Uncovering the Honeypot Effect: How Audiences Engage with Public Interactive Systems

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Figure 1: Different phases of audience engagement in *Encounters*: while *audience members* learn interaction possibilities by watching (left), *participants* interact individually (middle), and *facilitators* actively orchestrate a dance performance (right).

ABSTRACT
In HCI, the honeypot effect describes how people interacting with a system passively stimulate passers-by to observe, approach and engage in an interaction. Previous research has revealed the successive engagement phases and zones of the honeypot effect. However, there is little insight into: 1) how people are stimulated to transition between phases; 2) what aspects drive the honeypot effect apart from watching others; and 3) what constraints affect its self-reinforcing performance. In this paper, we discuss the honeypot effect as a spatiotemporal model of trajectories and influences. We introduce the Honeypot Model based on the analysis of observations and interaction logs from *Encounters*, a public installation that interactively translated bodily movements into a dynamic visual and sonic output. In providing a model that describes trajectories and influences of audience engagement in public interactive systems, our paper seeks to inform researchers and designers to consider contextual, spatial and social factors that influence audience engagement.

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INTRODUCTION
As interactive digital media permeates the public landscape, it becomes increasingly challenging to attract the attention of passers-by, to make them aware of the interaction opportunities, or to motivate them to engage meaningfully and sustainably. These challenges are not simply about optimizing hardware or creating more attractive displays. Instead, we require a better understanding about the relationship between people, their physical surroundings and their use of technology [21].

One particular user behavior, often observed in public contexts, is known as the *honeypot effect*. This effect is a social learning influence that causes individuals to be affected by the mere and passive presence or activities of others, regardless of any competition, reward or punishment [37]. In HCI, the honeypot effect is typically observed when passers-by move closer to a system and consider whether to engage after observing other people interacting [3]. Various aspects of the honeypot effect have been interrogated by other researchers. In particular, the specific roles and activities of users [29, 32], the influence of spatial configuration [11] including the various zones of engagement [24, 34] and the activities that take place [23]. However, the aspects that drive a honeypot effect and influence the motivations to engage with an interactive system have not yet been examined in detail.

In this paper we explore the honeypot effect by synthesizing the current state of knowledge from HCI literature, and merging it with our case study observations. We propose a spatiotemporal model of the honeypot effect that consists of a series of successive engagement trajectories and contextual influences. In particular, our model also introduces a concise terminology to capture and annotate the honeypot effect in interactive systems. The critical discussion of our case study results are described as a series of design considerations that aim to reflect on how to best support manifestations of the honeypot effect in public interactive systems.

Our in-the-wild case study focused on analyzing the audience engagement in *Encounters*, a public interactive installation that allowed people to influence dynamically projected visuals, sound effects and music with bodily gestures (see Figure 1). Because of its large scale, open-ended interaction design rationale and the use of various audience facilitators, *Encounters* formed the ideal context to capture the typical characteristics of audience engagement.

RELATED WORK

The honeypot effect was introduced to HCI to help explain the attraction to a system arising from others already engaged with it. This effect creates a "sociable buzz" in its vicinity [3]. The honeypot effect relies on the mere presence of others and suggests engagement will result in low social embarrassment. This effect is described in studies related to public displays (e.g. [2, 19]), media architecture (e.g. [11, 13]) and art installations (e.g. [16, 20]). The honeypot effect is commonly described as a natural attraction cue, such as integrating *calls-to-action* (e.g. [26]), embedding responsive visual content (e.g. [2]) or enabling opportunities for studying peers (e.g. [28]).

Dimensions of Audience Engagement

Stimulating engagement in a public installation typically involves creating an environment that benefits social interaction (e.g. [21, 33]) and positively influences the atmosphere (e.g. [4, 7]). Specifically, an environment that aims to motivate a honeypot effect should balance a range of *spatial*, *interactive* and *social* aspects. We discuss the significance of each to the honeypot effect.

Spatial. The layout of space influences the subjective experience of the environment [14], and technology has become increasingly apt in actively shaping that experience [10]. Hence, an interactive installation is not simply situated in a location, but its presence in itself creates "situations". For instance, *Urban HCI* provided a concise model of how the spatial configuration around a public installation creates such situations, highlighting the role of *potential interaction spaces* as possessing the ideal physical characteristics to stimulate social interaction [11]. The notion of *embodied constraints* describes how certain spatial configurations and physical structures invite or impede group activities around tangible, interactive systems [15]. Key design characteristics include configuring the nearby physical space to allow people to interact concurrently, allowing multiple access points to distribute control over the system, and providing interaction possibilities that adapt to people's skills.

Interactivity. The *Audience Funnel Framework* [24] describes how people tend to organically transition between various levels of interactivity while evolving towards engagement with a system. Transitions range from quickly glancing as a *viewer* and causing an initial response as a *subtle user*, to interacting as a *direct user*. As people transition, quantifiable conversions between phases can be recognized, which are typically low (i.e. high threshold) as people engage in an initial interaction. *Building blocks* have the ability to transform these initial forms of interaction into more active engagement. Hence, they are successful in increasing conversions, for example by motivating activity, triggering curiosity or stimulating collaboration with others [25]. One such building block is described in the *PACD model* [23], where gradually uncovering features of a system leads to *discovery* and active engagement.

In interactive systems, the typical aim is to motivate interaction while providing a potentially engaging experience. Notably, this design goal does not necessarily imply that the 'success' of an interactive system is proportionate to increasing the number of interactions [3]. Even the absence of any interaction from bystanders contains a potential opportunity for their interaction at a later stage [32], or for watching the activities that are performed by active participants [22, 35]. As such, besides providing active participants in a system with a pleasant experience, systems should take into account the different degrees of participation in their vicinity, while unobtrusively inviting bystanders to engage in participation [17].

Social. Users engaging with interactive systems tend to be driven by emotional, sensual, compositional and spatiotemporal influences [36], not dissimilar to how art is impacted by the relationship between the self and the art object [9]. Accordingly, user interaction in public contexts is shaped by the presence of others, including the social norms that govern the relationships between each of them. Public contexts expose a particular contrast between the roles of *performers* (i.e. acting in front of others) and *spectators* (i.e. learning from others to increase proficiency), potentially decreasing the likelihood of interaction for fear of social embarrassment [3, 30]. In fact, systems should be configured to accommodate for the physical proximity of the user [32]. As users gradually become conscious of their role, their perception of the system is shaped [8].

Interactive systems aim to take people on journeys while they explore and utilize the features [31]. These journeys, commonly referred to as *trajectories*, describe how people navigate through a predefined set of narratives that is purposively composed by the designers [1]. Whereas systems may intend that people follow *canonical trajectories,* the very nature of interactivity allows for

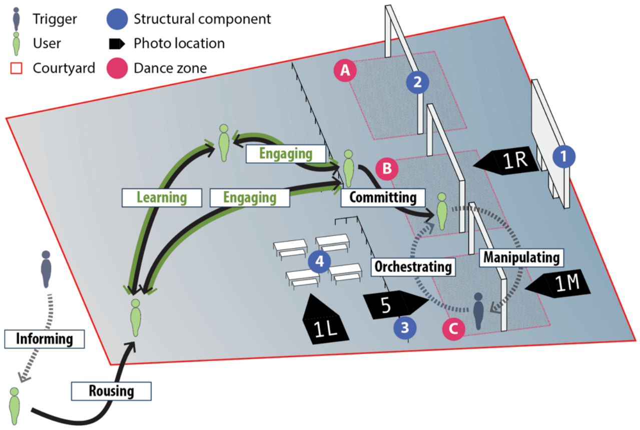

Figure 2: Schematic spatial representation of *Encounters*, the dominant trajectories and influences, and the main structural components: LED screen (1), archways with sensors (2), dance zones (A, B, C), fence (3) and seating area (4).

individual and unpredictable choices, i.e. *participant trajectories*, even when performers inform and support participants [18]. As such, engagement becomes a continuous dialogue between the system and the participant, between participants themselves, and between the participants and the spectators [30].

ENCOUNTERS

Our findings are based on the analysis of how people engaged with *Encounters*, a public, interactive installation that encouraged people to playfully explore a variety of dynamic visuals and soundscapes. *Encounters* was installed in a public courtyard during a summer festival in Melbourne, Australia, which ran over four evenings.

Technical Design

The interaction space of *Encounters* consisted of three 5x5m dance zones (see Figure 2). Each zone featured a large archway that supported a dynamic lighting system, six surround sound speakers, and an overhead Microsoft Kinect sensor that continuously monitored the area beneath. The dance zones were established by delineating a physical area underneath the archways by strategically pointing ambient lighting. A single 5x4m LED screen was installed facing all three dance zones. Depth data from the sensors was communicated to proprietary software at a rate of 30fps. The software processed, detected and interpreted a series of characteristics of every individual's movements in real-time, including the location in three-dimensional space, the velocity, and the distance from other nearby individuals. The system continuously broadcasted appropriate reactions to a music sequencer that controlled the surround sound and lighting, and to custom software that generated the dynamic imagery on the screen.

Conceptual and Social Design

The overarching artistic theme of *Encounters* was inspired by the wider cosmos, reflecting in part the dark and outdoor nighttime environment it was located in. Its dynamic visual and audio design switched between six distinct styles, each

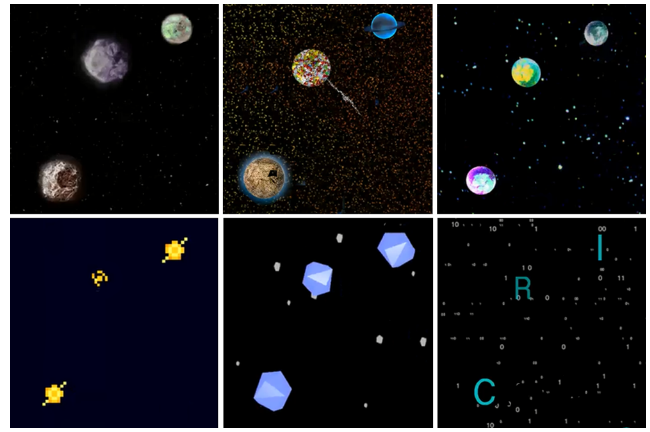

Figure 3: Overview of the visual aesthetics of *Encounters*, each representing identical depth sensor data.

of which was successively displayed for 10 minutes. The visual aesthetic styles were based on a particular artist's interpretation of the cosmos, ranging from a near-photorealistic representation (Figure 3, top left) to more abstract iconography (Figure 3, bottom left) or typography (Figure 3, bottom right). The dynamically composed soundscape of Encounters combined melodic and rhythmic elements of ambient and minimal music, which were composed to persuasively stimulate movement of people on stage. Each aesthetic style and accompanying soundtrack responded in real-time to the positions and activities of the people in the dance zones, and the physical distances between them. Each detected person was represented by a unique visual element, which was animated according to the input data, encompassing transformations such as scaling, rotating and morphing. One significant interaction was a ‘supernova’ that appeared as multiple persons approached within 30cm of each other, causing the corresponding elements to converge into a single visual entity. Various sound effects were overlaid on top of these soundtracks, and directly responded to a range of activities on stage, e.g. as people jumped on stage, a *whoosh*-ing sound was played.

As part of the artistic expression, three dancers stepped into the three dance zones every 30 minutes to perform a 10-minute prearranged choreography. The choreography consisted of three distinct phases, with each phase intensifying the interaction with participants. Initially the dancers performed a short solo routine (approx. 3min), during which they orbited around the people that were already present within the dance zones. During the second phase (approx. 2min), the dancers interrupted the rehearsed performance and talked directly to the people within the dance zones, as they encouraged them to form groups, for example by holding hands or bunching together. The formed group was then instructed to break apart, causing a drastic response in the visuals as the system recognized the transformation from a single, large entity to multiple, small elements. From this point on, the dancers encouraged participants to freely move around across the three dance zones, causing comet tails to appear on the LED screen that

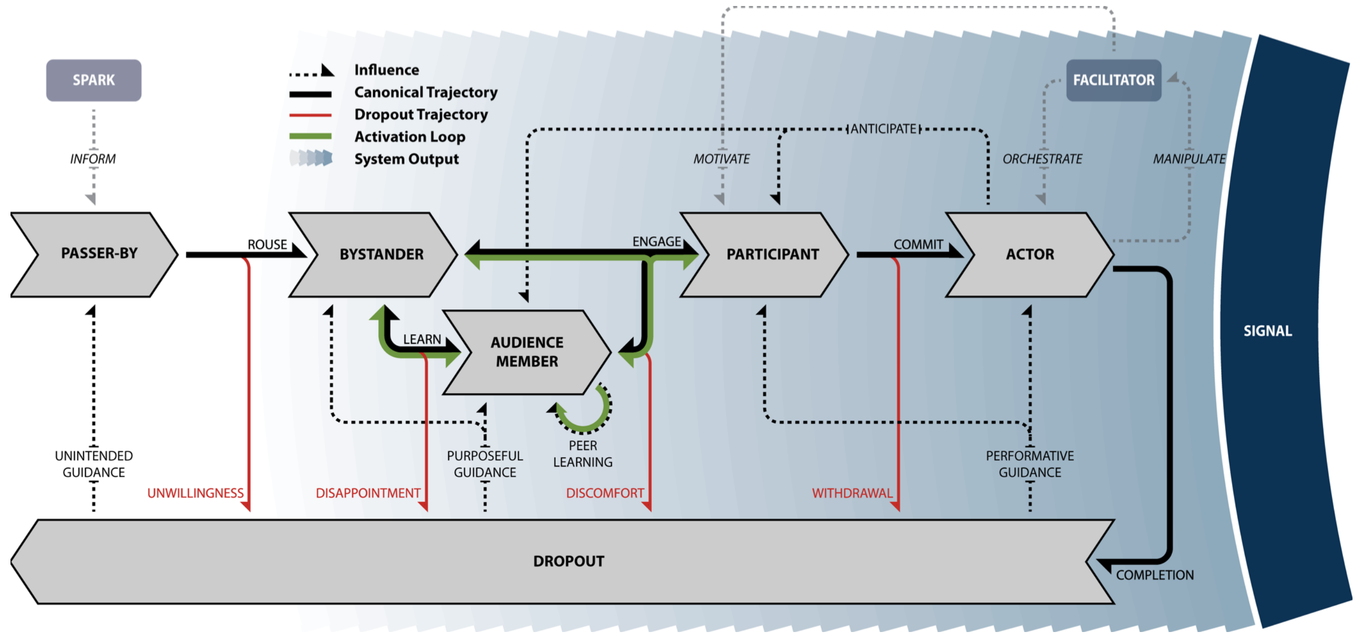

Figure 4: Honeypot Model containing the user roles, trajectories, influences and triggers that affect how audiences engage with interactive systems.

followed the movement of the participants. As participants started to improvise and engage with *Encounters* on their own terms, the last phase of the choreography (approx. 5min) consisted of dancers retreating into a solo performance, which finished with a brief ensemble dance.

In-the-Wild Field Study

Encounters was deployed on the same location during four separate evenings, running for a total time of 19 hours. Each performance started at 7PM and closed at night (until 11PM on three occasions, until 2AM on one occasion). Between performances, some spatial, technical, and artistic components were tweaked for optimization.

Evaluation Methodology

Each evening, three researchers conducted a contextual inquiry by observing the engagement behaviors taking place from randomly chosen locations around *Encounters*, and by conducting semi-structured interviews with participants, dancers and pitchmen. Questions aimed to uncover the trajectories between and experiences of different user roles: such as why participants felt motivated or discouraged to interact within the dance zone, how participants learnt about interactive features, and how dancers and pitchmen perceived their interaction with people. All interviews were audio recorded, and additional notes were taken on-site. In addition, all movements within the dance zones were recorded as video and depth data. The depth data was later segmented into tagged information to identify the number of people, start and end times, speed of movement, jumps, and configurations of people that were dancing over time.

Results

During the four evenings, a total of 1,159 people were counted entering the performance zones, with a maximum of 629 participants during the final performance (which took place alongside a major metropolitan light festival). On average, each person spent approximately 30 seconds in the performance area. There were about 3 people in the performance area at any given time, though the middle zone (B) seemed to attract substantially more people (5 people) than any other (2 people in area A and 3 people in area C).

We conducted a total of 125 interviews (of which 80 were taken from groups of people), taking an average of 6.0 minutes each (SD=37.4s). A team of four researchers analyzed the interview notes according to categorization methods used by Grounded Theory, including open coding and selective coding. Our analysis focused on revealing the nature of social and performative interactions, and the transitions of users as they engaged with *Encounters*. During each workshop session, groups of three to four attendees sorted the interview notes, while iteratively adjusting, debating and refining the coding scheme. This process is similar to previous studies that relied on group analysis [6]. Our approach helped in managing the sheer volume of data (i.e. 384 notes from 125 audio recordings), while allowing for new insights to emerge and previous insights to be refined. Hence, each session concluded with a plenary discussion of changes to the analysis process. The resulting analysis yielded a taxonomy of engagement types, a chronology of how people gained an understanding of the supported functionalities and perceived goals, and a classification of the influences that people experienced. These are further explained in the following sections.

HONEYPOT TRAJECTORIES AND INFLUENCES

The insights from the analysis were synthesized and a model consisting of user roles, trajectories, influences and triggers was created. All these aspects are integrated in the spatiotemporal Honeypot Model (Figure 4).

Figure 5: Dancers as facilitators (identifiable by EL wire wrapped around the body), involving participants and actors in dance as a way to motivate and engage.

Triggers

The most apparent and persuasive component of the system included the audiovisual feedback. However, potential participants were also informed via various printed and online publications, accessed remotely or in the vicinity of *Encounters*, while pitchmen roaming around the surrounding streets further encouraged passers-by to participate. Finally, hired dancers demonstrated the interaction features and encouraged collaborative behaviors such as group-based dance choreographies (see Figure 5).

Based on definitions from captology [12], depending on whether they increased the intrinsic motivation or the ability of passers-by to engage with the system, we propose these components acted either as *triggers*, i.e. respectively *sparks* or *facilitators*, as they specifically intended to persuade users to participate. *Encounters* captured the third type of trigger, *signals*, in the system itself, along with its supported functionalities and technologies.

User Roles

Initially, people became aware of the installation's existence through one or more triggers. As people entered the courtyard, noticed the music, saw the distant dynamic lights and visuals, and observed some physical activity among the attending audience, they became vaguely aware of the potential engagement with *Encounters*. Upon approaching closer by, people entered a seating area where many paused in order to observe the interactions that others performed, and to more intensely experience the visuals, sounds and music. Within the seating area, various forms of social interaction between people took place, such as telling each other about the installation's features. As people decided to enter the dance zones and their physical presence was detected by the overhead Kinect sensors, the system responded with appropriate visual and auditory feedback.

We identified two types of exploratory behaviors that emerged after people became aware of the interactivity. We coded these behaviors as *interacting oneself into existence*, which was characterized by people restricting themselves to a brief process of exploration. This process involved mimicking the behavior of others and performing basic, axial movements directly underneath the sensors, such as to identify themselves on the LED screen. As soon as they felt sufficiently comfortable and empowered, movements became more diverse, often involving acts such as running around, dancing and holding hands with others. The exploratory activities within the dance zones were also influenced by the performances that took place every 30 minutes, as dancers orchestrated the audience in a collaborative choreography (see Figure 5). Ultimately, people abandoned their engagement and left the dance zone.

Based on these observations, and complementary to the relevant terminology introduced in an analytic framework for public interfaces [29, 32], we identify six user roles.

- A **passer-by** roams around the immediate vicinity of an interactive system (i.e. *situated passer-by*) or learns about its existence via triggers. As some triggers may not be situated in the vicinity of the system, we propose the notion of *remote passers-by*.
- A **bystander** has experienced some form of (distant) visual, sonic, tangible or spatial expression of the interactive system (i.e. system output), yet is still unaware of the system's true interactive features.
- An **audience member** is familiar with the interactivity and the social norms surrounding a system, such as by reading instructions, or observing or discussing with others.
- A **participant** exhibits subtle forms of engagement with a system, such as moving slowly in the interaction space. Even though participants actively take part in interacting, they are still discovering interactive features and building a sense of comfort, and typically lack particular signs of profound commitment or enthusiasm.
- An **actor** demonstrates some committed form of engagement. This form of engagement is most noticeable in the nature of interactions (e.g. complex behaviors, challenging or testing out the system's capabilities), the extended amount of effort or time spent while interacting, or the apparent motivation to share their experience or seek the collaboration with others.
- A **dropout** has abandoned engagement with the interactive system, for instance by purposively not engaging with the system, or by leaving the interaction zone. Notably, any user role is able to drop out for various reasons (see subsection *Dropping Out*), even when no interaction with a system has yet occurred.

Trajectories

Within the context of our research, a *trajectory* describes the chronology of how people move towards and through distinct user roles. We have observed canonical and participant trajectories [1] in *Encounters*, and a range of dropout trajectories. Ultimately, we introduce the *activation loop* as a key trajectory to motivate and sustain engagement.

- The **canonical trajectory**, as envisioned by the *Encounters* designers, aimed to smoothly transition users from passer-by to actor and eventually dropout.
- Personal desires and expectations result in a participant to creating her own **participant trajectory** when experiencing an interactive system. Here, users organically transition back and forth between user roles.
- We observed instances of people abandoning every user role. We discovered that the reasons for choosing a **dropout trajectory** often corresponded with the experience that people had within their last actual role, although external issues could have occurred as well (e.g. unexpected phone call). For example, audience members typically dropped out because of social reasoning (e.g. crowdedness, perceived complexity of interactions), whereas actor dropouts were mostly due to having exhausted all interactive features of the system. As such, we propose four dropout trajectories (highlighted in red, Figure 4), which we articulate in subsection Dropping Out.
- We noticed how the activities of participants within a dance zone served as the main 'activator' for bystanders and audience members to move closer and engage for themselves. Particularly, it created a sense of anticipation to learn more about the features and interactivity. Occasionally, participants also retreated to a role as bystander or audience member, to gain more knowledge about the interactive features, or build a stronger sense of comfort. As such, we define the **activation loop**, a self-reinforcing trajectory that is capable of reactivating the interest and motivation to join the interaction.

Influences
We observed how the transition between user roles was affected by various forms of social interaction with other people. These included conversing with other participants (e.g. "*I talked with someone who stood next to me. He told me I could jump to change letters*", interview #68, young adult); studying the physical behavior of others (e.g. "*It was a little unclear in the beginning, but watching others helped to understand what was possible*", interview #54, young couple); and collaborating with actors (e.g. "*I felt sufficiently at ease to hold hands with strangers. It helped to identify myself on the screen*", interview #21, young family).

Accordingly, as users engage with an interactive system, their expectations are also shaped by the activities of others. We refer to these occurrences as *influences*, i.e. explicit or implicit forms of social interaction between people and that affect engagement with a system. We have identified 10 distinct influences in *Encounters* that depend on transitions between user roles, and will discuss them in the next section.

ANALYZING TRAJECTORIES AND INFLUENCES
To demonstrate the potential usefulness of the Honeypot Model in the design and evaluation of interactive systems, we further describe how particular spatial, social and interactive elements have affected the success of trajectories and influences in *Encounters*. By analyzing the nature of the observed trajectories and influences between user roles, we are able to reflect on their actual impact, which is then formulated as a set of design implications that aim to optimize the effectiveness of the honeypot effect in future endeavors. Figure 2 illustrates a graphical notation of how the main trajectories are physically situated within our case.

Rousing: From Passer-by to Bystander
Making activity in front of an interactive system visible beyond the interaction space itself is a potentially efficient technique to *rouse* initial engagement among passers-by [29, 34]. However, the spatial configuration of *Encounters* prevented the interaction activity to be noticed from surrounding streets. Therefore, we used various sparks to inform passers-by. These included symbols painted onto road surfaces, printed signage along main roads leading to the installation, and some digital signage in the alley that provided access to the courtyard. In addition, several clearly recognizable pitchmen mingled with passers-by. Although the pitchmen did not adhere to a strict schedule or script for approaching people, the process usually involved seeking contact, enquiring if they were having a good time, and asking if they would like to spend time at "*an interactive dance performance*". No additional details were shared about the range of supported interactions or expected behaviors in order to create a surprising experience.

The use of different sparks had a distinct effect on passers-by. The signage was most effective for passers-by that were initially unaware of the installation (e.g. "*I was walking past, noticed the signs, and just followed them*", interview #55, young couple), even though – or precisely because – it did not provide them with clear instructions (e.g. "*I read about Encounters in the online brochure. It didn't tell much about what could be done, and that motivated me to come and visit*", interview #11, young family). Those who already intended to visit *Encounters*, occasionally benefitted from additional information given by pitchmen: "*We wanted to see Encounters, but it was good to have the volunteers around to tell us more*" (interview #19, young couple).

Design implication. Making people aware often requires some form of advertising, which is dependent on the perceptual reach of the media output, its spatial configuration or persistence over time. While local signage forms an obvious choice, advertising may also involve more contextual techniques like those adopted by street performers to build up crowds, such as using the skills of dedicated pitchmen that directly address passers-by, or providing opportunities for glancing [5]. Along the rousing trajectory, the ideas about a system that develop among people should not be influenced, by not revealing details on particular functionalities, elements or characteristics of the system [32]. Such open-ended and ambiguous experiences create an opportunity for people to remain comfortable as an audience member, or seek further details about a system by more readily interacting with peers and bystanders.

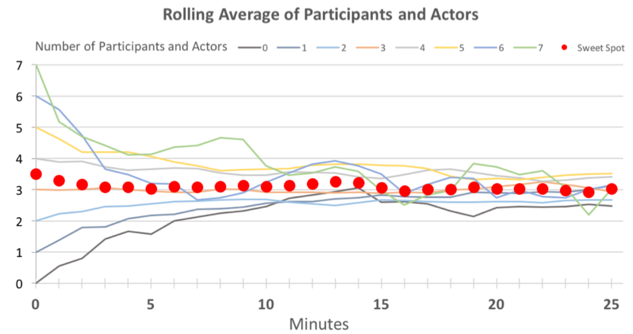

Figure 6: The honeypot sweet spot, i.e. the evolution of the rolling average number of participants and actors (Y axis) within any given dance zone over a 25-minute period (X axis).

Learning: From Bystander to Audience Member

We discovered that the typical trajectory for audience members included some form of *learning*. Since no instructive guidelines on how to interact in the dance zones were shown or explained, the learning process required some conscious effort. Most audience members first aimed to become familiar with the expected interactions (e.g. "*We've been enjoying [watching] other people do it. Trying to work it out from afar*", interview #22, middle-aged couple); the social norms that existed (e.g. "*As we watched others dancing, we could decipher the intrinsic rules of the game*", interview #49, young couple); or the inner workings (e.g. "*It took us a while to learn this must be picking up people's motions in one particular area*", interview #80, father and daughter). The learning trajectory commonly involved some form of social interaction with others, particular those who had previously participated: "*The people who aren't actually interacting, are [behind the fence], interacting with each other while trying to explain it. It's got everyone talking*" (interview #22).

Audience members that had no intention to learn, commonly watched the performance purely for personal enjoyment (e.g. "*You're just drawn to it. You can sit here and look at it*", interview #23, middle-aged couple); were discouraged by a perceived fear of social embarrassment (e.g. "*I entered a dance zone, but only for a short time. It felt more comfortable to just watch others*", interview #108, young couple); or refrained from further engaging because of social obligations (e.g. keeping an eye on personal belongings while family and friends were in a dance zone). These audience members appreciated and enjoyed a certain degree of physical and social comfort, which the space provided in the form of a seating area adjacent to the dance zones (see Figure 1, right). Notably, participants who dropped out, used this particular area to relax (see subsection *Dropping Out*) and, in turn, became themselves approachable sources of information to teach their peers about features of the system.

Design implication. Learning by watching other people's behavior in an interaction space (e.g. [27]) provides a context for one's own potential activities in later stages [10], even when people decide to refrain from any engagement. Learning also occurs via various forms of social interaction, particularly between different user roles along the canonical trajectory. Therefore, physical environments that aim to accommodate such learning process should focus on providing a comfortable space that caters for the physical and social needs of audience members. For instance, such space should warrant a nearby and uninterrupted visibility of the interactive system [22], while supporting stationary postures without fear for social embarrassment. Such space should also accommodate social interaction and opportunities for peer learning, for instance by stimulating approaching others, overhearing conversations or sharing experiences. Ultimately, such space should also accommodate for the absence of any interaction, such as from passive audience members. Here, a level of physical and social comfort is needed that supports spectating a performance, rather than socializing with peers.

Engaging: From Bystander over Audience Member to Participant

Two external factors influenced engagement in the dance zones: the number of people that simultaneously interacted, and the ambiguous meaning of unexpected events.

The Honeypot Sweet Spot

We discovered that the number of people simultaneously interacting with *Encounters* influenced the motivation of other participants. Figure 6 represents the rolling average of how the number of concurrent participants within the dance zones (Y-axis) affected the growth or decline of participants over a 25-minute timeframe (X-axis). The initial condition is the average number of people within a single dance zone per minute. Consequently, the diagram demonstrates that when two people are dancing, the number of participants tends to increase; whereas five participants trigger a decline over the course of 25 minutes. Our sensor data revealed that this number balances out at 3.1 participants per dance zone (SD=0.8). We refer to this number as the *honeypot sweet spot* (Figure 6, red-dotted line). We believe this phenomenon can be best explained by physical and spatial constraints: the archway's physical dimensions (5m) allows for a maximum of three people (3x approx. 1.75m) to stand next to each other, directly underneath a sensor. While there is still substantial space in front of or behind this line for people to move around, audience members might have perceived the dance zone to be fully occupied or experienced difficulties understanding the visual feedback: "*As more people entered the dance zone, we lost motivation. It got crowded, and we couldn't identify ourselves on the screen*" (interview #108, middle-aged couple).

This finding adds significance to previous findings in literature that indicate the honeypot effect is mainly unidirectional and self-reinforcing [26]. Our study shows that interactive systems are not necessarily able to accommodate a continuously increasing number of participants, but reveals a balance between user motivation and ergonomic, social, hardware and software constraints. Continuous recurring participation may not even always be desirable as, for example, the content or narrative may have reached its end, participants may have lost interest, or others may want to start interacting. As a result, participants can be expected to return to a role as audience member or bystander, and potentially even drop out of interaction.

Design implication. Interactive systems should consider how to tackle the *honeypot sweet spot*, i.e. the optimal number of participants that simultaneously interact. It requires taking into account a range of spatial and social constraints, such as the visibility of available interaction space, the hardware and software constraints that limit how many people effectively can be sensed or receive feedback in parallel, or simply the ergonomic dimensions of the system. To manage the *sweet spot* dropouts, specific trajectories could be designed to encourage people to seamlessly travel back and forth between the roles of participant, audience member and bystander depending on the number of simultaneous participants, or provide opportunities for dropouts to share their experiences with audience members. The aim is not to recommit dropouts into interaction, but rather stimulate knowledge transfer.

Unexpected Events

Encounters experienced an unexpected power outage during one dance performance, causing all audio and visual systems to shut down even though the dancers continued with their choreography. In follow-up interviews, participants remarked that they felt unsure if the power outage was deliberate and staged: "*It made us focus more on the dance performance, and we were less distracted by the visuals and the sounds*" (interview #49, young couple). This ambiguity therefore unintentionally made people wonder about how the installation was designed, and whether the temporary lack of interactivity was a legitimate part of the overall experience. It also illustrates how counterintuitively a lack of interactivity is still able to refocus the attention to the behavior that the interactivity was specifically meant to encourage and reinforce. In addition, it strengthens our earlier observation that triggers, such as dancers and volunteers, appear to fulfill a key motivational role, even in the (temporary) absence of an interactive system.

Design implication. Sudden disruptions in the interactivity of a system have the potential to positively influence engagement by way of creating an ambiguous situation that challenges participants to focus their attention to interpreting their own behavior. We propose further research is required to investigate the impact of such unannounced interaction shifts on user behavior, such as in terms of severity, frequency, persistence, and the potential boundaries between user frustration and curiousness. Here, we highlight that the impact of triggers is still relatively undervalued and underexposed, even though they appear to be crucial components of interactive systems.

Committing: From Participant to Actor

We observed that *Encounters* engaged participants through audiovisual feedback and dance performances, as well as through social interaction with each other. Participants who discovered the cause-and-effect narratives in *Encounters* committed to more persistent and dedicated forms of interaction: "*It got us all excited when we discovered that we could manipulate the visuals even more when we held hands with friends.*" (interview #3, two middle-aged couples). As participants were empowered to discover how the installation responded to performative and social interactions, they transformed into actors.

The Narrative of Participation

We observed participants transform into actors in two distinct ways: through participating in the dance performance and by initiating interactions with others. The second dance phase by facilitators temporarily orchestrated the engagement of participants. For instance, the choreography contained dance expressions that motivated participants to stand close together, and engage in activities like running, jumping or touching each other. As some participants became sufficiently empowered, they took on a role as actors and started manipulating the predefined choreography of the dancers: "*In my zone, people didn't want to form a cluster. [...] I kept orbiting around them. In the end I appreciated being part of their experience, but not creating their experience*", interview #10, dancer).

In order to fully explore the unpredictable responsive nature of sounds and visuals, some participants merged efforts to create group-level behaviors, such as maintaining close physical contact, or standing as far apart as possible. These collaborative behaviors happened within groups of relatives ("*[...] We tried to identify if there was a shape that was following us and I think there was. So we separated again to see if that was the case*", interview #20, middle-aged couple); between strangers (e.g. "*While trying to work it out, I held hands with others. It changed us into a big planet on the screen*", interview #6, young couple); and in collaboration with dancers (e.g. "*I imitated the dancers' moves. It's easy, and I get to see what is possible with the visuals on the screen*", interview #17, young adult).

Design implication. The transition from participant to actor requires a level of commitment that allows people to feel sufficiently empowered to immerse in their interaction and experiment with the possibilities of a system. Therefore, besides considering open-ended interaction mechanisms, triggers fulfill a particular role in easing the transition from participant to actor. Through their inside knowledge of an interactive system, triggers support a narrative for participants to immerse in, and, subsequently, facilitate opportunities for social and performative interaction between actors and triggers, and among groups of actors.

Collaborative Performances

At one occasion, a group of friends entered a dance zone and, after an initial phase of exploration, passed around a beach ball at each other. A subsequent interview revealed these participants aimed to explore the sensor's capabilities: "*It was fun! We could see that the sensors picked up the ball as we passed it around*" (interview #16, group of friends).

This improvisation positively impacted the social interaction, as two other participants joined in. On the other hand, the dance performance that started shortly thereafter required significant adjustment, as dancers were confronted with insufficient space in the dance zone to perform. Yet, as the *honeypot sweet spot* was already at its maximum, this particular dance became also relatively purposeless.

Design implication. In order to encourage collaborative behavior, a system's interactivity should motivate people to join efforts, in order to discover (hidden) features and positively influence the overall social experience. Design considerations involve forms of gamification that encourage deliberate and synchronous activities, in terms of technical features (e.g. software that recognizes collaborative actions), experience (e.g. visual and sonic feedback that responds to collaboration) and physical manifestations (e.g. providing *props* that require participants to collaborate). In this context, providing participants with detailed information about the system would increase the usability, yet might hinder the emergence of collaborative performances and more elaborate experimentations. However, collaboration may also hinder the engagement of others, or even the performance of the system in itself. As such, in order to accommodate a wide range of participants, one should consider spatial aspects (e.g. maximizing the dance zone) and technical features (e.g. responding meaningfully to varying levels of engagement).

Dropping Out: Transitioning out of Engagement

We observed people dropping out of *Encounters* for various reasons, which differed in terms of their prior user role.

- **Unwillingness** occurs among passers-by who have not (yet) experienced the interactive system, and where a general disinterest or discomfort (e.g. loudness, queuing, time constraints) might exist.
- **Disappointment** is caused by a contradiction between personal expectations and the actual experience, such as by feeling underwhelmed by the feedback or the general purpose of the interaction, which could be caused, among other reasons, by usability or user experience issues.
- **Discomfort** occurs as audience members have been unsuccessful in overcoming social fears (e.g. unfamiliarity, crowdedness). It mostly relates to a misalignment between personal expectations and what the system supports (e.g. a system requires excessive gestures, which an audience member is unwilling to perform for reasons such as social awkwardness or bodily constraints).
- **Withdrawal** occurs when participants have spent some time in the interaction zone, but drop out prior to transitioning to actor because of physical limitations (e.g. exhaustion) or spatial and social influences (e.g. perceived sense of crowdedness).
- **Completion** is the canonical reason for dropping out: participants have progressed through the complete narrative of the interactive system, or conclude that they have depleted all possible, expected or interesting interaction possibilities.

Design implication. Interactive systems need to be designed to avoid dropouts for external reasons, like limited usability or insufficient enjoyment. Systems should integrate gentle ways to abandon engagement and allow for different degrees of commitment with a system. Despite dropping out, specific trajectories can encourage dropouts to recommit into the canonical trajectory. Here, one can consider deploying triggers that attempt to relieve discomfort or deal with disappointment by disclosing or demonstrating the interactions that are supported by the system. We believe such interactions should highlight the general purpose of the system for potential engagement to (re)emerge, and refrain from posing additional challenges. Notably, if dropouts are to recommit, such trajectories should not have any social or other negative repercussions.

Social Interaction while Dropping Out

We observed that social interaction between dropouts and other users can take implicit forms, such as showing visible signs of physical exhaustion. More explicit forms of communication consist of dropouts who communicate their experiences with the people they pass in other stages of the trajectory, or bystanders who pick up on enthusiastic conversations between groups of dropouts. We thus distinguish between three types of social interaction.

- **Unintended guidance** occurs when passers-by are influenced, commonly involving overhearing conversations between dropouts, but can also involve reading status updates from dropouts on social networks.
- **Purposeful guidance** is an explicit interaction, when bystanders and audience members exchange information with dropouts, predominantly on the inner workings of a system or people's past experiences.
- **Performative guidance** occurs when participants and actors change behavior in response to the physical behavior of dropouts. It resembles some form of social risk assessment, such as when an actor stays behind in a dance zone as another actor suddenly drops out.

Design implication. Dropouts built up a particular experience that could be shared to those in other user roles. In fact, dropouts may easily and organically take on a role of *spark* or *facilitator*, enthusing those who have yet to engage in the interaction and sharing their insights and experience. Such interactions with other user roles can be encouraged by physically forcing them to meet or pass each other when dropping out, or by promoting collaboration with those who are not yet participating. Naturally, social interaction may be detrimental when dropouts report negative experiences to others, such as the reasons for dropping out that were mentioned earlier. However, we believe the role of dropouts is still underexposed in HCI, and suggest further research is required to investigate their effect on participant trajectories.

DISCUSSION

Our analysis yields new insights into the key factors of the honeypot effect, while still remaining flexible for adaptation and deployment in other application domains.

Triggering Audience Engagement

In the absence of any engaging activities or pre-existing participants (for example when a system is initially launched), motivating new participants to move closer and engage in an interaction becomes more challenging as the risk of social embarrassment is perceived to be higher. The Honeypot Model provides a framework that allows for simultaneously analyzing how triggers *influence* the *trajectory* of people, respectively through their behavior and spatial position. In addition, *Encounters* was characterized by a range of distinct triggers, unique in their temporality, sociality and proximity to the interaction zone. The ability of the Honeypot Model to accommodate such complex aspects, reveals its flexibility as an overall framework that describes – but not prescribes – the honeypot effect.

However, while triggers in *Encounters* influenced engagement by *informing* passers-by, *motivating* participants and *orchestrating* actors, other studies could consider how triggers can be utilized in different contexts. For example, amusement parks may need triggers that entertain queuing *audience members*, while street performers may rely on persons planted in the audience to orchestrate *bystanders* into cheering.

Promoting and Sustaining Engagement

As soon as some form of engagement with a system has been achieved, the challenge is to allow for different forms of engagement to emerge, and allow for their co-existence and sustainability over longer periods of time. In our model, we propose the *activation loop*, a trajectory that is crucial in activating new participants to join the interaction, and allowing dropouts to share experiences or recommit. The *activation loop* should not be understood as a mechanism that continuously pulls dropouts back into participation, but rather as an exchange of knowledge and motivation between those that interact (i.e. participants and actors) and those who are yet to engage in the interaction (i.e. bystanders and audience members).

Our analysis of the activation loop expands the common notion of the honeypot effect as solely relying on watching others. In fact, we argue the activation loop is one of its key elements, as the activities that occur allow for: 1) information to be exchanged between experienced dropouts and new participants to stimulate engagement (e.g. by sharing experiences), 2) bystanders and audience members to learn about the social norms and interactive features by observing the activities of participants and actors, and 3) dropouts to re-engage with the system after an initial period of withdrawal (e.g. to learn more about the supported features or social norms). We have illustrated that the activation loop relies on communication between different user roles.

However, there exists a limit to promoting engagement. We have identified a *honeypot sweet spot*; a natural equilibrium between the participation rate and system-specific constraints. We believe additional research is required to study the diversity of the honeypot sweet spot, such as its impact, optimization and applicability in varying contexts.

Limitations and Shortcomings

The Honeypot Model adds further consideration to existing knowledge about the honeypot effect. Since our findings are solely based on *Encounters*, we may not have identified influences that may exist in other contexts. Hence, the topology we propose is not deterministic. Applying the model to other domains will reveal the existence or absence of other components, such as the influence that actors have on remote passers-by through intended guidance (e.g. texting others while interacting) or how audience members potentially stimulate engagement by way of gestures and sounds (e.g. applause).

We believe that the Honeypot Model may prove fruitful when studying engagement in other contexts that rely on, or deal with, audience flows. Potential application domains span a wide array of contexts, ranging from street performances and media architecture, to urban games and mass tourist attractions. For example, amusement parks can apply the model to study how efficient transition through the activation loop can minimize waiting times; or public displays in community settings may require maximizing the activation loop to create opportunities for social interaction.

CONCLUSION

In this paper, we propose that the honeypot effect involves a series of spatial trajectories and contextual influences that should be modelled from well before the actual interaction takes place. Designing for a honeypot effect involves balancing the activation loop with the honeypot sweet spot. While the activation loop stimulates audience engagement, the honeypot sweet spot reduces the potential reach. However, the capacity of the honeypot sweet spot can be optimized by considering four design characteristics:

- optimizing the physical environment, by considering a range of ergonomic, spatial, technical and social aspects;
- deploying triggers to ease transitions between user roles;
- stimulating opportunities for collaborative interaction, peer learning and exploratory activities; and
- allowing for dropouts to leave without any repercussion, or empowering them to reactivate within the *activation loop* and to stimulate those who have yet to engage.

Our contributions and design implications are synthesized in the Honeypot Model, a spatiotemporal model that can be used by designers and researchers to annotate and optimize the impact of the honeypot effect. The Honeypot Model allows for the identification and study of different engagement styles, ranging from active and self-reinforcing, to passive and individual.

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