

Understanding Situated Action in Ludic Ecologies

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ABSTRACT

In order to understand the social mechanics of alternate reality games, this paper presents a situated action analysis of one game, “I Love Bees”. We examine the action traces found within the ILB forum accounts around teamwork and puzzle solving. The playful assemblages demonstrate that the presence or absence of certain non-human actants has a definite impact on each “ludic ecology,” and that each impact is contextually specific. We found that the careful design of in-game challenges by the game designers worked differently in practice because of the impact of unconsidered non-human actants. In response, players formed teams and adopted technologies to overcome their specific temporal, spatial and organizational constraints. Therefore, designers need to provide appropriate sociotechnical infrastructure to support player needs, and nonhuman actants should be considered when studying and designing hybrid digital/physical environments.

Author Keywords

Alternate reality games; Ludic systems; Teamwork; Qualitative research methods

ACM Classification Keywords

K.m. Computers and Society: Miscellaneous

INTRODUCTION

In August of 2004, a disparate group of influential technology journalists and committed Halo gamers began receiving little jars of honey with a slip of paper in them. On the paper was the phrase, “I Love Bees” and a URL. When the recipients went online to try to figure out what the honey jars presaged, they were greeted with a website that was ostensibly for Margaret’s Honey but which had been mysteriously hacked, with cryptic messages sprawling across the site’s pages. The messages implored people to help Margaret figure out what the hacking was all about [2,6]. As players voluntarily banded together into place-based teams they began to discover that the cryptic messages on the website were puzzles, which, if decoded and reconstructed properly, would help an alien artificial intelligence return home.

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This was the birth of the Alternate Reality Game (ARG) “I Love Bees” (ILB). Created by 42 Entertainment, ILB was designed to act as an interactive backstory for the launch of the videogame Halo II. However, it was not initially obvious that this was a Halo marketing effort as the game unfolded with no explicit references to that product. From a commercial standpoint, ILB was designed to produce exciting entertainment through immersive storytelling. This was achieved by applying a more ambitious networked collaborative experience found in Halo II to ILB gameplay [6]. ILB is one of the earliest and most popular of the ARG genre.

Collaborative problem solving was the focal game mechanic. Over the four months in which ILB was ‘live’, the game’s intricate world-bending challenges extended across the physical and the online worlds. Advancing the game required players to develop a collective intelligence within their specific and situated geographies. The act of puzzle solving encouraged startlingly sophisticated and highly contextual levels of leadership and teamwork, and the development of play-oriented or “ludic” expertise [9].

One central multi-week task in ILB involved decoding the coordinates hacked into the ILB website. As players discovered, the messages turned out to represent the latitude and longitude of public pay phones. In the game mythology, these payphones were referred to as “axons”. The goal of the axon hunt therefore was to correctly identify the payphones using the GPS coordinates. At a specific time, the payphones would ring. If players were physically present to answer the calls, they would receive a question. If answered correctly, the axon would be activated or ‘enhottenated’, unlocking further clues in the form of sound clips. The next major puzzle involved assembling the fractured sound clips into a coherent audiofile that advanced the game narrative. While the game lore around axons was complex, players treated axons as roughly synonymous with the payphones.

Our paper builds on work done previously [9] around the emergent social structures and manners in which collective actions were coordinated and achieved in the context of ILB. In this paper, we present an account of the ways in which the ILB axon hunt manifested across physical and digital space, through the actions of a number of human and non-human actors. An ARG is a powerful example of the way that communities can be engineered to voluntarily form around shared interests. Given the hybrid nature of ARG gaming and that ILB was essentially a puzzle

mystery, understanding what took place during the game involves tracing the actions of all the actors in the game's extended community. The players were primarily strangers, brought together by a common interest. They had to negotiate a large set of challenges to play a nation-wide ARG with no clear rules, no structured teams and no game-supplied tools for teaming, tasking and collaboration [9,12].

Our goal is to understand and describe the social mechanics of ILB, via four accounts of the dimensions and actions of a set of contextualized social actors [3], both human and non-human, hereinafter called 'actants'. We describe and analyze how players managed their participation in the game and what the impact was of a set of non-human actants on each team's overall attempts at play. Our approach to understanding of how ILB worked across spaces, time, people and processes is intended to inform future research on how to study and design these spaces in the future. Therefore, we conclude with insights on the ways in which our ecological account of situated action within ILB demonstrates the need to plan for action but enable spontaneity and creativity in both ludic environments and collaborative software systems. With our research objectives in mind, we seek to address the following two research questions:

1. What were the designed game mechanics or emergent social factors that impacted ILB teamwork?
2. What does an ecological approach to studying hybrid physical/digital gaming environments contribute to our understanding of the possibilities inherent to team or collaborative environments enabled by technology?

Just as biological ecologies highlight the flux and complexity of action grounded in time and environment, a situated gameplay action ecology or 'ludic ecology' highlights the interplay between all actors in a gaming environment, showing how and when actants enter into an ecology, the impact of their inter-actions, and their importance even when absent. In this way, a ludic ecology differs from an information ecology as described by [8] in that it attends to the specificity of the inter-actions of all actants in an ecology, not just the ways in which humans and technology are interrelated.

THEORETICAL FRAMEWORK

To guide our analysis of ILB teamwork and gameplay, we draw on the tradition of science and technology studies (STS) that emphasizes the importance of identifying, situating, and following the interactions between both human and non-human actors [4,5,7,10]. We synthesized our analytic approach from concepts and theories drawn from actor networks [1,4,5], information ecologies [8], and situated action theory [10,11].

We adhere to Bruno Latour's injunction to "follow the actors" [4]. We treat the many different ILB entities as actors instead of objects, calling them actants according to the actor network theory (ANT) terminology. This

ecological 'actant' approach provides a view of situated ILB action, grounded in the specificities of time, environment and external influences. Since ILB play is mobile, occurring both online and in the physical world, accounting for non-human actants respects the impact they bring to successful game action. We therefore looked for the traces of entities such as transit times, money, digital tools (both player adopted and game provided), and public venue operation times when coding our accounts.

Our use of an ecologies frame is meant to highlight the active, contextual situation of play within specific physical areas. For ILB, we found the idea of an ecology to be more accurate and appropriate than ANT's term 'network', with its current popular associations with predominately digital systems networks. The term ecology also suggests the fragility of the associations and action potentials between actants, environments and external forces.

Given that an important aspect of our ecological accounts is the situatedness of the actors and contexts, we employ the situated action theory from Suchman [10,11]. We use Suchman's theory of situated action to identify key areas of struggle, possibility and closure within each of the four ludic ecologies we describe.

Our work is decidedly action focused and contextually contingent. We highlight the situated nature of action in our account by describing actions between actants as inter-actions. The hyphen in 'inter-action' is intended to display the action orientation of the situation, and is intended also to escape the reductionist objectness of the more commonly accepted and understood 'interaction'. We strive to escape the researcher-centrism conceit of common "why" and "how" questions. Instead, we refocus attention on describing who acts and what they do, and what the impact is of their actions within their environment.

METHODOLOGY

The game did not provide players with a community website or specific tools to form teams, manage team tasks, or communicate and coordinate action between players. In the absence of any formal tools, ILB players created The Haunted Apiary forum on the ARG fansite unfiction.com. Over the four months of ILB gameplay, players grew The Haunted Apiary into the primary digital communications and teamwork management system, generating more than 54,000 posts by over 2,700 players. Forums were divided into six major themes, one of which was delegated to axon hunting. These conversations were organized by geography, usually based on major metropolitan regions in the United States.

Data for our study were obtained from the axon hunting forum. In-depth, iterative, multi-researcher coding was conducted on seven of the fourteen axon coordination threads to identify the various ways in which ludic action occurred in ILB. Following an ANT approach, we traced the human and non-human actors to understand their impact

on the evolution of the ludic ecologies in which they were situated. We then selected the four coordination threads: Washington DC at 450 posts, Washington State at 616 posts, Las Vegas at 190 posts, and San Diego at 177 posts (n=1433 posts). This four-region sub-set represented more than 40 percent of the total messages posted about axon hunting (N=3559). This was a purposive sample geared to maximize diversity along a number of meaningful dimensions. For example, one of the ludic ecologies we identified is San Diego, a large city (almost 1000 km²) with a car-based culture, whereas Washington, D.C., another of our ludic ecologies is compact (barely 175 km²) with dense public transit.

We anticipated that the dimensional differences between ecologies were likely to influence tool use, player challenges, and the type of leadership required to manage the highly temporal nature of axon hunting tasks in each geographic area. While we acknowledge that these are all very heterogeneous regions, we abide by the boundaries adopted by the players to describe their own geographic regions. This is in keeping with the ANT approach we adopt to describe and analyze our ecologies, and as a direct reflection of the historical nature of our dataset. We also highlight the fact that the key nexus of action for these ecologies were payphones, not mobile phones or Internet-enabled devices. ILB took place before mobile technology became ubiquitous. Indeed, mobile phones and Internet-enabled devices were practically non-existent in players' accounts, and therefore are not present in our ecology accounts.

THE LUDIC ECOLOGIES

Each of the four ludic ecologies we traced consisted of an actant group of digital tools (both player adopted and game provided), impediments, spatialities, temporalities and players, all situated within either the physical or digital world. Actants included such entities as the Haunted Apiary, Excel spreadsheets, payphone directories, physical locations of payphones, and GPSs. Each non-human actant supported at least one of three different role orientations:

1. Memory aid and documentation
2. Task completion support
3. Team communication

Noting that ILB players often adopted military language, cultural tropes, and organizational concepts to describe and structure their ILB play, we chose to use the same US military ranking system and rationale described in our previous work [9] to classify and understand the human actants in our ecologies. We use this military taxonomy to tag the leaders, gatekeepers and followers among the ILB players. The classification of a General is used to describe an ILB player who employs high-level, strategic thinking. A Lieutenant is a leadership-oriented individual, who focuses on tactics to solve more immediate, short-term problems. A Private displays minimal strategic or tactical

thinking, focusing more on the task at hand and providing situation reports.

We use the term '*spectator*' to denote ILB players who post to the axon coordination thread in their geographic region but who do not demonstrate action and therefore cannot be traced in our accounts. These players, for example, consisted of individuals who expressed their interest in the game, but disappeared before participating in any axon hunting activities. They are accounted for in the player numbers but are not visible in action traces within axon hunting.

For each of the four ludic ecologies we trace, we provide an environmental example that illustrates the unique features of each ludic ecology's inter-actions. Our accounts of inter-actions between all actants demonstrate that the presence or absence of certain non-human actants has demonstrable impacts on each ludic ecology, and that each impact is contextually specific to each ludic ecology. For example, the role of money as an actant is different between geographies, as is temporality. Spatiality operates for and against the success of DC, whereas it is a hindrance in San Diego and Las Vegas. Therefore, in accounting for and describing action contexts across all actants, we are able to present a highly contextual and strongly situated account of each environment, which would not have been possible if we had solely attended to the human actants.

The Washington State Ecology

The Washington State ecology was situated in the Pacific Northwest region of the United States. Bordered on the East by the Rocky Mountains and extending north to Canadian border, the entire state was part of the ecology, but most activity occurred in its largest city, Seattle.

The Washington State ecology's human actants consisted of 2 lieutenants, 11 privates, and 21 onlookers. Other actant groups in the Washington State ecology included the axons, digital tools, and impediments. Key physical environments were: Husky Stadium; Factoria Mall (a large shopping centre); and a number of intersections in downtown Seattle, such as Ballard and Market, Mercer and Broadway, and Republican and 15th. Though the team drew players from across the state, the axon hunting tasks were centred on the Puget Sound cities, especially Seattle. As with the other ludic ecologies we traced, the key digital environment was the Haunted Apiary.

Husky Stadium

The alignment of actors evidenced in the Washington data set did not yield critical incidents for us to trace, whether due to exceptional players, or limited forum posting, or the fact that axons were simply easy to locate and activate in this region. It is unclear from our analysis why Washington State players appeared to experience few challenges for enhottentation relative to the other ludic ecologies we examined. One notable exception is the impact of in-game technology, which hindered the successful activation of

axons at Husky Stadium. On two occasions the voice recognition software used in the game failed to recognize a player’s answer to an in game question:

“I said reach... and then repeated myself... but it didn’t accept it. Stupid voice recognition” (WA21)

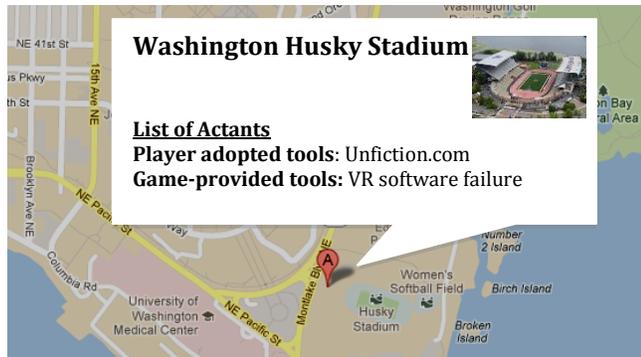


Figure 1: Washington Husky Stadium Actant List

Although it is unclear from our analysis why the Washington State team was so successful at axon enhancement, one possible reason may be their lieutenants’ use of the lead page of their axon hunting thread for team and task management. This list detailed axon statuses and highlighted location information obtained from players’ situation reports. This list may have made it easier for the Washington State players to locate and activate axons at Husky Stadium.

Despite the lack of critical incidents from which to trace action, as an ecology, Washington State provided interesting insight into the challenges of using forum-based, textual data for this type of analysis. In particular, it shows that the reliance on human actants to provide documented evidence of both human and non-human actions becomes problematic when the human actants do not record their activities on the forum, and therefore do not leave traces of both their actions and the actions of the non-human actants.

The San Diego Ecology

Our second ecology revolved around the southern California city of San Diego, which is the eighth largest city in the United States, with over 1.3 million inhabitants. Sharing a border with Mexico, the hilly coastal city unfolds in a pattern of urban/suburban communities amongst its many canyons.

The San Diego ecology’s human team consisted of 6 privates and 4 onlookers. Other actant groups included the axons, impediments, geographies, and temporalities. In contrast to the other ludic ecologies we traced, digital tools were not as influential in shaping the action within San Diego. Aside from the Haunted Apiary, which San Diego players used sparingly for team communication and basic axon tracking, the team did not mention the use of any other digital tools for memory and documentation, task completion support, or team communication. Key environments described by San Diego players were: the San

Diego Zoo; a McDonalds restaurant; the Maritime Museum/Star of India; and a 7-Eleven convenience store.

The San Diego Zoo

San Diego players experienced great difficulty identifying the exact location of the correct payphone at the San Diego Zoo. Using a trial-and-error approach to axon hunting, players scouted out potential payphones outside the Zoo grounds, tested them to confirm their acceptance of incoming calls, and waited at the scheduled call time to confirm or eliminate individual phones. After eliminating all phones outside the Zoo, players determined that the correct payphone must be located within the confines of the Zoo.

“I also tried the ones by the Photo Hut/Bathrooms near the Zoo exit. 3 ring, 1 doesn’t. Went last Saturday and none of them rang. There is a phone by the carousel and one by the Veteran’s Center, but on the first Axon Day I was at the Carousel phone and was in phone contact with someone at the Veteran’s Center, and neither phone rang. My only guess is that someone paid \$25 to answer the phone inside the Zoo itself” (SD2)



Figure 2: San Diego Zoo Actant List

Spatiality was an actant within the space of the Zoo. The fact that the zoo is a private space that requires payment for access limited the possibility for axon activation. This meant that the game task of activating this axon in order to advance the game storyline was difficult to achieve. Players refused to pay the \$25.00 entrance fee to attempt to find the correct payphone, particularly since this meant that multiple visits could be required if the phone was not located on the first visit:

“Not that I don’t mind going to the Zoo on a weekend, but I don’t have a membership and I’ve already planned my entertainment budget” (SD1).

Working in tandem with spatiality, temporality was another key actant in the space of the San Diego Zoo. The ability to activate the axon was hindered by the fact that the Zoo’s operating hours conflicted with the time the payphone was scheduled to ring. As one player notes:

“if the zoo axon is actually inside the zoo, then there’s no way it’s going hot this time - zoo doesn’t open until 9 AM” (SD4).

Given the preponderance of privates in the San Diego ecology, and in the absence of expressions of strategic thinking or tactical leadership, the San Diego team applied very few effective strategies or tactics to the task of axon hunting. In trying to determine the location of the San Diego Zoo axon, player actants relied on scouting and the methodical elimination of incorrect payphones, which was extremely time-consuming. After several failed attempts, they ultimately came to the conclusion that the phone was located within the confines of the Zoo. Once the location of the axon had been established, players basically abandoned all attempts at enhancement, as this would have required them to pay an entrance fee to gain access to the Zoo.

The San Diego Zoo example illustrates that the context in which action is expected to take place may have an impact on players’ willingness to participate in a game task and on a team’s ultimate success. In this example, spatiality, temporality, and money operated against players’ abilities to successfully enhance the axon. Not only was the axon located on private property; it was scheduled to ring at a time when the Zoo was closed. Thus, even if players were motivated to find the axon, and were willing to pay the entrance fee, the axon would be inaccessible. The Zoo situation was therefore a good example of the ways in which non-human actant positionality had a negative impact on human actants’ abilities to participate in the game.

The Las Vegas Ecology

The city of Las Vegas is situated in the Mojave Desert, within the state of Nevada. Billed as the “entertainment capital of the world”, Las Vegas is spread across a wide valley. This vast urban region is almost exclusively car dependent.

The human Las Vegas team within ILB consisted of 1 lieutenant, 8 privates and 8 onlookers. Of these human actors, however, only two players, 1 lieutenant and 1 private actively participated throughout the duration of the game. Other actant groups that acted in the Las Vegas ecology included the axons, digital tools, impediments, geographies, and temporalities. Key physical environments were hotels and casinos, specifically Excalibur, Caesar’s Palace, and the Hilton. In contrast to the other ludic ecologies examined in this paper, digital environments did not play a key role in Las Vegas inter-actions.

The Excalibur

Las Vegas casinos are spatially complex and physically vast, covering several acres. They typically consist of several buildings, including a casino floor with multiple different ‘games of chance’, restaurants, theatres, retail stores, and hotels. Casino layouts are intricate, containing numerous areas that need to be navigated in order to locate

the large number of payphones scattered throughout the buildings. Payphones are often located in areas out of public view, such as employee entrances, and are frequently set far apart from one another. Casino floors tend to be loud, making it difficult to hear phones ringing in the distance:

“Two more banks of phones in the casino, near the tower entrances, but the noise was so bad, and the phones so soft that there was no way I could’ve heard them (LV1).

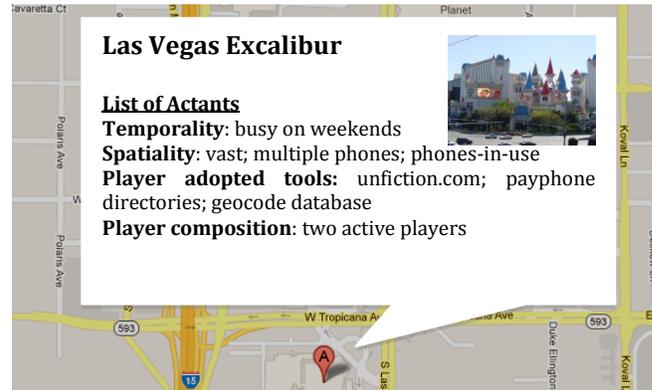


Figure 3: Las Vegas Excalibur Hotel & Casino Actant List

A challenge faced by Las Vegas players, particularly at Excalibur, was keeping non-players from interfering with the players’ access to the payphones. Unlike cities such as DC, which had levels of cell phone ownership and usage, the use of casino payphone banks revealed the relatively low rate of cell phone usage by the casino’s patrons:

“I went inside the Excalibur, my favorite of all the posh casinos, where nobody who stays there can afford cellphones, so they’re all using the payphones! Grrrrumble” (LV1).

This factor impacted the Las Vegas team’s ability to test and eliminate incorrect phones, and to answer correct phones at designated times. As two of the Las Vegas team members remark:

“Can’t really rule any out there, since there were so many people using them last time” (LV1).

“How is it that the phones at Excalibur ALWAYS have people on them? Phones are what, free now? And they all have free long distance? WTF?” (LV2).

Insufficient coverage greatly impacted Las Vegas players’ ability to locate, identify and activate axons. They repeatedly complained about the difficulty in covering multiple payphones at multiple locations, and called for greater participation and coordination. As one player decried:

“Are there ANY more Las Vegas lurking out there?? This is getting ridiculous, we need some more warm bodies. Too many places to cover” (LV1).

The Las Vegas players adopted a number of digital tools to help map their area and identify payphones at specific locations. Geocode databases and payphone directories acted in a key role at Excalibur. Geocode databases are online georeferencing tools that convert latitude and longitude coordinates to a point on a map. Payphone directories are Web-based digital resources that list payphone numbers by geographic area or location, allowing for the identification of specific payphones within their concrete locations. Taken together, these digital tools enabled the confirmation of a location on a map and the identification of payphones within the geographic region confirmed using the geocode database:

“36.099196 -115.172968 Geocode is exactly to 3850 LV Blvd. S, which is indeed the Excalibur Hotel. Geocode link” (LV1)

“Here’s a pretty good online reference to phones at the Excalibur (from Payphone-project.com)” (LV1)

The Las Vegas ecology showcased an interesting homogenizing bias in game design temporality. ILB’s game designers presumed that most ILB’s players would be willing to engage in axon hunting on the weekends, and that public spaces would be easily available in that time period. However, in Las Vegas, weekends are prime time for casino activity, and the casinos were most often filled with tourists on the weekends, particularly in the evenings. With the marked increase in tourist activity on the weekend, traffic and parking were difficult to manage for this team. Given this temporal disconnect, the most active players in Las Vegas decried the game designer’s time choices, stating that they disliked covering payphones in casinos on the weekend:

“I wasn’t planning on going back tonight, as I usually avoid the strip on the weekends like the plague, but I’ll be there” (LV1)

“Yeah, I don’t think I’ll be trying for the axons this weekend... seems a tad.. busy, to say the least... I think I’ll just stay home this weekend...” (LV2).

As noted, the Las Vegas team consisted solely of two active players: 1 lieutenant and 1 private. These players were responsible for determining and identifying the correct location of the first payphone at Excalibur. In typical “middle management” style, the lieutenant applied tactical thinking to the act of axon hunting, using digital tools to help map his geographic area and identify potential payphone locations. By comparison, the private spent more time in the field, methodically eliminating payphones through a trial-and-error process, and reporting back to the lieutenant with situation reports.

Three interesting insights emerged from our examination of the Las Vegas ecology. First, our examination illustrates that player engagement and participation is critical to success. As illustrated in the example, Las Vegas players

suffered from lack of participation and were therefore unable to cover the vast number of payphones in their area. Second, our examination suggests that time can be a strong influencer on how people play, and may conflict with designers’ ideas of when players will play (or should play) a game. While it may seem intuitive to design physical world game tasks for completion on evenings and weekends, Las Vegas illustrates that this is not always the case. Third, our examination shows that cellphones operate as actants on payphone usage. In the case of Las Vegas, the low cellphone usage and adoption by casino patrons operated against the success of the Las Vegas team as payphone were often in use during scheduled game tasks. This differed from cities such as DC where cellphone ownership was more prevalent.

The Washington, DC Ecology

The city of Washington, in the District of Columbia (DC), is the capital of the United States. Situated on the Atlantic seaboard, sandwiched between the states of Maryland Virginia, the metropolitan region is the seventh largest in the nation. Sporting a temperate climate DC residents rely heavily on public transportation within the city, and its famous beltway highway network outside.

The DC axon hunters consisted of one general, 2 lieutenants, 11 privates and 15 non-actors. Other actant groups included the axons, digital tools, impediments, geographies, and temporalities. Key physical environments were: Union Station; the National Gallery of Art; the National Building Museum; the Department of Agriculture; and a Georgetown movie theatre. Key digital environments were the DC axon coordination thread on the unfiction.com website, a player created and maintained DC status website, and an excel spreadsheet.

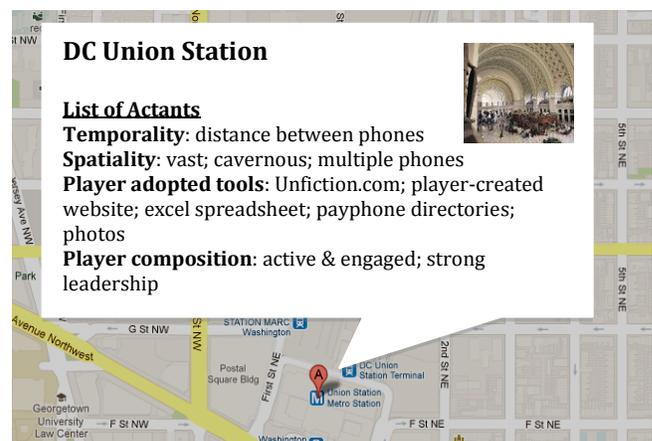


Figure 4: DC Union Station Actant List

DC Union Station

DC Union Station is a multi-level complex that is physically vast and spatially complex. It consists of a train station, a shopping center, and restaurants. Its design is a mix of old and new architecture yielding a large number of avenues that needed to be navigated in order to locate the

large quantity of payphones present in the station. These phones were often tucked away into corners that felt hidden, and often set far apart from one another, in various corners of the building. These areas included different levels of the station, such as the train platforms themselves:

“It’s a train station, for heaven’s sake, PLUS a mall! DC6 found three sets of phones. I’m willing to bet there are many more if you consider the entire facility [...] Note that this corner of the building has a two level restaurant - if there were payphones upstairs there, we might miss them too...” (DC1).

Searching for the correct payphones in Union Station came down to a process of trial and error. Players on the DC team spent a large amount of their time scouting areas within Union Station to identify and track potential payphone locations. One player reports on his axon hunting activities at Union Station:

“I went to Union Station, arriving about 15 minutes before the call. I looked over the station map and saw two locations (I missed the 3rd one, so sue me), and going to the first, I saw it was outgoing call only on 2 of the 3 phones there, so I went to the 4th booth of phones, each with 4 phones on it. Waiting until the time, no phones rang” (DC6).

Payphone directories are digital resources found on the Web that list payphone numbers by geographic area or location. These directories acted in a key role for Union Station. Payphone directories enable the identification of specific payphones within their concrete locations, through the cross-referencing of payphone numbers with information such as whether or not a specific phone accepts incoming calls. Within Union Station, payphone directories supplemented scouting activities by enabling the identification and eliminating of potential payphones.

“The payphone directory says that there are phone banks near gates C and G, and a lot at “track level” whatever that means” (DC11)

“There are, according to one of the payphone sites, a bunch of phones on the platforms. These most likely are on platforms for the MD and VA commuter trains (MARC and VRE). These platforms are accessible only to ticket holders” (DC1)

As the above quote suggests, money was also an actant in the DC ecology, particularly with regards to the process of axon identification. Money was required to purchase a ticket to access the commuter rail platforms in order to test the platform payphones for acceptance of incoming calls. In contrast to San Diego, however, money ultimately did not impact axon activation at Union Station as the correct locations of the payphones were determined to be in areas that did not require payment for access.

Another key actant were photos taken by players of the station. Photos offered a visual representation that aided in

memory and assisted with task completion as they provided a visual understanding of all the potential payphones.

“I took some pictures [...] I wandered around a major transportation hub taking pictures of maps and infrastructure” (DC11).

While the aforementioned tactics enabled DC players to eliminate incorrect payphones, and thereby narrow down the location of the correct payphones, it took a change in the game, which saw multiple payphones ringing over the course of a short timeframe, for the DC players to finally report a success at Union Station. In particular, the multiple phone calls, combined with the openness of Union Station, enabled players to pinpoint the areas in which the calls were coming. Players identified these areas as a bank of phones across from the rental car agencies and a restaurant.

“DC11 said he heard a phone ring on the other side of him - most likely at the rental phone group. But only one. And he said DC12 only heard 4 ring at the Au Bon Pain set” (DC1)

In this example, temporality was a key actant within the space of Union Station. The ability to hear a phone ringing across the station may have appeared useful to players, until they realized that timing was not on their side. There was no way for them to get across the station to the ringing phone in enough time to answer it successfully. Despite this, the spatiality of the environment ultimately played a positive role. The DC team’s ability to hear the phones ringing allowed the players to successfully locate the correct payphones on a subsequent axon hunt.

“Success in Union Station. DC12, DC11 and I got 10 of the 12 axons hot! I think it was DC12 4, DC11 3, and DC2 3 in the end. All the calls except the 9:15 were phones by the rental agencies and vending machines” (DC2)

Another key factor in the relatively successful activities within the DC ecology was the number of active and engaged players. Due to the physical distance between payphones at Union Station and the short length of time between axon calls (1-2 minutes on average), multiple players were required to successfully activate all axons. Another indication of the level of player engagement in the DC ecology was the creation, adoption, and concerted effort put into maintaining a separate team website for task and team management. Given that teamwork in ILB was purely voluntary, and there was little public recognition of effort, nor were there any badges or overt signs of achievement given to high performance, the active members of the DC team nevertheless worked within the website functions to create a strong and unified team system.

“Times (PST and EST) are listed along with GPS and city locations. Each location has a graphic created from street maps and satellite imagery; both the Mapquest star and acme crosshair locations are present. If a phone was positively identified, I’ve marked that with a white phone

icon. Notes from previous forum posts are included, please let any updates from previous or new visits and I'll incorporate the information. If someone has said they'll be visiting a particular axon, I'll add that information (in red text)" (DC2)

In contrast to San Diego where no players rose to the ranks of lieutenant or general, the DC team was composed of one general and two lieutenants. These players were instrumental in the navigation of and eventual success at Union Station. All three higher level players used digital tools to map, identify and document the payphones at Union Station. These digital tools were used in conjunction with scouting activities, which helped eliminate incorrect payphones. Privates on the DC team provided additional support, aiding the lieutenants in covering payphone locations and activating axons. The DC team was a tight knit group, with several highly engaged and active players.

The DC ecology is an example of where all the pieces come together. Despite facing potential temporal and spatial challenges in locating and activating axons at Union Station, the DC team recorded a large number of successes. This is in contrast to the Washington ecology who also recorded a number of successes but who faced very few challenges to enhancement. The DC team worked collectively to complete tasks, and adopted a variety of digital tools to help manage their team and tasks, as well as to help locate and identify payphones. The DC players overcame the temporal constraints of Union Station by ensuring adequate phone coverage.

COMPARISON

When the actants are compared across the ludic ecologies, we see that **spatiality** operated against success for players in most cases. Issues of venue size, number of payphones, ease of access, loudness, and occupied payphones negatively impacted players' abilities to successfully and efficiently enhance axons. In DC and Las Vegas, for example, the size and complexity of Union Station and the Excalibur casino, respectively, made it difficult to navigate all the possible locations where payphones could be located. Despite these spatial challenges, spatiality ultimately acted in support of the axon hunting activities of the DC team as the openness of Union Station allowed sound to carry more easily, enabling players to hear and correctly identify the locations of ringing phones.

Temporality further operated against players' success in ILB. In most cases, temporality made it difficult for players to reach the correct payphone on time and thereby activate the axon. At Union Station, the distance between payphones made it nearly impossible to get from one axon location to another axon location before the phone would start to ring. In San Diego, a conflict between the Zoo's operating hours and the time the payphone was scheduled to ring, made it impossible for players to access the axon. Temporality also acted through the appearance of a homogenizing bias that assumed ILB players would be willing to engage in axon

hunting on the evenings and weekends. This assumption negatively impacted the Las Vegas players who found weekend axon hunting to be a challenge due to the presence of additional actants, such as increased traffic, difficulties with parking, and the number of tourists on the Strip at this time. In contrast to the other ludic ecologies, temporality did not appear to have a negative impact on Washington.

Digital tools acted in a number of capacities across the four ludic ecologies. These digital tools consisted of both player adopted tools, such as the Haunted Apiary, and game provided tools, such as the voice recognition software.

Player-adopted tools acted to address the spatial and temporal challenges faced in the game. The Haunted Apiary forum served as the communication hub for team communication, task completion, memory and documentation for the ludic ecologies. Payphone directories and other mapping tools helped players to orient to these physical game spaces by identifying payphone locations based on GPS coordinates. They also listed payphone numbers, threaded by geographic region or location, enabling the identification of specific payphones within a site location.

In DC, the Haunted Apiary was supplemented by a player-created status website and an Excel spreadsheet. The website and spreadsheet acted as memory aides and documentation support, listing DC axon statuses (i.e., hot or cold), location information and maps, and situation reports transferred from the DC team axon coordination thread on the Haunted Apiary forum. The website factored prominently in axon hunting at Union Station, providing an organized and centralized location for information on payphones identified, tested, and eliminated or confirmed.

Game-provided tools negatively impacted player success when the tools failed to operate properly. The voice recognition software that was used in the game for the challenge/response component of the axon hunting task, needed to function properly in order to axons to be activated. If the software did not recognize a player's answer, the axon would remain cold. The voice recognition software acted in a negative capacity in Washington on two occasions when it did not recognize the player's answer to a game question.

The role of **money** as a means of access acted in different capacities across the ludic ecologies. Similar to spatiality, money had an impact on axon identification. The need to pay to enter an area to try to identify the correct payphones deterred players from attempting these axons. In San Diego, the \$25 entrance fee required to access the Zoo ultimately limited opportunities for axon activation as players refused to pay the fee to attempt to find the correct payphone location. However, money can also be said to have acted as a solution to issues of spatiality. Although players chose not to do so, they could have used money as a way to overcome

some of the issues of spatiality and therefore gain access to private locations.

Player composition likely operated for and against the success of the ludic ecologies depending on the types and quantity of players within each ecology. Ludic ecologies that consisted of teams with at least one higher-level player (i.e., a lieutenant) were more apt to use task management and team coordination tools than those teams that were composed solely of privates. Additionally, higher-level players made greater use of geographic mapping tools, such as payphone directories and geocode databases. In DC and Las Vegas, higher-level players used these tools to map their geographic areas and to help identify payphones at specific locations.

The quantity of players within an ecology, and their level of engagement, also operated for and against the success of the ludic ecologies. In ecologies with large numbers of active players, teams were better able to deal with spatial and temporal constraints than those with fewer players. For example, where DC had a large number of highly engaged and active players who could cover the majority of the DC axons, Las Vegas was composed of only two active players for a large part of the game, making it much more difficult to cover all the possible locations. As result, the Vegas team, despite having multiple axons, only reported successes at the Excalibur.

DISCUSSION

Our analysis brings to light the contextual nature of action. It shows that the carefully designed in-game challenges of the game designers or “puppetmasters” took on a life of their own in practice. Issues of spatiality, such as occupied payphones, and temporality, such as venue operating times, worked against the success of the ludic ecologies in many cases, making it difficult for axon identification and activation. To overcome these challenges, players self-organized into teams, and adopted various leadership roles to organize and structure their play. They assembled a sociotechnical infrastructure to further address the specific spatial, temporal and organizational challenges in their geographic regions. These tools provided support for team communication, memory and documentation, and task completion. Georeferencing tools, such as payphone directories and geocode databases, were used to map an area and help identify possible payphone locations. Content management tools, such as the Haunted Apiary and Excel spreadsheets, provided task and team maintenance support. Additionally, photos taken by players provided visual aides, offering task completion support.

In this work, we strove to understand how the designed game mechanics and emergent social factors impacted teamwork in the ARG ILB. To do so, we traced and accounted for all of the major actants, both human and non-human, in each of the studied ludic action ecologies. Our analysis demonstrates that different features, challenges, impediments and impacts become visible when non-human

actants are included in an action description and analysis. Whether it was the axon locations, as was the case for spatiality, or the physical distance between payphones and call times, as was the case for temporality, our analysis demonstrates that non-humans matter. They leave traces of their inter-actions visible in player accounts. Consequently, only presenting the player actants’ actions and ignoring the non-human actants distorts accounts of play and of hybrid inter-actions across geographies and across play worlds. Our exposition of the four different major ludic ecologies within ILB shows that accounting for each of the actants provides a stronger sense of the ‘situated action’ [10] shaping each ludic ecology.

As Latour points out [4], an actant can only provide an account when it leaves traces. Thus, while we recognize that the “puppetmasters” had an indisputable impact on the action within ILB, both through initial design and through continued intervention in game play, we have not accounted for their actions in our ludic ecologies. Given that our data was derived historically, through tracing the axon hunting inter-actions found in the Haunted Apiary forums, we did not find any first-hand accounts of examples of the PMs ‘acting’. Any account we have of PMs actions are second or third hand from players. Consequently, in true ANT fashion, the lack of attributable action traces in our data by PMs means PM impact cannot be counted in our analysis, and therefore we are unable to describe how the PMs actions influenced the shaping of each ludic ecology’s possibilities and outcomes.

In using an ANT infused ecological approach, which focused on tracing the actions through one example from each ludic ecology, it is likely that some of the similarities across the ecologies may not have come to light. This should not be taken to assume that similar impacts of similar actors in one ludic ecology were not present in the traces we found within other ludic ecologies. As Latour acknowledges [4], the space constraints of a written report forces an arbitrary stoppage when a page limit is achieved. Consequently, accounts are always incomplete and messy [5]; they are always contingent on factors outside of the plane of action itself.

IMPLICATIONS OF THE STUDY

In this paper, we have addressed the findings that come out of our two research questions. We considered the way that the ILB game design impacted teamwork between human and non-human actants, and we examined the role that the hybrid physical/digital game environment and non-human actors shaped the sociotechnical factors of ILB play.

By describing and accounting for play, teamwork and hybridity in ILB, we are able to present a highly contextual and strongly situated account of each of the four ludic ecologies. Our account illustrates that sociotechnical action is emergent, composed of interactions between all actants and between actants and the environments in which their

action occurs [10,11]. Had we not paid attention to the non-human actants in our accounts, we would have only been able to present a one-dimensional and therefore distorted view of action. The impacts of non-human actants on players' abilities to complete game tasks, and the ways in which players worked to overcome challenges imposed by non-human actants would not have come to light. We argue therefore that when studying similar gaming environments to ILB it is important to use an approach that allows for attention to be paid to both human and non-human actants to ensure a more in-depth, contextual picture of action.

<p>Finding 1: accounting for each of the actants in our ecologies provides a stronger sense of the 'situated action' [10] shaping within each ludic ecology.</p>	<p>Implication 1: studying hybrid physical/digital environments should use an approach that allows for consideration of both human and non-human actants.</p>
<p>Finding 2: the careful design of in-game challenges by PMs took on a life of their own in practice (e.g., wrong locations, occupied pay phones, software glitches).</p>	<p>Implication 2: when designing for future, similar environments, whether for an ARG or for a digital game environment, it is better to design game/work tasks that acknowledge and even leverage this uncertainty, than to design for action in advance.</p>
<p>Finding 3: players formed teams and adopted technology to overcome their specific temporal, spatial and organizational challenges.</p>	<p>Implication 3: provide appropriate sociotechnical infrastructure to support player needs [9,12].</p>

Table 1: Summary of key findings and their implications

Our analysis also has implications for the future design of hybrid gaming environments and collaborative systems. As with many complex collaborative systems, we demonstrate that action is highly contextual, and therefore cannot be adequately designed for in advance because the context in which the action occurs has an impact on outcome. As our player accounts revealed, the fun of ludic interaction comes from its contextual and emergent properties *in situ*. We therefore contend that game or work tasks should be designed so that they acknowledge and possibly leverage the rich uncertainty inherent in situated ludic action. Properly underspecified designs can foster user

engagement, tighter social relations, creative technology assemblage, and even enjoyment.

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