genre, both single-player and MMOG equivalents (such as *Runescape*). The types of RPG/MMOG play these revealed were passive, time-based or the types of play colloquially referred to as 'grinding' (defined as repetitive tasks to gain experience points and progress by Ducheneaut et. al. [10]).

I used to time it perfectly where I could play a round of CoD and it ended just in time for me to harvest and replant all my crops in Runescape.

I do my wow auctioning while playing battlefield 4.

I played probably 1000 games of Halo 3 while playing Runescape. I got three 99's doing it.

MMOG games like *EVE Online* and *World of Warcraft*, while criticised for their 'play-labour' styles of play, can be seen here to instead be integrating themselves with the player's gaming interests by offering a variety of ways to play with different registers of engagement. This facet of this genre should be considered further in analyses of their play and appeal.

The variety of these examples reflects a complex network of gaming practices. The contemporary screen ecology (be it through multiple monitors or multiple devices) affords different styles of play depending upon the affordances and constraints of games, the appropriation of multiple devices/hardware and screens, and the interests and creativity of players. We now turn to the relationship between different screen ecologies, gaming configurations and combinations, and registers of engagement.

Registers of Engagement

In this section we focus on four specific games as case studies to explore in greater detail the ways registers of engagement are produced through the interplay between game design and screen ecologies. In particular, we note that the designs of different games lend themselves to being accommodated within different screen configurations and gaming combinations.

Boring play and EVE Online

First released in 2003, *EVE Online* is a science-fiction themed MMOG with a number of interesting design configurations of relevance to bodies of literature in HCI. Unlike other MMOGs, which have been studied for their use of humanoid, personalized avatars [see 30, 5], interactions between players in *EVE Online* occur in-space between uncustomizable spaceships. These interactions do not necessarily demand consent; at any time in *EVE*'s vast universe, you are vulnerable to attack. Unlike (most) other MMOGs, this carries enormous consequence; when destroyed, the value of your ship is lost permanently. EVE also demands players trust each other in interactions and in tandem, allows treachery and betrayal [see 8], but despite this (and of potential interest to CSCW research) players form enormous communities of players (+10,000) which demand considerable logistical and work-like play.

Many of the participants in our *EVE Online* study referred (in jest) to their chosen MMOG as a 'boring' game. This was not to imply boring as a pejorative with any negative connotations (being tedious; irksome; tiresome) but as a state of engagement (or lack thereof). This is because a number of *EVE Online* play 'styles' do not require the player's full attention and consequently encourage the use of multiple screens.

For example, one participant used two desktop monitors (21.5" and 23") sometimes engaged in 'cloaky camping', which is where an *EVE* player waits hidden in a solar system hoping to find an unsuspecting victim acting carelessly. When they were playing this way, they used the second monitor to "*play whatever game I want, this is commonly either tf2* [Team Fortress 2] *or CSGO* [Counter Strike: Global Offensive] *simply because those are my current addictions.*" During large fleet battles, where hundreds of *EVE* players fight in coordinated battles, this same player used their second screen to "*play something that can I drop quickly or pause, games like FTL* [Faster Than Light] *are great for this because action is divided into short sections and its easy to pick up where I left off.*" This allowed them to stay engaged while waiting for commands to be issued to the fleet (often players have to wait several minutes at a time for instructions), but still able to quickly respond should an enemy fleet attack.

Another *EVE* play style that was often mentioned when discussing multiple monitors was mining. Mining involves orbiting asteroids, 'shooting' them with mining lasers, and then waiting until the player's ship is filled with minerals. When done in 'high security' space, the player will rarely come under attack, and consequently this is a very passive style of *EVE Online* play. One player mentioned how this integrated with their work, as "*it is easy to mine in one window on the computer screen, while writing in another.*" This is thus similar to 'cloaky camping', but more cyclical; a mining barge will be full at regular intervals, whereas a player might go hours camping a system without having opportunity to engage.

Another miner instead used their other screen to display a second instance of the *EVE* client, so that they could pilot two ships simultaneously. In the course of this study, we have encountered players who run over 6 instances of the *EVE* client simultaneously, and have seen posts online depicting over a dozen. *EVE's* low demand on the computer likely contributes to the occurrence of this play style.

In addition to these examples of multi-gaming and using multiple screens to do two discreet activities, we also encountered multiple screens augmenting the *EVE Online* experience. One player would use their second screen to display a third-party program which allowed them to compare ship-fits easier than the game client, while several use their second screen for IRC chat windows, TeamSpeak and game forums.

Each of these examples demonstrates the way in which *EVE Online*'s 'boring' play styles - in that it often has low registers of engagement - allow and encourage the simultaneous engagement with other, sometimes non-*EVE* media during *EVE* play. These included web browsing sites like reddit, video media like TV shows and game streaming, and the play of other games. This simultaneous media engagement is made possible due to the contemporary screen ecology; multiple screens and the ability to place the *EVE Online* client in windowed mode afford simultaneous engagement on a single computer. The ubiquity of other devices in the domestic environment, such as laptops,

smartphones and televisions, further transform the way *EVE Online* is played.

The above vignettes provided around styles of *EVE Online* play exemplify how players play *EVE* differently depending on the type of engagement they want to have; *EVE* as a passive game, during the play of another, or *EVE* as a demanding game, wholly consuming the player's attention. Thus it is not just that the contemporary screen ecology transforms the way *EVE Online* is played and experienced, but we suggest that the design of *EVE Online* affords and is therefore inclusive of a multi screen ecology, which lends itself to a more attractive play experience.

Group play and Progression Raiding in World of Warcraft
World of Warcraft is a popular fantasy themed MMORPG familiar to games research in HCI [10, 17, 23, 30]. In this study we examined the culture and practices of players of *World of Warcraft* who identified themselves as 'raiders' and engaged in 'progression raiding' (see below). In 2009 and 2010 (during the *Wrath of the Lich King* expansion) fourteen players were interviewed. Where possible, interviews were conducted in participants' homes and then a session of raiding was observed and video recorded. Follow-up questions and interviews were also conducted.

At the time of the study, raiding involved groups of 10 or 25-players, and was a particularly challenging form of play. It required strong group coordination and the individual prowess of group members to achieve success. Many players engage in a form of raiding known as 'progression raiding' that was the focus of this study. Progression raiding typically occurs in stable player guilds because of the difficulty of the encounters, the need for good coordination and for the group to have well-equipped individual players. Most 'boss encounters' (very powerful monsters) have complicated and unique game mechanics that need to be understood by players and are telegraphed through various sights, sounds other information in the game interface and often announced through the use of game modfications. During the 5-10 minutes of a boss fight players must concentrate intensely on what is occurring and make split-second decisions on how to act and respond.

Progression raiders in our study predominately made significant use of single screens, with other screens present in the domestic screen ecology turned off or silenced during raids. Raiding has a rhythm, particularly when guilds are working on a boss fight they have not yet mastered; periods of intense, demanding activity while the fight is going on, alternating with the low key, undemanding activity of preparing for the next attempt. However these periods are cyclical and predictable, and do not resume until the raid leader instructs the group to re-enter the fray. Consequently, like one player who had his computer in the corner of the lounge room, players could turn their attention elsewhere, to his wife were she sat at the dining room table knitting, or glance over at the television show his daughter was watching and engage in snippets of conversation. He had his computer in this room so he could be with his family in these cyclical periods of 'downtime'.

Per the demanding reliance on group coordination, raiding groups were typically required to be logged-on and ready to start 15 minutes before the raid's scheduled beginning. While waiting, some players watched television or interacted with mobile phones, while others alt-tabbed out of the game and did email, chatted on line, browsed YouTube, and so forth, and the distinctive sound of an raid invitation pulled their attention back to the *WoW* client.

Those players with multiple screens attached all had a designated 'central' screen, with a secondary screen peripheral to their set up. This second screen was used similarly, but also encouraged the inclusion of more simultaneous activities. One player used his second screen to review video and text strategy guides during the low-demand preparation for the next fight (such as running back to the group after dying). During the high-intensity fights, he displayed his VoIP client as well as a 3rd party text chat application. One player had *WoW* spread across horizontally adjacent screens allowing a wider view of the game world and cited the importance of "*peripheral vision*", especially in his role as a healer. Two neighbors, who raided together, and were also the raider leaders and fulfilled the important and complementary roles of 'main tank' and 'tank healer', had desktop computers, each with a single screen, in the living room of the same house. The desks were arranged side-by-side, allowing them to see each other's screens if they craned their necks.

While there are many ways to engage with *World of Warcraft*, and some of these lend themselves to engaging in other activities while playing, the intense experience of raiding in *World of Warcraft* meant that players were predominately focused on the game's single screen. Interestingly, the rhythm of raiding with alternating periods of attention demand did not result in a proliferation of screens as seen in the *EVE Online* cases. Rather, we observed players literally leaning forward intensely during fights and leaning back with a sigh or a curse after another failed attempt at a boss, and went from playing with two hands on mouse and keyboard, to playing with one hand. This switch to relatively relaxed play seemed to be an opportunity to recover and unwind, rather than an opportunity to quickly engage with another screen-based activity.

Intense play and DayZ
DayZ is a zombie-themed survival FPS with configurations of character and virtual world persistence common in the MMOG genre, and is consequently referred to as a MMOFPS. Like games in the blockbuster *Call of Duty* series, the player controls an armed humanoid avatar, navigating a virtual environment where they are able to shoot other avatars controlled by players. However, pertinent to prior research in HCI on the affect of voice configuration on the social experiences of virtual worlds [6], *DayZ* has a uniquely configured proximity-voice system that allows collocated, but ostensibly opposed, players to communicate and negotiate.

Unlike *EVE Online*, *DayZ* does not have a 'windowed'

mode, and thus does not easily allow players to use two monitors on the same machine (various third party programs and scripts do exist to overcome this issue). It is also a significantly more demanding game; at any moment while playing, another user could encounter the player and kill them. This has permanent consequence in *DayZ*, as dying removes all in-game advantage [see 7].

Thus, *DayZ* presents as a game unlikely to encourage the use of multiple monitors; it is an excellent example of a game that commands the player's attention at all times, and with a design that discourages distraction. However, in our study we saw several examples of player's integrating *DayZ* within other frames of their domestic screen ecology.

One case involved watching television, YouTube videos or 'live-streams' while playing *DayZ*. These were justified as ways to supplement 'boring' *DayZ* play; such as long walks players had to do to get their character between locations in *DayZ's* vast virtual world, or a player who would lie hidden along commonly traversed paths with a powerful sniper rifle waiting for unsuspecting players to pass by. Often these YouTube videos would be 'Lets Play!' style videos of *DayZ* play, or live-streams of *DayZ*, allowing the player to be entertained by *DayZ* when the actual *DayZ* was being passive or 'boring'. Players also used the ubiquity of multiple devices to circumvent the restrictions of *DayZ*'s lack of 'windowed' mode:

because I couldn't run it [DayZ] *in windowed mode, I would use my laptop to show the map and I ended up running team speak off it as well*

Another participant cited their use of an iPad for this purpose, displaying a third-party map program that allowed users to share their in-game locations with friends, and orientate themselves within the virtual world. This practice also circumvents how *DayZ* demands significant computing power; running other applications (such as a web browser or teamspeak client) on the desktop while *DayZ* is running may negatively affect play.

The above exemplifies the manner in which, when examining the relationships between the contemporary screen ecology and the play of digital games, we have to look beyond just screens on single computers to the multiple devices that constitute the complex screen ecology. The restrictions and affordances of these different devices work to allow players creative reappropriations to ensure their gaming experiences meet their gaming needs. While *DayZ* demands intense and focused engagement, and is ostensibly enjoyed as an immersive experience, we found that it still lent itself to multiple screen configurations. These were not as distractions, *per se*, but instead supported and augmented *DayZ* as the focus of their engagement.

Casual play and Candy Crush Saga
In contrast to *EVE Online* and *DayZ* which are commonly referred to as some of the most 'hardcore' games [27], *Candy Crush Saga* is a prominent 'casual' tile-matching puzzle game which can be played on mobile devices and on the social networking website, Facebook.com. First released in 2012, *Candy Crush Saga* is currently the most popular game on Facebook and quotes over 100 million unique players per day, suggesting it is the most popular individual game of all time. Like *EVE*, *Candy Crush* was a game commonly cited in online discussions as a multi-play game.

As a mobile game, *Candy Crush* is played in a variety of locations and times and interacts with a player's daily life in a different way to games like *EVE Online* that are restricted to play on powerful computers. This is of course relevant to HCI research on mobile gaming, which has however typically focused on the mobile context of play rather than the way mobile play is accommodated within a domestic environment [20]. Participants in this study – which involved semi-structured interviews with 13 participants, aged 18-64 [see also 9] – reported a number of different, salient ways in which the flexibility of mobile-screen gaming integrated with the consumption of media on other screens.

Several participants reported playing *Candy Crush* while watching television, both on desktop computers and laptops and traditional television screens. Our oldest participant described where they played;

I play it on an iPad. In the back room of my house, the lounge room kind of thing. And generally whilst watching TV that isn't particularly engaging.

Of note with this simultaneous frame of engagement was the type of TV typically watched; low demand (not 'particularly engaging') TV, or TV the participants had already seen. So unlike many of the multi-gaming situations already discussed, this example presents the integration of two low demand practices; *Candy Crush* rarely commands the player's full attention.

Those of our participants who were students, including several PhD students, reported playing *Candy Crush* while doing screen-based work, such as writing essays or marking assignments. In these cases, *Candy Crush* was played "*as more of a break between studying"*; the ease with which players could pick up their smartphone or tablet and play a single game of *Candy Crush* meant that they could quickly switch between play and work. Rather than suggesting this was a negative distraction, several participants felt this integrated well with their work tasks;

When I was doing something and I feel very tired with the work/research I like to take some breaks or change my mind to something else, to change my concentration to something else, then maybe I would play

One of the benefits of *Candy Crush* for this type of engagement is its implementation of limited lives. Players have a maximum of 5 lives in *Candy Crush*, and each time they fail an attempt, they lose a life. When no lives remain, the player can either wait 25 minutes for a life to regenerate or pay $0.99. This is thus one of the developer's primary sources of income, but the artificial limitation also served to help integrate *Candy Crush* play with the use of other screens and devices. This is best exemplified by one

participant who used it as a *"reward system"* in between spouts of work. Thus we see how *Candy Crush*'s timer, similar to the cyclical play of *EVE* mining, allows player attention at certain times while restricting it at others. Though an annoying restriction when the player wants control over their play, it means play can occur at regular intervals as breaks from, or in between, other types of screen engagement such as work or play.

GAMING MODALITIES

Having now discussed common physical arrangements of multiple screens in the domestic environment, overviewed various types of multi-gaming made possible by this screen ecology, and discussed how four games integrate with player engagement and appeal in this context, we will now propose a taxonomy of engagement modalities. The purpose of defining these modalities is to capture the different ways that modern games register player engagement in order to inform both the design and study of domestic gaming. This is not intended to be comprehensive taxonomy, but rather reflect the different genres of attention that we identified in this research and encourage deeper consideration about additional ways games can integrate with other games, as well as other domestic activities.

Cyclical Intermittent Games; games with regular, predictable cycles of 'downtime' - where the player does not need to interact of provide attention - and 'uptime', where the player must commit the majority of their attention. These include games in the FPS genre (such as *Call of Duty*, *Halo*, *Battlefield*) and MOBA genre (such as *League of Legends*) which have intense periods of play interspersed with waiting periods in excess of one minute (typically in the 'lobby' between player-versus-player games). As multiplayer games, the player has no ability to pause play to divert their attention.

Non-Cyclical Intermittent Games; games with irregular, unpredictable cycles of 'downtime' - where the player does not need to interact and only needs to provide little attention - and 'uptime' where the player must be committing the majority of their attention. The most prominent example in this genre was styles of *EVE Online* play, such as system-camping (whereby you wait, cloaked, for an unsuspecting victim to pass by) or some nullsec PvE (demanding little attention except when attacked).

Pausable Games; games which demanded the majority of a user's attention but could be paused when their attention is demanded elsewhere. These were typically single player RPG games, such as *Fable* or *Assassins Creed* or the campaign modes in FPS games like *Halo* or *Call of Duty*. Unlike cyclical intermittent games, the player has the ability to control when they need to give their full attention.

Slow Games; games which have regular periods of *active* waiting and rarely command the user's full attention for times in excess of one minute. The typical games in this genre are city building games such as *Sim City*, *Banished* or *Dwarf Fortress* where regular intervals of non-interactivity are demanded because of the manner in which certain aspects of the game require time to have passed (resources having been moved and a building having been built in *Banished*, for example). During this time, however, a small amount of attention must be paid unless something goes wrong (e.g., a goblin raid in *Dwarf Fortress*). Worth noting, the games in this genre that we observed players multi-playing all featured the ability to pause the game; if the game was at a situation where it was commanding the player's attention at an inconvenient time, the player could simply pause it.

Timed Games; those games which had regular intervals of *passive* waiting during which there is no ability for the player to interact. These were typically mobile games, such as *Candy Crush* or *Clash of Kings*, which use the freemium monetization pattern of playing by appointment [31], but also timed play in other games (like farming in *Runscape*). Players have to wait intervals of 10 or 25 minutes between performing in-game actions, after which the game would not demand attention but simply be accessible to play.

Passive Games; games which were entirely passive, never demanding the user provide their attention at any given moment. The most prominent example of these was *Civilization 5*, a turn based grand strategy game without simulated combat. The user is never *required* to attend to *Civilization 5*. Along with the similar *Total War* series, these were the most popular 'secondary' games.

DISCUSSION

In this paper, we have argued that the proliferation of screens in the domestic environment – referred to as the contemporary screen ecology – have transformed the way in which digital games are played and consequently, experienced. This has allowed the simultaneous play of digital games along with other screen-based media, such as web-browsing and television, but has also given rise to the phenomena of multi-gaming; the simultaneous play of multiple digital games.

We've explored this phenomenon through different screen configurations and multi-gaming combinations observed in our research of gaming in domestic environments. We also analyzed online discussions around multi-gaming on the site 'www.reddit.com'. These studies revealed a broad and complex network of practices that have emerged as a consequence of the contemporary screen ecology. These include the simultaneous play of multiple games, creative and imaginative practices, as well as the use of secondary games to overcome the arduousness of certain facets of modern games, such as grinding. In this analysis, it is clear that not all screens are equivalent or equal. Instead, different kinds of screens – TC, PC, laptop, tablet, mobile phone – lend themselves to different frames of activity and engagement.

We then analyzed four distinct case studies, drawing from separate research projects on the very-different *EVE Online*, *World of Warcraft, DayZ* and *Candy Crush Saga*. From these focused analyses, we identified the ways in which the contemporary screen ecology can not only transform the play of games, but the ways in which games can (or don't) respond to and indeed thrive as part of this

ecology. We highlighted aspects of the design of these games that encouraged their attraction for 'multi-gaming', such as having timed-features, windowed mode, and so forth. In the case of *DayZ* and *World of Warcraft*, which were not used to multi-game, we saw how they were still affected by the contemporary screen ecology even during the most demanding examples of play.

The consequences of these insights are threefold. Firstly, we wish to argue for a de-emphasis of what occurs 'within' the game for understanding the experience of digital games. It would be erroneous to analyze the play of *EVE Online* or *Candy Crush* if limited to the events within that individual game; the broader social, cultural and gaming contexts affect its play and consequently experience [1, 16]. As noted by Brendan Keogh [16], video game play is a "*messy assemblage*" that functions "*across worlds and across bodies*". We thus join Keogh in challenging the dominance of immersion in conceptualizations of game experience; how immersed can a player be reasonably considered being if they're playing *Pokemon* in between *Morrowind* load times? Or *Peggle* during *World of Warcraft* raids?

Our second insight is thus into the prominent role that the contemporary screen ecology is playing in how modern games are played and experienced. Whereas the 'gamer' is typically conceptualized as a nose-to-the-screen fully attentive, wholly engaged user, our results indicate a much more nuanced and varied practices of distributed interaction and engagement, that presents future research questions regarding how it is affecting gamer's attentiveness and capacity to multi-task. Such research should consider the different modes of sensation and interaction demanded by different screens, especially as touch, gesture and motion controlled screens continue to proliferate. Further, the embodied and material dimensions of such frames suggests a need for research that also considers the affordances and implications of physical spaces, peripheral's and furniture.

This latter note is interesting in the context of futurist perspectives that emphasize the likelihood of immersionist, virtual reality digital gaming (*á la* the *Occulus Rift* headset), as an inevitable step. This study complicates notions of immersion that emphasise the visual, and its sensory realism or capture, reflected in a game development paradigm that idolises *The Matrix*-esque virtual reality as the 'end-game' for game development. Rather, in this study we see how domestic technologies are being appropriated in ways that distribute immersion across multiple screens and modalities of input, or sometimes dilute game immersion through integration with the real world, suggesting a more complex conceptualization of immersion is needed.

Finally, we believe our insights highlight a number of rich areas of potential for future design. As far as we are aware, there do not exist any games where the simultaneous play of two games occurs in a symbiotic fashion, where one game affects the other and vice versa. Many games (such as the *Total War* genre) feature dramatic changes in game-play and engagement over the course of play (switching from passive, turn-based grand strategy to active, real-time strategy battles where the player controls the squads in his armies on the battlefield). However these occur in sequence; events outside of the battlefield do not progress until the battle is concluded. Simultaneous play, such as with one commenter's imagined link between their *Pixel Dungeon* play (where they control a *Dungeons and Dragons*-esque warrior raiding dungeons) and *Banished* (a medieval town builder-sim), reflects a way game design could incorporate the contemporary screen ecology.

Conversely, our insights could inspire the design of games which are designed to be consumed simultaneously with any number of other games which complement the way they demand the player's engagement. Rather than designing games meant to consume a player's entire attention, games could be designed to be slow, tedious or even *boring* and remain attractive to players because they engagingly mesh with their play of other games (or engagement with other media) on other screens.

In order to bolster this contribution of the paper, we have articulated the various combinations of games we identified in our analysis of multi-gaming examples sourced from our interviews and online discussions into genres. The purpose of articulating these genres is to encourage the consideration of how games are co-consumed with other media and activities, and the impact that new technologies can have on the play and experience of games and other computer-products. By expressing this as a taxonomy, we contribute to future HCI work that may consider the different ways games demand player attention and how this can be leveraged in the design of positive experiences or for other purposes (such as health or learning).

FUTURE WORK
In our next steps, we propose to extend Holmes et al.'s [12] earlier study on simultaneous TV & tablet use using eye-tracking data to examine levels of attention and engagement with game play on multiple screens. Though this will not reveal further insight into the broader screen ecology (e.g., mobile games, TV) (thus the strength of this qualitative, exploratory approach) this will allow us to create a taxonomy in accordance with game design patterns.

We also aim to explore screen configurations in domestic gaming through the 'battle stations' phenomena in more depth. In our examinations of screen configurations, we saw a complex interplay between gaming culture, capital, history and devices that prompt consideration for the design of both software and hardware, with implications for the play and enjoyment of digital games.

In this paper we have emphasised simultaneous computer use as our focus was on the changing contemporary screen ecology. However, the engagement modalities we have presented in this paper could just as easily be integrated with other non-computer activities, such as cooking, cleaning, studying and professional work. We therefore recommend future work consider more broadly how gameplay is integrated with other frames and activities, and the relationships between them, to better understand player experience as a potential rich site for design.

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