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Interaction as Performance: Performative Strategies in Designing Interactive Experiences

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1. Introduction

Designing interactions within a ubiquitous computing rhetoric we encounter established tenets originating from the visionary formulations (Weiser 1991) and updated scenarios (Abowd and Mynatt 2000). These have yet to be fully realized and include as main elements: multimodal interfaces, context-aware or adaptive computing, automated capture and access to live experiences, and connecting the physical and virtual worlds.

These themes can be related to important features of performances and theatrical practices which are traditionally aimed through staging and performing at the design and interactive emergence of embodied experiences. This is the case for different performance forms ranging from improvisational theater, performance art to more traditional theater, which are related to ubiquitous computing tenets above as they are embodied, include techniques to improvise and adapt action following an underlying script and models, aim at the creation of a fictional space, and are concerned with expressing and experiencing action (see Table 1).

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Ubicomp tenets	**Related Performative Aspects**
Tangible interaction	Embodied performance
Adaptivity , context awareness	Improvisation, interventions, creative constraints
Capturing , access to lived experience	Expressing action and experience
Connecting physical and virtual worlds	Staging a fictional space

Table 1: Relating Ubicomp tenets to performative perspective aspects

Research Objectives

The aim of this work is to propose a conceptual framework infused in and derived from selected analysis of performance and theater that can help in describing and designing for ubiquitous interaction experiences. The objectives include 1) select particular concepts from different works that investigate anthropology of performance, performance art and theater anthropology relevant to ubiquitous interactive experiences 2) exemplifying concepts with cases that include designing interactive experiences in a ubicomp context 3) summarise the concepts in a framework to draw relationships and orient opportunities for their application.

In the next section we summarise how design frameworks in HCI oriented attentions from experiential to theatrical and performative perspectives. In section 3 we introduce the foundations of a *Interaction as Performance* Framework . In sections 4 and 5 we introduce the framework composed of two interrelated views:

- Space and Constraints, section 4 deals with the design of a fictional space in particular considering creative constraints that facilitated and guide interpretation and action
- Time and Dramaturgy, section 5 deals with the timing and role of interventions and dramaturgy that shape collective emergence of action.

The proposal is that these are views implicitly considered in design ubiquitous experiences and that a Interaction as Performance framework allows making these elements salient so that they can be considered more explicitly by designers.

2. From Experiential to Theatrical Design Perspectives in HCI

Theatrical and performance perspective in HCI follow a broader development that has successfully impregnated HCI research with design perspectives and approaches that have valued experiential, affective and pleasurable aspects neglected by cognitive frameworks. Traditional human-computer interaction approaches to evaluate the usability of products for people tend to see the person as a "user" and the product as a "tool", where the latter is used to accomplish a task (cf. Jordan 2003).

Before the attention to experience design (Mc Carthy and Wright 2004) HCI researcher has been infused by frameworks that investigate the situated character of our actions and on how plans are used as resources (Suchman 1987), distributed character of cognition and action (Hollan et al 2000), the historical aspect of practice and to the mediating function of artefacts (Kuutti 1996). Phenomenological approaches have inspired different perspective of action related to technology use, as the notion of involved unreflected activity and breakdown (Bødker et al.1991). Ehn (1988) develops a different explanation of practices of design and use, using the

language games approach of Wittgenstein and the notion of family resemblance. Ehn also discusses the consequences of considering computer artefacts as tools. Artefacts are objects made by human work. In designing computer artefacts "the emphasis should be on concernful design of signs that make sense in the language game of use" (p. 164). According to Ehn computer should not be considered just tool but designed artifacts recognizing the important of skills. Dourish (2001), drawing from ethnomethodology and phenomenology, proposes a new model of human-computer interaction based on the notion of embodied interaction that he defines as "the creation, manipulation, and sharing of meaning through engaged interaction with artefacts" (p. 126). Embodied technologies acquire meaning through the way in which users incorporate them into working practices. As a consequence "the manipulation of meaning and coupling are primarily the responsibility of users not designers." Where coupling is the way we build up relationships between entities during action, changing our focus and attention. In embodied interactions the active nature of computers is important not as independent agents but "as augmentations and amplifications of our own activities." (Dourish 2001, p. 166). Design oriented frameworks have emerged as the one of Redström (2001) who proposes a design philosophy for everyday computational things, where meaningful presence is contrasted to previous imperatives from usability as, for example, efficient use. In this design approach, time is the central parameter as exemplified by Slow Technology (Hallnäs and Redström 2001) and aesthetics is the basis to de-sign presence. Redström describes "the presence of an artefact in terms of how it ex-presses itself as we encounter it in our everyday life. Then we can think of artefacts as "expressionals", artefacts as bearers of expressions rather than functions." (Hallnäs and Redström 2002).

Phenomenological approaches have also inspired design frameworks (Svanæs 1999). Deckers et al (2012) propose a design framework for perceptual crossing between person and artifact that can be used to apply using design notions, such as Focus the Senses, Active Behaviour Object, Subtleness, Reaction to External Event, these are relevant for designing perceptive activity in an artefact to reach involvement and reach a shared common space with the artifact.

All these contributions as well attention from performative approaches as design techniques in creating and evaluating scenarios (Iacucci and Kuutti 2002, Macaulay et al 2006, Binder et al. 2011) created the premise to explore performance and theatrical frameworks in HCI .

Laurel's work (1992) work was the first to consider theatrical metaphors and drama in the context of human-computer interaction by applying the principles of Aristotelian poetics. Human computer experiences can be structured around the precepts of dramatic form and structure. Laurel's aim is to derive a poetics of interactive form. "Interactivity" is here understood as the ability of humans to participate in actions in a representational context.

Reeves et al. (2005) present a taxonomy with four broad design strategies for the performer's manipulations of an interface and their resulting effects on spectators: the "secretive", wherein manipulations and effects are largely hidden; the "expressive," in which they tend to be revealed, enabling the spectator to fully appreciate the performer's interaction; the "magical", where effects are revealed but the manipulations that caused them are hidden; and, finally, the "suspenseful", wherein manipulations are apparent but effects are revealed only as the spectator takes his or her turn. Benford et al. (2006) extend the above framework for designing spectator

interfaces with the concept of performance frames, enabling one to distinguish audience from bystanders. They conclude that ambiguity to blur the frame can be a powerful design tactic, empowering players to willingly suspend their disbelief.

Dalsgaard and Koefoed Hansen (2008) further extend the perspective of users as performers and of audience. They not only observe how the user is simultaneously operator, performer, and spectator. Performing Perception is proposed to highlight how "her operations and thus her perception is heavily influenced by her knowledge of that her perception of the system is a performance for others" . A central facet of the "aesthetics of interaction" is rooted in, as they put it, the user's experience of herself "performing her perception." They argue that this three-in-one situation is always shaping the user's understanding and perception of the interaction, and they address the notion of the performative spectator and the spectating performer. This resonates with the concept of Spect-actor as proposed by Augusto Boal in the Theatre of the Oppressed tailored to situations of political or social oppression (Boal 1992).

Recent work addressed also temporal structures of interactive experiences with the concept of trajectories (Benford et al. 2009, Benford 2011, Gilroy et al 2009) . For Benford et al. (2009) trajectories are based on the fact that successful interactive experiences follow journeys that ensure a coherent and connected whole. These are shaped by the narratives of authors, influenced by orchestrators but also steered by participants, in evolving spatial, temporal and performative structures. They effectively draw from dramaturgy (Pfister 1998) proposing as key facets space, time, roles and interfaces. The framework presented is able to highlight important implications for designers by identifying transitions in trajectory in which continuity is at risk. Transitions include for example beginning and endings, transitions between

roles and traversals between physical and digital. Trajectories can be managed and interwoven enabling a coherent dramaturgy of experience. Recently Spence et al. (2013) reviewing current perspectives proposes Performative Experience Design as potentially providing useful guidance among others on rules that sets the performance frame and guides actions such as turn-taking, mediating the expression of self to another, attention to the unique aesthetics of performance. These could provide new "epistemological, theoretical, methodological, and practical approaches to understand people's interaction with an experience".

3. The Foundation of the *Interaction as Performance* Framework

The works above propose useful concepts however either use only a limited a remain limited in the extent of coverage the discussion is the framework of Interaction as Performance (Jacucci 2004, Jacucci and Wagner 2005, Jacucci et al 2005). This framework is based on anthropological studies of performance that have roots in a pragmatic view of experience. The framework proposes a variety of principles that characterize performative interactions.

Processual Character and Accomplishment

One of the principles is that of accomplishment and intervention. Already the etymology of the term "performance" shows that it does not have the structuralist implication of manifesting form but, rather, a processual sense of bringing to completion or accomplishing. The concept of event and processual character is also key: performances are not generally amorphous or open-ended; they have diachronic structure, a beginning, a sequence of overlapping but isolable phases, and an end. Expression and experience is another element of import. According to pragmatist

views, an experience is never completed until it is expressed. Also, in an experience there is a structural relationship between doing and undergoing.

To formulate a performance perspective that is useful in furthering our understanding of how design is or can be accomplished, we will gather characteristics from the work of the anthropologist Victor Turner and from the philosophy of John Dewey and Wilhelm Dilthey, on which Turner based his work. Moreover, other anthropological works, such as those of Eugenio Barba (theater anthropology) and Schieffelin (performance ethnography) will contribute additional traits. We have also found it useful to integrate these traits with views from performance art, such as the writings and works of Vito Acconci, a pioneer in this area. We will start in the following section by describing the core relationship between expression and experience as proposed by Turner. A more detailed articulation of characteristics will follow, along with an analysis of specific design episodes.

The relationship between Experience and Expression

Victor Turner, one of the founding fathers of performance studies, provided an explanation of how a performance perspective includes relating expressions to experience (drawing from the philosophy of Dewey and Dilthey). This explanation serves to address how experience, expression, and perception form an intricate relationship.

Turner bases his approach on previous thinkers who addressed “experience”: John Dewey, who saw an intrinsic connection between experience and aesthetic qualities, and Wilhelm Dilthey, who argued that experience urges us toward expression and communication with others (Turner 1986).

Following Dilthey, Turner explains how meaning, which is sealed up and inaccessible in daily life, is "squeezed out" (from the German Ausdruck) through expressions such as performances. In Turner's words, "an experience is itself a process which 'presses out' to an 'expression' which completes it." (Turner 1982, 13). According to this view, there is a processual structure of Erlebnis (experience or what is lived through); it has, first of all, a perceptual core. After perception, past experiences are then evoked, "but past events remain inert unless the feelings originally bound up with them can be fully revived" (Turner 1982, 14). Meaning is considered emergent and not predetermined in the event; it "is generated by 'feelingly' thinking about interconnections between past and present events." (Turner 1982, 14). Finally, it is not enough to achieve meaning for oneself, as an experience is never truly completed until it is communicated intelligibly to others or, in other words, it is expressed. As Turner puts it: "culture itself is the ensemble of such expressions—the experience of individuals made available to society and accessible to the sympathetic penetration of other 'minds.'"(Turner 1982, 14).

Energy and Consciousness as Opposed to Everyday behavior

Unlike other kinds of behavior, performance requires more effort in terms of the energy, skill, and consciousness (thinking) of the acts. Eugenio Barba's approach contributes additional traits and features, such as the skills, energy, and consciousness (thinking) of the performer. For example, Barba and Savarese (1999) distinguish between daily and extra-daily "techniques" such as performances (Barba and Savarese 1999) We are less conscious of our daily techniques, where we apply also the principle of least effort, that is, obtaining the maximum result with the minimum expenditure of energy, but "extra-daily techniques are based, on the contrary, on

wasting energy" (Barba 1995, 16). The principle might even be the opposite: "the principle of maximum commitment of energy for a minimal result." (ibid.)

Event Character, Temporal and Narrative Structure

The etymology of the term "performance" shows that it "does not have the structuralist implication of manifesting form, but rather the processual sense of bringing to completion or accomplishing" (Turner 1982, 91). A performance is always something accomplished: it is an achievement or an intervention in the world (Schieffelin 1997). According to Turner, performances are not generally "amorphous or open-ended, they have diachronic structure, a beginning, a sequence of overlapping but isolable phases, and an end" (Turner 1987, 80). It includes an initiation and a consummation. "There was one way I loved to say the word 'performance,' one meaning of the word 'performance' that I was committed to: 'performance' in the sense of performing a contract—you promise you would do something, now you have to carry that promise out, bring that promise through to completion" (Acconci, in Acconci and Moure 2001).

Implications to Designing Interactive Experiences

These relations of Table 1 to ubicomp tenets become clearer if considered in a wider framework of how original human computer interaction dominated by cognitive frameworks have been extended by experience design frameworks and performance perspectives (see table 2).

Original Human-computer Interaction foci	**Extensions of Experience Design and Performance Persp.**
Task, timeless, universal, replicable behaviour	Event, ephemeral, unique, replicable experience
Usability, accountability, affordance	Expression, sense experience
Users, designers, administrators	Actors, spectators, directors, performers

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Personalising, computer artefact's view	Configuring, actor's view
Recognising situations, sensing, simulating space	Staging situations, performing space
Eliminating secondary tasks	Amplifying action and communication

Table 2: Original HCI tenets and extensions from experience design and performance perspective

While traditional human-computer interaction identifies a repetitive task with general validity to be targeted by the design, performance points to the organisation of events that maintain a specificity given by the contingency of meaning and material. While, in general, human-computer interaction relies on recognition, accountability and affordances at the interface, performance focuses on perception and experience. As Dewey teaches, recognition is interpreting something we already know, while perception occurs when we experience a thing that imposes surprising qualities that create new insights. Dominant tenets are usability, making an operation easy and efficient, for example, or exploiting affordances so that they can be carried out unthinkingly and making the tool disappear. On the other side of Table 1, a performance perspective aims at creating experiences where participants are more aware, think feelingly about the artefacts around them and engage in the situation in reflection or perception in action. Moreover pervasive and context-aware scenarios propose sensing systems that measure and simulate space or recognise and sense situations. To this, "sensing humans" are contrasted with the idea that physical interfaces should make use of spatiality and materiality to enrich interaction using all senses. Moreover, space is configured and performed rather than measured, and situations are staged rather than recognised.

4. Space and Constraints: Designing a Fictional Space

When designing a interactive experience whether it's a desktop, mobile or ubiquitous installation the user interface provides context, language and affordances to create a space of possibility sometime governed by a metaphor as for example the desktop one in personal computers.. This is recognized by previous work such as Laurel (1992) computers as theater and the concepts such as frames (Dalsgaard and Koefoed Hansen 2008, Benford et al 2013) in search of a physical location, setting, or place that they do not interpret literally, but which will be used as a resource to create a "fictional" space. Performance has a lot to do with this process.

Spatial features may be functional, as in the case of the walls of a building, but they may also be symbolically charged, resulting in a specific perception of space during a performance. In a theatrical performance, for example, we are doing

"An essentially interpretative act, translating real bodies, words and movements into the objects of another, hypothetical world; . . . everything within the defined spatial compass of the stage is to be read differently from the objects seen elsewhere." (Counsell and Wolf 2001, 155)

Case: Bodily Interactions with Interactive Galaxy Installations

Galileo all'Inferno is a theatre show developed by Studio Azzurro, it has been performed daily between 10th - 12th of July 2008 in the Teatro Arcimboldi of Milan, Italy. The show is composed of two parts, both different from an aesthetic and the technological-interactive point of view.

The first part of the show is a dance performance, during which the public attends the show in a classic way, sitting in the stalls. In the second part of the show, at the end of

the performance the audience can get on the stage and interact with two interactive installations . “Ombra di stele”. A projector transfers the image of a stellar field to a transparent vertical screen. Once passed through the screen, the beam of light is refracted and reflected, delineating stars on the stage and some other stars on the opposite side of the entrance. When the visitor gets closer, (s)he is lighted by infrared rays, creating a shadow on the ground invisible to the visitor. This shadow is detected by a camera equipped with an IR filter. The signal is analyzed by a video-tracking algorithm that identifies the shapes of the shadows throughout a sequence of coordinates. The data are elaborated by a software that reacts in real time and generates the graphics. The image of the stellar field changes depending on the graphics and the stars concentrate around the shape of the infrared shadow based on two parameters: presence and persistence. As the visitor moves, the stars move with her/him with a certain inertia. Looking at the ground (or at the backcloth), the visitor sees a constellation of stars surrounding his/her silhouette. (see Figure 1).

In this installation the visitor as put forward in the Section on the Foundation is both experiencing and expressing in the way that is at the same time a user and an actor in the act (cfr Dalsgaard and Koefoed Hansen 2008). The design of the installation to be successful should bring the visitor to recognize the meaning attributed to the space in terms of the projection of the shadow into the star constellation and at the same time invite the visitor to approach and interact with the installation in the right position. The event and structured character of the interaction with the installation is concluded when the visitors discovers that the stars gather around the shadow of their bodies.

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Figure 1 **The art installation "Ombra di stelle".**

Figure 2 **The art installation Galassie.**

"Galassie". In this installation a projector throws a beam through a transparent screen positioned on the stage. It projects a geometry of a grate of coordinates, creating a visualization of stylized shapes similar to galaxies. The software is composed of two

main components: the video tracking (Retina) and the generative/reactive algorithms programmed in Processing OpenGL. The video tracking defines the position and detects the outlines of the visitors with the help of an infrared lighting system. Every person who gets on the stage generates an expanding galaxy from his body. As the user moves, (s)he's followed by his own galaxy and by a grate that visualizes persons movement in a cyclic and generative way. Moreover, by using a set of directional microphones, a component analyses acoustic features of voice based on a machine learning individualizes the emotional state of those present and influences the appearance of the galaxies. Three categories of emotions, neutral, positive or negative are detected and they modify the colour of the galaxies: a scale of grey corresponds to the neutral condition, a shade of light blue corresponds to the negative condition and a shade of red corresponds to a positive condition. Thus three semantic categories are used to send status events and the galaxies will change the dominant colour. As positive event is received all the galaxies change to "warm colours" yellow orange and red. If the status event is negative the colour ramp used by the galaxies changes to "cold colours" blue light blue violet. If the neutral event is received the galaxies turn to a grey scale. This effect will reinforce the emotional climate with introspective colours (blue Light blue) in a "negative" condition or joyful colours (orange red) in a "positive" emotional condition. The grey state should suggest the need for change stimulating reaction on the group.

From a performance perspective, constraints can do much more than simply reduce complexity and add structure. In the traditions of such theater directors as, for example, Jacques Lecoq, Philippe Gaulier, Keith Johnstone, Peter Brook, Augusto Boal, or John Wright, the main concern of a director is to avoid telling performers

what to do, while at the same time driving the creative process in order to make them work creatively and make things happen. The problem of avoiding dictating outcomes is common to design, which aims at the collective emergence of objects that provide new insights by encapsulating unexpected features.

The Creative use of Constraints

The problem is well known in most approaches to directing in the performing arts, where the major goal is to devise a performance by making it emerge with minimum control, and being ready to take advantage of the unexpected. As the theater director John Wright says, "this is a shifting and mercurial world where anything is possible and everything has yet to be found. This means that as a director or facilitator you've got to find strategies that are likely to make something happen rather than strategies for getting people to analyze what they think they might do." A particularly relevant aspect for design activities is how the role of constraints can be developed within collective activities (Jacucci, Linde, and Wagner 2005, 24).

It has been noted that the relationship between creativity and constraints is mysterious and symbiotic (Laurel 1993). "Creativity arises out of the tension between spontaneity and limitations, the latter (like river banks) forcing the spontaneity into the various forms which are essential to the work of art" (May, quoted in Laurel 1993, 101). As remarked by Laurel (1993, 106), the "value of limitations in focusing creativity is recognized in the theory and practice of theatrical improvisation." In fact, her model of human–computer activity appreciates the role of improvisation within a matrix of constraints.

Similarly constraints can become resources in improvised performances following specific approaches, such as, for example, the practice of Keith Johnstone. So the

designer or designers could be thought of as actors or directors utilizing constraints to make design happen.

Case: Analyzing phases in Interactive Galaxies Installations

A study of the installation employed emotion questionnaires that indicated dominantly positive feelings, further described in the subjective verbalizations as gravitating around interest, ludic pleasure and transport (Jacucci et al. 2009). However, through the video analysis, the contribution of multiuser participation in engagement was evident in exploration phases as they displayed similar features such as experience sharing and imitation, which were also found in the verbalizations.

The videoanalysis focused on two aspects of the installation, namely the interactivity and the co-presence with other visitors. The interaction analysis of people exploring the installations identified three recurrent phases: Circumspection, Testing, Play. All of them are based on the exploration of the installation affordances, showing what visitors recognized as the possible way to interact with it.

Circumspection is the phase in which the visitor is entering the interactive area, observing the current setting and selecting a point to start from.

Testing is the phase in which the visitor starts to try to interact with the artwork by making a particular bodily movement such as “moving an arm” in order to find out which movements have a consequence on the configuration of the installation. In this phase, visitors usually remain within a portion of the installation, and appropriate it by exploring and testing.

Play is the phase in which the visitor interacts with the art installation in an aware, active and involved way usually after having discovered the “working of a principle”

behind the installation. In this phase, they do not just to wait for the artwork reactions, but also try to provoke those reactions by using creatively the movements that were tested in the previous phase and new ones. In the following, we will highlight two characteristics of these three phases emerged from the analysis, namely sharing the art experience and relying on imitation as a guiding principle for interaction.

The social component of the art experience is apparent from episodes that we called co-testing and co-playing. When visitors came on the stage with friends or family, they experienced the artworks by taking into account both the installation and the other people accompanying them. Entrance in the installation space, testing the artwork possibilities and finally playing with it developed as a common activity, where the users oriented both to the artwork and to their accompanying people. People in these groups tended to focus on a same portion of the installation, and to take turns into testing or playing with the artwork.

As we have seen the event and processual character is demonstrated by different phases of circumspection, testing and playing that make up the experience of the visitor in both installations. In both cases the space is invested with different meaning and narrative that needs to be conveyed to the visitor along with constraints of how to act in it for a fictional space to emerge. Constraints are the features, rules and parameters that govern how the elements are animated, what they respond to or conversely what the visitor should do to animate them (that stars gather around the shadow after some time , or how the galaxies follow the movement , and change their colors).

5. Dramaturgy in Collective Emergence and Interventions

Although the creation of a fictional space can be seen as an exercise for a reader of a book (involving therefore a writer and a reader), in this context we refer to fictional space as something that emerges out of the ongoing interaction between participants in design, be it a short session or through a project. In theater we refer to fictional space, for example, as a representation of actions and human conflicts that participants create by performing and reacting to each other (Iacucci, Iacucci, and Kuutti 2002). It is fictional because it is not a substitute for reality. It is created by images that are free from the rules of reality and conventions. It has a perspective, and it is a space because one can be in it or out of it. There can be rules of being and behaving that come into play as one "takes part" and becomes involved in a fiction. Furthermore, from the inside one can look outside, and vice versa. "In some cases with performances we aim at such a space because in order to set the imagination free, we need to change some of the rules of reality. Hence we inevitably fall into fiction" (ibid., 174).

However, not everything that is put forward by participants can be fruitful for the performance. The collective emergence of the fictional space can be affected if it is interpreted by other participants and, even more importantly, if other participants are able to produce a reaction from it.

The etymology of the verb to "intervene" is from the Latin verb intervenire, which means "to come between." This has evolved into the contemporary sense of occurring, coming in between two events also by way of hindrance or modification, entering as an extraneous feature or circumstance. Performance is there to emphasize the opportunity of exploiting the features of our involved action in the world and also

in the way our accomplishments produce changes in it and therefore new insights for us. Performance is expression, and "like construction, signifies both an action and its result" (Dewey 1980/1934, 82). Performance approaches to knowing insist on immediacy and involvement (see Denzin 2003) and favor an experiential, participative, and interventionist epistemology.

In improvisational performance, participants need to interpret performers' offerings (as actors and spectators do in theater) as they occur: actions, symbols, and props that are introduced into the scene are interpreted in the light of the unfolding action. This is necessary for the completion of the collective endeavor, which can lead to the construction of the fictional space. This completion is achieved by other actors reacting to offerings. In other words, interpretations are not only the product of the imaginative activity of a single participant. Rather, what makes them valuable during group improvisations is their interactional character or their collective emergence (see Sawyer 1999). This highly dynamic and interactive endeavor, which sustains a fictional representation, is what constitutes the imaginative ground on which participants contribute with their performance. Obviously, every contribution or reaction can potentially constitute an imaginative or creative achievement of some sort, and it can be produced by a variety of kinds of cognitive processes. Nevertheless, it is not free imagination. Every product of the participants' imagination that does not become part of the representation can be ignored or can constitute an obstacle to it.

From performance we learn what kind of contributions from participants can foster the collective emergence of a fictional space (Iacucci, Iacucci, and Kuutti 2002), for example: those that can be interpreted and "reacted to" by some other participant be this another user or the computer; those that can be part of the fictional space in which

participants are performing (in that they can be interpreted as being part of it by other participants) as interpreted by some participant, and those that are inspired by the performance of physical actions, utterances, and significations by other participants.

Case: Spect-actors and Multimodal Synthetic Puppeting

Euclide is a virtual puppet (see Figure 3 to 5) that has an engaging role in the visit of a science museum in Naples, Italy. The system offers a multimodal interface to the puppeteer in order to animate a virtual puppet and entice the audience.

Figure 3 (left) shows a hidden animator controlling the movements and mimicry of a virtual character through a multimodal interface including a data glove. The animator's hand movements "activate'' the virtual character, controlling the mimicking, and digital effects alter the animator's voice.

The rendering of the character appears on a screen in a second space, the "stage" (see Figure y). Five stages are scattered about the museum. The animator monitors the audience members via a microphone and a camera and reacts to them (see Figure 3). Therefore, the puppeteer can react and respond to people talking to the character.

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Figure 3 The puppeteer and the set up in the backstage comprising among other things a midi keyboard and a glove to track hand gestures

Figure 4 Spectators gathering to interact with the synthetic puppet

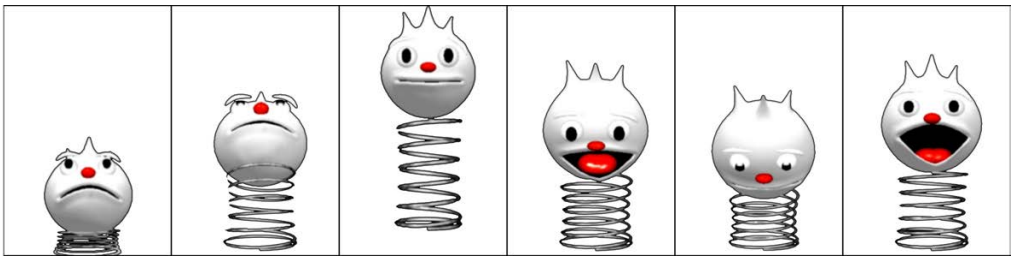

Figure 5 Different animations of the puppet

The system offers 100 different features to the puppeteer for animating the character, among them jumping (see Figure 5) or having different costumes. To allow use of this

great expressive power, with many elements sometimes utilized simultaneously, different modalities are proposed. The interface includes 11 screens, two computer keyboards, two mice, a data glove, a microphone, headphones, and a MIDI keyboard, all in the control room (see Figure 3). Among these devices, three screens, one computer keyboard, one mouse, the MIDI keyboard, the microphone, and the glove are dedicated to real-time puppetry. The other devices are dedicated to system launch, switching between interactive areas or setting the puppet to inactive in order for the puppeteer to take a break.

After interviews with 2 different puppeteers and onsite observations different phases were identified in the interactive sessions. First in an approach phase participants enter the interaction area, observing. Then they start trying to interact with the installation, by taking a particular action such as touching the screen in order to find out which actions have an effect on the installation. After this participants interact with the installation in an aware, active, and involved way. This phase includes the climax or main action of the interaction session. Ending is the phase in which participants have their attention diverted from the installation before they leave. Table 3 shows that these phases are balanced in the sessions, with the exception of Approach, which could not always be recorded. In this regard, the structure of the sessions as explained by the puppeteer during the interview confirms this distribution: more actions are proposed during the playing phase.

Visitor	Puppet
Enter (one or several people, or only a voice)	Stops activity
Present themselves	Presents itself
Laugh	Skips happily Asks what is funny
Say bad words or abuse a bit	Repeats in a mechanical way Cries, complains, and goes away
Say a keyword	Changes costume Tells a story Sings a song
Ask questions	Answers normally Answers as if crazy or slow Answers and asks the audience the same
Greetings	Greetings

Table 2 : Phases in interaction sessions between visitors and puppeteer.

The puppeteer use the above plan as a resource for action and intervene with different strategies to manage the emerging narrative. In this case, the spectators were mostly pupils and teenagers and sessions lasted more than two minutes, on average. It must be noted, however, that some sessions are interrupted by teachers and others are a continuation of a previous interaction. While improvised, sessions conform to a general structure, which is also reported in interviews with the puppeteers. These structure is similar to the ones discussed in the cases Ombre di Stelle and Galassie in the previous section. The groups of spectators generally are attentive to the installation (they did not talk to each other), actively interact with it, and show positive and growing interest as they interact. The puppeteer, therefore, is working with different resources, including a repertoire of gags, to be able to keep spectators engaged for several minutes. The narrative of the sessions emerges from the interaction and contribution of both the puppeteer and the spect-actors.

6. Conclusion

Designing for interactive experiences in ubiquitous computing requires considering embodiment, mixing virtual and physical, adaptivity, and social interaction. The coverage of interaction modalities in such systems can be broad encompassing different interface technologies, such as augmented reality (Morrison et al. 2009), multitouch and gestural interaction (Jacucci et al. 2010), and real time analysis of voice and speech coupled with position of users (as in the case of Galassie in this article see also Jacucci et al. 2009) where galaxies that are generated and move according to motion of visitors changing color depending on their voices.

Studies indicate the decisive contribution of multiuser participation in engagement suggesting that a user's experience and ludic pleasure are rooted in the embodied, performative interaction with installations, and is negotiated with the other visitors in social interaction.

There are several contributions of an "Interaction as Performance" perspective to the design of interactive experiences in a ubiquitous computing paradigm (cfr Figure 6):

Roles of users as performers and spectators, highlighting the embodied performance along with multiple roles of users simultaneously operator, performer, and spectator;

Fictional space, emphasizing the importance of a fictional space and its collective emergence;

Dramaturgical structures, foregrounding phases and the event character of experiences with dramatic structures.

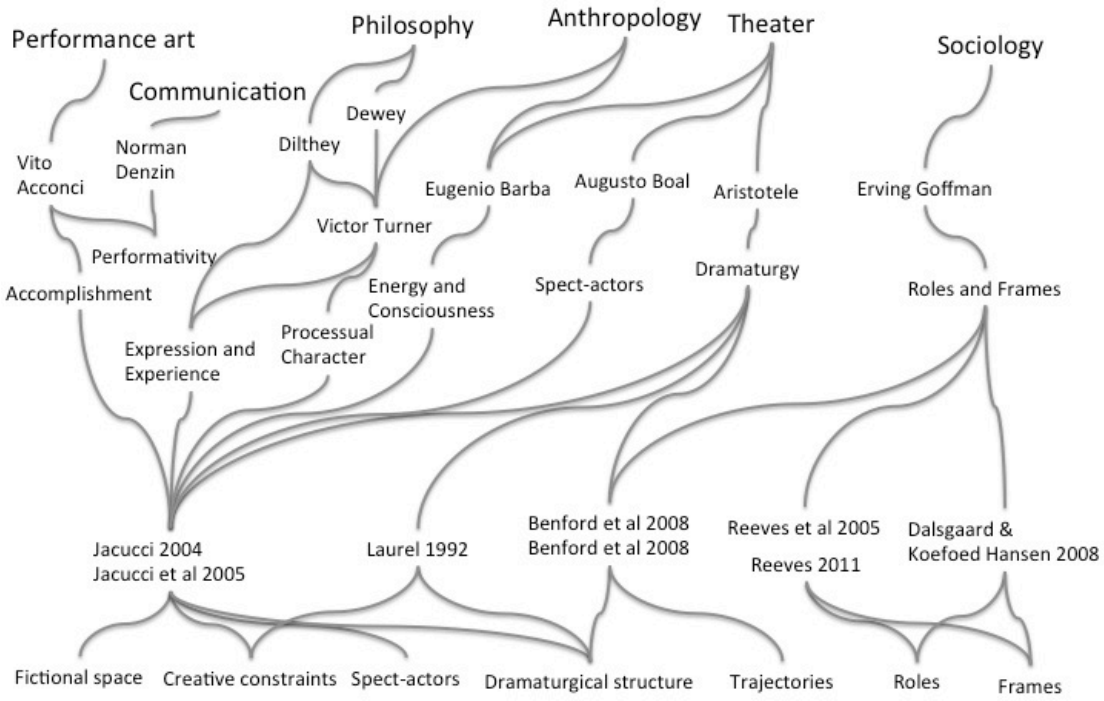

Figure 6 A map of basic concepts in Interaction as Performance perspectives.

The current frontier in engagement from a computational point of view, is to develop adaptivity of interactive systems that take into account the more dynamic aspects of the points above. User Modelling in Adaptive interaction points to methods for changing a user model or the user interface in response to traces of interaction (Brusilovsky 2001, Jameson 2009, Glowacka et al. 2013). This has been addressed for example in persuasive technologies and feedback systems that monitor user interaction to analyse how far the user's state of behavior is from the desired one and accordingly issues a feedback to reach it (Gamberini et al. 2012). Other approaches like affective loop experiences monitor users expression of emotions, the system responds by generating affective expressions, this in turn affects users making them respond and, step-by-step, feeling more and more involved with the system (Gilroy et al 2009). This could be the next challenge for Interaction as Perfromance perspective

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