Open-ended art environments motivate participation

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ABSTRACT
In this research we observe the situated, embodied and playful interaction that participants engage in with open-ended interactive artworks. The larger project from which this work derives [28] contributes a methodological model for the evaluation of open-ended interactive art that treats each work individually and recognises the importance of the artist intent and the traditions from which the work derives. In this paper, we describe this evolving methodology for evaluating and understanding participation via three case studies of open-ended interactive art installations. This analysis builds an understanding of open-ended free-play non-narrative environments and the affordances these environments enable for participants.

Categories and Subject Descriptors
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Documentation, Performance, Design, Experimentation, Human Factors.

Keywords
Open-ended, play, interactive art, ethnomethodology, HCI, Interaction Design, common-sense language, installation art

1. INTRODUCTION
As we have argued elsewhere, the fields of Human Computer Interaction (HCI) and art are increasingly intersecting. Interactive art is not a recent phenomenon, but HCI has, over several decades, become increasingly interested in evaluating participation in artworks that borrow technology and repurpose it for interactive environments. In this paper, we argue for an interdisciplinary approach to evaluating participation in interactive artworks. This approach combines established rigorous ethnographic approaches with longstanding art practice critical-theoretical traditions in order to develop better methods for understanding the situated practice of interactive art works.

Where HCI evaluation is, broadly speaking, guided by systems design and user expectations, interactive art, does not easily fit either the utilitarian or ludic moulds that HCI usually engages with. Art practice intersects with and is informed by art and critical theory. Even while considering the precedent works that inform art, art still remains a practice, and the situated work of participants in their interactions with interactive art can be evaluated in a tradition of “empirically grounded observations” based on the participants’ “practical engagement”. However, this emphasis on the observation of practical engagement does not mean that the traditions the works stem from can simply be ignored. Neither can the participants’ knowledge or understanding (their prior relationships with art traditions or prescriptive representations) be automatically dismissed as “theoretical” and therefore irrelevant to “practical engagement”.

In steering a path between HCI’s empirical tradition and art’s critical-theoretical tradition, we argue that interactive art cannot simply be evaluated according to the principles of systems design. Indeed, the utilitarian basis of systems design is in many cases of little relevance to interactive artworks. Artists who create open-ended interactive art works are not necessarily using technology as a systems designer would—they are not using technology to satisfy perceived or specified user requirements. Rather, they are more likely to be using technology in an attempt to create a whole environment that provides some kind of enriched, improved and/or extreme human experience. The strength of this kind of boundary work between HCI and art, while maintaining the rigour of established ethnographic approaches, lies in its ability to articulate how art might benefit from HCI-style evaluation and how HCI methods might become more robust by taking into account the critical-theoretical traditions that inform interactive artworks. This is because the very works that are under analysis emerge directly from and/or are in direct dialogue with these same arts and humanities analytical-critical traditions. What the environment affords is particular to, built upon, informed by, and respondent to arts and humanities analytical-critical-theoretical traditions (just as work environments are informed by an understanding of workplace and user requirements).

The contribution this paper makes is two-fold. First, it provides a methodological model for the evaluation of open-ended interactive artwork. The contribution of this approach in treating each work individually includes recognition of the importance of the artist intent and the traditions from which the work derives. In addition, the model applies rigorous, ethnographically informed methods to observe the naturally occurring actions of participants as they interact with the works. Second, the research builds an understanding of open-ended, free-play, non-narrative environments and the affordances these environments enable. The larger research project from which this work stems builds foundational work in establishing a set of sensitising guides and a common-sense language for evaluating participation in interactive artworks [28].

In the remainder of this paper we discuss the art-historical nature of open-ended works, describe the case studies and participants, introduce an evolving, interdisciplinary method for evaluation,
outline the findings and discuss the implications for HCI research of the affordances of open-ended environments.

2. OPEN-ENDED ART WORKS

In this section, we describe the nature and evolution of open-ended, non-narrative art works and present current discussions and early findings in evaluating participation in these works. As all the works discussed in this paper are open-ended in nature, it is important to highlight the art traditions this practice has been derived from. In an art theoretical context, the interplay between participant feedback and authorial intent reflects the critical philosophical shift investigating the relationship between author and reader roles of artist and participant (or author and reader) since the advent of post-structuralism (see, for instance, the work of Roland Barthes, Michel Foucault, and Umberto Eco). In relation to art and the role of the artist, once the work is out in the world, interpretation of the work becomes the responsibility of the active readers of the work, and with contemporary work there is often an additional social dimension included in participation.

Eco’s Opera aperta (or “open work”) [12], for instance, contributed to the reshaping of the reader’s role. In Opera aperta Eco argued that an open work is a text that is not limited to a single reading. An open work subverts formal language to allow varied interpretations, reflective of a pluralistic and less hierarchical worldview. An example of an ‘open’ work, Eco argues, is James Joyce’s Finnegan’s Wake, in which Joyce uses stream-of-consciousness writing and puns to create ambiguity rather than clarity. Eco emphasises the fact that words do not have meanings that are simply lexical, but rather, they operate in the context of utterance [3]. His call—as was Barthes’s in his essay [1] “Death of the Author”—is for works that offer their audiences (or where audiences themselves decide to take or make) their own readings and meanings. There is no capital-A artist or capital-A author prescribing a God’s-eye view of expected reading to the audience; rather, the work creates an environment that provokes the audience to actively participate in order to create their own unique (and subjective) meanings.

Artists practicing in this manner largely work with an understanding that all experience is mediated by the prior knowledge and lived experience that participants bring to the work. In this way the artist opens up multiple critical readings of the work, which in itself is multiple and not singular. As there is no ready-made narrative to extrapolate upon, and no general story to tell, the experience is more elusive, less generic, and less able to be categorised or generalised [15].

In a non-narrative work, each audience member writes their own story, bringing their own experience and knowledge, and mixing them with this new experience. This is also the intent of minimalist works: not to dictate or prescribe meaning, rather to allow the participant or audience to see what they see, to encounter the essence of the thing. Richard Serra, a prominent artist working with large-scale abstract works, insists there is no correct way to approach his sculpture: “It is not here to teach you anything. It is your experience and what thoughts it engenders that is your private participation with this work” [41, video segment 0.7 minutes]. Equally, each of the case studies in this research can be described as non-narrative and open to the participants’ experience. These are key concepts for this study.

Contemporary research. More recently, artist and writer Mary Flanagan has addressed the concerns of games, play, culture and activism. Flanagan’s research adds an art-historical understanding to the broader discussion and includes the nature and art theoretical origins of more open-ended and exploratory works such as pervasive and location-specific games that now form a part of the contemporary art and technology landscape [13, 14].

Brigid Costello, Ernest Edmonds and Lizzie Muller work at the evaluation end of participation in interactive installation art at Creativity and Cognition Studios, Sydney [33]. In one of their three interactive works, Costello & Edmonds [9] confirmed that participants reported a more personal, emotional response to the one level (of three) that remained open-ended. While the primary focus of Costello and Edmonds’s study was not on open-ended works per se, their incidental findings about participants’ responses to open-ended interactive work provides preliminary support for this research [9]. The focus of our research here is solely on open-ended works, with the intention to develop and articulate a better understanding of the situated nature of whether free-play as a construct occurs more within open-ended environments, and if so why.

3. THE CASE STUDIES

This research is built around a number of case study works that are integral to the work covered in this paper. We provide here a brief overview to orient the reader. The three case studies are all open-ended interactive art installations. Case study one, Talk2Me, is a solo work by the first author [29, 30], exhibited in the group show Reactive, 2005, Brisbane. Case study two comprises three works chosen from a group exhibition at the Interactive Art Programme of ACM International Conference on Multimedia 2006 [21]. Case study three is Space of Two Categories, a solo work by Hanna Haaslahti [18] exhibited in a group show at ACM International conference on Multimedia 2007.

3.1 Case Study One

Talk2Me, by Ann Morrison, 2005 is an interactive speech activated Mixed Reality work set in a large dome, Brisbane, Australia [29, 30]. This solo work was exhibited in two group exhibitions (see Figure 1).

Participants talk to three key-word-activated virtual robots (named COG, Alice, and Wall). Talk2Me was translated from a virtual reality interactive writing world into a tangible interactive installation, housed within a 10-foot geodesic yurt dome. Participants speak through microphones, hear through headphones suspended in the space, and view their ‘conversations’ (often random and nonsensical) projected onto the walls of the dome.

3.2 Case Study Two

Interactive Art Program, ACM Multimedia Conference, 2006, Santa Barbara, California, USA [21]. The chosen installations were from a group show at the Interactive Art Program at ACM MM 2006 conference exhibition (see Figure 2).

The works were Autonomous Light Air Vessels [2], Drafting Poems [25], and Books of Sand [39]. The exhibition housed a series of interactive installation works that were triggered by bodily interaction. For example, the audience was required to move, make a sound, make a mark, and/or respond in some way to the works, in order that the works respond back.

3.3 Case Study Three

Space of Two Categories, by Hanna Haaslahti [18], ACM Multimedia Conference 2007, Augsburg, Germany. This solo work was part of group exhibition at the ACM MM 2007 conference exhibition (see Figure 3).

In this interactive installation, a series of video animations of a young girl dancing, laughing, and playing is activated and
projected onto the moving shadows of the audience members as they move and gesture in the space.

Figure 1. Talk2Me, Ann Morrison, Reactive Exhibition, 2005, Brisbane, Australia. Images by artist.

Figure 2. Autonomous Light Air Vessels (ALAVs), Drafting Poems and Books of Sand. Interactive Art Program, ACM MM 2006. Images by artist.

Figure 3. Space of Two Categories, Hanna Haaslahti, Interactive Art Program, ACM MM 2007. Images by artist.

4. PARTICIPANTS AND DATA
For Talk2Me, the participants included university and high school teaching staff and students, visiting groups of high school children with their teachers, as well as the usual gallery visitors. An exhibition of a new media nature draws in for the one-month duration of the exhibition. On the opening night the audience swelled to include over 100 attendees, mostly friends, family, and colleagues of the exhibiting artists, as well as university students and their families covering diverse fields. More than 60 participants were observed interacting with the work over the one-month period of the installation.

Approximately 20 of these observed participants were interviewed about their interaction with the work. Additionally, 30 participants aged between 22 and 52 filled in questionnaires. Seventeen of these were female and thirteen were male. Most held either a bachelor or a master's degree in the fields of design, interaction design, media management, or writing. Fifty per cent of these self-reported their level of skill with ICT as being good or average, and the other 50% self-reported their level as expert ICT. All of these participants were regular gallery visitors in that they reported visiting a gallery more than three times per year.

The participants at ACM Multimedia Interactive Arts Program largely comprised presenters at the conference (both presenters of the papers and the artists presenting work) and other attendees. Subsequently, there was a strong technology, multimedia and/or interactive arts community of practice present. Approximately 55 people were observed interacting with the works, and each other, on opening night and on return visits to the exhibition. Additionally, 25 formal questionnaires for this exhibition were gathered from participants. Ten were from female participants and 15 were from male participants, with ages ranging between 22 and 65 years. Eighteen of the 25 made regular gallery visits (more than 3) each year, and 21 worked in Information Technology or a related or technical field. Three did not answer the demographic questions.

For Space of two categories, we observed approximately 50 people playing with the work. Additionally, we observed and/or initiated conversations at conference events with members who had attended the opening event. Fifteen participants filled in
questionnaires and these consisted mainly of members of the 2007 ACM Multimedia Conference (13), or other artist-painters from outside the conference (2). Of these five women and 10 men, (aged 20 -50), 8 made regular gallery visits (more than 3) each year, and 12 work in Information Technology or a related or technical field. We conducted the majority of the interviews, observations, and discussions on a quiet afternoon on the last day of the exhibition.

5. AN EVOLVING METHODOLOGY

The research and methodology as it evolves in this research are aligned with an ethnographic approach, “where the aim is not with theory building, as such, but rather respecification: a retelling that articulates practices in situ” [42: p.177] at that particular moment in time and circumstance. Additionally, the approach “assumes formulations of interest only in their relations to lived practice” [42: p.177]. With these works, the interactive objects/environments do not directly obey commands; rather, they are designed to instigate a more playful interaction with and for the participants, forming the “basis for more than repetition of relations of power, command and control, or obedient service.” [43: p.283].

5.1 Evaluation of participation

The evaluation methods implemented in this work evolved over the three case study implementations. We began the evaluation process using established interaction design methods such as observation and interview. The first author’s history at that point was as a practicing artist who evaluated the success or failure of a work with seemingly similar, but less formal methods. With each case study we increasingly took a ‘less is more’ approach. Additionally, having added quantitative methods to the iterated evaluation methods used here in larger-scale works [20, 31], we have extended the methodology with a broader understanding of what to apply when for fieldwork-style evaluations of interactive art works.

The approach, then, integrates aspects of grounded theory, action research and situated analysis. We ensure the free-play common-sense terms and ensuing theory emerges from the data echoing Glaser’s [16] insistence on constant comparison and theoretical saturation, emphasising theory development as the result, in this case in order to seek common-sense terms appropriate to this cross-disciplinary research inquiry. However, we do not ignore our own predilections, nor the impact of prior research in scoping the study. To this end, we additionally emphasise and integrate historical and contemporary theory ‘as data’ into the process and pursue any conflicts in the findings [11]. We insist on the situatedness of the researcher—the lived experience we bring to the work [8, 19]—and, by a process of natural progression, also the situatedness of the participants. We plan, act, observe, reflect [23]. With the progression of the research, we iterate the reflective design and evaluation processes to better probe into the data (and theory as data) with each progressive case study [11, 24], improving and adapting the processes on a case-by-case basis. In this final step as researchers, we pursue findings, seeking explanations, exceptions and proving or disproving findings each step of the way, while also investigating the relationships between the key findings [8, 11].

5.2 Case study implementation

In the first case study sessions of Talk2Me, more methods were used, including data collection (from the logged database, and from motion-sensor capture). Eventually these methods were pared back and only the most useful (in that they provided the most accessible and rich information) were implemented. The combination of methods eventually chosen for obtaining feedback for the last two case studies was:

Using artist intent to focus the observation, questionnaires and investigation as part of the method. The intent of the artist and how the work operates (the modalities used for interaction) focused the criteria and practice of observation and the questionnaire evaluation (and face-to-face questions) differently for each work. Discussion with the artist on the work, previous work, future work, and expectations, considerations and processes involved with this work were foregrounded for the artist as major aspects to be taken into account when arranging what needed to be evaluated as the ‘success’ of the work. For the researcher, these understandings set the priorities to be included in the research questions and focus of the evaluation. For example, if an artist had factored in difficulty, so the work required problem-solving by its participants, then questions around difficulty needed to be included in the questionnaires. If the artist intended fun, humour, reflection, that participants gesture a lot, that certain modalities were used, etc., then questions (and observations) around those intentions and modalities were factored into the questionnaires and codes were designed for note-taking of activity and analysis of that activity. Preparation for noting certain types of activities (or their absence) was part of the priming and planning of the study.

Informal observation of the participants with the work (and with others while at the work). Using Fly-on-the-wall style observation, the participants were not made aware that they were being observed. Notes were taken on activities of participants as they go about the work of play, uncovering what to do and how to do it, to uncover the order and orderliness in the natural common-sense way they go about this. The observation was of the natural endeavours and the order and types of activity participants employed in their approach and negotiation with the way/s to interact with the situated work (the work of play) in interacting with the open-ended environments. This observed orderliness by the participants in their approaching the situated work of interacting with the open-ended environments is the data that was collected and used for this ‘data-driven’ evaluation. [38: p. 80].

Informal discussion prior to filling in the questionnaire, and after coming out of the exhibition. Generally these discussions involved either how the work functioned, or what the work evoked for individuals. In some participants the work provoked strong reactions, with participants visibly excited, or even charged by their experience and consequently more vocal.

Completion of a short written questionnaire by the participants that included demographic information. The questions centered around the artist intent for the work.

Informal discussion after the questionnaire, often following up comments in the questionnaire. Generally, these discussions began around legibility of handwriting, or calls for clarification and/or queries on amounts of response needed. Some discussions occurred again in less formal surrounds, and were rekindled or continued outside of the exhibition.

Observation of, and discussion with, the participants to have a better understanding of their areas of expertise and predilections—to understand better their own expectations in experiencing the work.

Profiling: Collation of the varied information, to form a profile of each participant’s individual experience of the work. For
example, aspects of demographics (IT experience, art gallery visits, field of work, age, and gender), predilections, time spent with the work, activities undertaken, responses to various specific factors of the work and so on, form a picture of the level of and type of engagement for each participant. This information was compiled and cross-checked with other profiles to look for similarities in patterns in responses to emerge.

While the above methodology does not radically differ from established HCI methods, it integrates different methods that are in existence and improves upon, or clarifies the situated instances of what methods are used and when and how. Fieldwork analysis methods for understanding participation in interactive art works (and particularly open-ended ones) are still in early stages of development and use, so even such seemingly small shifts can act as pointers or contributions to the body of evolving knowledge. Moving away from evaluations of participation that focus on, for example, efficient interactions or systems design and adding artist intent to direct the focus of the observation, questionnaires and discussions, changes the point of focus of the research questions in an integrative approach of the artist voice with traditional HCI methods. Using an ethnographically informed approach to ensure observation of what actions and interactions participants naturally undertake in their work of play ensures rigour in the observational approach. The method inclusively integrates HCI and art processes.

5.3 Elevated Levels of Engagement
Elsewhere, and as a follow on from the research presented here [20, 31], we have implemented Flow, Presence and IMI questionnaires, loosely structured interviews and observation to crosscheck the relationship between the states of flow, presence and immersion, and intrinsic motivation as indicators of levels of engagement. There is a similarity in the kinds of states being queried here, even though different language is used. For example, presence queries activated thinking by introducing phenomena (virtual, mixed or real objects, ideas or activities) that require people to actively engage in thinking through ideas generated by working with these phenomena. Social presence (awareness and sharing with others) has similar parameters as mutual engagement where participants join with others as they are spontaneously driven by curiosity and spark together, losing themselves in a joint exploratory activity [4]. In observing children creating musical compositions together, Miell and MacDonald identify that mutually engaged states are indicated by the “presence of reasoned dialogue, the exploration of the ideas of more than one person and the attempt to integrate these.” [27: p.349].

Flow is posited as an optimised state of engagement (heightened attention to a specific activity with consequent lack of self-awareness and distortion of sense of time) in which a person is “so involved in an activity that nothing else matters.” [10: p.4]. Where participants are engaged with both the product at hand and with others in collaboration, Sawyer characterises this as group flow [40]. Similarly, interaction with the case study works presented here require the experience be intrinsically motivated, or inherent, for its own sake and an end-in-itself. Guthrie [17] makes a case for connection between high levels of engagement and intrinsic motivation, with the promotion of goal-oriented activities that involve understanding content, using effective strategies, and making links between old and new knowledge (in opposition to performance-related activities geared to extrinsic rewards).

Looking at these inter-disciplines, it becomes clear that they each search to measure, understand or define similar states of elevated experience. Engagement, intrinsic motivation, flow, immersion and presence are linked by their investigation of elevated states of engagement. Note also the work of Caillois [6] in defining paidia (anarchic wild free play) and Carse [7] in arguing for infinite play (play that is dramatic with no scripted conclusion—or pre-scripted activity—that is inclusive and centered around initiating activity so others can join in to continue the play). Moreover, Nachmanovitch [34] argues for divine improvisation, which combines concepts embodied in the terms lila (referring to a state of delight and enjoyment of the moment) and bricolage (referring to the act of improvising by using whatever is at hand).

We found obvious crossovers not only within play and art historical theories but also to education, psychology, phenomenology, flow, psychology, education, philosophy, and mixed reality investigations of optimised states via immersion factors and presence research. These are examples of similarities between flow, group flow, and mutual engagement states to social and spatial presence research to education, play and free play research. Where they fit with this research is not only as building foundations for further investigation and improving methods for observation and evaluation but also for understanding levels and types of engagement and to help build an inter-disciplinary set of boundary-object-style commonsense terms [28, 32].

6. OBSERVATION AND FINDINGS
The focus of the research was to better understand what it is that people do when they participate in open-ended works. In this section we first present the overall modes of activity observed for all case studies, assimilating the language we developed to describe this participation. We then present the individual findings for each case study. The modes of participation found over the situated instances of the three case studies were:

Interactive play, an active interaction mode, where interactors, (the participants) actively engage with the work through the modalities afforded by the work. The interactors—are engaged and invested in their interacting (they are beyond ‘just looking’). They may engage in interactive play through verbal, embodied, associative and/ or cooperative play—perhaps even with lila and paidia play.

Speculative play, where participants actively figure out how something works—both the conceptual and the technology aspects of the work, with testing and debating various theories; often done in collaboration with others/ strangers; (speculative play can occur through verbal, embodied, associative and/ or cooperative play—perhaps even with lila and paidia play).

Situated social play through the work, where participants gesture towards the work and discuss the work, so social communication is mediated through the work as a proxy. While this category could easily be shortened to social, the emphasis of social through the work may be lost by doing so; (situated social play can occur by verbal, embodied, associative and/ or cooperative play—perhaps even with lila and paidia play).

Comprehension, a stage or mode where participants attain getting the work (speculation is complete).

Hand over, where participants give up or pass on any alpha activity spots or access points at the work.

6.1 Findings with each case study
We describe observation of participants from each case study.
For the first case study, Talk2Me, the specific situated activities we observed were where participants moved into the interaction modes of *perchers* (where they sat down and engaged), *corresponders* (where they responded back to others and the robots) and that the installation housed activity spots (places where the action of interaction and access to the interaction took place from). In common with the other case studies, we noted participants ordered their activities, as *observers* (where participants passively watched the activity and/or listened in on the discussions) and in a *handing over* (of the activity spot) to others. In addition, we observed participants who *comprehended* the work—often after a period of *speculation*, and more engaged *interactors* (those invested in an embodied way and committed themselves both to the space, and to the interaction afforded there). Commitment is reiterated as a key indicator of engagement. Further, instances of *social situated play* through the work, where participants were interacting with others *through the work*, were observed. Additionally, entering the *spirit of play*, and instances of *verbal, embodied, associative* and *cooperative play* were observed as *deictic* gesturing (using hands for pointing to/on, often pointing towards the screen or headphones).

For the second case study—the works in the *Interactive Art Program*, at ACM Multimedia 2006—the observed activity modes were *interactive play*, *speculative play* and *comprehension*: *Deictic* gestures were used with two of the works. Additionally, instances of *social situated play* through the work were observed, as was entering the *spirit of play* and instances of *verbal, embodied, associative* and *cooperative play*. A particular situated activity that emerged was *batting/to bat* the act of *batting*, a gesture that hits away a flying object.

For the third case study, *Space of Two Categories*, the common modes of observed participation were *observation*, *speculation*, *interactive play*, *comprehension*, *embodied play*, *parallel*, *associative*, *cooperative* and *interactive play*. In addition, people easily operated in pairs, used *full body gestures*, with much large motor movement, large gestures and particularly extending the arms (*waving of arms*) with *social situated play* through the work. Generally, participants were quieter and more reflective in this open-ended work.

For all the installations, participants who did not appear to understand (or not wish to work at picking up) the interaction mode often *handed over* their position as *interactors* to other newcomers to the space. Those who had continued playing beyond *comprehension stage* would also mostly hand over to new participants. We witnessed what appeared to be an informal understanding that participation in a public environment is largely a democratic process, with most participants being polite and sharing accordingly. We also noted there were some, but relatively few, instances of competitive behaviour, where participants would, for example, dominate activity or keep it within a group of friends. In addition, we noted active and embodied participation on the part of audience members who entered into the spirit of the work beyond a casual initial observation of the works.

### 6.2 Summary of findings

Over all, the primary observed modes of activity with the open-ended works were entering into the *spirit of play*, *observation*, *embodied, verbal, associative* and *cooperative play*. Most participants visited and interacted in pairs or small groups, and while they did flow from interacting solo to interacting with others, where they were with others they did largely engage in some form of *co-interaction* and *social situated play* through the work. *Parallel play*, playing alongside others with little direct interaction, did occur, as did *solo play*, however these instances were less marked and less frequent. In addition, there were elements of *lila* and *paidia* observed with each case study. 1 *Bricolage* is to some degree implicit in works where the tools (or the modalities to interact with the work) are what is at hand and the participants enter into the work by playing spontaneously with these (the ‘whatever is at hand’).

### 7. DISCUSSION

The open-ended installation works discussed here act as singular entities that allow their subjects (named and enabled as participants) to walk around inside of them and/or interact physically with them through embodied gesture and/or speech. They offer multiple perspectives to their participants. As both participants and entities in the spaces/works (subject and objects), a participant takes up space and in their being in the work become part of the experience of the work for others at that situated moment in time.

The case studies are non-narrative works (there is no story to enter into here), where the participants bring their own knowledge and mix it with this new experience. The meaning is created by the situated interaction of the participants, not dictated by the artists (although there is orchestration of how to interact and what is available to be done with the content that is there). Participants’ thinking is to varying degrees activated in the environments with works giving a strong sense of their own materiality—be that in the form of words, sand, fog or flying objects. Participants also appeared to readily interact with the artwork when the interaction was framed around an object that resembled a common, recognisable, or everyday object—for example, a pen, a balloon, or a microphone—artefacts that suggest activity that the participants already know well-enough to draw them into acting in the environment. Even though the outcomes of their actions might cause unexpected results, participants are already ‘in action’ and to some degree involved with the work regardless that the upshots of their actions are not known at the outset.

From batting around *ALAFs*, and running fingers in the sand with *Books of Sand*, to jousting with whimsy in Talk2Me, and *waving of arms* in *Space of Two Categories*, the works act in varying degrees to positively charge their participants to perform creative acts of their own making in their exploration of the works. The works require their participants to play freely with their physicality (the artefact nature), and allow them to act with agency. The works make possible open outcomes with no predetermined scripted conclusion. Participants, in playing freely with others, initiate actions that allow others to do the same and to bring as many people as possible into the play.

The evolving evaluation methodology was adapted on a case-by-case basis to the situatedness of the environments, the participants and to the artist’s intent. Mainly, we found these environments encouraged effortful thought and situated playful behaviour while activating some participants.

**Need for Cognition.** Effective open-ended playful environments create a space and an atmosphere that encourages exploratory behaviour. They also require from their participants a willingness to think more independently and creatively. In order to generate a successful experience participants need to be able to interact autonomously, be intrinsically motivated, have

1 While these evaluations did not measure bio-detection states such as heart rate, certainly participants were observed in charged states. Bio-detection would be a useful method to add.
mastery (eventually) over what they are doing there, and to have a purpose (or to develop their own purpose) while they are there. For purpose, many appear to speculate and make up some kind of theory that they then test and subsequently continue to adapt from what they find in their testing and/or speculating. Pink [36] discusses right-brain conceptual works where the rules are mystifying, the solution is non-obvious and on the periphery and there is no routine left-brain work as part of the environment at all. Open-ended interactive works require conceptual thinking on the part of the participants. Where even rudimentary cognitive skills are required, extrinsic contingent incentive rewards no longer work best. Intrinsic rewards work where participants need to activate their thinking and act in non-mechanistic and right-brain ways [35, 36]. Quinn & Tran [37] test the personality trait need for cognition—a measure of how much an individual enjoys and engages in effortful thought using Cacioppo et al.’s work [5]. Participants rank their usual behaviour on questions such as, “I usually end up deliberating about issues even when they do not affect me personally” or “I prefer my life to be filled with puzzles that I must solve.” Quinn & Tran report that participants with high need for cognition also perform better on measures of creativity, and participants with a predisposition for high need for cognition, were anyway “intrinsically motivated to engage in effortful thought” [37: p. 360].

Self-initiating. For those more receptive to ambiguity in environments with no predetermined outcomes, open-ended play eschews achievement and allows participants to draw creativity from their inner inspiration and internal motivations. During free-play, there are choices and decisions to be made in a manner that offers potential for self-discovery. Trial and error is a large part of open-ended play, where unintentional mistakes may produce even fascination at the unexpected outcomes. An open-ended environment actively encourages (and requires) the participants to develop self-initiating behaviours [22]. For those who respond well to these environments, who enjoy high need for cognition, open-ended play gives a sense of freedom and autonomy, enabling participants to take initiative with agency and allows participants to implement their own unstructured creative thought.

Active State. In defining open-ended works, we argue for minimal works that set alive the audience to actively participate to create their own unique (and subjective) meanings. From a phenomenological perspective, Merleau-Ponty [26] argues that individuals create their own meaning for their lives, (as opposed to some kind of ultimate order that is imposed externally), and act as body-subjects with consciousness in the world, perceiving things with which they are intrinsically intertwined and mutually engaged. Carse [7] and Nachmanovitch [34] argue that, where successful, such experiences touch one’s spark, reconnect one’s nature, and suggest that to act intrinsically motivated in the flow of an optimised experience [10] is to be set alive. This is pertinent to the works analysed here, in that the participants are required to navigate space, place and experience the site/installation, and create/read their own meaning into the work. Further, there is a continual remake and re-interruption (active state) required from the active members to actively construct and co-construct even commonsense understandings.

8. CONCLUSIONS
This paper has presented findings from an emerging methodology for understanding how people interact in playful ways with open-ended environments. This kind of environment, as exemplified by the three case studies described here, encourage the individual to initiate and perform their own creative acts (not to perform as an audience under a prescribed artist or other’s vision or set of rules). Our intention in presenting this work is to establish support for researchers, artists, and designers of such environments in order to inform approaches to their evaluation and/or creation from the interdisciplinary range of HCI-analytic and art critical-theoretic perspectives outlined here.

A successful open-ended interactive environment (artistic or not) is one that promotes or requires exploratory behaviour from the participants in order that they activate the work. So what might this look like? In the works discussed here we found the use of artefacts that suggest familiar actions or activities enabled participants to engage readily with the work. Interaction from that point on then required some kind of continual input from the participants and often readily invited comment or other interactions from others nearby. The outputs from the work aroused curiosity in others and required some level of investigation to “figure out” how they worked. The interactivity enabled social interaction, with the space around the interactive object(s) allowing for more than one participant to be active at any one time. The works themselves did not require literal interactions, rather a playful curious approach on the part of the participants.

Returning to the two HCI and art perspectives, emerging from our work are two findings regarding the lessons we can pass on to the two communities. In the case where evaluation of some kind of participation in an art work (open-ended or not) is to take place, we recommend prior communication with the artist to establish the objective of the work and that this intent then be included as a central part of the research focus for the study. In this way the artist’s intent (and the derivations of the work) can act as a pivotal component and impact with whichever methods the study then implements. On the other hand, a finding that may be relevant to artists (or even, for example, game designers or those designing recreational computing activities) seeking to develop effective interactive artworks is the need to establish open-ended environments that promote free play where higher cognitive load, less obvious and/or more difficult or extended interaction activities are called for.

Our findings suggest that where an interactive environment is required that will stretch the capacity of the individuals or group participating, designing for open-ended activity will extend capacity for the participants. In particular, minimal open-ended works, by not being literal, proffer space for participants to experience and respond to abstract ideas and to draw on their inner-reflective and active-agent selves in an inventive way.

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10. REFERENCES